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ARTIFICIAL INTELLIGENCE IN INDUSTRIAL AUTOMATION CONTROL SYSTEM

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BOOK CHAPTER SERIES 2023

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Artificial Intelligence and Machine Learning to Enhance Service robots Privacy Of Cloud

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1. Background:

Service robots (SRs) are becoming increasingly prevalent in various service industries, including hotels and restaurants, as well as in retail settings. However, there is limited research on the actual impact of SRs in retail stores. While studies have compared the effectiveness of robots with other forms of media, none have yet explored different placement strategies for SRs in retail. This research also seeks to address the gap in understanding the complete hierarchy of effects, from capturing attention to influencing purchase decisions. This study aims to provide both valuable academic insights and practical recommendations for retail managers regarding the optimal placement of a Humanoid Service Robot (HSR) in a store to attract and convert shoppers.

2. Research Objectives and Methodology:

The main objective of this study is to determine the most effective placement of an HSR to attract and convert shoppers. To achieve this, we utilize 'the POS Conversion Funnel' framework to systematically evaluate the impact of HSR placement on sequential stages of customer conversion, encompassing stopping power, engagement, attraction, and selling power. We hypothesize that placing the HSR at the store entrance outside will excel in stopping power, drawing more attention due to higher visibility. Conversely, we anticipate that the HSR placed inside the store will be more successful in engaging and persuading potential shoppers to buy. A field experiment was conducted at a Belgian chocolate store in Brussels Airport, involving the placement of the HSR outside the entrance (HSRoutside) or inside the store behind the entrance (HSRinside). Passers-by were invited to participate in a store-related quiz on the robot's tablet, and their interactions were observed through four surveillance cameras over two days per condition, totaling 28 hours and involving 67,580 total passers-by (HSRoutside = 36,063; HSRinside = 31,517).

The methodological approach used mixes bibliometric, content analysis, and social network techniques. In this study, a state-of-the-art research was conducted through the SCOPUS and Web of Science databases. For the publication time span, the time from 1999 to 2019 was considered with the intent to understand how the level of attention towards the topic has changed before and after the introduction of Industry 4.0. The research methodology chosen for this study was a systematic literature review [25]. The main phases of the study were as follows:

1.

Phase 1: Research and Classification. The present phase was divided into three steps:

- Step 1: Identification;
- Step 2: Screening; and
- Step 3: Inclusion.

In phase 1, bibliometric data was collected (step 1). Then, a screening of the overall result was carried out to identify which documents can be taken into consideration, in line with the research areas deemed interesting and relevant (step 2). At the end of this step, the last step (step 3) aimed to select the documents to be analyzed in detail.

Phase 2: Analysis. Once phase 1 was completed, the next phase was phase 2, which was the analysis of the results. The approach used for the bibliometric analysis included:

- The use of indicators for the parameters studied; and

- SNA (social network analysis) for the keywords.

The indicators chosen to perform the analysis were total papers (TPs), which is the total number of publications, and total citations (TCs), which is the total number of citations.

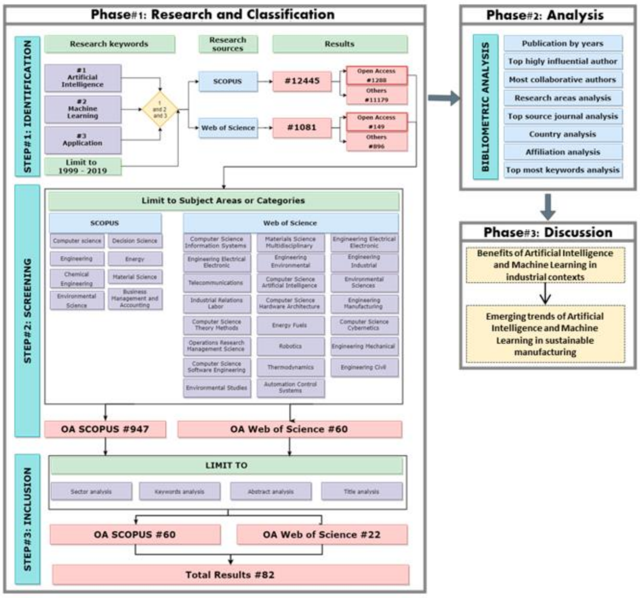
SNA finds application in various social sciences, and has lately been employed in the study of various phenomena, such as international trade, information dissemination, the study of institutions, and the functioning of organizations. The analysis of the use of the term SNA in the scientific literature has undergone exponential growth in the use of this mode of computable representation of complex and interdependent phenomena. For the purpose of the study, UCINET, NetDraw software was used, which was expressly designed for the creation and graphic processing of networks, and was used to represent the keywords in the network, and Excel for data input.

The software UCINET, NetDraw returned a sociometric network that describes the relationships between the classes, that is, data entered as input.

Furthermore, NVivo 12 software, the leading program for computer-assisted qualitative analysis (CAQDAS), was used to analyze keywords of all documents. In this specific case, it was used to identify the possible links between the keywords of the various documents examined, developing conceptual schemes from which to make interpretative hypotheses.

Phase 3: Discussion. At the end of the second phase, a third and final one followed, where the results were discussed, and conclusions were drawn.

In Figure 1, the main phases and steps followed for the analysis are shown



3. Results:

3.1 Phase 1: Research and Classification

The first phase consisted of the search for documents, which included the activities of collecting the material belonging to the academic universe. This first phase was divided into three steps as follows.

3.1.1. Identification (Step 1)

For a comprehensive survey of the phenomenon, an investigation on the Scopus (SCP) and Web of Science (WoS) databases was carried out using Boolean operators. We began by making a search query on the Scopus and WoS databases with the general keywords “artificial intelligence” AND “machine learning” AND “application”, as shown in **Table 1**.

Table 1. Keywords and time period.

In order to maintain the consistency of the results, the same keywords were used in both databases and a time horizon of 20 years was chosen, from 1999 to 2019.

The choice of keywords for performing the survey was based on the awareness that AI and ML can be an important tool in the effort to adopt responsible business practices in the context of smart production. In this regard, it is worthy to note that with the increasingly urgent discussions of climate change, it seemed appropriate to focus our research on the topic of sustainability. Thus, the selection of papers also considered applications on sustainability.

The search returned in total 13,512 documents.

The results extracted by Scopus are numerically superior to Web of Science (WoS): 12,445 for the first and only 1081 for the second one (**Table 2**).

Table 2. Total results of research on Scopus and WoS.

The result is not entirely unexpected, and the reason is to be found in the fact that Scopus, being an Elsevier product, collects data from all the other databases, in particular Science Direct and those queried by the Scirus search engine, while Web of Science (WoS) collects fewer documents.

From the documents extracted in Scopus, it was found that most of them are conference papers (57.28%) and, subsequently, chapters (33.85%).

On the contrary, the research on Web of Science (WoS) underlines that most of the documents are chapters (46.12%) and, subsequently, proceedings papers (42.86%).

All the document types are filled in **Table 3**.

Table 3. Distribution of document types in Scopus and Web of Science.

AI began working in the 1940s and researchers showed strong expectations until the 1970s when they began to encounter serious difficulties and investments were greatly reduced.

Since then, a long period began, known as the “AI winter” [**26**]: Despite some great successes, such as IBM’s Deep Blue system, which in the late 1990s defeated the then chess world champion Garri Kasparov, the study of solutions for AI has only come back for a few years. The push for a new technological development has been given by the I4.0, which considered AI as one of the primary key enabling technologies (KETs).

From this period onwards, the literature has been enriched with documents, as shown in **Figure 2**. Growth is apparent after 2011 when new technologies began to be implemented more frequently. In fact, the Industry 4.0 term first appeared at Hannover Messe in 2011 when Professor Wolfgang Wahlster, Director and CEO of the German Research Center for Artificial Intelligence, addressed the opening ceremony audience.

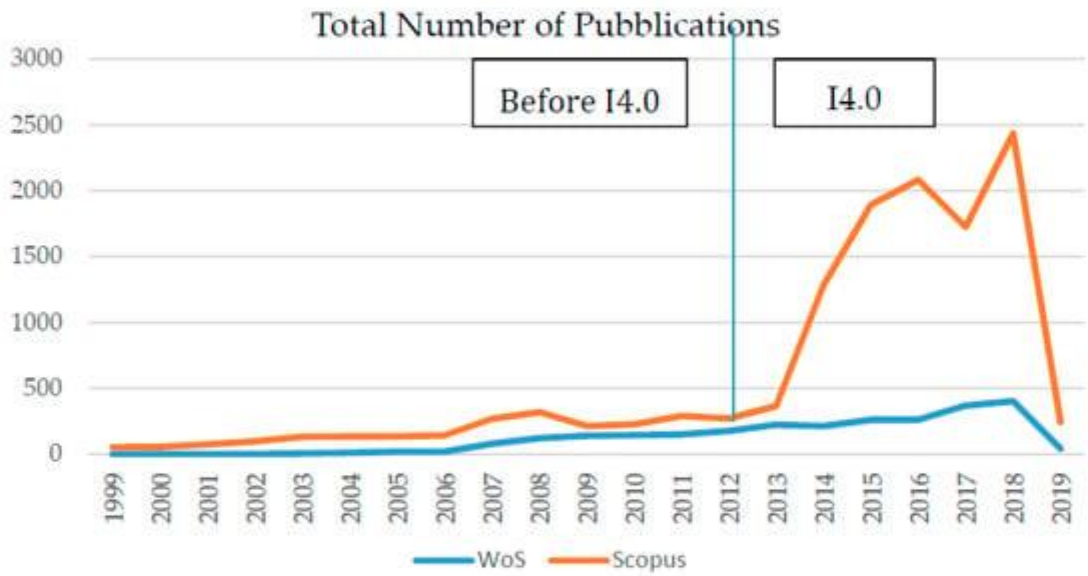


Figure 2. Research growth on Scopus and Web of Science.

In fact, this research indicates that over the time period considered (1999–2019), the number of published chapters remains almost constant until 2013, from which it undergoes an increase.

Subsequently, the increase in the adoption of these ones has led researchers to keep pace with the growth of I4.0 .

3.1.2. Screening (Step 2)

Trying to give an overview of the topics and areas interface, in the screening phase, an analysis of documents characterized by free access was chosen, excluding those that have restrictions, and to restrict the field to the thematic areas of scientific interest.

With this in mind, the number of open access items has been drastically reduced (1288 results for Scopus and 149 for WoS) and, also applying the filter related to the thematic areas (**Table 4**), it determined a further reduction: 947 for Scopus and 60 for WoS.

Table 4. Subject area filter on Scopus and WoS.

Note how the number of filters applied is different. The databases, in fact, offer the same search options, but, in the specific case of the thematic areas, the latter are more numerous and structured on Web of Science (WoS) compared to Scopus.

3.1.3. Inclusion (Step 3)

At the end of the screening process, the inclusion step was started, which consisted in the selection of documents, which was extracted from the last passage, destined to be included in the sample on which bibliometric analysis was performed. In this review step, for the purposes of eligibility, we examined the complete text of each document independently. For each chapter, we examined whether there was interest from the academic world, and if it contained case studies or real applications, proposals for new AI and ML algorithms, or possible future scenarios.

Therefore, the final sample to be analyzed consisted of 60 documents for Scopus and 22 for WoS.

3.2. Phase 2: Analysis

This section presents and discusses the findings of this review.

First, an overview of the selected studies is presented. Second, the review findings according to the research criteria, one by one in the separate subsections, are reported.

3.2.1. Top Highly Influential Analysis

This section lists the most highly cited documents in WoS and Scopus. The list is structured by research source, date, title, authors, source title, and top citation (TP) in WoS or Scopus, according to the research source, it is possible underline that the document by Larrañaga, Calvo, Santana et al. in 2006 has the highest citation count of 298. This chapter reviews machine learning methods for bioinformatics and it presents modelling methods. Moreover, the document year is 2006, so before I4.0 was introduced. Therefore, having more years than today has an advantage in terms of diffusion. This means that it is one of the most influential documents in the academic world, as it proposes some of the most useful techniques for modelling, giving the document the opportunity to become a pioneer in the computer science research area.

Obviously, all documents before I4.0, in general, have more citations than the most recent documents. However, it is significant to note that even recent documents have a very high number of citations compared to the year of publication. This denotes the interest in the topic from the scientific community.

The citation analysis revealed that the first chapter that we can identify among the most cited in the I4.0 period dates to 2016. The work, published by Krawczyk [**29**], proposes application models to further develop the field of unbalanced learning, to focus on computationally effective, adaptive, and real-time methods, and provides a discussion and suggestions on the lines of future research in the application subject of the study. It received 119 citations. Moreover, an chapter published by Wuest, Weimer, Irgens et al. [**30**] received much attention among the scientific community. It contributes by presenting an overview of the available machine learning techniques.

Finally, the citation analysis pointed out that the average number of citations of all documents is 16.58. This value is expected to increase rapidly considering the interest in the issues of ML and AI.

3.2.2. Publications by Years

Consistent with what is defined in **Section 3.1.1**., the study shows that the number of items included in the analysis is definitely low for the entire period before I4.0 and then suddenly increases, starting in 2012. The data shown in **Figure 3** also show two holes in the 2001–2008 and 2008–2011 intervals. This means that the technological applications were limited before it became an enabling technology of I4.0 in all respects, only to have a peak of technological implementation, as was foreseeable.

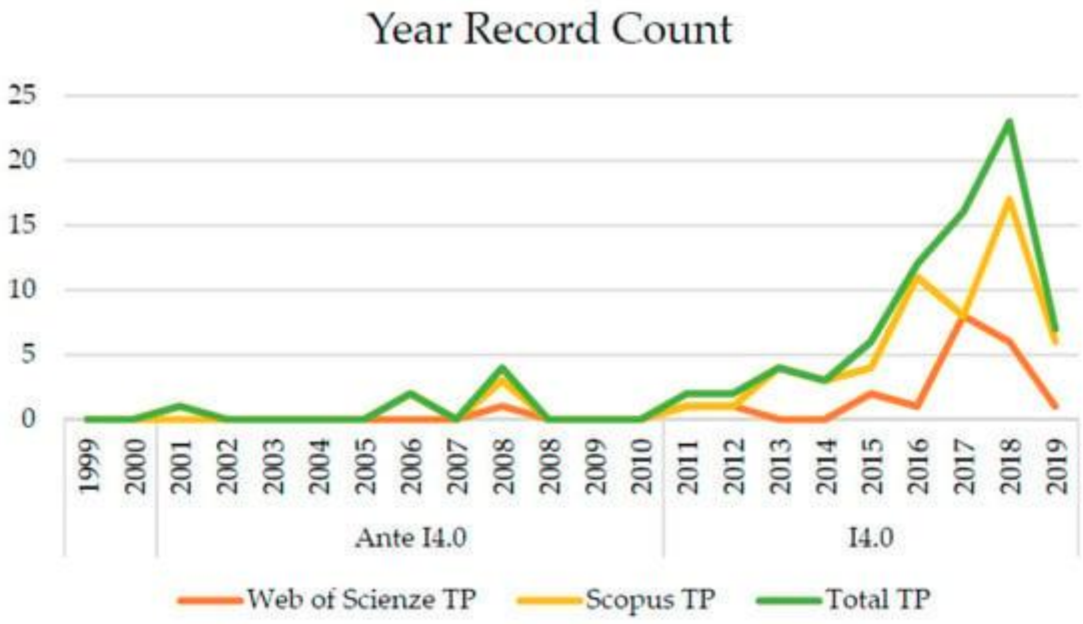


Figure 3. Years of publications.

With reference to 2019, the figure refers to the first months of the year, so it is plausible that during the year, there will be a further increase in the documents in the literature. Furthermore, an increase is expected in the coming years, in parallel with the growth of I4.0

3.2.3. Most Collaborative Authors

The analysis highlighted that most of publications have more than one author. From this point of view, it is possible to identify the number of authors for each document. As shown in **Figure 4**, most of the manuscripts were produced by groups ranging from two to five authors. The indicators chosen to perform the analysis were total papers (TPs), which is the total number of publications.

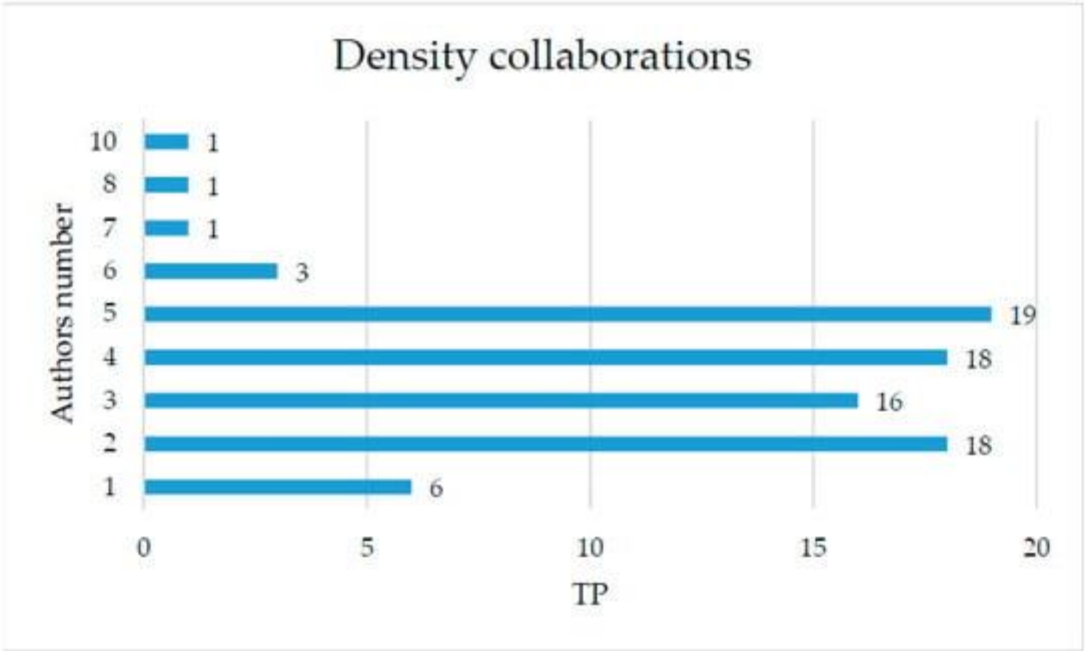


Figure 4. Collaborative groups.

3.2.4. Research Areas Analysis

The total research area analysis collected from the 82 papers was 164 because each paper can be considered as more than one research area analysis. Given the small number of documents identified in the period before I4.0, the ranking refers mostly to the current industrial revolution. Also, in this case, the result is consistent with the introduction of paradigm 4.0, which has intensified research and the adoption of technology.

The first thematic areas and disciplines that are at the top of the ranking are computer science, engineering and biochemistry, genetics, and molecular Biology, respectively, with 29%, 23%, and 6% of publications. Furthermore, the other disciplines identified for which applicative findings are found are considered transversal to the first three disciplines and this is a consequence of I4.0. In terms of the percentage contribution, the first three areas cover about 60% of the papers considered.

Considering the top 20 research areas, given the frequency of the research areas' distribution, **Figure 5** shows a higher level of concentration in the disciplines indicated above.

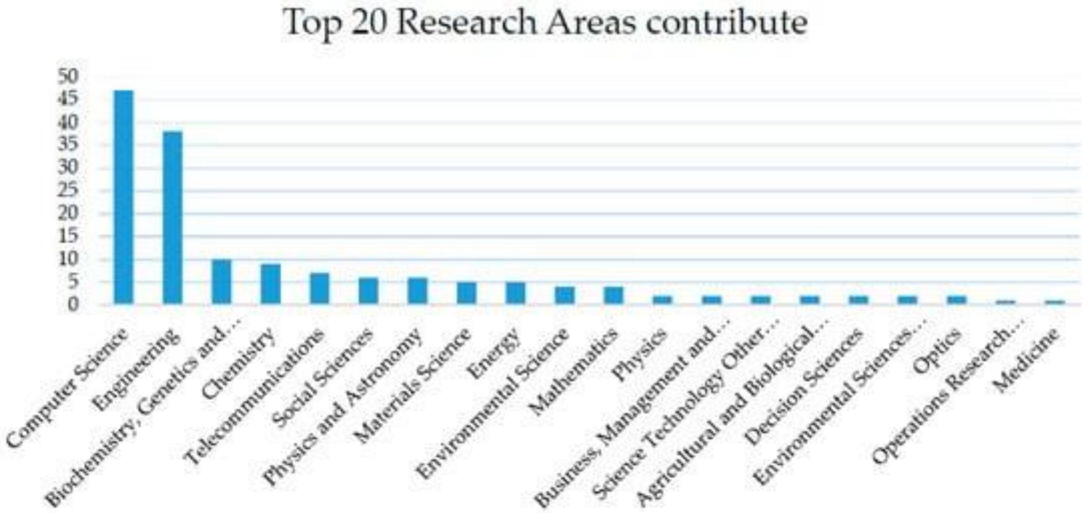


Figure 5. Top 20 research areas contributions.

In fact, in terms of the percentage contribution, the first five areas cover about 70% of the papers considered. Regardless, by only counting research areas found once, there is a total of 27.

This means two things:

- The large number of fields in which this kind of research is involved; and
- Most papers have a transversal approach, that is, the object of each research crosses more than one field of application, thus involving more research areas.

This confirms the wide interest in these subjects from several fields.

3.2.5. Top Source Journals Analysis

In this section, the top 20 sources or journals that were published most frequently were extracted.

A journal is a time-bound publication with the objective of promoting and monitoring the progress of the discipline it represents.

In this specific case, the total source journals detected from the documents is 74, but, considering the top 20, given the frequency of the source journals' distribution, only the first 13 sources have more than one paper published, with a total percentage contribution of 43% of the total.

After analyzing the sources separately, the results obtained in the two databases were found to not be the same. In WoS, the top source journal was *IEEE Access* with two publications while in Scopus, the top source journals are *Procedia Computer Science*, *Matec*

Web of Conferences, and *Machine Learning* with four publications, which contribute 5% of the total.

Aggregating the data collected from the two databases, the ranking moves to that obtained by Scopus, making sure that *IEEE Access* is no longer first in the standings, but only eighth, and that the former are precisely those of Scopus: *Procedia Computer Science, Matec Web Of Conferences,* and *Machine Learning,* with the same number of publications. Next, the 10 source journals have a 3% publication contribution while the rest have a one-to-one relationship (1%) with the corresponding source journal.

The low level of concentration of the sources suggests that there is a great deal of interest in these topics from several scientific journals. As a matter of fact, it is foreseeable that specialized sector sources (*AI Magazine* and *Machine Learning*) are among the first 13; however, it is interesting to note that other sources are involved, such as *Sustainability Switzerland* or *BMC Bioinformatics* and *Nuclear Engineering and Design*.

Figure 6 shows the top 20 source journals contributions.

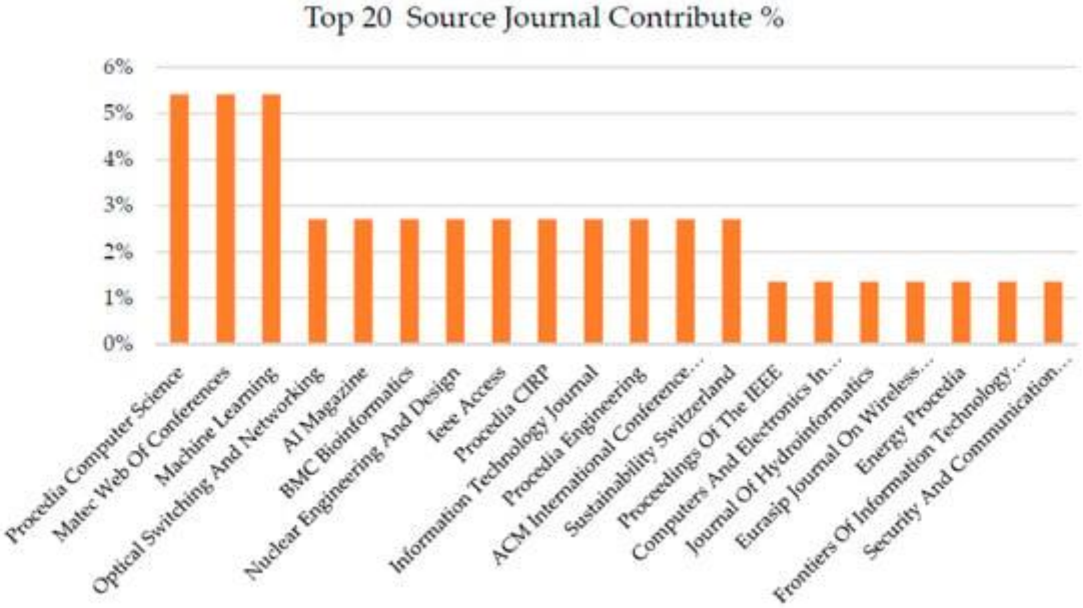


Figure 6. Top 20 source journals contributions.

3.2.6. Country Analysis

The results that emerged through research on the two databases are consistent with each other. In both cases, in fact, the countries that give the greatest contribution to the research are China and the United States (Figure 8). The result is obvious since in China and the United States, more than 1.3 billion and 0.3 millions of people live, respectively, and so there are more researchers than in the single European nations. Focusing on Europe, Germany published more papers than any other European country. This is not a random result: I4.0 was born in Germany, so this outcome was expected. However, the following observation cannot be ignored from this data: The USA and China carry the first two places in the list while it is not the same for European countries. Europe, despite its talents and resources, has lost ground. Presenting its report on artificial intelligence, the French deputy and mathematician Cédric Villani declared that, "Europe must be able to compete with China and the United States while protecting its citizens and pointing the way to go on ethical issues". If we are not careful, the 21st century rules will not be defined in Brussels, but in Shanghai. Artificial intelligence is also a land marked by intense geopolitical rivalry that could redefine global power relations.

Even so, regarding Europe, it is worthy to also note that since 2017, France, Germany, and Italy have intensified their trilateral cooperation to promote digitizing the manufacturing industry. In this regard, in the near future, we expect a significant evolution of smart production initiatives and therefore an increase in scientific research.

Figure 7 shows the country contribution distribution.

Figure 7. Top 20 countries contributions.

Affiliation Analysis

The total number of affiliation detected from the 82 papers is 153. Also, in this case, considering the top 20, the frequency of the affiliation distribution shows that most papers have a one-to-one relationship with the corresponding affiliation. Only the first four affiliations have three papers (2% of the contribution) and the second four have two papers (1.3% of the contribution). This result gives us information about the wide interest on this subject from several universities and research centers all over the world. Then, the affiliation analysis confirms the result of the country analysis In fact, if we try to sum the first eight affiliations by their own country, the outcome is:

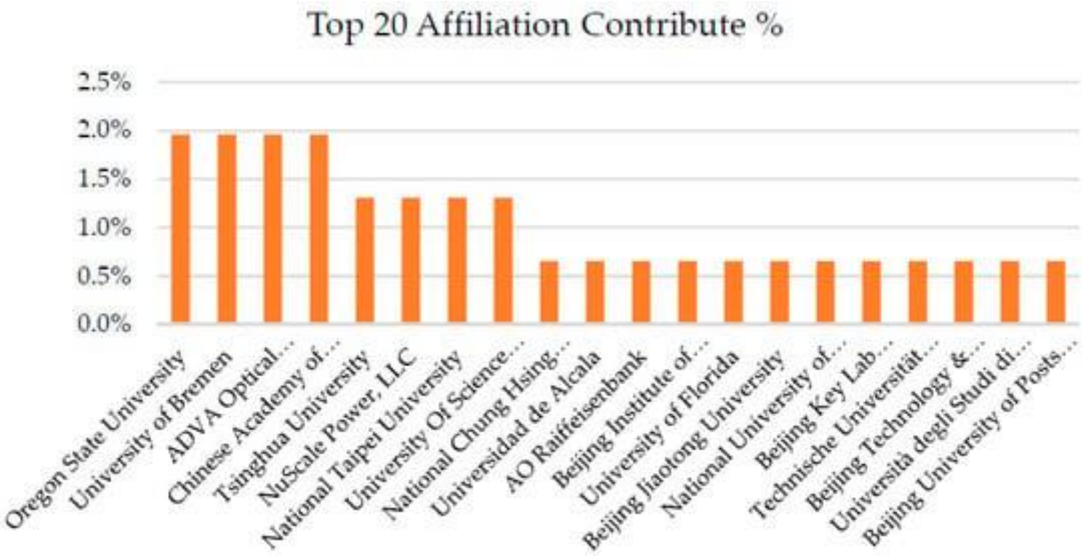


Figure 8. Top 20 institute affiliations contributions.

- Nine papers from China;
- Six papers from Germany; and
- Five papers from the USA.

In September 2018, the most important event on artificial intelligence was held in Shanghai. China is very determined to focus on future technologies.

For some months, China has become the world's leading power in terms of scientific publications. Late in the 20th century technologies, China chose to do what the English-speaking people call a "frog jump" and focus on 21st century technologies.

China, with its 800 million Internet users and without any privacy protection policy, has access to more personal data than the United States and Europe.

3.2.8. Top Keywords Analysis

Through NVivo 12, the top 20 keywords were extracted directly, which are those that always appear in association with each document.

Starting from this classification, the graphic representation, a word cloud shape, of the keywords (**Figure 9**) was extracted. It can be noted that the most used term is precisely "machine", "learning", and "intelligence", which the software represents with greater characters than all the other terms.

4. Discussion and Conclusion:

This study offers valuable insights into the effectiveness of different HSR placement strategies, according to the POS Conversion Funnel. Harbourside demonstrated superior stopping power, effectively drawing attention and initiating interactions. Conversely, Springside excelled in engagement, store interest, and ultimately led to more purchases. The overall sales impact appeared strongest in the outside placement condition, possibly due to the larger initial audience. These findings emphasize the importance of considering each step of the POS Conversion Funnel when deciding on optimal HSR placement. They hold relevance for both academia and retailers aiming to enhance customer experiences through HSR implementation, considering specific conversion challenges.

Autonomous Computer Vision Human Monitoring In Deep Learning

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Abstract

This chapter presents a comprehensive survey of deep learning applications for object detection and scene perception in autonomous vehicles. Unlike existing review papers, we examine the theory underlying self-driving vehicles from deep learning perspective and current implementations, followed by their critical evaluations. Deep learning is one potential solution for object detection and scene perception problems, which can enable algorithm-driven and data-driven cars. In this chapter, we aim to bridge the gap between deep learning and self-driving cars through a comprehensive survey. We begin with an introduction to self-driving cars, deep learning, and computer vision followed by an overview of artificial general intelligence. Then, we classify existing powerful deep learning libraries and their role and significance in the growth of deep learning. Finally, we discuss several techniques that address the image perception issues in real-time driving, and critically evaluate recent implementations and tests conducted on self-driving cars. The findings and practices at various stages are summarized to correlate prevalent and futuristic techniques, and the applicability, scalability and feasibility of deep learning to self-driving cars for achieving safe driving without human intervention. Based on the current surv

1. Introduction:

The rise of next-generation robots is reshaping modern societies. Understanding the psychological factors that influence attitudes towards robots is crucial as familiarity with this technology grows. This study examines the relationships between key psychological factors associated with attitudes towards robots. Attitudes, characterized by persistent positive, negative, or neutral assessments of a target, are formed through cognitive, affective, and behavioural information. Previous models have highlighted the importance of human attitude in predicting the adoption of new technologies like robots. Social influence, drawn from social information processing theory, suggests that an individual's social network shapes their perception of a technology. Self-efficacy beliefs, introduced by Bandura, play a role in an individual's perception of their ability to take action. While robot use self-efficacy has been explored in specific contexts, broader studies are still limited.

Computer vision (CV) has a rich history spanning decades1 of efforts to enable computers to perceive visual stimuli meaningfully. Machine perception spans a range of levels, from low-level tasks such as identifying edges, to high-level tasks such as understanding complete scenes. Advances in the last decade have largely been due to three factors: (1) the maturation of deep learning (DL)—a type of machine learning that enables end-to-end learning of very complex functions from raw data2 (2) strides in localized compute power via GPUs3, and (3) the open-sourcing of large labeled datasets with which to train these algorithms4. The combination of these three elements has enabled individual researchers the resource access needed to advance the field. As the research community grew exponentially, so did progress.

The growth of modern CV has overlapped with the generation of large amounts of digital data in a number of scientific fields. Recent medical advances have been prolific5,6, owing largely to DL's remarkable ability to learn many tasks from most data sources. Using large datasets, CV models can acquire many pattern-recognition abilities—from physician-level diagnostics7 to medical scene perception.

Here we survey the intersection of CV and medicine, focusing on research in medical imaging, medical video, and real clinical deployment. We discuss key algorithmic capabilities which unlocked these opportunities, and dive into the myriad of accomplishments from recent years. The clinical tasks suitable for CV span many categories, such as screening, diagnosis, detecting conditions, predicting future outcomes, segmenting pathologies from organs to cells, monitoring disease, and clinical research. Throughout, we consider the future growth of this technology and its implications for medicine and healthcare.

2. Research Questions:

This study aims to address the following research questions:
1. Is perceived social norm directly associated with positive attitudes towards robots?
2. Do robot use self-efficacy beliefs have a direct positive influence on attitudes towards robots?
3. Does robot use self-efficacy mediate the relationship between perceived social norm and attitudes towards robots?
4. Are there differences in perceived social norm, robot use self-efficacy, and attitudes towards robots between individuals with and without prior robot use experience?

3. Method:

In April 2023, an online survey was conducted with 969 U.S. respondents recruited from Amazon Mechanical Turk. The sample was evenly distributed by gender, with a mean age of 37.15 years. One-third of respondents reported prior experiences with robots, while the majority were new to or unsure about previous robot interactions. Respondents provided socio-demographic details and answered questions regarding their prior robot use experiences, perceived robot use self-efficacy, perceived social norm, and attitudes towards robots. Composite variables were created for analysis, demonstrating good reliability.

With recent advances in artificial intelligence (AI), machine learning (ML) and deep learning (DL), various applications of these techniques have gained prominence and come to fore. One such application is self-driving cars, which is anticipated to have a profound and revolutionary impact on society and the way people commute . Although, the acceptance and domestication of technology can face initial or prolonged reluctance, yet these cars will mark the first far reaching integration of personal robots into the human society The last decade has witnessed growing research interest in applying AI to drive cars Due to rapid advances in AI and associated technologies, cars are eventually poised to evolve into autonomous robots entrusted with human lives, and bring about a diverse socio-economic impact However, for these cars to become a functional reality, they need to be equipped with perception and cognition to tackle high-pressure real-life scenarios, arrive at suitable decisions, and take appropriate and safest action at all times

Embedded in the self-driving vehicles' AI are visual recognition systems (VRS) that encompass image classification, object detection, segmentation, and localization for basic ocular performance Object detection is emerging as a subdomain of computer vision (CV) that benefits from DL, especially convolutional neural networks (CNNs) This article discusses the self-driving cars' vision systems, role of DL to interpret complex vision, enhance perception, and actuate kinematic manoeuvres in self-driving cars This article surveys methods that tailor DL to perform object detection and scene perception in self-driving cars. In the survey, we also answer the following questions while appreciating the contribution of DL in these areas

1.What are the mutually reinforcing and fundamental operational requirements for fully functional self-driving cars?

2.What landmarks and developments have been achieved in self-driving cars in the last 20 years and what are some promising research directions for the next decade?

3.What is DL and how does DL create artificial perception? With the arrival of DL, is it eventually feasible to attain human level cognition and perception in self-driving cars?

4.Why is DL a promising technique for solving object detection and scene perception in self-driving cars? What are the cutting-edge DL models used for object detection and scene perception in self-driving cars?

5.With deployment of 5G mobile communication and conceptualization of ultra-fast 6G technology, how is multi-sensor data fusion and 3D point cloud analysis realized and impacted in autonomous vehicles?

6.What are the most recent and successful object detection techniques applied to autonomous vehicles and promising directions for further research?

The rest of the article is structured as follows: Section II provides a brief introduction to the evolution of self-driving cars, and discusses the levels of automation to gradually and progressively achieve fully autonomous vehicles. A list of abbreviations used in the paper is also presented in Table 1 and the Table 2 presents a summary of existing literature related to deep learning and self-driving cars. Section III introduces big data, the role of big data in autonomous vehicles and collecting driving data using LiDAR cameras. Processing driving data captured using various sensors in real-time is a significant challenge, and some promising solutions such as multimodal sensor fusion, road scene analysis in adversarial weather conditions, and polarimetric image analysis for object detection in autonomous driving scenarios are discussed in this section. Section IV introduces deep learning (DL) and the factors that make DL a powerful technique in computer vision. Section IV delves deeper into CNNs, RNNs, DBNs, and other widely used DL techniques in CV. In section V, we investigate the role of deep reinforcement learning (DRL) to enable vision in self-driving cars. We discuss unsupervised learning and explore the possibilities of scene perception in self-driving cars without being explicitly trained on data, leading to artificial general intelligence (AGI) in self-driving cars. Self-driving cars and their ability to achieve human level driving is jointly reviewed from a deep learning perspective with a focus on scene perception and object detection to complement advanced vision. We also provide insights into current applications of DL to achieve AGI that could enable self-driving cars to perceive their environment and take appropriate actions without the need of human intervention. Lastly, we enlist some promising future directions to achieve next generation autonomous vehicles based on the survey and conclude the paper.

4. Discussion:

Findings revealed that respondents with prior robot use experiences reported more positive attitudes, higher robot use self-efficacy beliefs, and higher perceived social norms compared to those without prior experiences. Perceived social norm was a strong positive predictor of positive robot attitudes, with or without previous robot use experience. Additionally, robot use self-efficacy was a significant factor in shaping attitudes, especially for those without prior experience. General interest in technology development also positively influenced attitudes towards robots. Mediation analysis indicated that robot use self-efficacy played a significant role in the link between perceived social norm and attitudes towards robots, further emphasizing the interconnectedness of these factors. These results underscore the importance of social psychological aspects in shaping attitudes towards robots, providing valuable insights for professionals implementing new robot technologies.

Introduction of Artificial Intelligence - Challenges and Applications

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Abstrac: The emergence and rise of artificial intelligence undoubtedly played an important role during the development of the Internet. Over the past decade, with extensive applications in the society, artificial intelligence has become more relevant to people's daily life. This chapter introduces the concept of artificial intelligence, the related technologies, and the existing controversies over the topic.

1. Introduction:

The Travel and Hospitality industry has been significantly impacted by the Covid-19 pandemic, with concerns about contact, volatile conditions, and the need for accurate information deterring travellers. This study proposes the use of AI technologies to not only enhance customer service and productivity but also to establish a dynamic Travel Risk Perception Index, fostering trust with travellers. The research comprises two key components: an empirical investigation into AI-driven bots for streamlined bookings, and the development of a hyperlocal Travel Risk Perception Index. This combination aims to offer a high level of personalization for increased value and effectiveness, particularly in the corporate travel market, an area that has been underexplored by researchers.

ather widely accepted definition of AI, also a relatively early one, was proposed by John McCarthy at the 1956 Dartmouth Conference, which outlined that artificial intelligence is about letting a machine simulate the intelligent behavior of humans as precisely as it can be. However, this definition seemingly ignores the possibility of strong artificial intelligence (which means the machine that has the ability or intelligence to solve problems by reasoning).

Before explaining what "artificial intelligence" is, we had better clarify the concept of "intelligence" first.According to the theory of multiple intelligences, human intelligence can be categorized into seven types: Linguistic, Logical-Mathematical, Spatial Bodily-Kinesthetic, Musical, Interpersonal and Intrapersonal intelligence.

1.1. Linguistic Intelligence

Linguistic intelligence refers to the ability to effectively express one's thoughts in spoken or written language, understand others' words or texts, flexibly master the phonology, semantics, and grammar of a language, manage verbal thinking, and convey or decode the connotation of linguistic expressions through the verbal thinking. For the people with strong linguistic intelligence, the ideal career choices could be politician-activist, host, attorney, public speaker, editor, writer, journalist, teacher, etc.

1.2. Logical-Mathematical Intelligence

Logical-mathematical intelligence designates the capability to calculate, quantify, reason, summarize and classify effectively, and to carry out complicated mathematical operations. This capability is characterized by the sensitivity to abstract concepts, such as logical patterns and relationships, statements and claims, and functions. People who are strong in logic-mathematical intelligence are more suitable to work as scientists, accountants, statisticians, engineers, computer software developers, etc.

1.3. Spatial Intelligence

Spatial intelligence features the potential to accurately recognize the visual space and things around it, and to represent what they perceived visually in paintings and graphs. People with strong spatial intelligence are very sensitive to spatial relationships such as color, line, shape, and form. The jobs suitable for them are interior designer, architect, photographer, painter, pilot and so on.

1.4. Bodily-Kinesthetic Intelligence

Bodily-kinesthetic intelligence indicates the capacity to use one's whole body to express thoughts and emotions, and to use hands and other tools to fashion products or manipulate objects. This intelligence demonstrates a variety of particular physical skills such as balance, coordination, agility, strength, suppleness and speed, and tactile abilities. Potential careers for people with strong body-kinesthetic intelligence include athlete, actor, dancer, surgeon, jeweler, mechanic and so on.

1.5. Musical Intelligence

Musical intelligence is the ability to discern pitch, tone, melody, rhythm, and timbre. People having relatively high musical intelligence are particularly sensitive to pitch, tone, melody, rhythm or timbre, and are more competitive in performing, creating and reflecting on music. Their recommended professions include singer, composer, conductor, music critic, the piano tuner and so on.

1.6. Interpersonal Intelligence

Interpersonal intelligence is the capability to understand and interact effectively with others. People with strong interpersonal intelligence can better recognize the moods and temperaments of others, empathize with their feelings and emotions, notice the hidden information of different interpersonal relationships, and respond appropriately. The professions suitable for them include politician, diplomat, leader, psychologist, PR officer, salesmen, and so on.

1.7. Intrapersonal Intelligence

Intrapersonal intelligence is about self-recognition, which means the capability to understand oneself and then act accordingly based on such knowledge. People with strong intrapersonal intelligence are able to discern their strengths and weaknesses, recognize their inner hobbies, moods, intentions, temperaments and self-esteem, and they like to think independently. Their suitable professions include philosopher, politician, thinker, psychologist and so on.

1.8. Naturalist Intelligence

Naturalist intelligence refers to the ability to observe the various forms of nature, identify and classify the objects, and discriminate the natural and artificial systems.

However, AI is a new type of technological science that investigates and develops the theories, methods, technologies and application systems to simulate, improve and upgrade the human intelligence. The AI is created to enable machines to reason like human being and to endow them with intelligence. Today, the connotation of AI has been greatly broadened, making it an interdisciplinary subject

2. Methodology:

The study draws on research in Tourism, Hospitality, and Robotics, exploring the adoption of robots and AI in these industries. Media Naturalness Theory highlights the importance of natural communication mediums, while Media Equation Theory suggests that computers can be viewed as social actors. The shift towards human-machine interaction in Service Systems of the Future is also examined. Personalization, rooted in AI, Machine Learning, HCI, and User Modelling, is investigated, along with the principles of Human-Centred AI, emphasizing the need for AI systems to understand humans. Additionally, the study incorporates Risk Perception Theory, aligned with the Protection Motivation Theory. For the first study, a partnership with a corporate travel management platform utilizing advanced AI, ML, NLP, and Behavioural Economics is established. The analysis involves over 10,000 users across various companies and roles, focusing on the value provided to employees. A combination of A/B testing, cohort analysis, and multivariate analysis is employed to assess impact on customer experience, engagement, accuracy, response time, and visibility.

The second study proposes a dynamic hyperlocal Travel Risk Perception Index, drawing insights from the Cybersecurity industry. This index combines data from multiple sources, including government, media, and social media, and integrates user behaviour analysis and risk engine to create an end-to-end travel risk visibility matrix and threat perception index, offering timely and trustworthy information for decision-makers.

3. Discussion:

The Human-Centred AI-driven Services Automation framework and Travel Threat Perception Index highlight the pivotal role of AI, personalization, automation, and natural human-machine interaction in revolutionizing the service industry. Practically, the framework underscores the value of offloading cognitive decision-making from users for routine tasks, enhancing engagement and satisfaction. For researchers, this study provides insights into the symbiotic relationship between humans and machines in an AI-driven environment.

Artificial Intelligence in Mental Health

Examples, Benefits & Trends

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Abstract
Mental health disorders are on the rise globally. At least 10% of the population is affected, with almost 15% percent of adolescents experiencing a mental health condition and suicide being the fourth leading cause of death among those aged between 15 and 29. As a key contributor to morbidity and mortality, mental illnesses are projected to cost the world's economy around $16 trillion between 2010 and 2030. No one seems to know exactly why depression and anxiety are so common nowadays. The rise is attributed to multiple contributing factors, from the demands of modern society to the impact of the COVID-19 pandemic that has aggravated existing mental health issues. Some experts even argue that what we see is just an increasing awareness of mental health disorders resulting in a surge of people actively seeking treatment. Indeed, the number of adults receiving inpatient or outpatient care or counseling has been steadily rising in the US in the last two decades. At the same time, access to care is still limited, says Mental Health America in its 2023 report. Almost 30 million US adults with a mental disorder do not receive any treatment.

1. Introduction and Background:

Recent research in social robotics has shown that the degree of anthropomorphism (human likeness) in a social robot can significantly impact how individuals perceive and interact with it. This study delves into how consumers respond to social robots in consumption settings, a topic that has gained increasing interest among consumer researchers. Meanwhile, the fields of marketing and psychology have provided extensive evidence on the persuasive effects of messages on target audiences. This study aims to bridge these areas of research by investigating how the degree of human likeness in a robot can influence the persuasiveness of the messages it conveys.

AI for mental health is gaining a foothold across clinical practice, already now. In particular, the following technologies have the most potential for an impact:

- Machine learning (ML) and deep learning (DL) that provide greater accuracy in diagnosing mental health conditions and predicting patient outcomes
- Computer vision for imaging data analysis and understanding non-verbal cues, such as facial expression, gestures, eye gaze, or human pose
- Natural language processing (NLP) for speech recognition and text analysis that is used for simulating human conversations via chatbot computer programs, as well as for creating and understanding clinical documentation

While ML algorithms and computer vision applications are quite mature fields, with universal use cases across industries, research on the use of AI for mental health treatment is in its infancy.

Unlike radiology or pathology, where AI demonstrates better accuracy than humans, mental healthcare is commonly described as an exclusively human field. There is scepticism among mental health practitioners that artificial intelligence solutions for mental health will ever be able to provide emphatic care, which they believe is vital.

However, people do like chatting with chatbots and can even develop an emotional connection with them. We are not talking here about the unsettling intimate bond developed between a lonely man and an AI operating system in the movie Her, but rather about people's willingness to pour their hearts out anonymously to an AI companion. People tend to believe that robots don't judge, are unbiased, and can provide instant answers to health-related questions. Just as important, talking to technology might help.

Multiple meta-analyses have confirmed that computer-aided cognitive behavioral therapy (CBT) delivered via desktop or mobile apps is equivalent to or even more effective than standard CBT. The National Institute for Health and Clinical Excellence (NICE) in England first recommended computerized CBT packages for depression, panic, and phobias back in 2006 on the grounds of clinical and cost effectiveness.9Moreover, studies suggest that the AI chatbot experience of people struggling with mental health issues has been overwhelmingly satisfactory.

More research is definitely required on the adoption of AI for mental health treatment, but the Food and Drug Administration (FDA) in the US has already relaxed policies for a broader use of digital therapeutic tools for individuals with mental health conditions.

1.1. Analyzing patient data to assess the risk of developing mental health conditions, classify disorders, and optimize treatment plans

Today, AI is used to analyze electronic health records (alongside blood tests and brain images), questionnaires, voice recordings, behavioral signs, and even information sourced from a patient's social media accounts. Data scientists employ a variety of techniques, such as supervised machine learning, deep learning, and natural language processing, to parse patient data and flag mental and physical states — pain, boredom, mind-wandering, stress, or suicidal thoughts — associated with a particular mental health disorder. Researchers from IBM and University of California have recently analyzed 28 studies exploring the use of artificial intelligence in mental health and arrived at a conclusion that, depending on the choice of an AI technique and quality of training data, algorithms manage to detect an array of mental illnesses with 63-92% accuracy.

1.2. Conducting self-assessment and therapy sessions

This category is largely represented by keyword-triggered and NLP chatbots. They offer advice, track the user's responses, evaluate the progression and severity of a mental illness, and help cope with its symptoms — either independently or with the help of a certified psychiatrist waiting on the other end of the virtual line.

The most popular AI-powered virtual therapists include Woebot, Replika, Wysa, Ellie, Elomia, and Tess.

For instance, the artificial intelligence chatbot Tess delivers highly personalized therapy based on CBT and other clinically proven methods, along with psychoeducation and health-related reminders. The interventions are done via text message conversation, meaning that emotion identification relies solely on language processing. An international team of scholars has tested the chatbot among a group of students to find out that the individuals who conversed with Tess daily over a period of two weeks displayed a significant reduction in mental health symptoms compared to participants who had sessions less frequently.

Another AI chatbot example, Ellie, not only understands words but can also interpret non-verbal signs, such as facial expression, posture, or gestures to comprehend an individual's emotional state and choose the right words to alleviate stress and anxiety.

The category also includes AI-powered mental health tracking tools. They may work in tandem with wearable devices that measure heart rate, blood pressure, oxygen levels, and other vital signs indicating changes in the user's physical and mental well-being. One of such solutions is BioBase, a mental health app that leverages AI to interpret sensor data coming from a wearable. Designed to help companies prevent employee burnout, the mental health tracker reportedly helps reduce the length and number of sick days by up to 31%.

1.3. Enhancing patient engagement

AI is becoming an integral part of patient engagement strategies adopted by healthcare organizations to improve and personalize patient experience.

Apart from helping users cope with their mental health conditions, AI chatbots are also used to make access to care as simple and frictionless as it is in many other service sectors. Healthcare organizations are embracing conversational AI to process phone calls, make appointments, provide patients with information on how to get to the provider, or deliver health education.

AI technologies are also incorporated into mobile apps and reminder systems to facilitate communication with a patient and assist interventions aimed at tracking their adherence to medication or treatment and empower them with knowledge on the importance of such adherence.

Implementing AI for improving patient outreach is another way to drive patient engagement. AI-powered tools can identify at-risk patients and automate outreach messages.

1.4. Equipping therapists with technology to automate daily workflows

Due to the very nature of mental health conditions, psychiatrists can seldom rely on legacy tech tools or other physicians' advice when interpreting medical data and devising treatment plans for patients. One way to lessen the administrative burden could be the implementation of AI-driven mental health platforms that automatically retrieve information from miscellaneous IT systems within a hospital and generate on-demand reports about every single patient's progress, current condition, and possible outcomes. An early example of such systems is OPTT, an AI platform that provides a rich selection of tools for mental health professionals looking to increase the capacity of their clinic. Preliminary research indicates that OPTT could improve access to quality mental healthcare by up to 400%.

2. Persuasion and Source Credibility:

Studies in psychology have highlighted the importance of source credibility in message persuasiveness. One key factor influencing source credibility is the perceived similarity between the source and the message receiver. While it may be expected that higher perceived similarity between a highly anthropomorphic robot and a consumer would lead to more positive perceptions, this study challenges this assumption. Drawing from the concept of the uncanny valley effect, which suggests that a robot that is "too" humanlike may evoke feelings of eeriness, this study proposes that high levels of perceived similarity may actually reduce the persuasiveness of a message delivered by the robot.

3. Exploring Mechanisms:

This study also aims to delve into the underlying mechanisms that explain the relationship between a social robot's degree of human likeness and its impact on message persuasiveness. Specifically, the research posits that consumers may experience a sense of discomfort when interacting with highly humanlike robots, which in turn diminishes the persuasiveness of the messages they convey. This aligns with previous findings on out-group homogeneity in social psychology, suggesting that people are less sensitive to physical differences among individuals from different racial or ethnic groups.

The hopes pinned on artificial intelligence apps and platforms for mental health care can be attributed to the following benefits AI delivers:

- **Affordability**. Unlike traditional counseling where you need to schedule and travel for appointments, AI-based and other mental health apps allow users to access therapeutic help anywhere, anytime. Moreover, they provide help at little or no cost, compared to costs associated with in-person therapy, missed work, the need to make other arrangements, and commute.

- **Accessibility**. AI-based apps remove such barriers to mental health treatment as staff shortages across the board and a lack of providers in rural and remote areas. This is important, since more than 100 million people in the US live in so-called Health Care Professional Shortage Areas. Location-agnostic AI chatbots and platforms can see you whenever you need and spend as much time with you as you need.
- **Efficiency**. Artificial intelligence algorithms for mental healthcare have already been proven to be successful in detecting symptoms of depression, PTSD, and other conditions by analyzing behavioral signals. Other studies have shown that algorithms can spot behavioral symptoms indicative of anxiety with over 90% accuracy and are 100% accurate at predicting who among at-risk teens are likely to develop psychosis. They also help patients struggling with mental distress: a randomized controlled trial conducted by AI chatbot Woebot researchers has revealed that participants experienced a substantial decrease in depression and anxiety after just two weeks of using the app.
- **Privacy and ease to open up**. AI-based therapists make people feel less self-restrained when they may need to share embarrassing details. This is especially important for those who can feel shame in face-to-face interactions because of stigma or fear of being judged. Actually, almost a quarter of people lie to doctors, with the most hushed topics being smoking, drinking habits, and sexual activity. For many, it’s easier to admit the true extent of their behavior to a robot because the robot won’t judge.
- **Support for therapists**. “AI could be an effective way for clinicians to make the best of the time they have with patients,” says Peter Foltz, a research professor at the University of Colorado Boulder. This is because AI can track and analyze substantial amounts of data faster and even more efficiently than any human. As a result, algorithms help with more accurate diagnoses. They can also spot early signs of trouble by monitoring the patient’s mood and behavior and alert clinicians so that they can quickly adjust treatment plans. This can be lifesaving for suicidal patients who need regular check-ins.

3.1 Current AI trends in mental health

Mental health tech continues to be the best-funded space in digital health despite the ongoing impacts of macroeconomic factors like inflation, supply chain disruptions, and interest rates.

In the booming 2021, mental health tech companies raised $5.5 billion worldwide (324 deals), a 139% increase from the previous year that recorded 258 deals, according to CBInsights’ State of Mental Health Tech 2021 Report.

“As the pandemic continued to exacerbate mental health issues (such as anxiety and depression), there was growth in demand and investor interest in digital tools that enhanced mental healthcare delivery,” the report said.

A number of startups that are using AI in mental healthcare have closed notable deals in 2022 as well. Among them is the AI chatbot Wysa (20$ million in funding), BlueSkeye that is working on improving early diagnosis (£3.4 million), the Upheal smart notebook for mental health professionals (€1.068 million), and the AI-based mental health companion clare&me (€1 million).

An analysis of the investment landscape and ongoing research suggests that we are likely to see the emergence of more emotionally intelligent AI therapists and new mental health applications driven by AI prediction and detection capabilities.

For instance, researchers at Vanderbilt University Medical Center in Tennessee, US, have developed an ML algorithm that uses a person’s hospital admission data, including age, gender, and past medical diagnoses, to make an 80% accurate prediction of whether this individual is likely to take their own life. University of Florida researchers are about to test their new AI platform aimed at making accurate diagnosis in patients with early Parkinson’s disease. Research is also underway to develop a tool combining explainable AI and deep learning to prescribe personalized treatment plans for children with schizophrenia.

3.2 Tentative Methodology:

The study will employ experimental methods, utilizing images of three different types of social robots with varying degrees of human likeness. Pre-testing will establish the level of anthropomorphism for each robot. Established scales will be used to measure both message persuasiveness and participants' sense of discomfort. The specific context for the persuasion scenario (e.g., charitable donation, product recommendation) is currently under consideration. Additionally, participant demographics and technology readiness will be assessed as control variables.

Conclusion

AI holds both incredible promises and many next-level complexities.

Like with many healthcare apps, there can be an issue of compliance with the GDPR, HIPAA, and other industry-specific guidelines. But there’s much more to that with artificial intelligence. One of the most significant challenges of implementing AI for mental healthcare is the potential for bias in AI systems, which can come with insufficient and poor quality databases. Another challenge is the lack of transparency over the use of algorithms and their decision-making logic that can hinder AI adoption due to distrust. There are also concerns about data privacy and security, with AI system often requiring large amounts of sensitive patient data to function properly. Finally, integrating AI tools into existing healthcare systems can be difficult and time-consuming, especially when many medical professionals need training to effectively use AI-based tools.However, AI is a work in progress, and we know that we are making progress. There will be new developments for sure as we are making strides toward a future where AI can help us provide better mental healthcare for those who need it. The mental health crisis needs to be addressed, and AI can play a crucial role.

Basic Logic in Artificial Intelligence, Internet of Things and Robotics

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Abstract:

The rapid development of Artificial Intelligence (AI) has significantly impacted service industries, particularly in leisure, hospitality, and tourism. This study explores how digital strategies, including robots, chatbots, voice assistants, and the Internet of Things (IoT), are transforming key business processes, ultimately enhancing customer experiences. Today's consumers have evolved in their approach to products and services, with AI playing a central role, notably through the widespread use of smartphones. Understanding how leisure travellers perceive and interact with AI tools is crucial for the tourism and hospitality industry, as it paves the way for enhanced customer experiences. Trust, particularly among employees, also plays a pivotal role in maximizing the effectiveness of technology in service delivery.

1. Logic and Artificial Intelligence

1.1 The Role of Logic in Artificial Intelligence

Theoretical computer science developed out of logic, the theory of computation (if this is to be considered a different subject from logic), and some related areas of mathematics.[4] So theoretically minded computer scientists are well informed about logic even when they aren't logicians. Computer scientists in general are familiar with the idea that logic provides techniques for analyzing the inferential properties of languages, and with the distinction between a high-level logical analysis of a reasoning problem and its implementations. Logic, for instance, can provide a specification for a programming language by characterizing a mapping from programs to the computations that they license. A compiler that implements the language can be incomplete, or even unsound, as long as in some sense it approximates the logical specification. This makes it possible for the involvement of logic in AI applications to vary from relatively weak uses in which the logic informs the implementation process with analytic insights, to strong uses in which the implementation algorithm can be shown to be sound and complete. In some cases, a working system is inspired by ideas from logic and then acquires features that at first seem logically problematic but can later be explained by developing new ideas in logical theory. This sort of thing has happened, for instance, in logic programming.

In particular, logical theories in AI are independent from implementations. They can be used to provide insights into the reasoning problem without directly informing the implementation. Direct implementations of ideas from logic—theorem-proving and model-construction techniques—are used in AI, but the AI theorists who rely on logic to model their problem areas are free to use other implementation techniques as well. Thus, in Moore 1995b (Chapter 1), Robert C. Moore distinguishes three uses of logic in AI; as a tool of analysis, as a basis for knowledge representation, and as a programming language.

A large part of the effort of developing limited-objective reasoning systems goes into the management of large, complex bodies of declarative information. It is generally recognized in AI that it is important to treat the representation of this information, and the reasoning that goes along with it, as a separate task, with its own research problems.

The evolution of expert systems illustrates the point. The earliest expert systems, such as MYCIN (a program that reasons about bacterial infections, see Buchanan & Shortliffe 1984), were based entirely on large systems of procedural rules, with no separate representation of the background knowledge—for instance, the taxonomy of the infectious organisms about which the system reasoned was not represented.

Later generation expert systems show a greater modularity in their design. A separate knowledge representation component is useful for software engineering purposes—it is much better to have a single representation of a general fact that can have many different uses, since this makes the system easier to develop and to modify. And this design turns out to be essential in enabling these systems to deliver explanations as well as mere conclusions.[5]

1.2 Knowledge Representation

In response to the need to design this declarative component, a subfield of AI known as *knowledge representation* emerged during the 1980s. Knowledge representation deals primarily with the representational and reasoning challenges of this separate component. The best place to get a feel for this subject is the proceedings of the meetings that are now held every other year:

Typical articles in the proceedings of the KR and Reasoning conferences deal with the following topics.

Topics in logical theory and the theory of computation, including
Nonmonotonic logic
Complexity theory
Studies in application areas, including
Temporal reasoning
Formalisms for reasoning about planning, action and change, and causality
Metareasoning
Reasoning about context
Reasoning about values and desires
Reasoning about the mental states of other agents, and especially about knowledge and belief
Spatial reasoning
Reasoning about vagueness
Argumentation and argumentation theory
Aggregation problems of many kinds, such as the integration of conflicting knowledge sources
Studies in application techniques, including
Logic programming
Description logics
Theorem proving
Model construction
Studies of large-scale applications, including
Cognitive robotics
Merging, updating, and correcting knowledge bases

These topics hardly overlap at all with the contents of the *Journal of Symbolic Logic*, the principal research archive for mathematical logic. But there is substantial overlap in theoretical emphasis with *The Journal of Philosophical Logic*, where topics such as tense logic, epistemic logic, logical approaches to practical reasoning, belief change, and vagueness account for a large percentage of the contributions. Very few *JPL* publications, however, deal with complexity theory or with potential applications to automated reasoning.

1.3 Philosophical Logic

A history of philosophical logic is yet to be written. Though philosophical logic has traditionally been distinguised from mathematical logic, the distinction may well be incidental in relation to the overall goals of the subject, since technical rigor and the use of mathematical methods seem to be essential in all areas of logical research. However, the distinction between the two subfields has been magnified by differences in the sorts of professional training that are available to logicians, and by the views of individuals on what is important for the field.

The statement of policy presented in *Journal of Symbolic Logic* (1936, Volume 1, No. 1) lists bringing together the mathematicians and philosophers working in logic among the goals of the new journal. Probably at this time both the mathematicians and the philosophers shared a sense that their subject was considered to be somewhat marginal by their colleagues, and may have felt a primary loyalty to logic as a subject rather than to any academic discipline. Articles in the first volume of the *JSL* were divided about equally between professional mathematicians and philosophers, and the early volumes of the *JSL* do not show any strong differences between the two groups as to topic.

This situation changed in the 1960s. The 1969 volume of the *JSL* contained 39 articles by mathematicians, and only nine by philosophers. By the early 1970s, many philosophers felt that philosophical papers on logic were unlikely to be accepted by the *JSL*, and that if they were accepted they were unlikely to be read by philosophers. At this point, the goals of the two groups had diverged considerably. Mathematicians were pursuing the development of an increasingly technical and complex body of methods and theorems. Many philosophers felt that this pursuit was increasingly irrelevant to the goal of illuminating philosophical issues. These divisions led to the founding of the *Journal of Philosophical Logic* in 1972. The list of sample topics in the first issue included:

Contributions to branches of logical theory directly related to philosophical concerns, such as inductive logic, modal logic, deontic logic, quantum logic, tense logic, free logic, logic of questions, logic of commands, logic of preference, logic of conditionals, many-valued logic, relevance logics;

Contributions to philosophical discussions that utilize the machinery of formal logic …;

Discussions of philosophical issues relating to logic and the logical structure of language, …;

Philosophical work relating to the special sciences, ….

Most of the articles over the subsequent 28 years of the *JPL* belong to the first of these four categories. But the description with which this list begins is not particularly illuminating: why should these particular topics be of interest to philosophers? Their most important shared feature is a sense that despite successes in formalizing areas of mathematical logic, the scope of logic remained severely limited. There are unsolved problems in formalizing the nonmathematical sciences that seem to require thinking through new and different logical issues (quantum logic and the logic of induction, for instance). The remaining topics cover a part, at least, of the even more pressing problems involved in extending logical theory to nonscientific reasoning. The dominant goal, then, of philosophical logic is the extension of logical methods to nonmathematical reasoning domains. This goal has a theoretical dimension if (as many philosophical logicians seem to feel) it requires reworking and extending logical formalisms.

The development and testing of applications, such as the problem of formalizing the reasoning involved in getting to the airport, posed as a challenge in McCarthy 1959 (see Section 2.2, below), doesn't even appear as a category in the list of *JPL* topics, and in fact most of the philosophical logic literature is theoretical in nature, and is tested using philosophical techniques. Essentially, this means that the theories are motivated and tested with small-scale, artificial examples, selected by the theoreticians. These examples usually serve more as demonstrations or illustrations than as tests.

1.4 Logic in AI and Philosophical Logic

The rough comparison in Section 1.2 of the contents of the main publications for research in logical AI and philosophical logic suggests the following picture. Theoretical work in logical AI and in philosophical logic overlap to a large extent. Both are interested in developing nonmetamathematical applications of logic, and the core topics are very similar. This overlap is due not only to commonality of interest, but to direct influence of philosophical logic on logical AI; there is ample evidence, as we will see, that the first generation at least of AI logicists read and were influenced by the literature in philosophical logic.

Since that point, the specialties have diverged. New logical theories have emerged in logical AI (nonmonotonic logic is the most important example) which are not widely known in philosophical logic. Other differences are due to the AI community's interest in the theoretical analysis of algorithms and, of course, with their sense of the importance of implementations. Some have to do with the emerging development in computer science of ambitious applications using unprecedentedly large bodies of logical axioms. The sheer size of these applications produces new problems and new methodologies. And other differences originate in the interest of philosophical logicians in some topics (metaphysical topics, for instance) that are primarily inspired by purely philosophical considerations.

Concern for applications can be a great influence on how research is carried out and presented. The tradition in philosophical logic predates applications in automated reasoning, and to this day remains relatively uninterested in such applications. The methodology depends on intuitions, but without any generally accepted methodology for articulating and deploying these intuitions. And the ideas are illustrated and informed by artificial, small-scale examples.[6] In general, the philosophical literature does not deal with implementability or efficiency of the reasoning, or indeed with any features of the reasoning process. And it is hard to find cases in which the philosophical theories are illustrated or tested with realistic, large-scale reasoning problems.

These differences, however, are much more a matter of style than of substance or of strategic research goals. It is difficult to think through the details of the reasoning process without the computational tools to make the process concrete, and difficult to develop large-scale formalizations of reasoning problems without computational tools for entering, testing, and maintaining the formalizations. Because the core theoretical topics (modal, conditional and temporal logic, belief revision, and the logic of context) are so similar, and because the ultimate goal (the formalization of nonmathematical reasoning) is the same, one can see logic in AI as a continuous extension of the philosophical logic tradition.

The early influence of philosophical logic on logic in AI was profound. The bibliography of McCarthy & Hayes 1969, one of the most influential early papers in logical AI, illustrates the point well. There are 58 citations in the bibliography. Of these, 35 refer to the philosophical logic literature. (There are 17 computer science citations, one mathematical logic citation, one economics citation, and one psychology citation.) This paper was written at a time when there were hardly any references to logical AI in the computer science literature. Naturally, as logical AI has matured and developed as a branch of computer science, the proportion of cross-disciplinary citations has decreased. A sampling of articles from the first Knowledge Representation conference, Brachman *et al*. 1989, held in 1989, shows only 12 philosophical logic citations out of a total of 522 sampled citations; a sampling of articles from Cohn *et al*. 1998, held in 1998, shows 23 philosophical logic citations out of a total of 468 sampled

Despite the dramatic decrease in quantity of explicit citations, the contemporary literature in logical AI reflects an indirect acquaintance with the earlier literature in philosophical logic, since many of the computational papers that are explicitly cited in the modern works were influenced by this literature. Of course, the influence becomes increasingly distant as time passes, and this trend is accelerated by the fact that new theoretical topics have been invented in logical AI that were at best only dimly prefigured in the philosophical literature.

Although philosophical logic is now a relatively small field in comparison to logical AI, it remains a viable area of research, with new work appearing regularly. But references to contemporary research in philosophical logic are rare in the AI literature. Similarly, the papers currently published in *The Journal of Philosophical Logic*, at least, do not show much influence from AI.[8] In Europe, the lines are harder to draw between professional divisions among logicians: some European journals, especially the *Journal of Logic, Language, and Information*, are successful in maintaining a focus in logic while attracting authors from all the disciplines in which logic is represented.

1.5 The Role of Artificial Intelligence in Logic

The importance of applications in logical AI, and the scale of these applications, represents a new methodology for logic—one that would have been impossible without mechanized reasoning. This methodology forces theoreticians to think through problems on a new scale and at a new level of detail, and this in turn has a profound effect on the resulting theories. The effects of this methodology will be illustrated in the sections below, dealing with various topics in logical AI. But the point is illustrated well by reasoning about action and change. This topic was investigated in the philosophical literature. Reasoning about change, at least, is part of tense logic, and the consequences of action are investigated in the literature on “seeing to it that”; see, for instance, Belnap 1996. The latter theory has no very robust account of action. The central construct is a variation on a branching-time modality of the sort that has been familiar since Prior 1967. Although it represents an interesting development in philosophical logic, the scale of the accomplishment is very different from the research tradition in logical AI reported in Section 4, below. The formalisms in this tradition not only support the formalization of complex, realistic planning problems, but provide entirely new insights into reasoning about the causal effects of actions, the persistence of states, and the interactions between actions and continuous physical processes. Developments such as this would have been impossible without the interactions between the logical theories and large-scale, practical applications in automated planning.

In Carnap 1955, Rudolf Carnap attempted to clarify intensional analyses of linguistic meaning, and to justify from a methodological point of view, by imagining how the analysis could be applied to the linguistic usage of a hypothetical robot. Carnap hoped that the fact that we could imagine ourselves to know the internal structure of the robot would help to make the case for an empirical science of semantics more plausible. This hope proved to be unjustified; the philosophical issue that concerned Carnap remains controversial to this day, and thought experiments with robots have not proved to be particularly rewarding in addressing it. Real robots, though, with real applications,[9] are a very different matter. Though it is hard to tell whether they will prove to be helpful in clarifying fundamental philosophical problems, they provide a laboratory for logic that is revolutionary in its potential impact on the subject. They motivate the development of entirely new logical theories that should prove to be as important for philosophy as the fundamental developments in logic of the late nineteenth century proved to be.

The emergence of separate mathematical and philosophical subspecialties within logic was not an entirely healthy thing for the field. The process of making mathematical logic rigorous and of demonstrating the usefulness of the techniques in achieving mathematical ends that was pursued so successfully in the first half of the twentieth century represents a coherent refinement of logical methodology. All logicians should be pleased and proud that logic is now an area with a body of results and problems that is as substantial and challenging as those associated with most areas of mathematics.

But these methodological advances were gained at the expense of coverage. In the final analysis, logic deals with reasoning—and relatively little of the reasoning we do is mathematical, while almost all of the mathematical reasoning that nonmathematicians do is mere calculation. To have both rigor and scope, logic needs to keep its mathematical and its philosophical side united in a single discipline. In recent years, neither the mathematical nor the philosophical professions—and this is especially true in the United States—have done a great deal to promote this unity. But the needs of Computer Science provide strong unifying motives. The professional standards for logical research in Computer Science certainly require rigor, but the field also puts its practitioners into contact with reasoning domains that are not strictly mathematical, and creates needs for innovative logical theorizing.

The most innovative and ambitious area of Computer Science, in terms of its coverage of reasoning, and the one that is closest in spirit to philosophical logic, is AI. This article will attempt to provide an introduction, for outsiders who are familiar with logic, to the aspects of AI that are closest to the philosophical logic tradition. This area of logic deserves, and urgently needs, to be studied by historians. But such a study will not be found here.

2. John McCarthy and Common Sense Logicism

2.1 Logical AI

The most influential figure in logical AI is John McCarthy. McCarthy was one of the founders of AI, and consistently advocated a research methodology that uses logical techniques to formalize the reasoning problems that AI needs to solve. All but the most recent work in McCarthy's research program can be found in Lifschitz 1990a, which also contains an introduction to McCarthy's work Lifschitz 1990b; for additional historical background, see Israel 1991.

McCarthy's methodological position has not changed substantially since it was first articulated in McCarthy 1959 and elaborated and amended in McCarthy & Hayes 1969. The motivation for using logic is that—even if the eventual implementations do not directly and simply use logical reasoning techniques like theorem proving—a logical formalization helps us to understand the reasoning problem itself. The claim is that without an understanding of what the reasoning problems are, it will not be possible to implement their solutions. Plausible as this Platonic argument may seem, it is in fact controversial in the context of AI; an alternative methodology would seek to learn or evolve the desired behaviors. The representations and reasoning that this methodology would produce might well be too complex to characterize or to understand at a conceptual level.

From McCarthy & Hayes 1969, it is clear that McCarthy thought of his methodology for AI as overlapping to a large extent with traditional philosophy, but adding to it the need to inform the design of programs capable of manifesting general intelligence. This idea is not uncongenial to some philosophers (see, for instance, Carnap 1956 (pp. 244–247) and Pollock 1995). In practice, the actual theories that have emerged from McCarthy's methodology are influenced most strongly by work in philosophical logic, and the research tradition in logical AI represents a more or less direct development of this work, with some changes in emphasis. This review will concentrate on logical AI in relation to philosophical logic, without further comment on relations to philosophy in general or to the feasibility of developing human-level intelligent systems.

2.2 The Formalization of Common Sense

McCarthy's long-term objective was to formalize *common sense reasoning*, the prescientific reasoning that is used in dealing with everyday problems. An early example of such a problem, mentioned in McCarthy 1959, is getting from home to the airport. Other examples include:

Narrative understanding. The reasoning involved in reconstructing implicit information from

narratives, such as sequencing of eventualities, and inferred causal connections.
Diagnosis. For instance, detecting faults in physical devices.
Spatial Reasoning. For instance, reasoning about the parts of rigid bodies and their shapes, and their relation to the shape of the whole.
Reasoning about the attitudes of other agents. For instance, making informed guesses about the beliefs and desires of other agents, not from "keyhole observation" but from conversational clues of the sort that could be obtained in a brief, interactive interview.

Stated baldly, the goal of formalizing common sense would probably seem outrageous to most philosophers, who are trained to think of common sense as rather elusive. But whether or not the ultimate goal is appropriate and achievable, the specific formalization projects that have emerged from this program have been successful in several ways. They have succeeded in breaking new territory for logic by extending the scope of the reasoning problems to which logical techniques can be successfully applied. They have demonstrated that logical techniques can contribute usefully to the solution of specific AI problems—planning is the most successful of these, but some success has been achieved in other areas as well. They form the basis of one approach to developing complete, autonomous agents. And they have illuminated many specific forms of nonscientific reasoning—for instance, qualitative reasoning about the behavior of physical devices

Although McCarthy has advocated this program of formalization since 1959—an almost prehistorical date for AI—the program has not been taken on board and pursued by a dedicated community until recently. Research in this area has gained much momentum since 1990.

3. Nonmonotonic Reasoning and Nonmonotonic Logics

3.1 Nonmonotonicity

Aristotle believed that most reasoning, including reasoning about what to do and about sublunary natural phenomena, dealt with things that hold "always or for the most part." But Aristotelian logic deals only with patterns of inference that hold without exception. We find at the very beginning of logic a discrepancy between the scope of logical theory and common sense reasoning. Nonmonotonic logic is the first sustained attempt within logical theory to remedy this discrepancy. As such, it represents a potential for a sweeping expansion of the scope of logic, as well as a significant body of technical results.

The consequence relations of classical logics are monotonic. That is, if a set Γ of formulas implies a consequence C then a larger set $\Gamma \cup A$ will also imply C. A logic is *nonmonotonic* if its consequence relation lacks this property. *Preferred models* provide a general way to induce a nonmonotonic consequence relation. Invoke a function that for each Γ produces a subset $M\Gamma$ of the models of Γ; in general, we will expect $M\Gamma$ to be a proper subset of these models. We then say that Γ implies C if C is satisfied by every model in $M\Gamma$. As long as we do not suppose that $M\Gamma\cup\{A\} \subseteq M\Gamma$, we can easily have an implication relation between Γ and C without imposing this relation on supersets of Γ.[14]

This model theoretic behavior corresponds to expectation-guided reasoning, where the expectations allow certain cases to be neglected. Here is an important difference between common sense and mathematics. Mathematicians are trained to reject a proof by cases unless the cases exhaust all the possibilities; but typical instances of common sense reasoning neglect some alternatives. In fact, it is reasonable to routinely ignore improbable possibilities. Standing in a kitchen in California, wondering if there is time to wash the dishes before leaving for work, one might not take the possibility of an earthquake into account.

There seem to be many legitimate reasons for neglecting certain cases in common sense reasoning. A qualitative judgment that the probability of a case is negligible is one reason. But, for instance, in a planning context it may be reasonable to ignore even nonnegligible probabilities, as long as there is no practical point in planning on these cases.

The motivations for nonmonotonicity seem to involve a number of complex factors; probability (perhaps in some qualitative sense), normality, expectations that are reasonable in the sense that one can't be reasonably blamed for having them, mutual acceptance, and factors having to do with limited rationality. It may well be that no one has succeeded in disentangling and clarifying these motivating considerations. In the early stages of its emergence in logical AI, many researchers seem to have thought of nonmonotonic reasoning as a general method for reasoning about uncertainty; but by the end of the 1980s, implementations of fully quantitative probabilistic reasoning were not only possible in principle, but were clearly preferable in many sorts of applications to methods involving nonmonotonic logic. A plausible and realistic rationale for nonmonotonic logic has to fit it into a broader picture of reasoning about uncertainty that also includes probabilistic reasoning.

3.2 Historical Motivations

Three influential papers on nonmonotonic logic appeared in 1980: McDermott & Doyle 1980, Reiter 1980, and McCarthy 1980. In each case, the formalisms presented in these papers were the result of a gestation period of several years or more. To set out the historical influences accurately, it would be necessary to interview the authors, and this has not been done. However, there seem to have been two motivating factors: strategic considerations having to do with the long-range goals of AI, and much more specific, tactical considerations arising from the analysis of the reasoning systems that were being deployed in the 1970s.

Section 2.2 drew attention to McCarthy's proposed goal of formalizing common sense reasoning. The brief discussion above in Section 3.1 suggests that monotonicity may be an obstacle in pursuing this goal. An additional motive was found in Minsky 1974, which was widely read at the time. This paper presents an assortment of challenges for AI, focusing at the outset on the problem of natural language understanding.[16] Minsky advocates frame-based knowledge representation techniques[17] and (conceiving of the use of these representations as an alternative to logic), he throws out a number of loosely connected challenges for the logical approach, including the problem of building large-scale representations, of reasoning efficiently, of representing control knowledge, and of providing for the flexible revision of defeasible beliefs. In retrospect, most AI researchers would tend to agree that these problems are general challenges to any research program in AI (including the one Minsky himself advocated at the time) and that logical techniques are an important element in addressing some, perhaps all, of the issues. (For instance, a well structured logical design can be a great help in scaling up knowledge representation.)

Minsky apparently intended to provide general arguments against logical methods in AI, but McDermott & Doyle 1980 and McCarthy 1980 interpret Minsky 1974 as a challenge that can be met by developing logics that lack the monotonicity property. Perhaps unintentionally, the paper seems to have provided some incentive to the nonmonotonic logicians by stressing monotonicity as a source of the alleged shortcomings of logic. In fact, the term 'monotonicity' apparently makes its first appearance in print in Minsky's 1974 paper.

The development of nonmonotonic logic also owes a great deal to the applied side of AI. In fact, the need for a nonmonotonic analysis of a number of AI applications was as persuasive as the strategic considerations urged by McCarthy, and in many ways more influential on the shape of the formalisms that emerged. Here, we mention three such applications that appear to have been important for some of the early nonmonotonic logicians: belief revision, closed-world reasoning, and planning.

3.2.1 Belief Revision

Doyle 1979 provides an analysis and algorithm for a "truth maintenance system". The TMS answers a general need, providing a mechanism for updating the "beliefs" of knowledge bases. The idea of the TMS is to keep track of the support of beliefs, and to use the record of these support dependencies when it is necessary to revise beliefs.

In a TMS, part of the support for a belief can consist in the *absence* of some other belief. This introduces nonmonotonicity. For instance, it provides for defaults; that Wednesday is the default day for scheduling a meeting means the belief that the meeting will be on Wednesday depends on the *absence* of special-case beliefs entailing that it will not be on Wednesday.

The TMS algorithm and its refinements had a significant impact on AI applications, and this created the need for a logical analysis. (In even fairly simple cases, it can be hard in the absence of analytic tools to see what consequences a TMS should deliver.) This provided a natural and highly specific challenge for those seeking to develop a nonmonotonic logic. The TMS also provided specific intuitions: the idea that the key to nonmonotonicity has to do with inferences based on unprovability was important for the modal approaches to nonmonotonic logic and for default logic. And the TMS's emphasis on interactions between arguments began a theme in nonmonotonic logic that remains important to this day.

3.2.2 Closed-world reasoning

The study of databases belongs to computer science, not specifically to AI. But one of the research paradigms in the scientific analysis of databases uses logical models of the representations and reasoning (see Minker 1997 for a recent survey of the field), and this area has interacted with logical AI. The deductive database paradigm was taking shape at about the same time that many AI researchers were thinking through the problems of nonmonotonic logic, and provided several specific examples of nonmonotonic reasoning that called for analyses. Of these, perhaps the most important is the *closed-world assumption*, according to which—at least as far as simple facts are concerned, represented in the database as positive or negative literals—the system assumes that it knows all that there is to be known. It is the closed world assumption that justifies a negative answer to a query "Is there a direct flight from Detroit to Bologna?" when the system finds no such flight in its data. This is another case of inference from the absence of a proof; a negative is proved, in effect, by the failure of a systematic attempt to prove the positive. This idea, which was investigated in papers such as Reiter 1978 and Clark 1978 also provided a challenge for nonmonotonic logics, as well as specific intuitions—note that again, the idea of inference rules depending on the absence of a proof is present here.

3.2.3 Planning

Rational planning is impossible without the ability to reason about the outcomes of a series of contemplated actions. Predictive reasoning of this sort is local; in a complex world with many features, we assume that most things will be unchanged by the performance of an action. But this locality has proved to be difficult to formalize. The problem of how to formalize this "causal inertia"[18] is known as the *Frame Problem*.
It is very natural to suppose that inertia holds by default; variables are unchanged by the performance of an action unless there is a special reason to think that they will change. This suggests that nonmonotonic temporal formalisms should provide an appropriate foundation for reasoning about action and change. So attempts to formalize the reasoning needed in planning also created a need for nonmonotonic logics. One of the earliest attempts to formalize nonmonotonic reasoning,

Conclusion

Various factors, such as AI performance expectations, perceived effort to use AI, intrinsic motivation, social influence, technology readiness, experience, and age, influence consumers' decisions to adopt new technologies. Younger consumers tend to be more accepting of AI in tourism compared to their older counterparts. This study delves into individual acceptance and use of information technology, with a specific focus on Generation Z, a cohort with extensive exposure to technology in their upbringing.

Using a sample of 754 university students, including those studying tourism, this study employs a self-administered questionnaire with four main sections: attitudinal and subjective norm variables, behavioural intention variables, usage behaviour variable, and socio-economic and demographic data. Structural equation modelling (SEM) based on partial least squares (PLS) is used to assess the relationship between attitudinal and norm dimensions and consumers' willingness to integrate AI into their tourism experiences. The study also explores how smartphone usage frequency moderates the effects of these constructs on AI acceptance.

Future of Artificial Intelligence in Fields like E-Commerce

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Abstract:

The surge in E-Commerce has revolutionized the tourism industry, offering services like information retrieval, ticketing, and bookings that bridge the gap between users and industry stakeholders with Artificial Intelligence. This evolution is attributed to the constant interaction of users with the tourism ecosystem, alongside the proliferation of online services and promotions Despite their potential to enhance customer engagement, the adoption of these apps is still in its early stages (Leon, 2018). This chapter to investigate the multifaceted variables affecting the usage of tourist apps, drawing from a comprehensive integration of existing models in technology adoption literature.

1.Literature and Methodology:

The attitude towards mobile app usage is influenced by a range of factors, including emotions, moods, ethical considerations, usage frequency, familiarity, and physical environment aspects (Carter and Yeo, 2016). Previous studies on travel applications have employed various technology adoption models (Castañeda et al., 2019; Chen et al., 2019; Cheng and Jin, 2019; Choi et al., 2018; Escobar-Rodríguez and Carvajal-Trujillo, 2014; Hui et al., 2007; Lu et al., 2015; Mohsin et al., 2017; Morosan and DeFranco, 2016; Munar and Jacobsen, 2014; Okumus and Bilgihan, 2014; Palau-Saumell et al., 2019; Stocchi et al., 2019; Wu et al., 2009; Xu et al., 2019).

The Social Cognitive Theory (SCT) suggests that external influences play a role in behavior regulation, highlighting the subjective norm's impact on app usage. However, studies present differing perspectives on this aspect (Tak and Panwar, 2017; Castañeda et al., 2019). Additionally, Unified Technology Adoption Theory (UTAUT) emphasizes the importance of performance expectations and effort expectations in the app adoption process (Venkatesh et al., 2012). Hedonistic motivations, interpreted as perceived enjoyment, and other variables related to app functionality, navigation, and ease-of-use are also considered influential (Hew et al., 2015; Kapoor and Vij, 2018).

The findings reveal that attitudinal and norm-based factors significantly influence users' behavioural intention towards AI. Moreover, smartphone usage behaviour acts as a moderator, affecting consumers' acceptance and willingness to use AI devices.

This research contributes to a deeper understanding of the factors influencing AI acceptance in leisure, hospitality, and tourism. It provides valuable insights for business managers in the hospitality industry to identify barriers hindering consumer acceptance of AI. Additionally, policy makers and educational institutions can leverage this knowledge to emphasize the significance of new technologies in daily life and leisure activities.

Artificial Intelligence (referred to hereafter by its nickname, "AI") is the subfield of Computer Science devoted to developing programs that enable computers to display behavior that can (broadly) be characterized as intelligentMost research in AI is devoted to fairly narrow applications, such as planning or speech-to-speech translation in limited, well defined task domains. But substantial interest remains in the long-range goal of building generally intelligent, autonomous agents,[even if the goal of fully human-like intelligence is elusive and is seldom pursued explicitly and as such.

Throughout its relatively short history, AI has been heavily influenced by logical ideas. AI has drawn on many research methodologies: the value and relative importance of logical formalisms is questioned by some leading practitioners, and has been debated in the literature from time to timeBut most members of the AI community would agree that logic has an important role to play in at least some central areas of AI research, and an influential minority considers logic to be the most important factor in enabling strategic, fundamental advances.

The relations between AI and philosophical logic are part of a larger story. It is hard to find a major philosophical theme that doesn't become entangled with issues having to do with reasoning. Implicatures, for instance, have to correspond to inferences that can be carried out by a rational interpreter of discourse. Whatever causality is, causal relations should be inferrable in everyday common sense settings. Whatever belief is, it should be possible for rational agents to make plausible inferences about the beliefs of other agents. The goals and standing constraints that inform a rational agent's behavior must permit the formation of reasonable plans.

In each of these cases, compatibility with an acceptable account of the relevant reasoning is essential for a successful philosophical theory. But the methods in the contemporary philosophical inventory are too crude to provide anything like an adequate account of reasoning that is this complex and this entangled in broad world knowledge.

Bringing an eclectic set of conceptual tools to the problem of idealized reasoning in realistic settings, and using computers to model and test the theories, research in AI has transformed the study of reasoning—especially of practical, common sense reasoning. This process and its outcome is well documented in Russell & Norvig 2010.

The new insights and theories that have emerged from AI are of great potential value in informing and constraining many areas of philosophical inquiry. The special case of philosophical logic that forms the theme of this article may provide support for the more general point. Although logic in AI grew out of philosophical logic, in its new setting it has produced new theories and ambitious programs that would not have been possible outside of a community devoted to building full-scale computational models of rational agency.

This entry assumes an audience consisting primarily of philosophers who have little or no familiarity with AI. The entry concentrates on the issues that arise when logic is used in understanding problems in intelligent reasoning and guiding the design of mechanized reasoning systems. Logic in AI is by now a very large and not very well demarcated field—nothing like complete coverage has been achieved here. Sections 3 and Section 4 provide an overview with some historical and technical details concerning nonmonotonic logic and reasoning about action and change, a topic that is not only central in AI but that should be of considerable interest to philosophers. The remaining sections provide brief and more or less inadequate sketches of selected topics, with references to the primary literature.

Minker 2000b is a comprehensive collection of survey papers and original contributions to the field of logic-based AI, with extensive references to the literature. Jack Minker's introduction, Minker 2000a, is a useful orientation to the field. This volume is a good beginning point for readers who wish to pursue this topic further. Brachman & Levesque 2004a provides an introduction to the field of knowledge representation in textbook form. Davis 1991a and Mueller 2006a are book-length treatments of the challenging problem of formalizing commonsense reasoning. Antonelli 2012a is a good entry point for readers interested in nonmonotonic logic, and Shanahan 2009a is a useful discussion of the frame problem. Wooldridge 2000a deals with logical formalizations of rational agents.

2. AI Application in E-Commerce

Personalized Shopping

Artificial Intelligence technology is used to create recommendation engines through which you can

engage better with your customers. These recommendations are made in accordance with their browsing history, preference, and interests. It helps in improving your relationship with your customers and their loyalty towards your brand.
AI-Powered Assistants
Virtual shopping assistants and chatbots help improve the user experience while shopping online. Natural Language Processing is used to make the conversation sound as human and personal as possible. Moreover, these assistants can have real-time engagement with your customers. Did you know that on amazon.com, soon, customer service could be handled by chatbots?
Fraud Prevention
Credit card frauds and fake reviews are two of the most significant issues that E-Commerce companies deal with. By considering the usage patterns, AI can help reduce the possibility of credit card fraud taking place. Many customers prefer to buy a product or service based on customer reviews. AI can help identify and handle fake reviews.
3. Applications Of Artificial Intelligence in Education
Although the education sector is the one most influenced by humans, Artificial Intelligence has slowly begun to seep its roots into the education sector as well. Even in the education sector, this slow transition of Artificial Intelligence has helped increase productivity among faculties and helped them concentrate more on students than office or administration work.
Some of these applications in this sector include:
Administrative Tasks Automated to Aid Educators
Artificial Intelligence can help educators with non-educational tasks like task-related duties like facilitating and automating personalized messages to students, back-office tasks like grading paperwork, arranging and facilitating parent and guardian interactions, routine issue feedback facilitating, managing enrollment, courses, and HR-related topics.
Creating Smart Content
Digitization of content like video lectures, conferences, and textbook guides can be made using Artificial Intelligence. We can apply different interfaces like animations and learning content through customization for students from different grades.
Artificial Intelligence helps create a rich learning experience by generating and providing audio and video summaries and integral lesson plans.

Voice Assistants
Without even the direct involvement of the lecturer or the teacher, a student can access extra learning material or assistance through Voice Assistants. Through this, printing costs of temporary handbooks and also provide answers to very common questions easily.
Personalized Learning
Using top AI technologies, hyper-personalization techniques can be used to monitor students' data thoroughly, and habits, lesson plans, reminders, study guides, flash notes, frequency or revision, etc., can be easily generated.
4. Applications of Artificial Intelligence in Lifestyle
Artificial Intelligence has a lot of influence on our lifestyle. Let us discuss a few of them.
Autonomous Vehicles
Automobile manufacturing companies like Toyota, Audi, Volvo, and Tesla use machine learning to train computers to think and evolve like humans when it comes to driving in any environment and object detection to avoid accidents.
Spam Filters
The email that we use in our day-to-day lives has AI that filters out spam emails sending them to spam or trash folders, letting us see the filtered content only. The popular email provider, Gmail, has managed to reach a filtration capacity of approximately 99.9%.
Facial Recognition
Our favorite devices like our phones, laptops, and PCs use facial recognition techniques by using face filters to detect and identify in order to provide secure access. Apart from personal usage, facial recognition is a widely used Artificial Intelligence application even in high security-related areas in several industries.
Recommendation System
Various platforms that we use in our daily lives like e-commerce, entertainment websites, social

media, video sharing platforms, like youtube, etc., all use the recommendation system to get user data and provide customized recommendations to users to increase engagement. This is a very widely used Artificial Intelligence application in almost all industries.
Also Read: How Does Artificial Intelligence (AI) Work and Its Applications
5. Applications of Artificial Intelligence in Navigation
Based on research from MIT, GPS technology can provide users with accurate, timely, and detailed information to improve safety. The technology uses a combination of Convolutional Neural Networks and Graph Neural Networks, which makes lives easier for users by automatically detecting the number of lanes and road types behind obstructions on the roads. AI is heavily used by Uber and many logistics companies to improve operational efficiency, analyze road traffic, and optimize routes.
6. Applications of Artificial Intelligence in Robotics
Robotics is another field where Artificial Intelligence applications are commonly used. Robots powered by AI use real-time updates to sense obstacles in its path and pre-plan its journey instantly.
It can be used for:
Carrying goods in hospitals, factories, and warehouses
Cleaning offices and large equipment
Inventory management
7. Applications of Artificial Intelligence in Human Resource
Did you know that companies use intelligent software to ease the hiring process?
Artificial Intelligence helps with blind hiring. Using machine learning software, you can examine applications based on specific parameters. AI drive systems can scan job candidates' profiles, and resumes to provide recruiters an understanding of the talent pool they must choose from.
8. Applications of Artificial Intelligence in Healthcare
Artificial Intelligence finds diverse applications in the healthcare sector. AI applications are used in healthcare to build sophisticated machines that can detect diseases and identify cancer cells. Artificial Intelligence can help analyze chronic conditions with lab and other medical data to ensure early diagnosis. AI uses the combination of historical data and medical intelligence for the discovery of new drugs.
Least Square method (Hair et al., 2017).

Discussion:

The model exhibits high predictive accuracy, validating the impact of various factors on consumers' intention to use travel apps. Notably, performance expectancy, perceived personal outcome expectations, and information design emerge as pivotal determinants.

Theoretical implications arise from the amalgamation of diverse approaches into a unified model, offering insights into the multifaceted elements influencing app adoption. Practically, companies in the app development space can leverage these findings to enhance their offerings, ensuring a competitive edge in the dynamic market.

Limitations include the sample composition primarily comprising university students, potentially affecting generalizability. Additionally, the study focused on the concept of tourism apps in general, warranting further research for specific travel app analysis.

An Introduction of Sentiment Analysis in Artificial Intelligence

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Abstract
In this chapter condenses the investigation of various regulated and unsupervised learning procedures of study for sentiment analysis Based on Machine Learning Techniques. The development of social web contributes tremendous measure of client produced substance, for example, client audits, remarks and suppositions. This client created substance can be about items, individuals, occasions, and so forth. This data is extremely valuable for organizations, governments and people. While this substance intended to be useful breaking down this heft of client created content is troublesome and tedious. So there is a need to build up a smart framework which naturally mine such colossal substance and order them into positive, negative and unbiased class. Slant investigation is the robotized mining of mentalities, suppositions, and feelings from content, discourse, and database sources through Natural Language Processing (NLP). The target of this paper is to find the idea of Sentiment Analysis in the field of Natural Language Processing, and shows a similar investigation of various methods utilized in this field.

I. INTRODUCTİON

Sentiment analysis is a sort of normal dialect preparing for following the state of mind of people in general about a specific item or theme. supposition investigation which is additionally called conclusion mining, includes in building a framework to gather and inspect feelings about the item made in blog entries, remarks, audits or tweets. notion investigation can be helpful in a few different ways. for instance, in showcasing it helps in judging the achievement of a promotion crusade or new item dispatch, figure out which renditions of an item or administration are well known and even recognize which socioeconomics like or aversion specific highlights

There are a few difficulties in sentiment investigation The first is an assessment word that is thought to be sure in one circumstance might be viewed as negative in another circumstance. a second test is that individuals don't in every case express suppositions seamy. Most conventional content handling depends on the way that little contrasts between two bits of content don't change the importance in particular. in sentiment examination, in any case, "the photo was awesome" is altogether different from "the photo was not incredible". individuals can be opposing in their announcements. most audits will have both positive and negative remarks, which is to some degree reasonable by breaking down sentences each one in turn. be that as it may, in the more casual medium like twitter or websites, the more probable individuals are to consolidate diverse assessments in a similar sentence which is simple for a human to see, however more troublesome for a pc to parse. now and again even other individuals experience issues understanding what somebody thought in light of a short bit of content since it needs setting. for instance, "that motion picture was comparable to its last motion picture" is altogether subject to what the individual communicating the assessment thought of the past model. the client's yearning is on for and reliance upon online counsel and proposals the information uncovers is only one purpose for the develop of enthusiasm for new frameworks that arrangement specifically with conclusions as a top of the line protest. assumption investigation focuses on states of mind, though conventional content mining centers around the examination of actualities. there are couple of fundamental fields of research prevail in sentiment examination: notion order, include based sentiment characterization and conclusion rundown. conclusion characterization manages grouping whole records as per the suppositions towards specific items. highlight construct sentiment grouping in light of the other hand thinks about the feelings on highlights of specific articles. feeling rundown assignment is not the same as customary content outline in light of the fact that exclusive the highlights of the item are mined on which the clients have communicated their sentiments. feeling rundown does not outline the surveys by choosing a subset or rework a portion of the first sentences from the audits to catch the fundamental focuses as in the great content synopsis. dialects that have been contemplated generally are english and in chinese. by and by, there are not very many inquires about led on feeling grouping for different dialects like arabic, italian and thai.

II. TECHNIQUES

A. Support Vector Machine (SVM)

Support Vector Machine model[4,5] an administered learning approach ordinarily performs well on different content classification undertakings. Gotten from the vector-space show, it is an established method to weight each term through applying the tf idf recipe, in which the part tf speaks to the event recurrence inside the content. The idf (= log (df/n)) for the most part compares to the logarithm of the backwards report recurrence (meant df), while n shows the aggregate number of writings.

As an option, standardize the two segments with the end goal that the main conceivable qualities would fall in [0 - 1]. For the tf part, we select the increased tf weighting plan characterized as atf = 0.5 + 0.5 . (tf/max tf), where max tf relates to the maximal event recurrence for the basic content and nidf is gotten by essentially partitioning the idf esteem by log(n). In view of this portrayal we utilize the uninhibitedly accessible SVM light model [6,7] which decides the hyperplane that best isolates the cases having a place with the two classifications. For this situation the best hyperplane alludes to the one having the biggest division (or edge) between the two classes (and obviously together with a decrease for the quantity of wrong characterizations). This first form has a place with the direct classifier worldview and we have likewise viewed as nonlinear portion capacities (polynomial, sigmoid). The utilization of non-straight part works did not enhance the nature of the order, at any rate in our grouping undertaking.non-linear kernel functions did not improve the quality of the classification, at least in our classification task.

B. TF*PDF Algorithm’

TF*PDF algorithm[1,2,3] is a managed learning calculation adjusted in the ETTS which is helpful in following the developing point in a specific data region of enthusiasm on the Web, by outlining the change posted on it. TF*PDF calculation is composed in a way that it would allot substantial term weight to these sort of terms and in this manner uncover the fundamental subjects since the web ended up far reaching, the measure of electronically accessible data on the web, particularly news files, has multiplied and debilitates to wind up overpowering. It very well may be utilized in a data framework that will separate fundamental themes in a news file on a week by week premise. By acquiring a week by week report, a client can comprehend what the principle news occasions were in the previous week. When all is said in done, related research on subject distinguishing proof is ordered into two kinds.

Initial one is term weighting strategy to extricate valuable terms that is applicable to gathered reports and displayed moreover. Second is TF-IDF generally utilized for term weighting in Natural dialect handling and data extraction process [1].

In this way, so as to satisfy the target to perceive the terms that clarify the interesting issues, TF*PDF is advanced to tally the centrality (weights) of the terms. Unique in relation to the traditional term weight checking calculation TF*IDF, in TF*PDF calculation, the heaviness of a term from a channel is directly corresponding to the term's inside channel recurrence, and exponentially relative to the proportion of report containing the term in the channel. The aggregate weight of a term will be the summation of term's weight from each channel as takes after.

$$W_j = \sum_{c=1}^{c=D} |F_{jc}| \exp(n_{jc}/N_c) \quad (1)$$

where, Wj=Weight of term j; Fjc=Frequency of term j in channel c; njc=Number of document in channel c where term j occurs; Nc=Total number of document in channel c; k=Total number of terms in a channel; D=number of channels

There are three major compositions in TF*PDF algorithm. The first composition that contributes to the total weight of a term significantly is the "summation" of the term weight gained from each channel, provided that the term deems to explain the hot topic discussed generally in majority of the channels. In other words, the terms that deem to explain the main topic will be heavily weighted. Also, larger the number of channels, more accurate will be this algorithm in recognizing the terms that explain the emerging topic. The second and third compositions are combined to give the weight of a term in a channel in many documents compare to the one occurs in just a few containing certain terms of significant weight, the results would be deviated from having terms that explain the hot topics in majority channels. In short, TF*PDF algorithm give significant weights to the terms that explain the common hot topic in majority channels.

C. F-Measure

In unsupervised procedure, arrangement is finished by looking at the highlights of a given content against notion vocabularies whose estimation esteems are resolved preceding their utilization. Supposition dictionary contains arrangements of words and articulations used to express individuals' emotional sentiments and feelings. For instance, begin with positive and negative word vocabularies, investigate the record for which slant need to discover. At that point if the archive has more positive word dictionaries, it is certain, else it is negative. The dictionary based strategies to Sentiment investigation is unsupervised learning since it doesn't require earlier preparing with a specific end goal to characterize the information.

The F-measure[8,9] is an unsupervised learning method isn't the F-score or F measure utilized in content characterization or data recovery for estimating the arrangement or recovery viability (or accuracy).F-measure investigates the thought of implication of content and is a unitary proportion of content's relative logic (understanding), rather than its custom (unequivocality). Logic and convention can be caught by specific parts of discourse. A lower score of F-measure[10,11] demonstrates relevance, set apart by more noteworthy relative utilization of pronouns, verbs, qualifiers, and interpositions; a higher score of F measure shows custom, spoken to by more prominent utilization of things, descriptive words, relational words, and articles. F-measure is characterized in view of the recurrence of the POS(Part of discourse) use in a content (freq.x beneath implies the recurrence of the grammatical feature x): $F = 0.5 * [(freq.noun + freq.adj + freq.prep + freq.art) – (freq.pron + freq.verb + freq.adv + freq.int) + 100]$ ..

D. EFS Algorithm

Hardly any examination procedures have shown that the blend of both the machine learning and the dictionary based methodologies enhance opinion order performance[12,13]. The principle preferred standpoint of their mixture approach utilizing a dictionary/learning advantageous interaction is to achieve the best of the two universes steadiness and in addition meaningfulness from a painstakingly outlined vocabulary, and the high exactness from a great regulated learning algorithm.EFS[14,15] takes the best of the two universes. It first uses various component choice criteria to rank the highlights following the channel demonstrate. After positioning, the calculation creates some hopeful component subsets which are utilized to locate the last list of capabilities in view of grouping exactness utilizing the wrapper demonstrate. Since our structure creates many less applicant highlight subsets than the aggregate number of highlights, utilizing wrapper show with competitor include sets is adaptable. Additionally, since the calculation produces hopeful capabilities utilizing different criteria and all component classes together, it can catch the majority of those highlights which are separating. The calculation takes as information, an arrangement of n highlights F = {f1, … , fn}, an arrangement of t include determination criteria Θ = {θ1, … , θt}, an arrangement of t limits T = {τ1, … ,τt} comparing to the criteria in Θ, and a window w. τi is the base number of highlights to be chosen for paradigm θi. w is utilized to change τi (in this way the quantity of highlights) to be utilized by the wrapper approach.

III. MEASURE OF PERFORMANCE FOR SENTIMENT ANALYSIS

In the review work EFS in this section, a new method has been designed to set a scale for measuring the sentiment analysis ed image based on Gray Level Co-occurrence Matrix (GLCM) features such as Energy, Contrast, Correlation, Homogeneity and Entropy. In the literature GLCM has been used to analyse and classify the texture features. With the ground truth that a analysis image posses the same properties of the input image, it is true that GLCM feature measures must be same for both the input, and output sentiment analysis images.

The GLCM introduced by [16] applied on a gray-scale image is a second-order statistical measure that characterizes the texture of an image with features such as frequency of the pixel repetition and specified spatial relationship occur in an image. These relations are ordered in a matrix form, and the statistical values are obtained from the generated matrix. GLCM calculates how often pairs of pixel with specific values and in a specified spatial relationship occur in an image.

Statistical parameters calculated from the input image and analysis image from their GLCM values are presented below.

1)Energy:
It provides the sum of squared elements in the GLCM of the input image and the analysis image. It can also be referred as uniformity or the angular second moment. It is obtained from the relation:

$$Energy = \sum_{i=0}^{G-1}\sum_{j=0}^{G-1} p(\text{i}-j)^2$$

where p(i, j) is the (i, j)th entry in the co-occurrence matrix of texture images, G is the number of gray levels within the image.

2)Contrast: It calculates the local variation of intensity contrast between a pixel and its neighbour pixel for the whole image. If the obtained contrast is 0 then the image is said to be a constant image with no variation. Contrast is measured as:

$$Contrast = \frac{1}{(G-1)^2}\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(\text{i}-j)^2\, p(\text{i, j})$$

where p(i, j) is the (i, j)th entry in the co-occurrence matrix of texture images, G is the number of gray levels within the image.

3)Correlation: It is the measure of joint probability occurrence of the specified pixel pairs in the input image and the analysis image. It can be computed as:

$$Correlation = \frac{\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(\text{i}-\mu_i)(j-\mu j)\text{p(i, j)}}{\sigma_i\sigma_j}$$

where p(i, j) is the (i, j)th entry in the co-occurrence matrix of texture images, G is the number of gray levels within the image, mean of co-occurrence in ith row $\mu = \sum_{i,j=0}^{G-1} ip_{ij}$, mean of co-occurrence in jth row $\mu = \sum_{i,j=0}^{G-1} jp_{ij}$ and standard deviation in ith row σ_i, standard deviation in jth row σ_i of the texture image.

4)Homogeneity: It measures the elements in the GLCM to the GLCM diagonal to estimate the closeness of distribution. Homogeneity is obtained as,

$$Homogeneity = \sum_{i,j} \frac{\mathrm{p}(i,j)}{1+|i-j|}$$

5) Entropy: It is the statistical measure of randomness that occurs in a texture image. It is defined as,

$$Entropy = -\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} p(\mathrm{i,j}) \log p(\mathrm{i,j})$$

where p(i, j) is the (i, j)th entry in co-occurrence matrix of texture images, G is the number of gray levels in the image.

Having presented the measures that can be used to analysis the performance of the EFS sentiment analysis scheme, the experimental part is carried out, and the same is presented in the forthcoming SECTION.

IV. EXPERIMENTS AND RESULTS OF SENTIMENT ANALYSIS

From the examination we have done over the above calculations we found that regulated machine learning procedures have demonstrated moderately preferred execution over the unsupervised vocabulary based techniques. In any case, the unsupervised strategies is vital too in light of the fact that regulated techniques request a lot of marked preparing information that are exceptionally costly though obtaining of unlabelled information is simple. Most areas with the exception of film surveys need marked preparing information for this situation unsupervised techniques are exceptionally helpful for creating applications. The vast majority of the scientists detailed that Support Vector Machines (SVM) has high precision than different calculations. The primary impediment of administered learning is that it for the most part requires substantial master commented on preparing corpora to be made sans preparation, particularly for the current application, and may come up short when preparing information are lacking. The fundamental preferred standpoint of half and half approach utilizing a dictionary/learning blend is to achieve the best of the two universes, high exactness from a great managed taking in calculation and strength from vocabulary based approach.

The performance of the EFS sentiment analysis scheme with the orthogonal polynomials coefficients is measured as described in Section 4.4 by comparing the original texture images and the results of the EFS sentiment analysis system.

For the Beans original image and its corresponding sentiment analysis output with the EFS scheme, we could obtain the Energy values as 8.665E-5 and 8.514E-5 respectively, contrast values as 1887.560 and 1807.018, Correlation values 2.477E-4 and 2.572E-4, Homogeneity values 0.046 and 0.046, and Entropy 9.565 and 9.475. The performance measure values are also computed for these other schemes and are presented in Tables 1, 2, 3 and 4 respectively for Beans image, Wall image, Brick image and average of 100 input images. From the Tables 1 and 4, it can be observed that the EFS sentiment analysis scheme could provide almost similar Energy, Contrast, Correlation, Homogeneity and Entropy between original and sentiment analysis images, when compared with other schemes.

Table 1 Comparison of GLCM Features of Sentiment analysis Beans Image, with Other Schemes 0.1

	Energy	Contrast	Correlation	Homogeneity	Entropy
Input Image	8.665E-5	1887.560	2.477E-4	0.046	9.565
Sebastiani Method	1.365E-5	1734.142	3.123E-4	0.048	9.124

Savoy Method	1.381E-5	1733.158	3.227E-4	0.045	9.239
Herring Method	1.368E-5	1418.736	3.231E-4	0.043	9.326
EFS Scheme	8.514E-5	1807.018	2.572E-4	0.046	9.475

Table 2 Comparison of GLCM Features of Sentiment analysis Various with Other Schemes 0.5

	Energy	Contrast	Correlation	Homogeneity	Entropy
Input Image	1.118E-4	2561.982	1.947E-4	0.052	9.497
Sebastiani Method	1.087E-4	2167.594	2.152E-4	0.041	9.540
Savoy Method	1.125E-4	2190.041	2.128E-4	0.040	9.529
Herring Method	8.665E-5	1887.560	2.477E-4	0.046	9.565
EFS Scheme	1.106E-4	2451.882	1.899E-4	0.049	9.402

Table 3 Comparison of GLCM Features of Sentiment analysis Brick Image, with Other Schemes 0.10

	Energy	Contrast	Correlation	Homogeneity	Entropy
Input Image	5.871E-4	400.164	0.001	0.121	7.995
Sebastiani Method	1.298E-4	2467.929	1.712E-4	0.035	9.381
Savoy Method	1.253E-4	2605.178	1.596E-4	0.034	9.416
Herring Method	1.271E-4	2601.047	1.564E-4	0.034	9.391
EFS Scheme	5.886E-4	346.196	0.001	0.118	7.958

Table 4 Comparison of GLCM Features of Sentiment analysis Images (Average of 100 Images)

	Energy	Contrast	Correlation	Homogeneity	Entropy
Input Average of 100 Images	3.748E-4	1965.438	2.544E-4	0.054	8.528
Sebastiani Method	1.269E-4	1454.412	3.368E-4	0.049	9.324
Savoy Method	1.261E-4	1459.685	3.357E-4	0.043	9.329
Herring Method	1.308E-4	1418.736	3.436E-4	0.048	9.306
EFS Scheme	3.318E-4	1917.722	2.440E-4	0.054	8.299

The time taken to the image with the EFS orthogonal polynomials based sentiment analysis scheme, as well as with the other schemes is measured with a computing system, having Pentium Dual core 2.8 GHz CPU and 1 GB RAM. These times taken by the EFS and other sentiment analysis schemes are presented in Table 4.6, as an average over 100 input sample images. It is evident from Table 4 and 5, that the EFS sentiment analysis scheme consumes very less time when compared with Savoy and Herring schemes. The higher time consumption by these schemes attribute to the scanning and matching methods present in their sentiment analysis process. The EFS sentiment analysis scheme with orthogonal polynomials coefficients, takes only 40 to 60% of time than that of Sebastiani method.

Table 5Average Time Taken (Seconds) for Process by the Other and EFS Schemes Over 100 Input Image

EFS Scheme	Sebastiani Method	Savoy Method	Herring Method
1.050	2.534	14.635	17.234
1.464	2.507	14.726	17.131
1.490	2.522	13.954	17.097
1.481	2.519	14.623	17.155

IV. CONCLUSION

Use of Sentiment analysis to mine the immense measure of unstructured information has turned into a critical research issue. Presently business associations and scholastics are advancing their endeavors to locate the best framework for notion investigation. Albeit, a portion of the calculations have been utilized in assessment investigation gives great outcomes, yet no strategy can resolve every one of the difficulties. The vast majority of the specialists revealed that Support Vector Machines (SVM) has high precision than different calculations, however it additionally has restrictions. More future work is required on additionally enhancing the execution of the estimation characterization. There is a gigantic need in the business for such applications on the grounds that each organization needs to know how shoppers feel about their items and administrations and those of their rivals. Distinctive kinds of methods ought to be joined keeping in mind the end goal to defeat their individual disadvantages and advantage from each other's benefits, and improve the assessment characterization execution

Knowledge Representation Based on Semantic Networks in Artificial Intelligence

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Abstract:

The rapid advancement of information technologies and digital applications has reshaped communication channels and resources, offering individuals unprecedented opportunities for innovation and collaborative content creation. Makerspaces, communal environments providing access to cutting-edge technologies, emerge as pivotal hubs for fostering innovation. This study focuses on the potential of 3D printing technology within makerspaces to democratize product innovation, transferring a share of the creative process from producers to consumers.

1.Literature and Methodology:

The study explores the relatively uncharted territory of how makerspace participants leverage 3D printing technology, a transformative design tool, to drive their creative and commercial pursuits. With a foundation in bricolage theory, the research investigates how individuals interact with digital fabrication tools, motivations for joining makerspaces, and the influence of community dynamics. The central research question addressed is: "How and why do individuals engage with new Industry 4.0 enabling technologies within makerspaces?"

A semantic network is a graphic notation for representing knowledge in patterns of interconnected nodes. Semantic networks became popular in artificial intelligence and natural language processing only because it represents knowledge or supports reasoning. These act as another alternative for predicate logic in a form of knowledge representation.

The structural idea is that knowledge can be stored in the form of graphs, with nodes representing objects in the world, and arcs representing relationships between those objects.

Semantic nets consist of nodes, links and link labels. In these networks diagram, nodes appear in form of circles or ellipses or even rectangles which represents objects such as physical objects, concepts or situations.

Links appear as arrows to express the relationships between objects, and link labels specify relations.

Relationships provide the basic needed structure for organizing the knowledge, so therefore objects and relations involved are also not needed to be concrete.

Semantic nets are also referred to as associative nets as the nodes are associated with other nodes

1.1 Semantic Networks Are Majorly Used For

- Representing data
- Revealing structure (relations, proximity, relative importance)
- Supporting conceptual edition
- Supporting navigation

1.2 Main Components Of Semantic Networks

- **Lexical component:** nodes denoting physical objects or links are relationships between objects; labels denote the specific objects and relationships
- **Structural component**: the links or nodes from a diagram which is directed.
- **Semantic component:** Here the definitions are related only to the links and label of nodes, whereas facts depend on the approval areas.
- **Procedural part:** constructors permit the creation of the new links and nodes. The removal of links and nodes are permitted by destructors.

1.3 Advantages Of Using Semantic Nets

- The semantic network is more natural than the logical representation;
- The semantic network permits using of effective inference algorithm (graphical algorithm)

- They are simple and can be easily implemented and understood.
- The semantic network can be used as a typical connection application among various fields of knowledge, for instance, among computer science and anthropology.
- The semantic network permits a simple approach to investigate the problem space.
- The semantic network gives an approach to make the branches of related components
- The semantic network also reverberates with the methods of the people process data.
- The semantic network is characterized by greater cognitive adequacy compared to logic-based formalism.
- The semantic network has a greater expressiveness compared to logic.

1.4 Disadvantages Of Using Semantic Nets

- There is no standard definition for link names
- Semantic Nets are not intelligent, dependent on the creator
- Links are not alike in function or form, confusion in links that asserts relationships and structural links
- Undistinguished nodes that represent classes and that represents individual objects
- Links on object represent only binary relations
- Negation and disjunction and general taxonomical knowledge are not easily expressed.

1.5 Six Mostly Used Types Of Semantic Networks

- **Definitional Networks-** These networks emphasises and deals with only the subtype or is a relation between a concept type and a newly defined subtype. A producing network is referred to as generalization hierarchy. It supports the inheritance rule for duplicating attributes.

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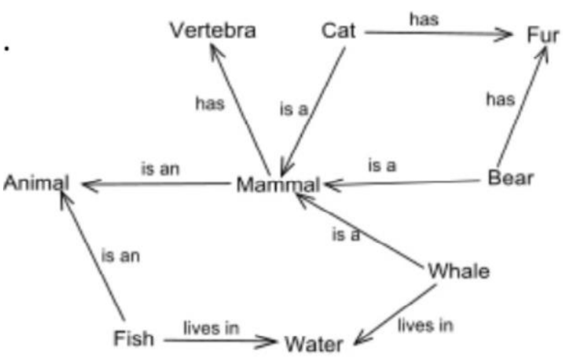
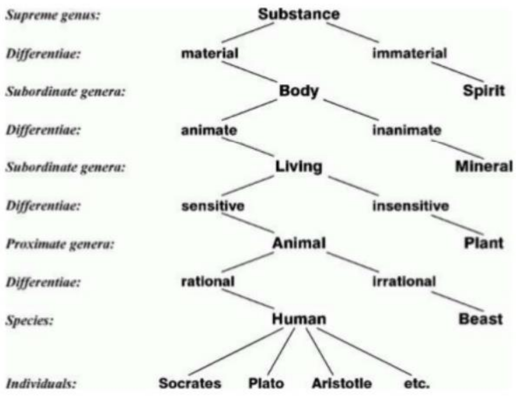
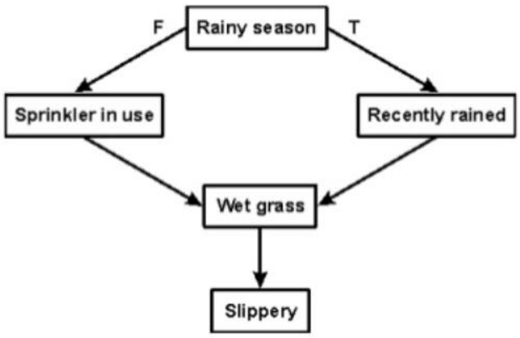


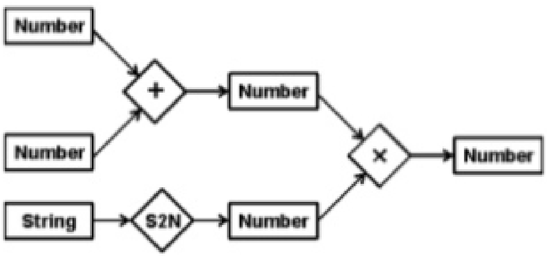
- **Assertion Networks –** Designed to assert propositions is intended to state recommendations. Mostly data in an assertion network is genuine unless it is marked with a modal administrator. Some assertion systems are even considered as the model of the reasonable structures underlying the characteristic semantic natural languages.



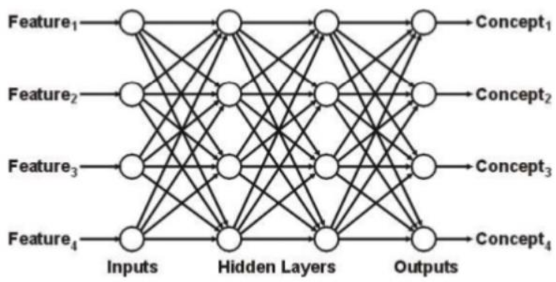
- **Implicational Networks –** Uses Implication as the primary connection for connecting nodes. These networks are also used to explain patterns of convictions, causality and even deductions.



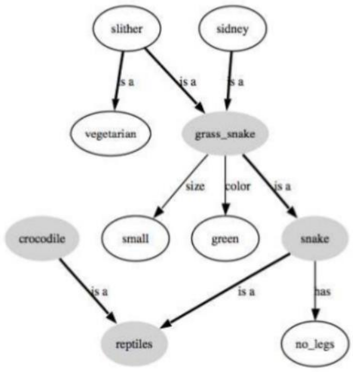
- **Executable Network-** Contains mechanisms that can cause some changes to the network itself by incorporating some techniques, for example, such as attached procedures or marker passing which can perform path messages, or associations and searches for patterns



- **Learning Networks –** These are the networks that build and extend their representations by acquiring knowledge through examples. Contain mechanisms in such networks brings changes within the network itself through representation by securing information. A classic example could be like, the changing of new information from the old system by including and excluding nodes and arcs, or by changing numerical qualities called weights, and connected with the arcs and nodes.



- **Hybrid Networks –** Networks that combine two or more of previous techniques, either in a single network or in a separate, but closely interacting network Hybrid network has been clearly created to implement ideas regarding human cognitive mechanisms, while some are created generally for computer performance.



Since Semantic networks in artificial intelligence also come in many other varied forms, we mentioned only a few major ones, there are many more nearly 40. While these tools have greater potential for supporting not only machines but also human users in their quest for processing ideas, language, they cannot replace the cognitive capabilities of a human brain.

2. Methodology

Knowledge Representation, as we discussed in our **previous article**, is an integral part of **Artificial Intelligence (AI)**. It works along with Reasoning to enable machines to comprehend and represent accumulated data and knowledge in a reasoning way. It is concerned with thinking and how it contributes to intelligent machines. Moreover, it uses various techniques to accomplish an accurate representation of knowledge. These techniques are:

- Logical Representation.
- Semantic Networks.
- Production Rules.
- Frames Representation.

It is one of these techniques, **Semantic Networks**, that we are going to discuss in detail today, by answering various critical questions associated with it, like defining the principles of semantic networks;

- **What do you mean by semantic networks?**
- **What is the difference between Semantic Nets and Frames? etc.**

But, let's begin the discussion by answering the most crucial question:

WHAT ARE SEMANTIC NETS IN AI?

Semantic Networks or **Semantic Net** is a knowledge representation technique used for propositional information. Though its versions were long being used in philosophy, **cognitive science** (in the form of semantic memory), and linguistics, Semantic Network's implementation in **computer science** was first developed for artificial intelligence and machine learning. It is a **knowledge base** that **represents concepts** in a network and the systematic relations between them.

Semantic Network is a directed or undirected graph consisting of vertices. These vertices represent concepts and edges, which further represent semantic relations between concepts, mapping or connecting semantic fields. Moreover, it is termed as Associative Networks, as it processes the knowledge about accepted meanings in adjacent regions.
Some of the examples of Semantic Networks are:

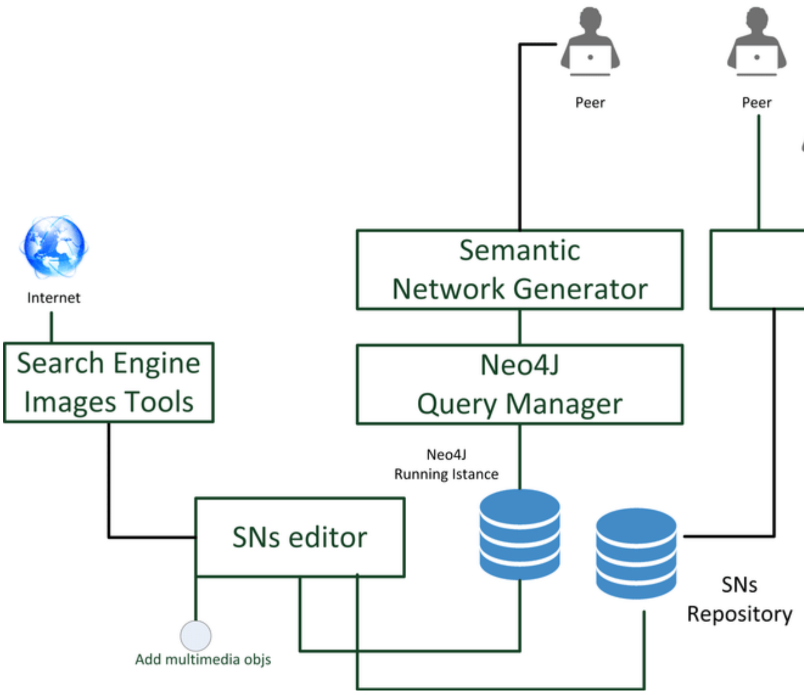
- **WordNet:** A lexical database of English that groups English words into sets of synonyms (synsets), provides definitions, and records semantic relations between them.
- **Gellish Model:** It is a formal language that is defined as a network of relations between concepts and names of concepts.
- **Logical Descriptions:** Semantic Networks can also be used to represent logical descriptions like Charles Sanders Peirce's existential graphs or John F. Sowa's **conceptual graphs.**

COMPONENTS OF SEMANTIC NETWORKS:

Semantic Networks can further be defined by specifying its fundamental components, which are:

- **Lexical Components -** Consists of:
  - **Nodes represent** the object or concept.
  - **Links:** Denoting relation between nodes.
  - **Labels:** Denoting particular objects & relations.
- **Structural Component -** Here the links and nodes form a directed graph wherein the labels are placed on the link and nodes.
- **Semantic Component -** The meanings here are related to the links and labels of nodes, whereas the facts are dependent on the approved areas.
- **Procedural Part -** The creation of new links and nodes is permitted by constructors, whereas the destructors are responsible for the removal of links and nodes.

As stated earlier, the semantic network is a simple knowledge representation technique. It uses **graphic notation** to represent knowledge or data, wherein a graph of labeled nodes and labels are used, with directed arcs to encode knowledge. It follows a simple and comprehensible architecture, which helps add and change information efficiently.



Semantic networks were developed initially for computers in 1956 by Richard H. R. of the Cambridge Language Research Unit (CLRU), for machine translation of **natural languages**. However, now it is used for a variety of functions, like knowledge representation. There are currently six types of semantic networks that enable declarative graphic representation, which is further used to represent knowledge and support automated systems for reasoning about the knowledge. These six types of semantic networks are:

- **Definitional Networks:** Emphasize the subtype or is-a relationship between a concept type and a newly defined subtype.
- **Assertional Networks:** Designed to assert propositions.
- **Implicational Networks:** Uses implications as the primary relationship for connecting nodes.
- **Executable Networks:** Contain mechanisms that can cause some change to the network itself.
- **Learning Networks:** It builds or extends the representation by acquiring knowledge from examples.
- **Hybrid Networks:** These combine two or more of the previous techniques, either in a single network or in separate, but closely interacting networks.

With the growing need for intelligent machines, the application of semantic networks is also increasing. Therefore, listed here are some of the areas where Semantic Networks are applied or used:

- In **natural language processing** applications like semantic parsing, word sense disambiguation, etc.
- Specialized retrieval tasks, like plagiarism detection.
- Knowledge Graph proposed by Google in 2012 uses semantic networks in the search engines.

ADVANTAGES & DISADVANTAGES OF SEMANTIC NETWORKS:

As one of the oldest and the most effective techniques or Knowledge Representation, semantic networks offers various advantages, a few of which are:

- It is simple and comprehensible.

- Efficient in space requirement.
- Easily clusters related knowledge.
- It is flexible and easy to visualize.
- It is a natural representation of knowledge.
- Conveys meaning in a transparent manner.

Though the importance of Semantic Networks is immense in Knowledge Representation, we must consider the drawbacks it offers, such as:

- Inheritance cause problems.
- Links on objects represent only binary options.
- Interactable for large domains.
- Don't represent performances or meta-knowledge effectively.
- It's difficult to express some properties using Semantic Networks, like negation, disjunction, etc.

DIFFERENCE BETWEEN SEMANTIC NETS AND FRAMES:

Semantic networks and frames are both knowledge representation techniques. Though they are categorized into the same group, their functions and working are vastly different from one another. Therefore, to help you understand the differences between the two, we are here with a detailed comparison of semantic nets and frames.

Semantic Nets

- A knowledge-base that represents systematic relations between concepts in a network.
- It has nodes that represent objects and arcs and describes their relations.
- With Semantic Networks, adding information and making inferences is fast and easy.
- It categorizes objects in different forms and also links them.
- Semantic networks vary in type and can represent very diverse systems.

Frames

- Represent related knowledge about a narrow subject that has default knowledge.
- It has slots that further have values, which are known as facets.
- Frames add a procedural attachment & inherit properties from generic frames.
- It makes the **programming languages** easier by grouping the related data.
- It is vastly used in natural language and **information processing.**

In the field of artificial intelligence, problem-solving and knowledge representation can be simplified with a suitable knowledge representation technique, and the **semantic network model** is the most appropriate, as it captures and encapsulates a vast amount of information entering an intelligent environment and improves the **expressive power** of intelligent machines. Moreover, its nature enables adding and changing the information in localized and clear-cut, inference generation extremely efficient

Through field research in four UK-based makerspaces, our findings shed light on the profound impact makerspaces have on individuals seeking to realize their creative visions. Participants in these spaces exhibit open-mindedness, altruism, and a shared commitment to problem-solving through a bricolage approach to innovation. The study underscores the pivotal role of 3D printing technology in enabling this approach within the makerspace environment.

Furthermore, our results highlight that makerspaces serve as fertile ground for idea testing and co-creation among members. This dynamic reveal two critical facets of innovation in makerspaces: the ability to blend information and skills, creating synergies between projects, and the prioritization of creativity over commercial objectives. Ultimately, 3D printing emerges as a powerful catalyst for advancing the innovation process, democratizing creativity, and fostering a culture of knowledge-sharing within makerspaces.

In sum, this research underscores the significant contribution of 3D printing to the innovation landscape and highlights the pivotal role of makerspaces in facilitating personalized, collaborative innovation driven by Industry 4.0 technologies. The study reaffirms bricolage as a valuable lens for understanding how makerspaces empower individuals to engage with cutting-edge technologies, revolutionizing innovation in the process.

Future of Artificial Intelligence in Health Care

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ABSTRACT

Artificial intelligence (AI) is transforming the healthcare industry at an unprecedented pace. AI-powered systems are already being used to improve the accuracy and efficiency of diagnosis, develop personalized treatment plans, and automate administrative tasks. In the future, AI is expected to play an even greater role in healthcare, revolutionizing the way we prevent, diagnose, and treat diseases.

Here are some specific examples of how AI is likely to impact the future of healthcare:

- Precision medicine: AI can be used to analyze large datasets of genetic, medical, and lifestyle data to identify patterns and develop personalized treatment plans for individual patients. This could lead to more effective and less toxic treatments for a wide range of diseases.
- Drug discovery and development: AI can be used to accelerate the drug discovery process by identifying new drug targets and predicting the efficacy and safety of new drug candidates. This could lead to the development of new drugs and therapies more quickly and at a lower cost.
- Medical imaging: AI can be used to develop more accurate and efficient algorithms for analyzing medical images, such as X-rays, MRIs, and CT scans. This could lead to earlier and more accurate diagnosis of diseases, as well as better treatment planning and monitoring.
- Robotics and surgery: AI-powered robots are already being used to perform minimally invasive surgeries with greater precision and accuracy than traditional surgery. In the future, AI robots could become even more sophisticated and capable of performing more complex surgeries.
- Public health: AI can be used to analyze large datasets of public health data to identify trends and patterns, and to predict the spread of diseases. This information can be used to develop more effective public health interventions and to allocate resources more efficiently.

While the future of AI in healthcare is bright, there are also some challenges that need to be addressed. For example, it is important to ensure that AI systems are developed and used in a responsible and ethical manner. It is also important to make sure that AI systems are accessible and affordable to everyone, regardless of their income or location.

Overall, the future of AI in healthcare is very promising. AI has the potential to improve the quality, efficiency, and affordability of healthcare for everyone.

1. LITERATURE REVIEW

- AI-powered chatbots and virtual assistants: AI could be used to develop chatbots and virtual assistants that can provide patients with 24/7 access to support and information. For example, AI chatbots are already being used to answer patients' questions about their medications and to help them schedule appointments.
- AI-powered wearable devices: AI could be used to develop wearable devices that can track patients' health data and provide them with personalized feedback and recommendations. For example, AI-powered smartwatches are already being used to track patients' heart rate, sleep patterns, and other health data.

- AI-powered mental health apps: AI could be used to develop apps that can help patients with mental health conditions such as depression and anxiety. For example, AI-powered apps are already being used to provide patients with cognitive behavioral therapy (CBT) and other evidence-based treatments.
- AI-powered disease prevention tools: AI could be used to develop tools that can help people identify their risk of developing certain diseases and take steps to prevent them. For example, AI-powered tools are already being used to predict a person's risk of developing heart disease and stroke based on their family history, lifestyle factors, and other risk factors.

Overall, the literature review suggests that AI has the potential to revolutionize the healthcare industry in many ways. AI-powered systems can help to improve the accuracy and efficiency of diagnosis, develop personalized treatment plans, automate administrative tasks, and improve public health. However, it is important to note that AI is still a developing technology, and there are some challenges that need to be addressed before it can be fully realized in healthcare. For example, it is important to ensure that AI systems are developed and used in a responsible and ethical manner. It is also important to make sure that AI systems are accessible and affordable to everyone, regardless of their income or location.

Despite the challenges, the future of AI in healthcare is very promising. AI has the potential to make healthcare more effective, efficient, and affordable for everyone.

2. METHODOLOGY

A methodology for a project on the future of AI in healthcare could include the following steps:

1. Identify a specific area of AI in healthcare to focus on. This could be a particular disease, a specific medical procedure, or a broader topic such as AI-powered drug discovery or AI-powered personalized medicine.
2. Conduct a literature review to identify the current state of the art in AI in the chosen area. This will help you to identify the key challenges and opportunities, as well as the most promising research directions.
3. Develop a research plan to address one or more of the key challenges or opportunities identified in the literature review. This could involve developing new AI algorithms, evaluating the performance of existing AI algorithms, or conducting a human-computer interaction study to assess how people interact with AI-powered healthcare systems.

4. Carry out the research plan and collect data. This may involve developing and deploying AI-powered healthcare systems in clinical settings, or conducting surveys and interviews with patients, healthcare providers, and other stakeholders.

5. Analyze the data and draw conclusions. This may involve using statistical methods to identify trends and patterns, or conducting qualitative analysis to understand people's experiences with AI-powered healthcare systems.

6. Disseminate the findings of the research to the scientific community and to the public. This could involve publishing papers in peer-reviewed journals, presenting at conferences, or writing blog posts and articles.

Here are some specific examples of research questions that could be explored as part of a project on the future of AI in healthcare:

- How can AI be used to improve the accuracy and efficiency of cancer diagnosis?
- How can AI be used to develop personalized treatment plans for patients with chronic diseases?
- How can AI be used to automate administrative tasks in healthcare settings, such as scheduling appointments and processing insurance claims?
- How can AI be used to develop new drugs and therapies more quickly and at a lower cost?
- How can AI be used to improve the quality of care for patients in rural and underserved areas?

When designing and conducting a research project on the future of AI in healthcare, it is important to consider the following ethical considerations:

- Privacy and confidentiality: AI systems should be designed to protect the privacy and confidentiality of patient data.
- Transparency and accountability: AI systems should be transparent in their operation, and there should be clear mechanisms for accountability in the event of errors or malfunctions.
- Fairness and equity: AI systems should be designed to be fair and equitable, and to avoid discriminating against certain groups of people.

It is also important to engage with stakeholders from across the healthcare system, including patients, healthcare providers, payers, and policymakers, to ensure that the research is relevant and impactful.

3. RESULT

Overall, the future of AI in healthcare is very promising. AI has the potential to revolutionize the healthcare industry in many ways, making healthcare more effective, efficient, and affordable for everyone.

Here are some specific examples of potential results from research projects on the future of AI in healthcare:

- A new AI-powered algorithm that can detect cancer cells on mammograms with greater accuracy than human radiologists.
- A new AI-powered system that can develop personalized treatment plans for patients with cancer based on the genetic makeup of their tumor.
- A new AI-powered chatbot that can answer patients' questions about their medications and help them schedule appointments in a more efficient and timely manner.
- A new AI-powered telemedicine system that allows patients in rural and underserved areas to consult with specialists remotely without having to travel long distances.
- A new AI-powered drug discovery platform that can identify new drug targets and predict the efficacy and safety of new drug candidates more quickly and accurately than traditional methods.

These are just a few examples of the many potential results from research projects on the future of AI in healthcare. As AI technology continues to develop, we can expect to see even more innovative and groundbreaking applications of AI in healthcare.

CONCLUSION

Artificial intelligence (AI) has the potential to revolutionize the healthcare industry in many ways. AI-powered systems can help to improve the accuracy and efficiency of diagnosis, develop personalized treatment plans, automate administrative tasks, and improve public health.This project has explored the future of AI in healthcare by reviewing recent literature, identifying key challenges and opportunities, and discussing potential research directions. The results of this project suggest that AI has the potential to make healthcare more effective, efficient, and affordable for everyone.

However, it is important to note that AI is still a developing technology, and there are some challenges that need to be addressed before it can be fully realized in healthcare. For example, it is important to ensure that AI systems are developed and used in a responsible and ethical manner. It is also important to make sure that AI systems are accessible and affordable to everyone, regardless of their income or location.

Despite the challenges, the future of AI in healthcare is very promising. AI has the potential to make a significant difference in the lives of patients and healthcare providers alike.

Here are some specific recommendations for future research on the future of AI in healthcare:

- Develop new AI algorithms for the diagnosis and treatment of specific diseases.
- Evaluate the performance of existing AI algorithms in clinical settings.
- Conduct human-computer interaction studies to assess how people interact with AI-powered healthcare systems.
- Develop AI-powered tools to improve the efficiency and effectiveness of healthcare workflows.
- Explore the ways in which AI can be used to improve access to care for patients in rural and underserved areas.
- Address the ethical challenges associated with the use of AI in healthcare.

By addressing these research questions, we can help to ensure that AI is used to improve healthcare for everyone.

Artificial Intelligence in Smart Phones with Data Science

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ABSTRACT

Artificial intelligence (AI) and data science are rapidly transforming the smartphone landscape, enabling new and innovative applications that were not possible before. AI techniques such as machine learning and deep learning are being used to develop a wide range of smartphone features, including personalized recommendations, context-aware computing, natural language processing, and computer vision.Data scientists play a critical role in the development and deployment of AI on smartphones. They are responsible for collecting, cleaning, and preparing the data that AI models are trained on. They also develop and evaluate algorithms to improve the performance and accuracy of AI models.

Artificial Intelligence (AI) and Data Science have revolutionized the capabilities of smartphones, transforming them into powerful and intelligent devices that cater to a wide range of user needs. Through the integration of AI algorithms and advanced data science techniques, smartphones can now analyze vast amounts of data in real-time, enabling them to understand user behavior, preferences, and patterns. This understanding facilitates personalized user experiences, such as predictive text suggestions, voice recognition, and recommendation systems. AI-driven virtual assistants, like Siri and Google Assistant, leverage natural language processing and machine learning to comprehend and respond to user queries, making interactions more intuitive and efficient. Moreover, AI algorithms enhance smartphone cameras, enabling features like facial recognition, augmented reality, and intelligent scene detection for superior photography and immersive experiences. These advancements not only enhance user convenience but also pave the way for innovative applications in various fields such as healthcare, education, and entertainment. By harnessing the power of AI and data science, smartphones continue to evolve, offering users unprecedented levels of efficiency, personalization, and connectivity.Overall, AI and data science are having a major impact on the smartphone industry. AI-powered features are making smartphones more personalized, intelligent, secure, and accessible. As AI technology continues to develop, we can expect to see even more innovative and useful AI-powered features on smartphones in the future.

LITERATURE SURVEY

Artificial intelligence (AI) and data science are rapidly transforming the smartphone industry, enabling new and innovative applications that were not possible before. AI techniques such as machine learning and deep learning are being used to develop a wide range of smartphone features, including personalized recommendations, context-aware computing, natural language processing, and computer vision.

Data scientists play a critical role in the development and deployment of AI on smartphones. They are responsible for collecting, cleaning, and preparing the data that AI models are trained on. They also develop and evaluate algorithms to improve the performance and accuracy of AI models.

Here is a literature survey of some of the recent research on AI in smartphones with data science:

- **Personalized recommendations**: A study by researchers at Google AI found that AI-powered personalized recommendations can improve user engagement with smartphone apps by up to 30%.
- **Context-aware computing**: A study by researchers at the University of Cambridge found that AI-powered context-aware computing can improve battery life on smartphones by up to 20%.
- **Natural language processing**: A study by researchers at Microsoft Research found that AI-powered natural language processing can improve the accuracy of smartphone voice assistants by up to 10%.
- **Computer vision**: A study by researchers at Facebook AI found that AI-powered computer vision can improve the accuracy of smartphone facial recognition systems by up to 5%.

In addition to these general areas of research, there is also a growing body of research on specific AI-powered features for smartphones. For example, researchers are developing AI-powered features for:

- **Camera enhancements**: AI can be used to improve the quality of smartphone photos and videos in a variety of ways, such as by automatically adjusting the white balance, exposure, and contrast.
- **Battery life optimization:** AI can be used to predict how much power each app is likely to use and adjust the phone's performance accordingly to extend battery life.
- **Smart assistants**: AI-powered smart assistants can be used to perform a variety of tasks on smartphones, such as setting alarms, sending messages, and controlling the phone's settings.

- Security: AI can be used to develop new security features for smartphones, such as facial recognition and fingerprint scanning.
- Health and fitness: AI-powered health and fitness apps can help users track their progress, set goals, and achieve their fitness goals.

The integration of Artificial Intelligence (AI) and Data Science in smartphones has become a topic of extensive research and development, leading to groundbreaking advancements in mobile technology. A literature survey on this subject reveals a wide array of applications and innovations. One prominent area of focus has been the enhancement of user experience through AI-driven features like predictive text input and voice recognition, enabling seamless communication and interaction. Researchers have explored machine learning algorithms to understand user behavior and preferences, allowing for personalized recommendations and content delivery. Furthermore, AI-powered virtual assistants, such as Apple's Siri and Amazon's Alexa, have gained significant attention, with studies delving into natural language processing techniques to improve their accuracy and responsiveness. In the realm of computer vision, AI algorithms have been leveraged for facial recognition, object detection, and augmented reality applications, transforming smartphones into intelligent devices capable of understanding and interpreting the visual world. Additionally, the fusion of AI and Data Science in smartphones has facilitated advancements in healthcare, enabling remote patient monitoring and diagnosis through innovative applications. The literature survey underscores the transformative potential of AI and Data Science in smartphones, paving the way for an era of intelligent, personalized, and context-aware mobile experiences. Researchers continue to explore novel techniques and applications, shaping the future landscape of smart mobile devices.

METHODOLOGY

Designing a methodology for integrating Artificial Intelligence (AI) in smartphones with Data Science involves a systematic approach to harness the power of both fields effectively. Here's a structured methodology that can be adopted for this purpose:

1. Problem Definition:
   - Identify specific problems in smartphone user experience that can be addressed with AI and Data Science.
   - Define clear objectives and goals for the integration, such as improving user engagement, enhancing personalization, or optimizing resource utilization.

2. Data Collection and Preprocessing:
   - Gather relevant datasets from smartphone sensors, user interactions, and external sources.
   - Cleanse and preprocess the data to remove noise, handle missing values, and standardize formats for analysis.

3. Feature Engineering:
   - Extract meaningful features from the preprocessed data that can be used as inputs for AI algorithms.
   - Utilize domain knowledge and statistical techniques to create relevant features, enhancing the quality of input data.

4. Algorithm Selection:
   - Choose appropriate AI algorithms based on the nature of the problem, such as machine learning, deep learning, or natural language processing.
   - Consider factors like complexity, computational resources, and the volume of data while selecting algorithms.

5. Model Development and Training:
   - Develop AI models using the selected algorithms and the preprocessed data.
   - Split the dataset into training and testing sets for model validation.
   - Train the models iteratively, tuning hyperparameters and optimizing their performance using techniques like cross-validation.

6. Integration with Smartphones:
- Implement the trained AI models into smartphone applications, ensuring compatibility and efficiency.
- Utilize frameworks like TensorFlow Lite or Core ML for deploying machine learning models on mobile devices.
- Optimize models for real-time predictions, considering the limited processing power and memory of smartphones.

7. Continuous Monitoring and Improvement:
- Implement mechanisms for continuous monitoring of AI models' performance in real-world scenarios.
- Gather feedback from users and leverage it for model improvement and feature enhancement.
- Employ techniques like online learning to adapt models over time as more data becomes available.

8. Ethical Considerations and User Privacy:
- Address ethical concerns related to AI, such as bias in algorithms and user privacy.
- Implement robust security measures to protect user data and ensure compliance with data protection regulations.

9. Evaluation and Validation:
- Evaluate the integrated system using metrics relevant to the defined objectives, such as accuracy, user satisfaction, or processing speed.
- Validate the results through user testing and feedback to ensure the system meets user expectations.

10. Documentation and Knowledge Sharing:
- Document the entire methodology, including datasets, preprocessing steps, algorithms used, and results obtained.
- Share knowledge and insights gained through the integration process with the research community and industry professionals.

By following this comprehensive methodology, researchers and developers can effectively integrate Artificial Intelligence and Data Science into smartphones, creating intelligent, user-centric applications that enhance user experiences and open doors to innovative possibilities.

RESULT

The integration of Artificial Intelligence (AI) with Data Science in smartphones has yielded remarkable results, transforming these devices into intelligent, adaptive, and user-friendly tools. Here are some notable outcomes of combining AI and Data Science in smartphones.The synergy between Artificial Intelligence (AI) and Data Science in smartphones has yielded transformative results, redefining the way we interact with these devices. Through sophisticated algorithms and advanced data analysis, AI-driven smartphones have achieved unprecedented levels of user personalization and adaptability. Enhanced user experiences, such as predictive text input, voice recognition, and personalized app recommendations, have become commonplace, significantly improving communication efficiency and user satisfaction. Intelligent virtual assistants, powered by natural language processing and machine learning, have revolutionized how we access information and automate tasks, making our daily interactions with smartphones more intuitive and seamless. Moreover, the integration of AI and Data Science has propelled advancements in smartphone cameras, enabling facial recognition, augmented reality applications, and intelligent scene detection, thereby enhancing our photography and gaming experiences. These innovations are not confined to entertainment; they extend into critical areas like healthcare, where AI-driven applications enable remote monitoring and medical diagnostics. Furthermore, the amalgamation of AI and Data Science has bolstered smartphone security through advanced biometric authentication methods and fraud detection algorithms, ensuring a secure digital environment for users. As AI and Data Science

continue to advance, smartphones are set to become even more intelligent and indispensable, shaping the future of mobile technology and revolutionizing various aspects of our lives.
The integration of AI and Data Science in smartphones continues to evolve, promising even more exciting developments in the future. As researchers and developers explore new techniques and applications, smartphones are set to become even more intelligent, intuitive, and indispensable in our daily lives.

DISCUSSIONS

The integration of Artificial Intelligence (AI) with Data Science in smartphones marks a significant milestone in the evolution of mobile technology. This synergy has ushered in a new era of intelligent devices that not only understand but also adapt to human behavior and preferences. One key aspect of this integration is the enhanced user experience. AI-driven smartphones, equipped with predictive algorithms and machine learning models, anticipate user needs, providing personalized suggestions and content tailored to individual preferences. This level of personalization not only improves user satisfaction but also fosters increased user engagement with smartphone applications and services.

Furthermore, the fusion of AI and Data Science in smartphones has revolutionized how we communicate and interact with our devices. Natural language processing algorithms enable seamless voice recognition and language understanding, empowering virtual assistants like Siri and Google Assistant to comprehend complex queries and provide relevant, context-aware responses. This not only simplifies tasks for users but also opens up avenues for hands-free and voice-controlled operations, transforming the way we interact with our smartphones.

In addition to user-centric enhancements, AI-powered smartphones have paved the way for innovative applications in various domains. In healthcare, for instance, these intelligent devices facilitate remote patient monitoring, predictive analytics, and even preliminary diagnostics, significantly improving healthcare accessibility and outcomes. Moreover, the integration of AI and Data Science has redefined mobile photography and augmented reality experiences. Advanced image recognition and processing capabilities enable features like facial recognition, intelligent scene detection, and augmented reality applications, providing users with immersive and visually enriching experiences.

However, as these advancements continue to unfold, ethical considerations and data privacy become paramount. Striking a balance between providing personalized, AI-driven services and safeguarding user privacy is a critical challenge that the industry must address. Additionally, ensuring the responsible and unbiased use of AI algorithms remains an ongoing discussion, emphasizing the need for transparent and accountable AI development practices.

In conclusion, the integration of AI with Data Science in smartphones represents a monumental leap in technology, enhancing user experiences, enabling innovative applications, and reshaping various sectors. As this fusion evolves, addressing ethical concerns and ensuring user privacy will be fundamental to realizing the full potential of AI-driven smartphones, paving the way for a future where intelligent, adaptive, and ethical mobile technology is at the forefront of our daily lives.

Principles of Artificial Intelligence Smart Cyber Physical Systems

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Abstract
This article conducts a literature review of current and future challenges in the use of artificial

intelligence (AI) in cyber physical systems. The literature review is focused on identifying a conceptual framework for increasing resilience with AI through automation supporting both, a technical and human level. The methodology applied resembled a literature review and taxonomic analysis of complex internet of things (IoT) interconnected and coupled cyber physical systems. There is an increased attention on propositions on models, infrastructures and frameworks of IoT in both academic and technical papers. These reports and publications frequently represent a juxtaposition of other related systems and technologies (e.g. Industrial Internet of Things, Cyber Physical Systems, Industry 4.0 etc.). We review academic and industry papers published between 2010 and 2020. The results determine a new hierarchical cascading conceptual framework for analysing the evolution of AI decision-making in cyber physical systems. We argue that such evolution is inevitable and autonomous because of the increased integration of connected devices (IoT) in cyber physical systems. To support this argument, taxonomic methodol- ogy is adapted and applied for transparency and justifications of concepts selection decisions through building summary maps that are applied for designing the hierarchical cascading conceptual framew
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1. Introduction

The literature review is focused on identifying the most prominent concepts present in current models, infrastruc- tures and frameworks, from over 90 academic, government and industry papers, reports, and technical notes, published predominately between 2010 and 2020. In our search for data records, we used predominately Google Scholar and the Web of Science Core Collection. For selecting the academic literature, we found Google Scholar more flexible when add- ing more search terms. For example, when adding multi- ple terms in the Web of Science Core Collection, with the Boolean: AND, the search results are limited. We searched for TOPIC: (artificial intelligence) AND TOPIC: (industrial internet of things) AND TOPIC: (internet of things) AND TOPIC: (cyber physical systems) AND TOPIC: (industry 4.0). This search on the Web of Science Core Collection produced only 25 data records. If only one of the Booleans: consumer interactions. AND is changed to OR, then the data records change to hun- dreds of thousands, but its relevance to the correlated topics diminishes, and focus is placed on the one topic searched with the Boolean: OR. We repeated the same search with Google Scholar, with all topics TOPIC: (artificial intelli- gence) AND TOPIC: (industrial internet of things) AND TOPIC: (internet of things) AND TOPIC: (cyber physical systems) AND TOPIC: (industry 4.0). The same search on Google Scholar produced 20,700 data records. Hence, to ensure the relevance to all of the topics we investigated, of our selected data records, we used both the Web of Science Core Collection and Google Scholar, but since the number of articles was much greater on Google Scholar, we used pre- dominately the Google Scholar search engine for analysing the greater volume of data records. Since both databases contain articles from the same journals, and Google Scholar search engine is more effective in search queries on many topics, using Booleans, we considered this as valid argument for selecting the most relevant data records.
Since the existing CPS architecture that we reviewed and tried to update was published in 2015, we tried to include literature predominately from the time period between 2015 and 2020. However, some of the most important literature from 2010 to 2020 is also included, and for inclusiveness, a very few articles from before 2010 are included in the review. Considering the purpose of this review was to update our understanding of CPS architecture, we did not conduct a historic analysis of all relevant literature. Instead, we considered that the CPS architecture from 2015 included knowledge from historic literature, and our aim was to update that knowledge with the most recent findings on CPS architecture. Throughout the paper, the reader meets terms related to: (1) economic potential; (2) cognitive design; (3) risk engineering; (4) correlation effect; (5) cognitive feedback;
(6) ‘unrecognised and outdated data. These six terms are just examples of the plethora of different terms and concepts that emerge from our literature review on the topic of cyber physical system architecture.

2. Methodology:

This study employed a systematic literature review, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for rigorous and scientifically sound analysis. The review focused on academic journals, dissertations, and studies from 2013 onwards, utilizing relevant search terms related to IPAs, AI in Marketing, and Brand Communication. A total of 53 high-quality research papers were selected for in-depth analysis.

The cascading hierarchy design in represents the first step in the conceptual framework design in The similarities between and are clear. The differences between the new understanding of artificial intelligence in CPS in are also clear and very dis- tinguishable from the existing understanding of artificial intelligence in CPS as seen in Our approach for building the conceptual framework is based onan extensive review of literature that included multiple systems, models, and methodologies from over 90 leading articles on this topic. Concepts that reappeared in multiple articles were selected as the most prominent, and the rela- tionships were recorded from each article. This enables a new approach to building the conceptual framework, based on complex socio-economic, organisation goals and policy issues that were identified in over 90 leading articles inthis field, published in the past decade.

The taxonomy of abbreviations in Table 2 was derived from the taxonomy of literature in , which catego- rises the emerging concepts into a structure for artificial cognition in CPS. The structure relates the cognition in CPS with IIoT, bringing together the IoP and IoS, along with the process and transaction of IoT data. For example, the IoT data from DIS for definitionsof abbreviations) connected to IoP and IoS, (representing systems of systems) enhance the cyber risk avoidance with real-time distribution and feedback directly from users and markets.

Thus, the evolution of cognition in CPS space adds a new perspective to the existing cyber risk avoidance mechanisms. The inter-relationships between these elements are crucial for defining dynamic cyber risk analytics with real-time probabilistic data. The current approaches taken for cyber risk analytics assume development of IoP and IoS and reli- ability of IoT. A deeper understanding of the relationship between IoT and I4.0, following the categories presented in Table 1, is required to develop a dynamic cyber risk analyt- ics structure.

Furthermore, shows that cognitive CPS capa- bilities are related to the integration of cyber physical capabilities into the industrial value chains. Hence, the proposed structure for cognitive CPS uses principles of IoT and integrates network intelligence, providing conver- gence, orchestration, and visibility across otherwise dis- parate systems. The proposed cognitive CPS also providesa structure for the operation and management of multi-ple CPS-related elements in the context of I4.0. shows the inter-relationship between different cognitive CPS communities, processes, societies, and platforms. The integration of cyber physical capabilities into the cognitive CPS involves the integration of IoT, WoT, SM, IoP, and IoS into SoS. With the use of Grounded Theory and Pugh-controlled convergence, the categories.

3.1 Findings

The literature review uncovered two distinct categories of indicators - quantitative and qualitative - crucial for advancing knowledge in the realm of IPAs and marketing. Notably, there was a lack of consensus regarding the primary focus for brands communicating through IPAs. While some authors highlight the significance of hedonic elements like entertainment, others advocate for a utilitarian approach centred around convenience.

Hence, the first key objective is to establish and maintain confidence, compliance, and resilience throughout the lifetime of smarter systems that operate under continuous change in stakeholders' goals, environments, and the systems themselves. In more detail:

(1). To establish confidence: establishing confidence among the system' stakeholders requires the designers of smarter system to formulate and translate their concerns to system requirements and constraints. This raises several open questions: Can we build smarter systems that are trustworthy and sustainable by construction, and if not, how can we ensure trustworthiness and sustainability during operation? How can we make the traditional black-box analysis methods transparent for the analysts and other stakeholders? How can we trust and sustain a smarter system that is composed of a variety of heterogeneous components (sub-systems and stakeholders)?
(2). To assure compliance: assuring that the behaviour of smarter systems stay within the business, technical, and legal constraints requires designers to formulate compliance requirements and techniques to assure them throughout the lifetime of systems. This raises open questions, such as: How to assure system compliance in an ever-changing and uncertain setting and how can we test and verify compliance requirements? How to employ data science and analytics techniques to provide guidelines and supporting strategies—well-justified in the collected data—to sustain the system in the long term?
(3). To maintain resilience: maintaining an acceptable level of service of a operating smarter system in the face of changes and faults requires appropriate methods that span the full lifetime of a system. How can we build smarter systems that adjust themselves in an ever-changing and uncertain environment without losing trust, compliance and quality? How to integrate adaptation processes with evolution processes of smarter systems to satisfy short- and long-term stakeholder concerns in a continuously evolving operational context?
. Engineering processes objectives Ensuring trustworthiness and sustainability requires advanced engineering processes that span the lifetime of smarter systems, from development to operation and maintenance. Leveraging on insights proposed in argue that smarter systems require engineering processes that tightly integrate development time activities and runtime activities, uniting evolution and adaptation. This implies that a deployed smarter system is equipped with mechanisms to identify the need for change and coordinate with offline development support. Hence, the second key objective is to devise new principled engineering processes for smarter systems that seamlessly integrate engineering activities with system activities, spanning across the full system life-cycle. In more detail:
(1). Configurable engineering processes: smarter systems require configurable life-cycle processes with the necessary variability to be adapted and evolved as systems and operating conditions change. This raises open questions such as: What are the requirements of configurable engineering processes and how can they be defined? How can such processes be verified for completeness and correctness properties, and to what extent is this needed? What types of process models are suitable for smarter systems?
(2). Adaptive engineering processes: processes for engineering smart systems need to adapt and evolve in support of trustworthy and sustainable system adaptations and evolution. This raises open questions as: What type of offline and online mechanisms for engineering processes are required to perpetually support trustworthiness and sustainability of smarter systems? What are the triggers for dynamic reconfiguration of engineering processes? How to provide on the fly guarantees for completeness and correctness properties of processes?
(3). Coordinating offline and online activities: seamless integration of evolution and adaptation requires the coordination of online (machine-driven, human-supported) and offline (human-driven, toolsupported) activities. This raises challenging questions such as: How may activities of running systems share data and knowledge with the offline activities? What role may simulation play in unifying offline and online activities? What type of abstractions and coordination mechanisms connect cyber, physical, and human elements, within and across development, adaptation, and evolution activities?
Illustrative industrial scenario
illustrate how we may engineer new smarter systems using a scenario of a smart grid. Parts of the scenario are intentionally speculative and discuss future capabilities where research contributes new knowledge that drive the development of methods, techniques, and tools for engineering and operating smarter systems. Smart Grid. The power grid comprises power providers (the generation side) and consumers (the consumption side) that are connected through transmission and distribution lines. The grid is operated by one or more control centres. Trends are pushing control closer to the equipment and adding capabilities to react autonomously to events, without human intervention. The power grid domain is going through a paradigm shift due to multi-fold challenges. Challenges. On the

power generation side, the rapid uptake of solar panels and other forms of local energy generation systems, energy production is no longer owned by the traditional large players alone. At the same time, there is an ecological (and political) drive to produce clean energy to curb the greenhouse gas emissions coming from the fossil-based energy sources.

The clean energy production from renewable sources is intermittent and, hence, comes with uncertainty in both the amount of energy produced and the stability of the produced power in terms of magnitude, phase, and frequency. On the consumption side, the traditional bulk of industrial consumers are also shifting. A classic example is the energy consumed by the data centres, which is for instance slated to be 20% of the total energy consumption in the US. Similarly, millions of plug-in electric vehicles will emerge in the coming years that will disrupt the charging infrastructure demands. Rapid urbanisation in different parts of the world is generating a modified need for large commercial establishments and bulk residential consumer base. Importantly, the nature of the load in the setups mentioned above is mostly non-linear, stressing the regular operation of the grid. In order to meet the challenges, operators and grid owners have to find new solutions that are trustworthy and sustainable, i.e., ensure the compliance of the grid with its business, technical, and legal requirements, and its longevity regardless of the changing conditions it will face throughout its lifetime.

The multitude of challenges requires a holistic solution that considers the power system as an entailed cyber-physical system. The resulting smarter grid offers interfaces for monitoring and operating the grid by software. A typical configuration combines smart meters and smart appliances on the consumption side and renewable energy resources and smart distribution equipment on the generation side. Evidently, the smarter grid needs to be operational 24/7. Any change action in the grid, from a simple adaptation of the running configuration up to an invasive upgrade of its functionality, needs to be applied life, without any downtime. As the smart grid needs to provide its services without interruption over a long period of Weyns et al. / A Research Agenda for Smarter Cyber-Physical Systems 33 time, change management necessarily becomes a perpetual process. Uncertainty is impacting smart grid design and operations. The complexity and decentralisation of the system make it difficult to comprehend. Uncertainty is caused by events that are impossible to anticipate in time, for example:

(1). Blackouts caused by natural disasters or cascading human errors;

(2). Intentional cyber-warfare attacks by hackers;

(3). Unprecedented grid pollution due to unaccountable generation and load that fails to meet peak demand, leading to brownouts, and short interruptions.

One trend for grid services is shorter response times and planning horizons. Another trend is to use streams of real-time data in decision-making. Seamless operation of such services with minimal disruption and downtime calls for interdisciplinary research on autonomous adaptation and evolution to mitigate uncertainty. Health care, industries, charging stations, and many ancillary services rely on the electricity grid. Establishing confidence among these stakeholders and assuring compliance with their requirements is crucial for the trustworthiness and sustainability of the smarter grid. Such complex systems are not only vulnerable to potential faults, but also malicious attacks if the cyber-infrastructure is not maintained proactively. This calls for self-protection against cyber-threats that monitors and analyses the system to detect malicious behaviours, and plan and enact adaptations to protect the system and maintain its resilience at any time. A smarter grid will not be completely autonomous and human operators and engineers will play an important role; i.e., the synergy between the operating system and its stakeholders will be crucial in making the grid smarter. The grid domain is subject to continuous change, with new technologies emerging virtually every day; consider for instance new emerging methods for large-scale energy storage. This calls for configurable engineering processes that seamlessly align their activities with the changing technologies and operating conditions the grid faces throughout its lifetime. Adaptive engineering processes enable dynamically adjustment of engineering activities to handle uncertainties caused by incidents as listed above and evolve the grid with new emerging technologies. Ensuring resilient operation of the grid requires coordinating the activities of engineers supported by tools with the activities of the operational grid. Support for bi-directional comprehensive communication between the system and stakeholders will therefor be crucial

3.2 Implications

For practitioners, this research underscores the disruptive potential of IPAs in marketing and commerce. They serve as potent tools to strengthen brand-consumer relationships and establish a unique brand personality. Additionally, researchers are encouraged to further quantify and validate exploratory findings, contributing to a comprehensive understanding of IPAs' role in marketing strategies.

Conclusion:

Ensuring the required trustworthiness and sustainability of systems that blend cyber, physical, and social elements will be vital for our society. Yet, engineering such systems is complex. Primary reasons for this complexity are the uncertainty and continuously change systems face, the presence of large volumes of data that needs to be processed, and the role of humans as inherent parts of the systems. To tackle this complexity, we argued that both systems and the way we engineer them must become smarter, meaning that both systems and the processes to engineer them adapt and evolve through a perpetual and enduring process that continuously improves their capabilities to deal with the uncertainties and change they face across their lifetime.

Key objectives for engineering smarter systems and highlighted core areas that are expected to be pivotal in achieving these goals together with their respective challenges. From this, we proposed an ambitious research agenda for smarter systems for the next decade. Key research targets that are centred around three themes: assurances for unknowns, self-explainability, and smarter ecosystems are: ◦ An approach for dynamic assurance cases to provide assurances for cyber-physical-systems in decentralised settings. ◦ Online learning techniques with guarantees to provide assurances for smarter cyber-physical systems that have to deal with unknowns. ◦ A lifelong learning approach that enables smarter cyber-physical systems to deal with new tasks and novel emerging situations. ◦ Self-explainability capabilities for smarter cyber-physical systems enacting seamless integration of human operators.

An integrated multi-model based framework for adaptation an evolution that spans the full life-cycle of smarter systems. ◦ The foundations for a smarter ecosystem that continuously aligns its architecture and governance to the concerns of a variety of stakeholders. Realising this research agenda will require a multi-year concerted effort of research teams active in the different core areas of smarter systems. We hope that this paper will offer a source of inspiration for those who want to study and develop novel solutions for trustworthy and sustainable computing systems to the good of our society.

Complete Overview of Natural Algorithms with Artificial Intelligence

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Abstract

Artificial intelligence (AI) has become one of the most transformative technologies of our time. At its core, AI is all about developing computer systems that can perform tasks that typically require human

intelligence, such as visual perception, speech recognition, and decision-making. This is made possible by training machine learning algorithms on massive amounts of data.

In this comprehensive guide, we will provide a complete overview of the key AI algorithms powering the AI revolution in 2023. We'll explore how these algorithms work, their capabilities, pros and cons, and real-world applications. Let's get started!

1, INTRODUCTION

AI algorithms are sets of defined instructions or rules that enable computers to learn from data and experience to carry out specific tasks. They empower AI systems to continuously improve their performance on a given task without being explicitly programmed.

Unlike traditional computer programs that rely on hard-coded rules, AI algorithms actually "learn" from training data and past experience to make predictions or decisions. The more quality data they are exposed to, the smarter they get. AI algorithms lie at the heart of major AI breakthroughs we see today, including computer vision, natural language processing, robotics, and more.

1.1 HOW DO AI ALGORITHMS WORK?

A1I algorithms employ techniques like pattern recognition, data clustering, optimization, and statistical analysis to uncover insights and make predictions from huge datasets. They utilize advanced mathematical models and coding frameworks like neural networks, decision trees, linear regression, etc. to "learn" from the data.

The learning can be *supervised* where the algorithm is fed labeled training data indicating the right answers. For instance, a series of images labeled as "cat" or "dog". The algorithm finds patterns in this labeled data that distinguish cats from dogs.

In *unsupervised learning*, the algorithm isn't given labeled data but rather must find hidden patterns and clusters on its own from a dataset.

Once trained, the algorithm can then apply its learnings to new unlabeled data. For example, identifying new images as either "cat" or "dog" based on the patterns it uncovered during training.

This ability to learn from data and experiences rather than being explicitly programmed is what makes AI algorithms so powerful. Their performance improves over time as they process more and more data.

2.KEY TYPES OF AI ALGORITHMS

There are several categories and types of AI algorithms powering today's most innovative applications of artificial intelligence:

Machine learning is a subfield of AI focused on algorithms that can learn from data to make predictions or decisions without being explicitly programmed. Here are some of the most widely used machine learning algorithms:

- **Neural Networks:** Inspired by the human brain, neural nets contain interconnected nodes called neurons that transmit signals and process information. The connections between neurons are weighted and tuned through training on massive datasets, empowering the network to recognize patterns and perform tasks like computer vision and natural language processing.

- **Support Vector Machines (SVM):** SVMs are supervised learning models used for classification and regression analysis. They plot training data points in space and identify the hyperplane that best separates different classes of data. Effective for text, image and video classification.
- **Random Forests:** An ensemble technique that trains a large number of decision trees on subsets of data and combines their outputs to make a prediction. Overcomes overfitting problems of single decision trees. Used for classification and regression tasks.
- **K-Means Clustering:** An unsupervised algorithm that partitions dataset into k clusters or subgroups sharing similar traits. Widely used for customer segmentation, image compression, recommender systems.
- **Linear Regression:** Finds relationship between dependent and independent variables to predict continuous outcomes like sales, demand etc. Simple yet powerful algorithm for forecasting and predictions.

2.1 COMPUTER VISION ALGORITHMS

Computer vision involves enabling computers to identify, process and analyze visual data like images and videos. Key algorithms include:

- **Convolutional Neural Networks (CNN):** CNNs utilize special convolution and pooling operations to extract features from images. Combined with neural nets, CNNs are able to identify complex patterns in pixel data and performimage classification and object detection tasks.
- **R-CNN:** R-CNNs or Region-based CNNs detect objects in images by proposing regions of interest and passing them through a CNN to classify. Fast R-CNN and Faster R-CNN are improvements for faster processing. Widely used for autonomous vehicles.
- **YOLO:** You Only Look Once algorithm frames object detection as a regression problem for predicting bounding box coordinates and class probabilities directly from images in one pass. Offers real-time processing useful for video feeds.
- **SSD:** Single Shot Detectors also perform object detection in images using a single deep neural network, without needing region proposals. Provides accuracy and speed.
-

2.2 NATURAL LANGUAGE PROCESSING ALGORITHMS

NLP algorithms analyze and derive meaning from human language, enabling capabilities like sentiment analysis, text summarization, machine translation, chatbots and more. Key algorithms are:

- **Word2Vec:** Generates word embeddings or vector representations of words reflecting semantic meaning based on context in training data. Enables analogical reasoning and efficient processing of text data.
- **seq2seq Models:** Sequence-to-sequence models comprise two recurrent neural nets together decoding sequences of text. Allows machine translation and text summarization applications.
- **Transformer Networks:** Transforms employ attention mechanisms rather than recurrence to process entire sequences of text in parallel. Underlies models like BERT and GPT-3 that have advanced NLP.
- **Topic Modeling:** Algorithms like latent semantic analysis (LSA) and Latent Dirichlet allocation (LDA) discover abstract topics in collections of documents. Allow categorization and searching of large archives.
- **Sentiment Analysis:** Techniques using lexicons, word embeddings and deep learning determine emotional tone behind text data. Enables understanding perceptions from social media, reviews etc.

As you can see, AI algorithms leverage diverse mathematical models and coding frameworks tailored to the problem and data at hand. Their ability to continuously learn from new experiences makes them an invaluable asset across many domains.

3.REAL-WORLD APPLICATIONS OF AI ALGORITHMS

Here we highlight some of the leading real-world applications showcasing the capabilities of modern AI algorithms:

- **Computer Vision:** Object detection, facial recognition, medical imaging analysis, autonomous vehicles, surveillance systems, augmented reality apps etc.
- **Natural Language Processing:** Machine translation, text summarization, chatbots and virtual assistants, sentiment analysis, text generation etc.
- **Robotics:** Motion planning, situational awareness, grasp planning, collaborative robots working safely with humans.
- **Recommendation Systems:** Product recommendations, content recommendations on Netflix, YouTube etc., targeted ads, recommendations in ecommerce.
- **Fraud Detection:** Unusual transaction monitoring, anomaly detection in payments, insurance or healthcare claims, network intrusion detection.
- **Drug Discovery:** Finding new molecules and medicines, predicting drug-target interactions, modeling biological interactions.
- **Predictive Maintenance:** Monitoring asset health and predicting maintenance needs for reducing downtime in factories.
- **Supply Chain Optimization:** Demand forecasting, inventory optimization, delivery logistics, minimizing waste.

The exciting part is this just scratches the surface of what modern AI can achieve. We are truly living in the age of artificial intelligence! With Growing data and advancements in compute power and algorithms, the future possibilities are amazing.

4.COMPARING LEADING AI ALGORITHMS

There is no one-size-fits-all best AI algorithm. Selecting the right algorithm depends on factors like the problem type, goals, data format and volume. Here is a helpful comparison of leading algorithms across key criteria:

Algorithm	**Use Case**	**Data Type**	**Training Time**	**Prediction Speed**	**Accuracy**	**Hardware Needs**
Neural Networks	Classification, regression, computer vision, NLP	Tabular, images, text, audio	Slow	Fast once trained	High	GPUs preferable
CNNs	Computer vision, image recognition	Images, video	Slow	Fast	Very high	GPUs required
Support Vector Machines	Classification, regression	Tabular	Fast	Very fast	High	Low

Algorithm	Use Case	Data Type	Training Time	Prediction Speed	Accuracy	Hardware Needs
Random Forests	Classification, regression	Tabular	Fast	Very fast	High	Low
K-Means	Clustering, customer segmentation	Tabular	Fast	Very fast	Medium	Low
Linear Regression	Regression, forecasting	Tabular	Fast	Very fast	Medium	Low
Word2Vec	NLP, text analytics	Text corpus	Slow	Fast	High	Low-medium
RNNs/LSTMs	Sequence data like text, time series	Text, time series	Slow	Fast	High	GPUs preferable

PROS AND CONS OF AI ALGORITHMS

Let's summarize some of the key advantages and limitations of modern AI algorithms:

ADVANTAGES

- **Continuous learning:** Ability to keep improving with more data and feedback without reprogramming.
- **Domain agnostic:** Same algorithms like neural nets can be applied to diverse problems like computer vision, NLP, fraud detection etc.
- **Handling complexity:** Ability to uncover complex patterns and insights humans could miss.
- **Automation:** Once trained, models can keep operating without human intervention.

LIMITATIONS

- **Data dependence:** Performance heavily reliant on quality and quantity of training data.
- **Interpretability:** Difficult to explain the internal logic behind predictions made by models like neural networks.
- **Compute needs:** Deep learning models require powerful, expensive hardware like GPU clusters.
- **Overfitting:** Models may latch onto spurious patterns that do not generalize beyond training data.
- **Security:** Potential for bias, adversarial attacks, misuse of models.

While extremely capable, AI algorithms do have drawbacks that must be carefully managed. Overall though, their ability to learn continuously from data allows them to expand their capabilities over time and take on increasingly complex real-world tasks.

THE FUTURE OF AI ALGORITHMS

The future of artificial intelligence hinges on developing more advanced algorithms that can mimic human-level flexibility and general intelligence. Here are some promising directions for AI algorithm innovation:

- **Multimodal learning:** Algorithms that can process multiple data types like text, images, audio, sensor data together like humans do to improve decision making.
- **Transfer learning:** Ability to take knowledge gained solving one problem and transfer it to accelerate learning on related problems. Enables more flexible, human-like learning.
- **Generative AI:** Models that can create novel, realistic content like images, videos, speech and text rather than just classify existing data.
- **Reinforcement learning:** Agents that can optimize sequences of decisions to maximize reward through trial-and-error experience like AlphaGo and robotic control.
- **Explainable AI:** Algorithms that can provide insights into their internal logic and decisions to build trust. Critical for high-stakes applications.
- **Low-power AI:** Advances like neural architecture search to develop leaner, more efficient AI models that can run on low-power devices rather than massive supercomputers.

Tremendous progress is being made on all these fronts to make AI smarter, more useful, and scalable. With incredible growth in data and compute infrastructure, it is sure to accelerate rapidly. The future of AI algorithms looks extremely exciting!

HERE ARE SOME COMPARATIVE TABLES FOR POPULAR AI SERVICES AND THE ALGORITHMS THEY USE:

Image Recognition Services

Service	Algorithm Used	Description
Google Vision	Convolutional Neural Networks	Detects objects, text, and landmarks in images. Highly accurate computer vision.
Amazon Rekognition	Convolutional Neural Networks	Image and video analysis service. Facial analysis, object and scene detection.
Microsoft Computer Vision	Convolutional Neural Networks	Analyzes image content, detects objects, extracts text.
Clarifai	Convolutional Neural Networks	Detects objects, concepts, faces. Customizable models.

Pros and Cons

Algorithm	Pros	Cons
Convolutional Neural Networks	Very high accuracy for image recognition. Can be trained on new classes.	Computationally intensive. Requires large datasets and GPUs for training.

Language Services

Service	Algorithm Used	Description
Google Cloud NLP	BERT, Transformer	Syntax analysis, entity recognition, sentiment

Service	Algorithm Used	Description
	Networks	analysis, content classification.
AWS Comprehend	Neural Networks, Word2Vec	Sentiment analysis, key phrase extraction, topic modeling, language detection.
Microsoft Azure Text Analytics	LSTM Networks, Word2Vec	Sentiment analysis, key phrase extraction, language detection.
IBM Watson NLP	Various deep learning models	Diverse NLP capabilities like classification and tone analysis.

Pros and Cons

Algorithm	Pros	Cons
BERT	Cutting-edge NLP accuracy powered by transformers.	Computationally intensive to train and run.
Word2Vec	Efficient semantic representations of words.	Limited to individual words, no context.
LSTM Networks	Excellent for sequence data like text.	Difficult to train, complex architecture.

Recommendation Systems

Service	Algorithm Used	Description
Amazon Recommendations	Collaborative Filtering	Product recommendations based on collective customer data.
Netflix	Matrix Factorization	Predicts what users will like based on taste profiles.
YouTube Recommendations	Deep Neural Networks	Recommends relevant engaging videos to users.
Spotify	Neural Collaborative Filtering	Combines deep learning with collaborative filtering for music.

Pros and Cons

Algorithm	Pros	Cons
Collaborative Filtering	Good accuracy from collective wisdom of users.	Suffers from cold start problem for new users/items.

Algorithm	Pros	Cons
Matrix Factorization	Scalable recommendations with latent taste profiles.	Limited expressiveness compared to deep learning.
Neural Collaborative Filtering	Highly accurate recommendations. Learns nuanced user preferences.	Complex methods requiring significant data and compute.

HIGH-LEVEL OVERVIEW OF SOME OF THE MOST POPULAR CATEGORIES OF AI SERVICES AND THE ALGORITHMS COMMONLY USED

- **Computer Vision Services:** Google Vision, AWS Rekognition, Microsoft Computer Vision, Clarifai, etc. Use convolutional neural networks for image recognition and analysis.
- **Natural Language Services:** Google Cloud NLP, AWS Comprehend, IBM Watson NLP, etc. Employ deep learning models like BERT, RNNs, Word2Vec for NLP tasks.
- **Recommendation Systems:** Amazon, Netflix, YouTube, Spotify recommendations. Leverage collaborative filtering, matrix factorization, and neural models.
- **Chatbots and Virtual Assistants:** Alexa, Google Assistant, Siri, Watson Assistant. Use NLP algorithms and knowledge graphs to understand language.
- **Fraud Detection Services:** Stripe Radar, Sift, Forter, etc. Apply anomaly detection and deep learning to identify payment fraud.
- **Autonomous Driving Tech:** Waymo, Cruise, Argo AI, Aurora, etc. Use computer vision and deep reinforcement learning for autonomous control.
- **Drug Discovery:** Companies like Atomwise, Exscientia, Insitro use deep learning for molecule generation and optimization.
- **Personalization and Targeting:** Services like Optimizely, Evergage, Reflektion personalize content using ML techniques like clustering.
- **Search Engines:** Google, Bing rank pages using algorithms like PageRank, deep learning on billions of signals.

In summary, major categories leverage specialized algorithms tailored to their use case and data types, with deep learning being a driving force behind many advanced AI services today. Let me know if you would like me to expand on any specific category or service in more detail!

OVERVIEW OF THE MAJOR CATEGORIES OF AI SERVICES AND THE ALGORITHMS THEY COMMONLY EMPLOY

Computer Vision

- Services: Google Vision, AWS Rekognition, Clarifai, Orbital Insight
- Algorithms: Convolutional neural networks, R-CNNs, SSDs
- Pros: Highly accurate image recognition and analysis
- Cons: Expensive to develop and scale, data hungry

Natural Language Processing

- Services: AWS Comprehend, IBM Watson, Google Cloud NLP, Microsoft Azure Text Analytics
- Algorithms: Transformer networks, RNNs, BERT, GPT-3, Word2Vec
- Pros: Understand nuanced language, sentiment analysis

- Cons: Difficult to perfect contextual understanding

Recommendation Systems

- Services: Netflix, Amazon, YouTube, Spotify recommendations
- Algorithms: Collaborative filtering, matrix factorization, neural collaborative filtering
- Pros: Personalized content/product recommendations
- Cons: Can create filter bubbles and lack diversity

Chatbots and Virtual Assistants

- Services: Alexa, Siri, Google Assistant, customer service chatbots
- Algorithms: NLP, knowledge graphs, neural networks, rule-based systems
- Pros: Convenient hands-free interaction, 24/7 availability
- Cons: Limited capability for complex conversational dialogue

Autonomous Vehicles

- Services: Waymo, Cruise, Argo AI, Aurora, Motional
- Algorithms: Computer vision, deep reinforcement learning
- Pros: Self-driving capabilities, increased safety
- Cons: Massive development costs, regulation, safety risks

Let me know if you would like me to dive deeper into any specific category or service from this high-level overview. There are certainly many more applications and algorithms we could discuss!

COMPARISON TABLE OF SOME POPULAR AI SERVICES AND THE ALGORITHMS THEY UTILIZE

Service	**Use Case**	**Algorithms Used**	**Pros**	**Cons**
IBM Watson	Natural language processing, chatbots	Neural networks, SVM, logistic regression, tree ensembles	Versatile set of NLP capabilities like classification and sentiment analysis	Can be costly, challenges understanding nuance and context
AWS Rekognition	Image recognition and analysis	Convolutional neural networks	Highly accurate object, scene and facial recognition	Significant data and compute resources needed
Netflix Recommendations	Personalized content recommendations	Matrix factorization algorithms	Effective personalized suggestions at scale	Can get trapped in filter bubbles
Alexa	Voice assistant	Neural	Convenient	Limited ability

Service	Use Case	Algorithms Used	Pros	Cons
		networks, NLP, knowledge graphs	hands-free experience	for complex dialogue
Stripe Radar	Fraud detection	Neural networks, random forests, logistic regression	Adaptive fraud screening, minimal false positives	Fraud patterns constantly evolve requiring ongoing learning
Waymo	Self-driving technology	Deep neural networks, reinforcement learning	Advanced autonomous driving capabilities	Very costly to develop and safely validate

In summary, different categories of AI services tend to leverage algorithms tailored to their specific data types and tasks, with deep learning being a common approach for state-of-the-art performance. The choice comes down to accuracy needs, latency, scalability, and other factors.

COMPARISON TABLE OF POPULAR TEXT AND IMAGE AI SERVICES AND THE ALGORITHMS THEY USE

Text AI Services

Service	Algorithms	Pros	Cons
Google Cloud NLP	BERT, Transformer Networks	Advanced NLP accuracy	Computationally intensive
AWS Comprehend	RNNs, Word2Vec	Scalable text processing	Less contextual understanding than BERT
IBM Watson NLP	CNNs, RNNs	Diverse NLP capabilities	Can be costly
Azure Text Analytics	RNNs, Word2Vec	Built-in sentiment analysis	Limited to Azure ecosystem

Image AI Services

Service	Algorithms	Pros	Cons
Google Vision	CNNs	Highly accurate computer vision	Requires large datasets
AWS	CNNs	Facial recognition and	Raises privacy concerns

Service	Algorithms	Pros	Cons
Rekognition		analysis	
Clarifai	CNNs	Customizable image recognition	Less accurate than Google & AWS
Orbital Insight	CNNs	Satellite image analysis	Specialized use case

In summary, advanced deep learning algorithms like CNNs, BERT and RNNs are powering cutting-edge text and image AI services today. However, they require large amounts of data and computing power to train. The choice comes down to use case needs and resources available.

COMPARISON OF SOME OF THE MOST POPULAR AI SERVICES FOR TEXT AND IMAGE GENERATION

Text Generation Services

Service	Model/Algorithm	Pros	Cons
Claude (Anthropic)	Constitutional AI	Safe, honest model	Limited capabilities compared to large models
ChatGPT	GPT-3 Transformer	Very human-like, versatile	Potential for harmful misinformation
Google Bard	Transformer	Backed by Google, more general knowledge	Prone to false claims currently
Jasper (Anthropic)	Constitutional AI	Helpful assistant focused on honesty	Less capable than ChatGPT for now
Cohere	Generative AI	Control over tone, editable responses	Smaller model, less human-like

Image Generation Services

Service	Model/Algorithm	Pros	Cons
DALL-E 2	Transformer	Extremely high image quality and control	Limited free tier access
Midjourney	VAEs, CLIP model	Affordable, active community	Images can lack coherence
Stable Diffusion	Latent diffusion models	Open source model, free access	Requires tuning for best results
Google	Vision Transformer	Backed by Google,	Prone to AI-generated

Service	Model/Algorithm	Pros	Cons
Imagen		photorealistic	misinformation
Nightcafe	GANs	Fun, creative image generation	Lower resolution images

Artificial Intelligence with Reinforcement Learning, and Our Future

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Abstract:

This research explores the potential of Natural Computing (NC) in the field of tourism studies, with a specific focus on the resident-tourist relationship (RTR) in local destinations. Leveraging principles from Artificial Immune Systems (AIS), we propose a novel approach to understanding and modeling the complex dynamics of RTR as a Complex Adaptive System. The study provides a theoretical and practical framework for assessing tourism impacts, predicting negative effects, and informing policy decisions in real-world contexts.

Introduction:

Computational Social Science (CSS) has emerged as a transformative field, employing artificial computational worlds to analyze and simulate real-life social systems and processes. This study extends CSS principles to encompass Natural Computing (NC), an interdisciplinary approach that draws inspiration from nature and computation. We aim to investigate the applicability of NC, specifically Artificial Immune Systems, in reshaping our understanding of the RTR in tourism studies.

Research Problem:

The resident-tourist relationship is pivotal in evaluating the effects of tourism on local communities. Existing theories offer valuable insights, yet a comprehensive methodological approach to understanding RTR remains elusive. This study addresses the need for a robust model that can assimilate diverse practical evidence, ultimately informing policy decisions through simulations.

Methodology and Discussion:

We conceptualize RTR as a Complex Adaptive System, characterized by self-organizing phenomena and emergent properties arising from interactions among various components of the tourist destination system. To tackle the complexity of emergent phenomena and non-linear interactions, we turn to Artificial Immune Systems (AIS). Specifically, we adopt the Danger Zone theory (DZT) within AIS, mirroring natural immunological principles. This metaphorical framework aids in developing an adaptive decision support model for the resident-tourist relationship.

Preliminary Conclusions:

The RTR-AIS approach holds promise as a theoretical and practical framework for assessing tourism impacts. By leveraging principles from natural immune systems, we can simulate and measure various resident-tourist reaction scenarios. This approach has the potential to enhance policy decision-making processes in real-world tourism contexts.

Conclusion:

The integration of Natural Computing, particularly Artificial Immune Systems, offers a fresh perspective on understanding the resident-tourist relationship in local destinations. This study paves the way for a more comprehensive and adaptable approach to assessing tourism impacts, ultimately benefiting local communities, and informing effective policy decisions.

An Integration of Artificial Intelligent Based Genetic Algorithm

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Abstract:

Artificial Intelligence (AI) has rapidly evolved from a burgeoning science to a ubiquitous presence in our daily lives, with investments in AI systems projected to reach $77.6 billion in 2022 (IDC, 2019). AI-powered smart devices, integrated into activities ranging from self-driving cars to voice-assistant technologies, offer convenience and efficiency, despite concerns regarding data privacy (TechCrunch, 2019). This paper delves into the influence of mind perception in shaping customer-brand relationships facilitated by AI-enabled devices. A genetic algorithm is used to solve complicated problems with a greater number of variables & possible outcomes/solutions. The combinations of different solutions are passed through the Darwinian based algorithm to find the best solutions. The poorer solutions are then replaced with the offspring of good solutions.

Introduction:

The proliferation of Artificial Intelligence (AI) has transformed our interactions with technology. This paper explores the nuanced role of mind perception in customer-brand relationships, particularly in the context of AI-driven smart devices. These devices, equipped with the ability to recommend and make decisions based on customer data, sometimes create the impression of autonomous decision-making. Mind perception encompasses the capacity for decision-making and organized behavior (agency dimension) and the ability to exhibit emotions and personality traits (experience dimension) (Morera et al., 2018). It all works on the Darwinian theory, where only the fittest individuals are chosen for reproduction. The various solutions are considered the elements of the population, and only the fittest solutions are allowed to reproduce (to create better solutions). Genetic algorithms help in optimizing the solutions to any particular problem.

The whole process of genetic algorithms is a computer program simulation in which the attributes of the problem & solution are treated as the attributes of the Darwinian theory. The basic processes which are involved in genetic algorithms are as follows:

- A population of solutions is built to any particular problem. The elements of the population compete with each other to find out the fittest one.
- The elements of the population that are fit are only allowed to create offspring (better solutions).
- The genes from the fittest parents (solutions) create a better offspring. Thus, future solutions will be better and sustainable.

Theoretical Framework:

This study is anchored in the attachment-aversion (AA) theory, positing that affective, behavioral, and intellectual dimensions influence the psychological determinants of brand attachment or aversion (Schmitt, 2013). We hypothesize that positive experiences with AI-enabled smart devices entice, enable, and enrich consumers, fostering brand attachment and motivational strength.

Working of Genetic Algorithms in AI

The working of a **genetic algorithm in AI** is as follows:

- The components of the population, i.e., elements, are termed as genes in **genetic algorithms in AI**. These genes form an individual in the population (also termed as a chromosome).

- A search space is created in which all the individuals are accumulated. All the individuals are coded within a finite length in the search space.
- Each individual in the search space (population) is given a fitness score, which tells its ability to compete with other individuals.
- All the individuals with their respective fitness scores are sought & maintained by the genetic algorithm & the individuals with high fitness scores are given a chance to reproduce.
- The new offspring are having better 'partial solutions' as compared to their parents. Genetic algorithms also keep the space of the search space dynamic for accumulating the new solutions (offspring).
- This process is repeated until the offsprings do not have any new attributes/features than their parents (convergence). The population converges at the end, and only the fittest solutions remain along with their offspring (better solutions). The fitness score of new individuals in the population (offspring) are also calculated.

Key Terminologies in Genetic Algorithms

- **Selection Operator** – This operator in **genetic algorithms in AI** is responsible for selecting the individuals with better fitness scores for reproduction.
- **Crossover Operator** – The crossover operator chooses a crossover site from where the merge will happen. The crossover sites in both the individuals available for mating are chosen randomly and form new individuals.
- **Mutation Operator** – This operator in the genetic algorithm is responsible for embedding random genes in the offspring to maintain diversity and avoid premature convergence.
- **Premature Convergence** – If a problem is optimized quickly, it means that the offspring were not produced at many levels. The solutions will also not be of optimal quality. To avoid premature convergence, new genes are added by the mutation operator.
- **Allele** – The value of a particular gene in a chromosome is termed as an allele. The specified set of alleles for each gene defines the possible chromosomes of that particular gene.

Benefits and Uses of Genetic Algorithms

- The solutions created through genetic algorithms are strong & reliable as compared to other solutions.
- They increase the size of solutions as solutions can be optimized over a large search scale. This algorithm also can manage a large population.
- The solutions produced by genetic algorithms do not deviate much on slightly changing the input. They can handle a little bit of noise.
- Genetic algorithms have a stochastic distribution that follows probabilistic transition rules, making them hard to predict but easy to analyze.
- Genetic algorithms can also perform in noisy environments. It can also work in case of complex & discrete problems.
- Due to their effectiveness, genetic algorithms have many applications like neural networks, fuzzy logic, code-breaking, filtering & signal processing. You can learn more about the **genetic algorithms in AI** via the top courses offered by upGrad.

Methodology:

An online survey was conducted among 99 smart device users in the US and India, with an average age of 39.9 years. Utilizing reflective Partial Least Squares Structural Equation Modeling (PLS-SEM), we validated the constructs and examined their relationships.

Machine learning and artificial intelligence (AI) are transforming nearly every aspect of human life at a breakneck pace. Using artificial intelligence technology for agricultural product marketing is more efficient and convenient than using traditional marketing channels. Producers of local agricultural products have begun using artificial intelligence technology to broadcast live broadcasts in order to combat low sales and widespread support for many agricultural products. As a result of self-media platforms powered by artificial intelligence, consumers are becoming increasingly adept at identifying their own agricultural products and brand names (AI). As a result of the use of self-media technology in agriculture, progress in refrigeration and cold chain logistical systems has accelerated at the same time. Because of the urgency with which fresh agricultural products must be received, the cold chain storage requirements for these products are more stringent. Farmers who broadcast their products live not only increase the number of customers but they also help to open up new avenues for economic development, such as tourism and entertainment. The integration of artificial intelligence into agricultural product production, processing, sales promotion, and cold chain distribution logistics as well as research into agricultural product marketing strategies in an AI environment is therefore critical to the future of the industry.

In the context of agricultural product marketing, we will first develop a model for self-media analysis. An agricultural product practitioner can become an expert in marketing operations by employing descriptive analysis methods and various statistical analysis methods for the data generated by the operation. This is achieved by employing a model based on Douyin live broadcast and WeChat and Weibo video blog promotion. Using consumer preferences and behavior analysis in tandem with operational analysis, it is possible to create agricultural products and live broadcast activities for individual consumption. The marketing process of the farming industry is investigated using statistical methods, primarily hypothesis testing to determine whether the effect of activities has met expectations, time series analysis to forecast the sale of agricultural products, and regression analysis to guide the farming industry's production, inventory, and management decisions. A comprehensive analysis is done in the field of affiliate marketing. When using descriptive analysis to create daily traffic channels, hot items, slow-moving items, and inventory warnings, it is essential to be as specific as possible.

Second, design a system for the distribution and logistics of agricultural commodities using artificial intelligence. To design a suitable planning algorithm or an artificial intelligence model algorithm based on the findings of this research into the agricultural product logistics distribution mode, it is necessary to conduct research into the agricultural product logistics distribution mode to develop a suitable problem model. Comparing the developed algorithm model to the current agricultural product logistics and transportation system improves the algorithm's performance. The ultimate objective of the mathematical model for agricultural product logistics and distribution is to deliver the corresponding products on time in response to the real-time needs of actual consumers and intermediary physical stores and then to establish optimal distribution routes to minimize logistics and distribution costs as much as possible. Due to the development and implementation of artificial intelligence algorithms, agricultural products can be delivered to consumers in the shortest amount of time possible. This affords consumers the opportunity to receive services of higher quality. The O2O Internet of Things (IoT) and the self-media platform, which are both available on the O2O platform, enable consumers to monitor agricultural products in real time. When product quality issues are identified, it is possible to identify the source of the issue and make timely returns and exchanges, which aids in resolving product after-sales issues and effectively excavates potential customers.

Finally, an agricultural product display system should be constructed. Because the product has no physical characteristics, it is difficult to locate it when shopping online. Self-media technology has the potential to significantly alter this circumstance. With the goals of reducing the distance between consumers and agricultural products and increasing consumer recognition of agricultural products, a system for the visualization of agricultural products is being developed using both the big data cloud platform and the self-media live broadcast platform. In addition, the Internet of Things, 5G technology, and virtual reality technology are being utilized to realize cloud adoption and cloud interaction among agricultural product consumers, enabling them to engage in immersive experiential consumption. Using We-media and 5G technology, it is possible to develop visual agriculture and stream agricultural processes such as processing, production, harvesting, and distribution of agricultural products over the Internet in order to increase efficiency. This will help promote rural tourism and the arts and entertainment industries in the surrounding area. In the modern era, rural economic forms are becoming more diverse, and new media agricultural product operation small family teams can help accelerate the development of new types of agricultural businesses, such as small family farms and Internet workshop

Results:

Our findings support all proposed hypotheses. The affective dimension positively correlates with enticing experiences (β=.321, $p < .01$), while the behavioural dimension enables consumers (β=.246, $p < .05$), and the intellectual dimension enriches consumers (β=.501, $p < .01$). Together, these dimensions explain 78.0% of motivational strength, with significant positive effects.

Furthermore, the study reveals that the perception of mind in artificial intelligence moderates the relationship between enriching experiences and motivational strength. As the perception of mind increases, the impact of enriching experiences on motivational strength diminishes.

Conclusion:

This study empirically validates the AA theory in the context of AI-enabled devices, offering insights into the pivotal role of mind perception in shaping customer-brand relationships. Additionally, it highlights the moderating effect of mind perception on the relationship between enriching experiences and motivational strength. These findings have practical implications for designing AI systems that foster meaningful interactions with consumers. Over the past few decades, there has been a significant shift in the production, marketing, and management of agricultural products, and these approaches must be further optimized in light of the rise of artificial intelligence (AI). As a result of AI's rapid advancements, many agricultural producers have become agricultural product operators, and agricultural product operators have begun to implement AI technology in product production, marketing, and distribution. In this study, agriculture product management is analyzed, and AI technology is employed to investigate how to integrate production, marketing, and distribution. In addition, this study provides a classification model for agricultural products that combines factor analysis with an improved SVM based on a GA. It was discovered that the improved method can rapidly and accurately identify quality categories of agricultural products, significantly improve classification accuracy, and can be widely used to evaluate agricultural product quality.

Artificial Neuron Feed Forward Neural Network

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Abstract:
This working chapter delves into the intricate connections between tourists and intelligent virtual assistants, aiming to understand and cultivate love ties. The study investigates attachment and perceived value as drivers of affection towards intelligent virtual assistants, as well as loyalty intentions as a consequence of this affection. Attachment is defined as the sense of closeness a tourist feels towards an intelligent virtual assistant, signifying a cognitive and emotional bond. The study also explores how tourists' beliefs and values influence their relational love with the virtual assistant. Furthermore, it examines how brand love fosters loyalty towards the virtual assistant. The research, based on data collected from 124 participants, suggests that attachment plays a significant role in developing affection for intelligent virtual assistants. Additionally, tourists' values and beliefs contribute to the development of relational love. The findings affirm that loyalty towards a specific virtual assistant is achievable when tourists develop a love relationship with it. This study offers valuable insights for both understanding and designing AI systems, with ongoing efforts to expand and refine the model.

Introduction

Feed forward neural networks are artificial neural networks in which nodes do not form loops. This type of neural network is also known as a multi-layer neural network as all information is only passed forward. During data flow, input nodes receive data, which travel through hidden layers, and exit output nodes Why are neural networks used?

Neuronal networks can theoretically estimate any function, regardless of its complexity.

Yet, supervised learning is a method of determining the correct Y for a fresh X by learning a function that translates a given X into a specified Y. But what are the differences between neural networks and other methods of machine learning? The answer is based on the Inductive Bias phenomenon, a psychological phenomenon.

Machine learning models are built on assumptions such as the one where X and Y are related. An Inductive Bias of linear regression is the linear relationship between X and Y. In this way, a line or hyperplane gets fitted to the data.

When X and Y have a complex relationship, it can get difficult for a Linear Regression method to predict Y. For this situation, the curve must be multi-dimensional or approximate to the relationship.

A manual adjustment is needed sometimes based on the complexity of the function and the number of layers within the network. In most cases, trial and error methods combined with experience get used to accomplishing this. Hence, this is the reason these parameters are called hyperparameters.

What is a feed forward neural network?

Feed forward neural networks are artificial neural networks in which nodes do not form loops. This type of neural network is also known as a multi-layer neural network as all information is only passed forward.

During data flow, input nodes receive data, which travel through hidden layers, and exit output nodes. No links exist in the network that could get used to by sending information back from the output node.

A feed forward neural network approximates functions in the following way:

- An algorithm calculates classifiers by using the formula y = f* (x).

- Input x is therefore assigned to category y.
- According to the feed forward model, y = f (x; θ). This value determines the closest approximation of the function.

Feed forward neural networks serve as the basis for object detection in photos, as shown in the Google Photos app.

What is the working principle of a feed forward neural network?

When the feed forward neural network gets simplified, it can appear as a single layer perceptron.

This model multiplies inputs with weights as they enter the layer. Afterward, the weighted input values get added together to get the sum. As long as the sum of the values rises above a certain threshold, set at zero, the output value is usually 1, while if it falls below the threshold, it is usually -1.

As a feed forward neural network model, the single-layer perceptron often gets used for classification. Machine learning can also get integrated into single-layer perceptrons. Through training, neural networks can adjust their weights based on a property called the delta rule, which helps them compare their outputs with the intended values.

As a result of training and learning, gradient descent occurs. Similarly, multi-layered perceptrons update their weights. But, this process gets known as back-propagation. If this is the case, the network's hidden layers will get adjusted according to the output values produced by the final layer.

Layers of feed forward neural network

- Input layer:

The neurons of this layer receive input and pass it on to the other layers of the network. Feature or attribute numbers in the dataset must match the number of neurons in the input layer.

- Output layer:

According to the type of model getting built, this layer represents the forecasted feature.

- Hidden layer:

Input and output layers get separated by hidden layers. Depending on the type of model, there may be several hidden layers.

There are several neurons in hidden layers that transform the input before actually transferring it to the next layer. This network gets constantly updated with weights in order to make it easier to predict.

- Neuron weights:

Neurons get connected by a weight, which measures their strength or magnitude. Similar to linear regression coefficients, input weights can also get compared.

Weight is normally between 0 and 1, with a value between 0 and 1.

- Neurons:

Artificial neurons get used in feed forward networks, which later get adapted from biological neurons. A neural network consists of artificial neurons.

Neurons function in two ways: first, they create weighted input sums, and second, they activate the sums to make them normal.

Activation functions can either be linear or nonlinear. Neurons have weights based on their inputs. During the learning phase, the network studies these weights.

- Activation Function:

Neurons are responsible for making decisions in this area.

According to the activation function, the neurons determine whether to make a linear or nonlinear decision. Since it passes through so many layers, it prevents the cascading effect from increasing neuron outputs.

An activation function can be classified into three major categories: sigmoid, Tanh, and Rectified Linear Unit (ReLu).

- Sigmoid:

Input values between 0 and 1 get mapped to the output values.

- Tanh:

A value between -1 and 1 gets mapped to the input values.

- Rectified linear Unit:

Only positive values are allowed to flow through this function. Negative values get mapped to 0.

Function in feed forward neural network

Cost function

In a feed forward neural network, the cost function plays an important role. The categorized data points are little affected by minor adjustments to weights and biases.

Thus, a smooth cost function can get used to determine a method of adjusting weights and biases to improve performance.

Following is a definition of the mean square error cost function:

$$C(w,b) \equiv \frac{1}{2n}\sum_x \|y(x) - a\|^2.$$

Image source

Where,

w = the weights gathered in the network

b = biases

n = number of inputs for training

a = output vectors

x = input

‖v‖ = vector v's normal length

Loss function

The loss function of a neural network gets used to determine if an adjustment needs to be made in the learning process.

Neurons in the output layer are equal to the number of classes. Showing the differences between predicted and actual probability distributions. Following is the cross-entropy loss for binary classification.

Cross Entropy Loss:

$$L(\Theta) = \begin{cases} -log(\hat{y}) & \text{if } y = 1 \\ -log(1-\hat{y}) & \text{if } y = 0 \end{cases}$$

Image source

As a result of multiclass categorization, a cross-entropy loss occurs:

Cross Entropy Loss:

$$L(\Theta) = -\sum_{i=1}^{k} y_i \log(\hat{y}_i)$$

Gradient learning algorithm

In the gradient descent algorithm, the next point gets calculated by scaling the gradient at the current position by a learning rate. Then subtracted from the current position by the achieved value.

To decrease the function, it subtracts the value (to increase, it would add). As an example, here is how to write this procedure:

$$p_{n+1} = p_n - \eta \nabla f(p_n)$$

The gradient gets adjusted by the parameter η, which also determines the step size. Performance is significantly affected by the learning rate in machine learning.

Output units

In the output layer, output units are those units that provide the desired output or prediction, thereby fulfilling the task that the neural network needs to complete.

There is a close relationship between the choice of output units and the cost function. Any unit that can serve as a hidden unit can also serve as an output unit in a neural network.

Advantages of feed forward Neural Networks

- Machine learning can be boosted with feed forward neural networks' simplified architecture.
- Multi-network in the feed forward networks operate independently, with a moderated intermediary.
- Complex tasks need several neurons in the network.
- Neural networks can handle and process nonlinear data easily compared to perceptrons and sigmoid neurons, which are otherwise complex.
- A neural network deals with the complicated problem of decision boundaries.
- Depending on the data, the neural network architecture can vary. For example, convolutional neural networks (CNNs) perform exceptionally well in image processing, whereas recurrent neural networks (RNNs) perform well in text and voice processing.
- Neural networks need graphics processing units (GPUs) to handle large datasets for massive computational and hardware performance. Several GPUs get used widely in the market, including Kaggle Notebooks and Google Collab Notebooks.

Applications of feed forward neural networks

There are many applications for these neural networks. The following are a few of them.

Physiological feed forward system

It is possible to identify feed forward management in this situation because the central involuntary regulates the heartbeat before exercise.

Gene regulation and feed forward

Detecting non-temporary changes to the atmosphere is a function of this motif as a feed forward system. You can find the majority of this pattern in the illustrious networks.

Automation and machine management

Automation control using feed forward is one of the disciplines in automation.

Parallel feed forward compensation with derivative

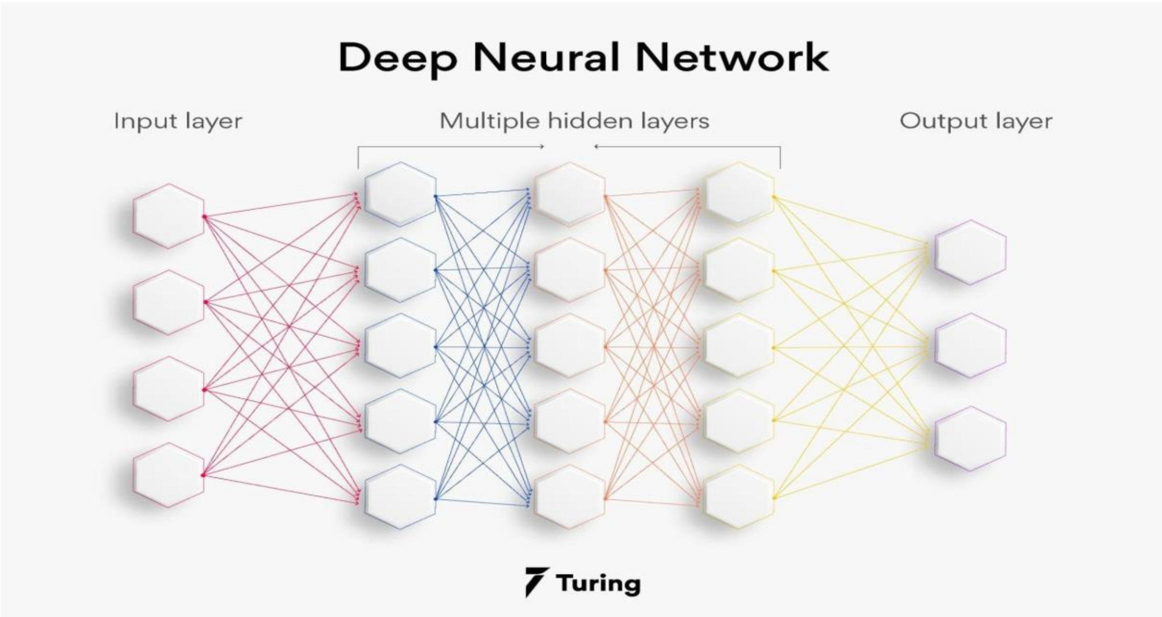
An open-loop transfer converts non-minimum part systems into minimum part systems using this technique.

Understanding the math behind neural networks

Typical deep learning algorithms are neural networks (NNs). As a result of their unique structure, their popularity results from their 'deep' understanding of data.

Furthermore, NNs are flexible in terms of complexity and structure. Despite all the advanced stuff, they can't work without the basic elements: they may work better with the advanced stuff, but the underlying structure remains the same.

Let's begin. NNs get constructed similarly to our biological neurons, and they resemble the following:



Neurons are hexagons in this image. In neural networks, neurons get arranged into layers: input is the first layer, and output is the last with the hidden layer in the middle.

NN consists of two main elements that compute mathematical operations. Neurons calculate weighted sums using input data and synaptic weights since neural networks are just mathematical computations based on synaptic links.

The following is a simplified visualization:

In a matrix format, it looks as follows:

$$[x_1 \quad x_2]\begin{bmatrix} w_{11} & w_{12} & w_{13} \\ w_{21} & w_{22} & w_{23} \end{bmatrix} = \begin{bmatrix} x_1 w_{11} + x_2 w_{21} \\ x_1 w_{12} + x_2 w_{22} \\ x_1 w_{13} + x_2 w_{23} \end{bmatrix}' = \begin{bmatrix} h_1 \\ h_2 \\ h_3 \end{bmatrix}'$$

In the third step, a vector of ones gets multiplied by the output of our hidden layer:

$$\begin{bmatrix} h_1 \\ h_2 \\ h_3 \end{bmatrix}' \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = h_1 + h_2 + h_3 = y$$

Using the output value, we can calculate the result. Understanding these fundamental concepts will make building NN much easier, and you will be amazed at how quickly you can do it. Every layer's output becomes the following layer's input.

The architecture of the network

In a network, the architecture refers to the number of hidden layers and units in each layer that make up the network.

A feed forward network based on the Universal Approximation Theorem must have a "squashing" activation function at least on one hidden layer.

The network can approximate any Borel measurable function within a finite-dimensional space with at least some amount of non-zero error when there are enough hidden units.

It simply states that we can always represent any function using the multi-layer perceptron (MLP), regardless of what function we try to learn.

Thus, we now know there will always be an MLP to solve our problem, but there is no specific method for finding it.

It is impossible to say whether it will be possible to solve the given problem if we use N layers with M hidden units.

Research is still ongoing, and for now, the only way to determine this configuration is by experimenting with it.

While it is challenging to find the appropriate architecture, we need to try many configurations before finding the one that can represent the target function.

There are two possible explanations for this. Firstly, the optimization algorithm may not find the correct parameters, and secondly, the training algorithms may use the wrong function because of overfitting.

What is backpropagation in feed forward neural network?

Backpropagation is a technique based on gradient descent. Each stage of a gradient descent process involves iteratively moving a function in the opposite direction of its gradient (the slope).

The goal is to reduce the cost function given the training data while learning a neural network. Network weights and biases of all neurons in each layer determine the cost function. Backpropagation gets used to calculate the gradient of the cost function iteratively. And then update weights and biases in the opposite direction to reduce the gradient.

We must define the error of the backpropagation formula to specify i-th neuron in the l-th layer of a network for the j-th training. Example as follows (in which $z_i^{[l](j)}$ represents the weighted input to the neuron, and L represents the loss.)

$$\delta_i^{[l](j)} = \frac{\partial \mathcal{L}(\hat{y}^{(j)}, y^{(j)})}{\partial z_i^{[l](j)}}$$

Image source

In backpropagation formulas, the error is defined as above:

Below is the full derivation of the formulas. For each formula below, L stands for the output layer, g for the activation function, ∇ the gradient, W[l]T layer l weights transposed.

A proportional activation of neuron i at layer l based on bli bias from layer i to layer i, wlik weight from layer l to layer l-1, and ak[l−1] (j) activation of neuron k at layer l-1 for training example j.

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ABSTRACT: Project based learning is the methodology in which projects drive knowledge and is used in dedicated subjects without negotiating the coverage of the required technical material. This paper discusses the scheme and delivery of project based learning in computer science engineering as major project which adopts undergraduate creativities and emphasizes on real-world, open-ended projects. These projects foster a wide range of abilities, not only those related to content knowledge or technical skills, but also practical skills. The goal for this innovative undergrad project is to show how a trained machine model can predict the price of a cryptocurrency if we give the right amount of data and computational power. It displays a graph with the predicted values. The most popular technology is the kind of technological solution that could help mankind predict future events. With vast amount of data being generated and recorded on a daily basis, we have finally come close to an era where predictions can be accurate and be generated based on concrete factual data. Furthermore, with the rise of the crypto digital era more heads have turned towards the digital market for investments. This gives us the opportunity to create a model capable of predicting crypto currencies primarily Bitcoin. This can be accomplished by using a series of machine learning techniques and methodologies.

I1ntroduction

Bitcoin is a payment system of digital cryptocurrency which is entirely decentralized. Transactions based on this network are fully cryptographed. During recent years, cryptocurrencies have had a boom in its prices, Bitcoin has been increasingly considered an investment asset by many traders. Due to its high volatile nature of bitcoin, it has become increasingly hard to predict the price of it and make good financial decisions. Implementing Machine learning in Bitcoin predictions have been focused by many investors and researchers by applying various techniques modelling with various structured data and feature dimensions. To predict the value of Bitcoin with different frequencies, machine learning techniques are used to classify Bitcoin by daily price and high-frequency price. The birth of long short-term memory (LSTM) and the artificial recurrent neural network (RNN) architecture proposed by Sepp Hochreiter and Jürgen Schmidhuber in the year 1997 has sparked a new wave of optimism in predicting the future better . The design of LSTM is the analysis of time-series data points and their sequential relationships, gave hope that we can train the model to estimate the next move before we even see it. Even though our predictions could be close to reality, our goal is to push the error of our prediction to zero .

The money that we used to understand:

As far as the written record has existed, money and banking have gone hand in hand. As discussed by Yuval Noah Harari, in the sweeping history of human race sapiens: it is easy to remember who owes what obligation to whom in kinship, but the economy of obligations is impossible to scale, above all once you add strangers. Currencies around the world are pure manifestations of sovereignty conjured by governments (Steil, 2007). Digital currencies are just the recent innovation and their widespread is a thing of the future. Bitcoins as we know it is the first-ever implemented decentralized database system used not just to store data but also used as cryptocurrencies. The peer-to-peer electronic cash system is not a walk in the park to digest. The technological improvements have outpaced the need of financial networks and outgrown the need for banks in the process. Nakamoto proposed a digital currency that would live on the network of other computers, meaning that the community would provide the processing power of their computer to keep it alive. The key to the entire system was termed as blockchain.

So, what is Bitcoin? To truly comprehend this, you need to know that Bitcoin is a network that runs on a computer program. It is nothing but zeros and ones stored on a computer, relying on a software operating at the very core of it all. It is electronic money; it is not money stored electronically. For instance, google wallet that stores credit card, debit card and the loyalty card is a digital wallet that stores money traditionally, but bitcoin has a different approach (pagliery, 2014)

Problem Statement:

One of the major problems with Bitcoin is the price prediction in Bitcoin because of its high volatility.

Our objective is to design and train the financial data set using LSTM and RNN with feature selections to predict the Bitcoin price and achieve a minimal root mean squared error

a) Financial Assessment:

In 2016, the author Dahlberg, explored the financial aspects and capabilities in hedging using generalized Auto Regression condition called Heteroskedasticity (GARCH), to state the fact that Bitcoin reacted quickly to sentiment. There was also found the status in the market between commodity and currency as it contains both the properties. The portfolio management and the risk analysis are a method of GARCH which is useful in exploring the relationship between commodities like Gold, copper, etc. It is also useful in estimating the volatility of financial market returns . The Bitcoin value prediction using blockchain network-based features was attempted many times to predict its value, but the study has been able to show the price fluctuations in Bitcoin price with the classification accuracy of 55%. Furthermore, it is agreed by the researchers that the highest accuracy of blockchain price could be found in the neural networks.

b) Price Prediction:

The value of Bitcoin keeps changing every day just like the stocks. There are a large number of algorithms in place to predict the value of stock market data. However, the parameters are quite different for cryptocurrencies. Therefore, it is necessary to have a good prediction method in place that is reliable for investors to make quick investing decisions. Thus, we feel necessary to leverage Machine learning technology to predict the price of bitcoins .

c) Machine Learning:

Data mining is described and perceived as the extraction of prior significant information from data. Machine Learning gives a specified reason for Data mining . The Machine Learning can be part of two classifications, the demonstrating of datasets with labelled examples which are named as supervised learning. The feature called target can either be discrete or continual, be that as it may, this impacts the model. In the off chance, the variable target is detached, the request model is used. In case if the target variable is persistent, the regression model is used .
The unsupervised in Machine learning includes the displaying of datasets with no known qualities or results. This technique's motivation is to frame bunches or gatherings by utilizing comparable information. The goal of this method is to anticipate the cost of bitcoin. The supervised algorithms incorporate wavelets discrete change and wavelets, different sorts of artificial neural organizations incorporate MLP, RNN and LSTM.

d) Methodology:
i. Multilayer Perceptron:

The multilayer perceptron's are otherwise known as the simple feed-forward neural networks. The MLPs form the bedrock for the models in Neural Network. In neural network methodology, the inputs are the example fed to the model and the outputs are the predictions. Each layer is the modular subfractions. The input and output layer and the layer between these two layers are called the hidden layer are part of the model. Each layer output is a unit which can be viewed as comparable to a neuron in the mind. The functions of the model are defined in weights as these parameters are adjusted when training the model. The fundamental restriction of MLP connection to RNN is that they are influenced by the gradient slope issue. This issue is that as layers and time steps of the network identify with one another through augmentation, subsidiaries are vulnerable to disappearing gradients .

ii. Recurrent Neural Network:
Elman built up the recurrent neural network (RNN), the RNN was organized like MLP, with the special case that signs can stream forward and back in an iterative manner. The context layer is added to smoothen another layer. Despite passing contribution between the layers, the context layer is dealt with yield layer to be dealt with into the accompanying layer with the accompanying data. After each

timestep, this state is overwritten. . This outcome is a strong network. The length of the network memory is the complete length of the worldly window, it is a suitable method for the prediction task . In some experimentation, RNN has indicated abilities to take care of long-haul conditions, practically speaking they regularly have trouble learning because of long-term dependencies and gradient drop challenges between them.

iii. LSTM:

Like RNN, Bayesian optimization was picked for choosing boundaries for this model where feasible. This is a heuristic hunt strategy which works by expecting the function was examined from a Gaussian process and keeps a back conveyance for this function as the consequences of various hyperparameter choices are distinguished. One would then be able to enhance the normal improvement over the best outcome to pick hyperparameters for the following experiment . The presentation of both the RNN and LSTM network are assessed on approved data with huge overfitting measures set up. Dropout is executed in the two layers. Likewise, an early plug is modified into the model to forestall overfitting. This stops the model if its validation loss does not improve for 5 epochs.

iv. Feature Engineering:

The major player in the data set is the establishment of a trained dataset in the model. We provide bulk observations of data in the past or data experience as a learning input. Perceptively, we expect to receive better results the more we deliver. We would distinguish the labels and features; we can understand the value that we want to predict by using the labels. The value of Bitcoin price in an hour, two, etc. (labels) or the price of bitcoin in just an hour (Label).

In the training sample, the labels are just used for training. The range of feature is shown in the model with their associated labels. For example, the price of Bitcoin an hour ago and two hours ago as in our objective, we want the model to learn the relationship between the precedent values and the expected Bitcoin price .

e) Data Exploration:

To start training the model using LSTM and RNN we need the dataset. An example dataset with financial pricing data is used for this method. The first step is to make sure that we have all the packages ready to load the data into the IDE and clean the data for any empty rows and null values.

```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt
import seaborn as sns
data = pd. read_csv("data/bitcoin.csv")
data = data.sort_values('Date')
data. head ()
```

the data(head) function gives the top five rows from the head. For our purpose, the close () column is called as it contains the information of the price of Bitcoins at the end of the day for the particular date. Using the MatPlotlib we then plot the value of the price of Bitcoin which is shown below.

```
price = data[['Close']]
plt.figure(figsize = (15,9))
plt.plot(price)
plt.xticks(range(0, data.shape[0],50), data['Date'].loc[::50],rotation=45)
plt.title("Bitcoin Price",fontsize=18, fontweight='bold')
plt.xlabel('Date',fontsize=18)
plt.ylabel('Close Price (USD)',fontsize=18)
```

```
plt.show()
```

Since the values of Bitcoin are shown in the graphical view, the dataset is then checked if it contains any null values.

```
price.info()
```

f) Data Preparation:

i. Normalization:
In this step we make sure that the data taken is normalize in values. The goal of this method is to change the numeric column in the dataset to a common scale, without misrepresenting the difference in range of values. For this purpose, we will use MinMaxScaler from the sklearn library,

```
from sklearn.preprocessing import MinMaxScaler
min_max_scaler = MinMaxScaler()

norm_data = min_max_scaler.fit_transform(price.values)

print(f'Real: {price.values[0]}, Normalized: {norm_data[0]}')
print(f'Real: {price.values[500]}, Normalized: {norm_data[500]}')
print(f'Real: {price.values[1200]}, Normalized: {norm_data[1200]}')
```

g) Data Split:

During this method, two problems are tackled in this step, the first being that the data is to be split into training and test data. The value obtained from the training method is used to teach our model while the test data we will use as the baseline for comparison in our prediction. To make sure that the predictions make sense, we cannot test on the same data that we train as we would run into the risk of over fitting the network values. In addition to this, we would also have to prepare the data for the LSTM network. This specific type of network would require us to send the data in chunks, isolating the history data which we use in the training and our target which tells us how far in the future that our model needs to learn to predict.
The Univariate data function would then be responsible for this part of the network,

```
def univariate_data(dataset, start_index, end_index, history_size, target_size):
  data = []
  labels = []

  start_index = start_index + history_size
  if end_index is None:
    end_index = len(dataset) - target_size

  for i in range(start_index, end_index):
    indices = range(i-history_size, i)
    # Reshape data from (history_size,) to (history_size, 1)
    data.append(np.reshape(dataset[indices], (history_size, 1)))
    labels.append(dataset[i+target_size])
    return np.array(data), np.array(labels)
```

The split will have in this next step:

```
past_history = 5
```

```
future_target = 0

TRAIN_SPLIT = int(len(norm_data) * 0.8)


x_train, y_train = univariate_data(norm_data,
                                   0,
                                   TRAIN_SPLIT,
                                   past_history,
                                   future_target)

x_test, y_test = univariate_data (norm_data,
                                  TRAIN_SPLIT,
                                  None,
                                  past_history,
                                  future_target )
```

h) Building the model:

In this step, the model is architecture is built, which will take several tries and experience to find the right layers and hyperparameter for each one of them. The necessary library for the model is imported,

```
from keras.models import Sequential
from keras.optimizers import Adam
from keras.layers import Dense, LSTM, LeakyReLU, Dropout

num_units = 64
learning_rate = 0.0001
activation_function = 'sigmoid'
adam = Adam(lr=learning_rate)
loss_function = 'mse'
batch_size = 5
num_epochs = 50

# Initialize the RNN
model = Sequential()
model.add(LSTM(units = num_units, activation=activation_function, input_shape=(None, 1)))
model.add(LeakyReLU(alpha=0.5))
model.add(Dropout(0.1))
model.add(Dense(units = 1))


# Compiling the RNN
model.compile(optimizer=adam, loss=loss_function)
```

Then the model is called upon using this function,

```
model.summary()
```

i) Training the model:

Since we now have our data ready, we can now start training the data using Keras,

```
history = model.fit(
  x_train,
  y_train,
```

```
    validation_split=0.1,
    batch_size=batch_size,
    epochs=num_epochs,
    shuffle=False
)
```

It is also very important in finding the right parameter. It is also very important that the parameter shuffle is set to false, and the analysis completely depends on the order of the information. Since we have used very less amount of data, training the data was quite easy without a GPU. On more advanced models and more granulated information, these models can take hours or days to train.

```
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(len(loss))

plt.figure()

plt.plot(epochs, loss, 'b', label='Training loss')
plt.plot(epochs, val_loss, 'r', label='Validation loss')
plt.title("Training and Validation Loss")
plt.legend()

plt.show()
```

The chart below shows the comparison between both functions:

j) Prediction:

Since our model is completely trained, we can now start making predictions and evaluating them to see how our model is doing.

```
original = pd.DataFrame(min_max_scaler.inverse_transform(y_test))
predictions = pd.DataFrame(min_max_scaler.inverse_transform(model.predict(x_test)))

ax = sns.lineplot(x=original.index, y=original[0], label="Test Data", color='royalblue')
ax = sns.lineplot(x=predictions.index, y=predictions[0], label="Prediction", color='tomato')
ax.set_title('Bitcoin price', size = 14, fontweight='bold')
ax.set_xlabel("Days", size = 14)
ax.set_ylabel("Cost (USD)", size = 14)
ax.set_xticklabels('', size=10)
```

CONCLUSION

Predicting the future will always be on the top of the list of uses for machine learning algorithms. Here in this project we have attempted to predict the prices of Bitcoins using two deep learning methodologies. This work focuses on the development of project based learning in the field of computer science engineering, by taking into account the problem definition, progression, student assessment and use of hands on activities based on use of deep learning algorithm to develop application which can predict bitcoin prices

Convolution Neural Network for Image processing and signal processing and its applications

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Abstract:

Image processing using artificial neuronal networks (ANN) has been successfully used in various fields of activity such as geotechnics, civil engineering, mechanics, industrial surveillance, defence department, automatics and transport. Image preprocessing, date reduction, segmentation and recognitionare the processes used in managing images with ANN.
An image can be represented as a matrix, each element of the matrix containing colour information for a pixel. The matrix is used as input data into the neuronal network. The small dimensions of the images, to easily and quickly help learning, establish the size of the vector and the number of input vectors. The transfer function used is a sigmoidal function. The learning rate includes values between [0,1] and the error it is recommended to be below 0.1.

Introduction

The image is a function defined on a spatial domain, it has a limited scale of numeric values (natural numbers – □, real numbers – ℝ, or complex numbers – □), values which can be used to form a matrix (Fig. 1). images to be abstract (mathematical functions with two variables, continuous or discrete) , non-visible (unperceived by naked eye, which imply a sum of bidimensional fields of parameters such as temperature, pressure, density, etc.) and visible (perceived by naked eye and generated as distributions of light intensity).

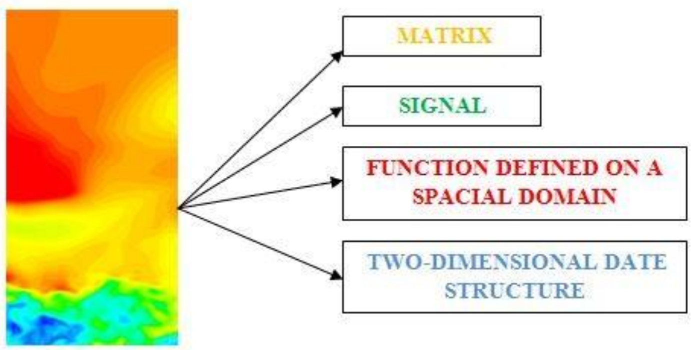
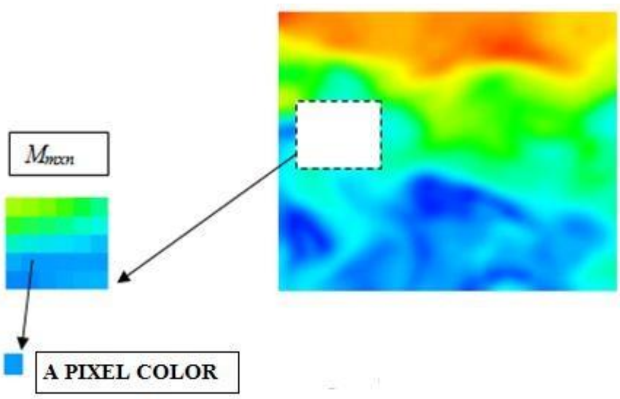


Fig. 1 – Image definition.

Depending on the type of data that is the matrix, the images are divided into images of intensity scale and indexed (each component being a unique number, a scalar) and vector images (each component being a vector, vector number which in turn splits into several parts). Scalar image intensity is an image where each pixel value (real or natural numbers) is considered a measure of luminous intensity. Scalar indexed image is an image in which the value of a pixel is an index where information can be associated with the colour of the pixel in question.
An image can be represented as a matrix $M_{m \times n}$, each element of the array containing



information of colour for a pixel (Fig. 2).

Fig. 2 – Scalar indexed image.

Each colour can be represented as a combination of three basic colours: red, green and blue (Fig. 3). The array is used as input to the neural networks that are aimed at identifying images or grading.

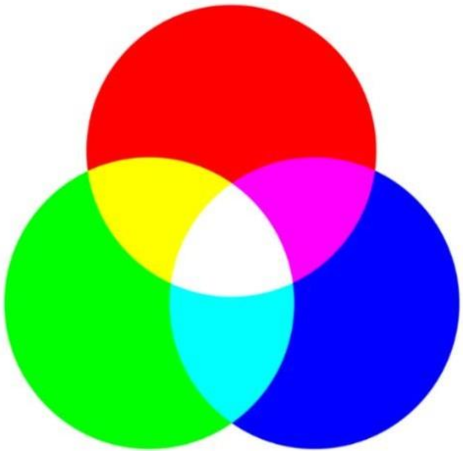


Fig. 3 – RGB system.

Each input neuron represents colour information in the image, and each output neuron corresponds to an image. All images will be scaled to the same size (width and height) and small to be easy and quick to learn. On the sizes of the images shall be determined on the size of the input vector and the number ofneurons. The transfer function for this type of problem is called sigmoid function. The rate of learning has values in the range [0.1] and the error it is recommended to have less than 0.1.

Processing of images with ANN involves different processes, such as:

Image preprocessing, an operation which shows a picture (contrast enhancement, noise reduction) with the same dimensions as the original image. The objective of images preprocessing with ANN consists in improving, restoring or rebuilding images. The resolved issues are the cartographic types, to optimize a function, an approximation function for the reconstruction of an image.

Data reduction or feature extraction involves extracting a number of features smaller than the number of pixels in the input window. The operation consists in compressing the image followed by extracting geometric characteristics (edges, corners, joints), facial features, etc.

Segmentation is a division of an image into regions.

Recognition involves the determination of objects in an image and their classification.

Image processing with ANN is used in various domains, such as:

industrial inspection (quality control) in order to detect the defectiveproducts in the production of steel, textiles, fruits, vegetables, plants and food;

medicine for detection of tumours and the establishment of a medicaldiagnosis;

defence system to identify targets for various navigation systems,orientation, recognition;

service of documents, namely automatic processing of forms, sortingemails, the possibility of learning a handwritten text, etc.;

identification and authentication for registration number recognition,fingerprint analysis in order to identify persons;

optimization problems;

geotechnical engineering, in order to classify the hazardous areaswith possible landslides, to determine the characteristics of the soils;

civil engineering, for the study of the rubberized concrete`shomogeneity, to identify the fissures/cracks in different structures.

The Current Status of Artificial Neural Networks Used for ImageProcessing

Issues Resolved with ANN in Civil Engineering

At the moment, the Civil Engineering is the most poorly developed in terms of image processing with ANN. A branch of Civil Engineering which has used artificial intelligence to solve the problems of cracks' identification is the composite structures.
Composites are increasingly being used in aerospace, naval and cars due to increased strength and rigidity in relation to its weight. Composite materials could be damaged in the presence of fissures. Seed (2014) proposed the use of neural networks to classify the images obtained by scanning. These pictures include characteristics of ultrasounds.
In 2015, Pandelea A. et al. studied homogeneity of concrete samples with added rubber using ANN by analysing the sample surface images.

Issues Solved Using ANN in Geotechnical Engineering

Regarding to the determination of soil moisture in a manner as practical, rapid, non-destructive, given the relatively low costs there have been several studies that have been evaluated the effectiveness of ANN (Arsoy *et al*., 2013; Namdar-Khojasteh *et al*., 2010; Elshorbagy & Parasuraman, 2008; Persson *et al*., 2001, 2002; Persson, 2005).
Relying on the fact that the soil changes its colour depending on the amount of water, ANN were used to estimate the soils moisture using colour
Landslides is due to the interaction of several factors such as earthquakes, rainfall, snow melt, weather, human activities (construction of roads and buildings) etc. Starting from the idea of satellite images classification (Civco, 1993, Atkinson and Tatnall, 1997, Bandibas and Kohyama, 2001), the recognition of forms and texture of the soil (Khotanzad and Lu, 1991), Melchiorre have used artificial neural networks for classification of areas prone to landslides.
In order to reduce the number of casualties, Chauhan et al. (2010), Kawabata and Bandibas (2015) have created a network that generate maps concerning the susceptibility of lands from landslides. To get this map, there arenecessary two stages: the first stage consists of gathering images ASTER and GIS and the second phase intend to train the network with these images. Choose to study an area where there have been landslides in the aftermath of an earthquake. Data entry of the network are images relating to landslides, the slope of the terrain, elevation, aspect, distance from the nearest geological boundary and density of geologic boundaries. The obtained images from satellite are slope, elevation, aspect and the rest are images of GIS. The output consists of a network map that shows whether they have or not landslides.

Issues resolved with ANN in transportation

Mackeown et al. (1994) proposed a method for the recognition of rural roads and urban colour images through the involvement of a network which to classify objects in the image. The performance of the network lies in the recognition of 70% of the region and to 90% of the image area.
Ahmadi (2008) processed satellite images with high resolution for the purpose of road extraction and vectorization.
The problem of detecting a vehicle from an area in real time has been resolved by the Gader (1995). The network was trained initially with images in infrared with tanks in their purpose of detecting in real time. Another set of datawhich has been coached

network includes images of cars from a parking lot. Forthese set of images, the network can detect a specific type of vehicle.

Issues Resolved with ANN in the Field of Mechanics

Based on an intelligent system that uses infrared thermal imaging, diagnosis can be established for cooling radiators (Taheri-Garavand, 2015). Theradiator also met under the name of heat exchanger is a very important element in the cooling system of vehicles. The procedures underlying this system are: the acquisition of thermal images, the images preprocessing and processing, the

wavelet for decomposition of thermal images, extracting features of an original image to a thermal one, selection features using genetic algorithms and their classification using ANN. It was used a network having 16 inputs (images) and6 output (defects of cooling radiators). After analysing the image, the ANN produces a diagnostic for the radiator.

onclusion of artificial network

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Even if you’re not working in the data science or software engineering space, it’s tough to avoid getting in front of the term artificial neural networks.

Artificial neural networks (ANN) are ubiquitous. They are used in chatbots, medical imaging, media planning, and a ton of other areas. But have we asked with a sense of deep curiosity: what is an artificial neural network, and what can it really achieve?

We have all come across the common definition that artificial neural networks replicate the functioning of the human neural system. That explains the working principle, but most of us still don’t know what makes an ANN so special or what problem sets it’s ideal for. To clear the air, here’s the most comprehensive and yet accessible guide you will find on artificial neural networks.

hen a dozen terms like **artificial intelligence**, machine learning, deep learning, and neural networks, it’s easy to get confused. The actual bifurcation between these verticals is not that complicated.

AI is the universal set which is the subject-matter at hand. It is the systematic study of how intelligent programs operate and are made. Machine learning is a subset of AI that focuses on how machines can learn by themselves. Deep learning is a further subset of ML that focuses on how layers of neural networks can be used to generate outputs. You can use **this** visualization to navigate the hierarchy:

So what is an artificial neural network? The answer is exactly how the popular media touts it. It’s a system of data processing and output generation that replicates the neural system to unravel non-linear relations in a large dataset. The data might come from sensory routes and might be in the form of text, pictures, or audio.

The best way to understand how an artificial neural network works is by understanding how a natural neural network inside the brain works and drawing a parallel between them. Neurons are the fundamental component of the human brain and are responsible for learning and retention of knowledge and information as we know it. You can consider them the processing unit in the brain. They take the sensory data as input, process it, and give the output data used by other neurons. The information is processed and passed until a decisive outcome is attained.

The basic neural network in the brain is connected by synapses. You can visualize them as the end-nodes of a bridge that connects two neurons. So, the synapse is the meeting-point for two neurons. Synapses are an important part of this system because the strength of a synapse would determine the depth of understanding and the retention of information.

When you are practicing an activity, you are strengthening these synaptic relations. **This** is how you can visualize the neural network in your brain: All the sensory data that your brain is collecting in real-time is processed through these neural networks. They have a point of origination in the system.

And as they are processed by the initial neurons, the processed form of an electric signal coming out of one neuron becomes the input for another neuron. This micro-information processing at each layer of neurons is what makes this network effective an efficient. By replicating this recurring theme of processing data across the neural network, ANNs are able to produce superior outputs.

In an ANN, everything is designed to replicate this very process. Don't worry about the mathematical equation. That's not the key idea to be understood right now. All the data entering with the label 'X' in the system is having a weight of 'W' to generate a weighted signal. This replicates the role of a synaptic signal's strength in the brain. The bias variable is attached to control the results of the output from the function.

So, all of this data is processed in the function and you end up with an output. That's how a one-layer neural network or a perceptron would look like. The idea of an artificial neural network revolves around connecting several combinations of such artificial neurons to get more potent outputs. That is why the typical artificial neural network's conceptual framework looks a lot like **this**:

We'll soon define the hidden layer, as we deep dive into how an artificial neural network functions. But as far as a rudimentary understanding of an artificial neural network is concerned, you know the first principles now.

This mechanism is used to decipher large datasets. The output generally tends to be an establishment of causality between the variables entered as input that can be used for forecasting. Now that you know the process, you can fully appreciate the technical definition **here**:

"A network modeled after the human brain by creating an artificial neural system via a pattern-recognizing computer algorithm that learns from, interprets, and classifies sensory data."

How do artificial neural networks work and learn?

Brace yourself, things are about to get interesting here. And don't worry – you don't have to do a ton of math right now.

The magic happens first at the **activation function**. The activation function does initial processing to determine whether the neuron will be activated or not. If the neuron is not activated, its output will be the same as its input. Nothing happens then. This is critical to have in the neural network, otherwise, the system will be forced to process a ton of information that has no impact on the output. You see, the brain has limited capacity but it has been optimized to use it to the best.

One central property common across all of the artificial neural networks is the concept of non-linearity. Most variables which are studied, possess a non-linear relationship in real life.

Take for instance the price of chocolate and the number of chocolates. Assume that one chocolate costs $1. How much would 100 chocolates cost? Probably $100. How much would 10,000 chocolates cost? Not $10,000; because either the seller will add the cost of using extra packaging to put all the chocolates together or she will reduce the cost since you are moving so much of her inventory off her hands in one go. That is the concept of non-linearity.

An activation function will use basic mathematical principles to determine whether the information is to be processed or not. The most common forms of activation functions are Binary Step Function, Logistic Function, Hyperbolic Tangent Function, and Rectified Linear Units. Here’s the basic definition of each one of these:

- **Binary step function:** This function activates a neuron on the basis of a threshold. If the function has the end-result which is above or beneath a benchmarked value, the neuron is activated.
- **Logistic function:** This function has a mathematical end-result in the shape of an ‘S’ curve and is used when probabilities are the key criteria to determine whether the neuron should be activated. So, at any point, you can **calculate the slope** of this curve. The value of this function lies between 0 and 1.

  Slope is calculated using a differential function. The concept is used when two variables don’t have a linear relationship. The slope is the value of a tangent that touches the curve at the exact point where the nonlinearity kicks in. The problem with the logistic function is that it is not good for processing information with negative values.
- **Hyperbolic tangent function:** It’s quite similar to the logistic function, except its values fall between -1 and +1. So, the problem of a negative value not being processed in the network goes away.
- **Rectified linear units (ReLu):** This function’s values lie between 0 and positive infinity. ReLu simplifies a few things – if the input is positive, it will give the value of ‘x’. For all other inputs, the value would be ‘0’. You can use a Leaky ReLu that has values between negative infinity and positive infinity. It’s used when the relationship between the variables being processed is really weak and might get omitted by the activation function altogether.

Now you can refer to the same two diagrams of a perceptron and a neural network. What is the difference, apart from the number of neurons? The key difference is the hidden layer. A hidden layer sits right between the input layer and the output layer in a neural network. The hidden layer's job is to refine the processing and eliminate variables which will not have a strong impact on the output.

If the number of instances in a dataset where the impact of the change in the value of an input variable is noticeable on the output variable, the hidden layer will show that relationship. The hidden layer makes it easy for the ANN to give out stronger signals to the next layer of processing.

Even after doing all this math and understanding how the hidden layer operates, you might be wondering how does an artificial neural network actually learn? Let's start with the basic question of what is learning. Learning, in the simplest terms, is establishing causality between two things (activities, processes, variables, etc.). When you 'learn' how to throw a curveball, you are establishing causality between the physical action of throwing the ball a certain way and getting the ball's trajectory to get curved a certain way.

Now, this causality is very difficult to establish. Remember the saying correlation does not equal causation? It's fairly easy to determine when two variables are moving in the same direction. It is very difficult to say with absolute certainty which variable is causing the movement in which variable. Obviously, we are often able to establish this intuitively; but how do you make an algorithm understand intuition?

You use a cost function. Mathematically, it is the squared difference between the actual value of the dataset and the output value of the dataset. You can also consider the degree of error. We square it because sometimes the difference can be negative.

You can brand each cycle of input to output processing with the cost function. Your and the ANN's job is to minimize the cost function to its lowest possible value. You achieve it by adjusting the weights in the ANN. (Remember the synaptic relations, aka the weights? That's what we are talking about). There are several ways of doing this, but as far as you understand the principle, you would just be using different tools to execute it.

With each cycle, we aim to minimize the cost function. The process of going from input to output is called forward propagation. And the process of using output data to minimize the cost function by adjusting weight in reverse order from the last hidden layer to the input layer is called backward propagation.

You can keep adjusting these weights using either the Brute Force method, which renders inefficient when the dataset is too big, or Batch-Gradient Descent, which is an optimization algorithm. Now you have an intuitive understanding of how an artificial neural network learns.

Recurrent neural networks (RNN) vs. convolutional neural networks (CNN)

Understanding these two forms of neural networks can also be your introduction to two different facets of AI application – computer vision and natural language processing. In the simplest form, these two branches of AI help a machine visually identify objects and understand the context of linguistic data. As you can imagine, there are already used applications of these branches in self-driving cars and virtual assistants like Siri.

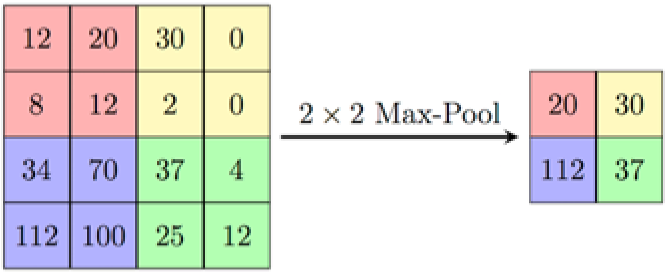
Now, each of these branches has its own established neural network. NLP is highly dependent on recurrent neural networks. The difference between an RNN and an ANN is that in an ANN, each input signal is considered to be independent of the next input signal. So, the input data that exists between two nodes, in and of itself does not have any relationship.

In reality, that is not the case. When we are communicating, each word clears the contextual way for the next word. Hence, the fundamental nature of language is that it creates interdependencies between information that is inputted earlier and the information that is inputted later. RNNs are sensitive to this by running a parallel memory that establishes the relationship between these inputs to clear the context.

Convolutional neural networks are ideally used for computer vision. Apart from the generally used activation functions, they add a pooling function and a convolution function. A convolution function, in the simpler terms, would show how the input of one image and an input of a second image (a filter) will result in a third image (the result). You can imagine this by visualizing it as a filtered image (a new set of pixel values) sitting on top of your input image (original set of pixel values) to get a resulting image (changed pixel values).

A pooling function will take the maximum or minimum value, depending on the added function, to make processing on this set of information easy. Here is how you can visualize them:

Convolutional function



Pooling function

5 applications of artificial neural networks

What we've talked about so far was all going on underneath the hood. Now we can zoom out and see these ANNs in action to fully appreciate their bond with our evolving world:

1. Personalize recommendations on e-commerce platforms

One of the earliest applications of ANNs has been on personalizing eCommerce platform experiences for each user. Do you remember the really effective recommendations on Netflix? Or the just-right product suggestions Amazon? They are a result of the ANN.

There is a ton of data being used here: your past purchases, demographic data, geographic data, and the data that shows what did people buying the same product buy next. All of these serve as the inputs to determine what might work for you. At the same time, what you really buy helps the algorithm get optimized. With every purchase, you are enriching the company and the algorithm that empowers the ANN. At the same time, every new purchase made on the platform will also improve the algorithm's prowess in recommending the right products to you.

2. Harnessing natural language processing for conversational chatbots

Not long ago, chatboxes had started picking up steam on websites. An agent would sit on one side and help you out with your queries typed in the box. Then, a phenomenon called natural language processing (NLP) was introduced to **chatbots** and everything changed.

NLP generally uses statistical rules to replicate human language capacities, and like other ANN applications, gets better with time. Your punctuations, intonations and enunciations, grammatical choices, syntactical choices, word and sentence order, and even the language of choice can serve as inputs to train the NLP algorithm.

The chatbot becomes conversational by using these inputs to both understand the context of your queries and to formulate answers in a way that would best suit your style. The same NLP is also being used for audio editing in music and security verification purposes.

3. Predicting outcomes of a high-profile event

Most of us follow the outcome predictions being made by AI-powered algorithms during the presidential elections as well as the FIFA World Cup. Since both the events are phased, it helps the algorithm quickly understand its efficacy and minimize the cost function as teams and candidates get eliminated. The real challenge in such situations is the degree of input variables. From candidates to player stats to demographics to anatomical capabilities – everything has to be incorporated.

In stock markets, predictive algorithms that use ANNs have been around for a while now. News updates and financial metrics are the key input variables used. Thanks to this, most exchanges and banks are easily able to trade assets under high-frequency trading initiatives at speeds that far exceed human capabilities.

The problem with stock markets is that the data is always noisy. Randomness is very high because of the degree of subjective judgment which can impact the price of a security is very high. Nevertheless, ANNs are being used in market-making activities by every leading bank these days.

4. Credit sanctions

Actuarial tables were already being used to determine the risk factors associated with each insurance applicant. ANNs have taken all that data a notch higher.

All the lenders can run through the decades of data they possess with the strongly established weights in the system and use your information as input to determine the appropriate risk profile associated with your loan application. Your age, gender, city of residence, school of graduation, an industry of engagement, salary, and savings ratio, are all used as inputs to determine your credit risk scores.

What was earlier heavily dependent on your individual credit score has now become a much more comprehensive mechanism. That is the reason why several private fintech players have jumped into the personal loans space to run the same ANNs and lend to people whose profiles are considered too risky by banks.

5. Self-driving cars

Tesla, Waymo, and Uber have been using similar ANNs. The inputs and product engineering might have differed, but they were deploying sophisticated visual computing to make self-driving cars a reality.

Much of self-driving has to do with processing information that comes from the real-world in the form of nearby vehicles, road signs, natural and artificial lights, pedestrians, buildings, and so on. Obviously, the neural networks powering these self-driving cars are more complicated than the ones we discussed here, but they do operate on the same principles that we expounded.

Conclusion

ANNs are getting more and more sophisticated day by day. NLPs are now helping in early mental health issue diagnosis, computer vision is being used in medical imaging, and ANNs are powering drone delivery. As ANNs become more complex and layered, the need for human intelligence in this system would become less. Even areas like design have started deploying AI solutions with generative design.

The eventual evolution of all the ANNs put together would be General Intelligence – a form of intelligence so sophisticated that it can learn and perceive all the information known and unknown to humanity. While it is a very distant reality, if even possible, it has become a conceivable concept thanks to ANN's wide adoption.