Artificial Intelligence ChatBot on Telegram

It is time to talk!

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***Abstract*—Artificial Intelligence is a field, which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence. These disciplines are comprised of AI algorithms which seek to create expert systems which make predictions or classifications based on input data.**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

Today, a lot of hype still surrounds AI development, which is expected of any new emerging technology in the market. As noted in Gartner's hype cycle (link resides outside IBM), product innovations like, self-driving cars and personal assistants, follow "a typical progression of innovation, from overenthusiasm through a period of disillusionment to an eventual understanding of the innovation's relevance and role in a market or domain." As Lex Fridman notes here (00:15) (link resides outside IBM) in his MIT lecture in 2019, we are at the peak of inflated expectations, approaching the trough of disillusionment.

Strong AI is made up of Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI). Artificial general intelligence (AGI), or general AI, is a theoretical form of AI where a machine would have an intelligence equaled to humans; it would have a self-aware consciousness that has the ability to solve problems, learn, and plan for the future. Artificial Super Intelligence (ASI)—also known as superintelligence—would surpass the intelligence and ability of the human brain [1]. While strong AI is still entirely theoretical with no practical examples in use today, that doesn't mean AI researchers aren't also exploring its development. In the meantime, the best examples of ASI might be from science fiction, such as HAL, the superhuman, rogue computer assistant in 2001: A Space Odyssey.

Since deep learning and machine learning tend to be used interchangeably, it's worth noting the nuances between the two. As mentioned above, both deep learning and machine learning are sub-fields of artificial intelligence [2], and deep learning is actually a sub-field of machine learning.

II. Chatbot with Python

A. Maintaining the Integrity of the Specifications

Deep learning is actually comprised of neural networks. "Deep" in deep learning refers to a neural network comprised of more than three layers—which would be inclusive of the inputs and the output—can be considered a deep learning algorithm.

The way in which deep learning and machine learning differ is in how each algorithm learns. Deep learning automates much of the feature extraction piece of the process, eliminating some of the manual human intervention required and enabling the use of larger data sets. You can think of deep learning as "scalable machine learning" as Lex Fridman noted in same MIT lecture from above. Classical, or "non-deep", machine learning is more dependent on human intervention to learn. Human experts determine the hierarchy of features to understand the differences between data inputs, usually requiring more structured data to learn.

III. Natural Language Processing

Natural language processing helps computers communicate with humans in their own language and scales other language-related tasks. For example, NLP makes it possible for computers to read text, hear speech, interpret it, measure sentiment and determine which parts are important [3].

Today's machines can analyze more language-based data than humans, without fatigue and in a consistent, unbiased way. Considering the staggering amount of unstructured data that's generated every day [2], from medical records to social media, automation will be critical to fully analyze text and speech data efficiently.

"Deep" machine learning can leverage labeled datasets, also known as supervised learning, to inform its algorithm, but it doesn't necessarily require a labeled dataset. It can ingest unstructured data in its raw form (e.g. text, images), and it can automatically determine the hierarchy of features which distinguish different categories of data from one another [4]. Unlike machine learning, it doesn't require human intervention to process data, allowing us to scale machine learning in more interesting ways.

A. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

B. Units

- Speech recognition: It is also known as automatic speech recognition (ASR), computer speech recognition, or speech-to-text, and it is a capability which uses natural language processing (NLP) to process human speech into a written format. Many mobile devices incorporate speech recognition into their systems to conduct voice search—e.g. Siri—or provide more accessibility around texting.
- Customer service: Online virtual agents are replacing human agents along the customer journey. They answer frequently asked questions (FAQs) around topics, like shipping, or provide personalized advice, cross-selling products or suggesting sizes for users, changing the way we think about customer engagement across websites and social media platforms. Examples include messaging bots on e-commerce sites with virtual agents, messaging apps, such as Slack and Facebook Messenger, and tasks usually done by virtual assistants and voice assistants.
- Computer vision: This AI technology enables computers and systems to derive meaningful information from digital images, videos and other visual inputs, and based on those inputs, it can take action. This ability to provide recommendations distinguishes it from image recognition tasks. Powered by convolutional neural networks, computer vision has applications within photo tagging in social media, radiology imaging in healthcare, and self-driving cars within the automotive industry.
- Recommendation engines: Using past consumption behavior data, AI algorithms can help to discover data trends that can be used to develop more effective cross-selling strategies. This is used to make relevant add-on recommendations to customers during the checkout process for online retailers.
- Automated stock trading: Designed to optimize stock portfolios, AI-driven high-frequency trading platforms make thousands or even millions of trades per day without human intervention.

C. Equations

Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, [5] but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

D. LaTeX-Specific Advice

Please use "soft" (e.g., `\eqref{Eq}`) cross references instead of "hard" references (e.g., `(1)`). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don't use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

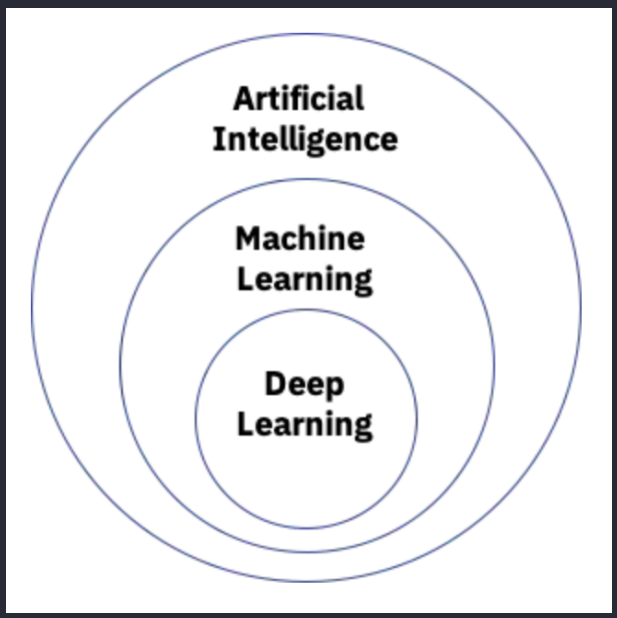

Fig. 1. Chart - AI ML DL

Please note that the `{subequations}` environment in LaTeX will increment the main equation counter even when there are no equation numbers displayed. If you forget that, you might write an article in which the equation numbers skip from (17) to (20), causing the copy editors to wonder if you've discovered a new method of counting.

In the following we will obtain the closed form expression for $H(l)$ where $1 \leq l \leq v-1$. Let us define the constants

$$\begin{aligned}
\alpha_1 &= \frac{n\lambda}{(n-1)\lambda + \beta + \delta}, \qquad (2)\\
\alpha_2 &= \frac{(n-1)\lambda}{(n-1)\lambda + \beta + \delta},\\
\alpha_3 &= \frac{(n-1)\lambda}{\delta},\\
\alpha_4 &= \frac{n\lambda}{\delta},\\
\alpha_5 &= \frac{\beta}{n\lambda + \delta},\\
\alpha_6 &= \frac{\beta}{\delta}.
\end{aligned}$$

The idea of 'a machine that thinks' dates back to ancient Greece. But since the advent of electronic computing (and rel-

ative to some of the topics discussed in this article) important events and milestones in the evolution of artificial intelligence include the following:

IV. PETBot UFPR

A. Some Common Mistakes

- 1950: Alan Turing publishes Computing Machinery and Intelligence. In the paper, Turing—famous for breaking the Nazi's ENIGMA code during WWII—proposes to answer the question 'can machines think?' and introduces the Turing Test to determine if a computer can demonstrate the same intelligence (or the results of the same intelligence) as a human. The value of the Turing test has been debated ever since.
- 1956: John McCarthy coins the term 'artificial intelligence' at the first-ever AI conference at Dartmouth College. (McCarthy would go on to invent the Lisp language.) Later that year, Allen Newell, J.C. Shaw, and Herbert Simon create the Logic Theorist, the first-ever running AI software program.
- 1967: Frank Rosenblatt builds the Mark 1 Perceptron, the first computer based on a neural network that 'learned' though trial and error. Just a year later, Marvin Minsky and Seymour Papert publish a book titled Perceptrons, which becomes both the landmark work on neural networks and, at least for a while, an argument against future neural network research projects.
- 1980s: Neural networks which use a backpropagation algorithm to train itself become widely used in AI applications.
- 1997: IBM's Deep Blue beats then world chess champion Garry Kasparov, in a chess match (and rematch).
- 2011: IBM Watson beats champions Ken Jennings and Brad Rutter at Jeopardy!
- 2015: Baidu's Minwa supercomputer uses a special kind of deep neural network called a convolutional neural network to identify and categorize images with a higher rate of accuracy than the average human.
- 2016: DeepMind's AlphaGo program, powered by a deep neural network, beats Lee Sodol, the world champion Go player, in a five-game match. The victory is significant given the huge number of possible moves as the game progresses (over 14.5 trillion after just four moves!). Later, Google purchased DeepMind for a reported $400 million.

An excellent style manual for science writers is [7].

B. Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads. [6] Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is "Heading 5". Use "figure caption" for your Figure captions, and "table head" for your table title. Run-in heads, such as "Abstract", will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text [7].

$$
\begin{aligned}
&P(O(1))((n-1)\lambda+\beta+\delta) = n\lambda P(0), \qquad (3)\\
&P(O(l))((n-1)\lambda+\beta+\delta) = (n-1)\lambda P(O(l-1))\\
&\qquad + n\lambda P(R(l-1)), \quad 2 \le l \le v-1,\\
&P(O(v))\delta = (n-1)\lambda P(O(v-1)) + n\lambda P(R(v-1)),\\
&P(A(O,l))r = \delta P(O(l)), \quad 1 \le l \le v,\\
&P(R(1))(n\lambda+\delta) = \beta P(0),\\
&P(R(l))(n\lambda+\delta) = \beta P(O(l-1)), \quad 2 \le l \le v-1,\\
&P(R(v))\delta = \beta P(O(v-1)),\\
&P(A(R,l))r = \delta P(R(l)), \quad 1 \le l \le v,\\
&P(0)(n\lambda+\beta) = r \sum_{U=O,R} \sum_{l=1}^{v} P(A(U,l)),\\
&1 = P(0) + \sum_{U=O,R} \sum_{l=1}^{v} \big[P(U(l)) + P(A(U,l))\big].
\end{aligned}
$$

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. [5]

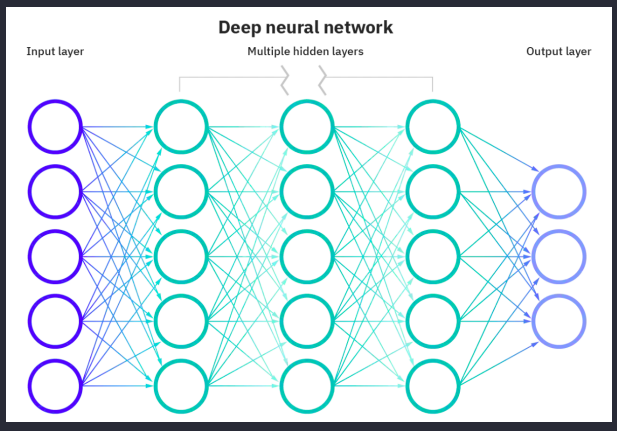

Fig. 2. Deep Neural Network

C. Figures and Tables

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

Fig. 3. Find PET Bot

The traditional finance system is of course littered with victims of large-scale pyramid schemes and other fraud which probably outweigh the losses in the cryptocurrency world.

But despite rapid growth, the crypto market is far smaller overall and recent history points to an industry-wide security problem. The programming language which Python is said to have succeeded is ABC Programming Language, which had the interfacing with the Amoeba Operating System and had the feature of exception handling. [7]

As the $600m hacker warned in a recent public post: ”We, the hackers, are the armed forces. If you are given weapons and guarding billions from the crowd while being anonymous, will you be a terrorist or the Batman?

TABLE I
TABLE TYPE STYLES

Table Head	Table Column Head		
	Table column subhead	*Subhead*	*Subhead*
copy	More table copy[a]		

[a]Sample of a Table footnote.

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. [2] In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

$$\begin{aligned} P(O(l)) &= H(l)P(0), \\ P(R(l)) &= G(l)P(0), \\ P(A(O,l)) &= \frac{\delta}{r}H(l)P(0), \\ P(A(R,l)) &= \frac{\delta}{r}G(l)P(0), \end{aligned} \tag{4}$$

where

$$H(l) = \begin{cases} \dfrac{n\lambda}{(n-1)\lambda+\beta+\delta} & ,l=1 \\ \dfrac{(n-1)\lambda}{(n-1)\lambda+\beta+\delta}H(l-1) & \\ \quad + \dfrac{n\lambda}{(n-1)\lambda+\beta+\delta}G(l-1) & ,2 \le l \le v-1 \\ \dfrac{(n-1)\lambda}{\delta}H(l-1) + \dfrac{n\lambda}{\delta}G(l-1) & ,l=v \end{cases}$$

$$G(l) = \begin{cases} \dfrac{\beta}{n\lambda+\delta} & ,l=1 \\ \dfrac{\beta}{n\lambda+\delta}H(l-1) & ,2 \le l \le v-1 \\ \dfrac{\beta}{\delta}H(l-1) & ,l=v \end{cases}$$

Part of the problem is that these systems are built on open source technology. Open source is great because it uses the collective intelligence of a community to improve software and protocols, but one of the flip sides of open source is that some brilliant mind out there might find some weakness in the code. [1]

As well as cyber-attacks, everyday investors have been stung over the years by other types of crypto-catastrophe like so-called exit scams and rug pulls. [3] Investigators are still trying to ascertain how many millions, or maybe even hundreds of millions, were lost in the mysterious demise of the Africrypt exchange which collapsed earlier this year when the founders disappeared.

The transformation can be represented by aligning two alphabets; the cipher alphabet is the plain alphabet rotated left or right by some number of positions. [4] For instance, here is a Caesar cipher using a left rotation of three places, equivalent to a right shift of 23 (the shift parameter is used as the key)

$$R_{1,2} = \frac{1}{2}\left[\ \alpha_2 \pm \sqrt{\alpha_2^2 + 4\alpha_1\alpha_5}\ \right].$$

$$\begin{aligned} H(l) = \frac{1}{2(R_1-R_2)}\Big[&(-\alpha_2+2\alpha_1+R_1-R_2)R_1^l \\ &+ (\alpha_2-2\alpha_1+R_1-R_2)R_2^l\Big], \\ &1 \le l \le v-1, \end{aligned} \tag{5}$$

and at the boundary $l = v$, the solution involves a different set of coefficients:

A Caesar cipher with a shift of one is used on the back of the mezuzah to encrypt the names of God. This may be a holdover from an earlier time when Jewish people were

not allowed to have mezuzot. The letters of the cryptogram themselves comprise a religiously significant "divine name" which Orthodox belief holds keeps the forces of evil in check.

$$H(v) = \alpha_3 H(v-1) + \alpha_4\alpha_5 H(v-2). \tag{6}$$

Since $G(l)$ is defined as a function of $H(l-1)$, we also have

$$\begin{aligned} G(1) &= \alpha_5, \\ G(l) &= \frac{\alpha_5}{2(R_1-R_2)}\Big[(-\alpha_2+2\alpha_1+R_1-R_2)R_1^{l-1} \\ &\quad + (\alpha_2-2\alpha_1+R_1-R_2)R_2^{l-1}\Big],\ 2 \le l \le v-1, \\ G(v) &= \alpha_6 H(v-1). \end{aligned} \tag{7}$$

The Vigenère cipher is a method of encrypting alphabetic text by using a series of interwoven Caesar ciphers, based on the letters of a keyword. It employs a form of polyalphabetic substitution.

An interesting question arises if the SB adjusts its bidding rate β in a manner proportional to the bidding rate of all other bidders. From the state equations (3) we can set a value μ representing the relative rate at which both SBs and other bidders are bidding, with respect to the other bidding and decision rates. Thus the quantity μ illustrates the [7] "similar" behaviour of SBs and of the other bidders, and we have

$$\mu \equiv \frac{\beta}{n\lambda+\delta} = \frac{(n-1)\lambda}{(n-1)\lambda+\beta+\delta}\,.$$

Then, the outcome of the auction for the SB will be equivalent to that for the other bidders taken together. In fact if n is large enough, this simplifies to

$$0 = \beta^2 + \beta[n\lambda+\delta] - n\lambda[n\lambda+\delta], \tag{8}$$

IBM Watson gives enterprises the AI tools they need to transform their business systems and workflows, while significantly improving automation and efficiency. [7] For more information on how IBM can help you complete your AI journey, explore the IBM portfolio of managed services and solutions

Human language is astoundingly complex and diverse. We express ourselves in infinite ways, both verbally and in writing. Not only are there hundreds of languages and dialects, but within each language is a unique set of grammar and syntax rules, terms and slang. When we write, [8] we often misspell or abbreviate words, or omit punctuation. When we speak, we have regional accents, and we mumble, stutter and borrow terms from other languages.

$$\beta \approx \frac{n\lambda+\delta}{2}\left[\sqrt{1+4\frac{n\lambda}{n\lambda+\delta}}-1\right], \tag{9}$$

or

$$\mu \approx \frac{1}{2}\left[\sqrt{1+4\frac{n\lambda}{n\lambda+\delta}}-1\right]. \tag{10}$$

IBM has been a leader in advancing AI-driven technologies for enterprises and has pioneered the future of machine learning systems for multiple industries. Based on decades of AI research, years of experience working with organizations of all sizes, and on learnings from over 30,000 IBM Watson engagements [6], IBM has developed the AI Ladder for successful artificial intelligence deployments:

V. Chatbots

ELIZA was the very first chatbot as mentioned above. It was created by Joseph Weizenbaum in 1966 and it uses pattern matching and substitution methodology to simulate conversation.

The program was designed in a way that it mimics human conversation. The Chatbot ELIZA worked by passing the words that users entered into a computer and then pairing them to a list of possible scripted responses. [4] It uses a script that simulated a psychotherapist. The script proved to be a significant impact on natural language processing and unnatural intelligence, with copies and variants protruding up at academies around the country.

However, Weizenbaum was troubled by the reaction of users. He intended ELIZA to be a mere caricature of human conversation, yet suddenly users were confiding their most profound thoughts in ELIZA. Experts were declaring that chatbots would be indistinguishable from humans within a small number of years.

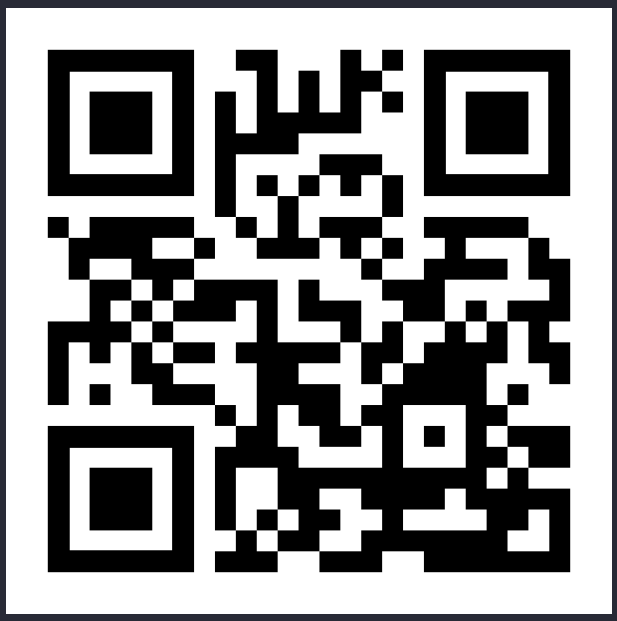

Fig. 4. Find PET Bot

Weizenbaum rejected the notion that machines could replace human intellect. He argued instead that such devices were just tools, and extensions of the human mind. [5] He further stressed that computers' understanding of language was entirely dependent on the context in which they were used. Furthermore, Weizenbaum argued that a more general computer understanding of human language was not possible.

In the decades that followed, chatbot makers have built upon Weizenbaum's model to strive for more human-like interactions. Passing the Turing test has grown to a common

goal, which tests new bots' conversational talents against a board of human judges. The hardest thing in the Turing test issue is that there's no limit on what people can discuss. [6]

VI. A.I. and Deep Learning

PARRY was constructed by American psychiatrist Kenneth Colby in 1972. The program imitated a patient with schizophrenia. It attempts to simulate the disease. It is a natural language program that resembles the thinking of an individual.

PARRY works via a complicated system of assumptions, attributions, and "emotional responses" triggered by changing weights assigned to verbal inputs. [3] To validate the work, PARRY was tested using a variation of the Turing test. It was in the early seventies when human interrogators, interacting with the program via a remote keyboard, were weak with more than random accuracy to distinguish PARRY from an original paranoid individual.

Fifty years ago Kenneth Mark Colby was the only psychiatrist thinking about how computers could contribute to the understanding of mental illness. [2] He thus began the project Overcoming Depression that lasted until his death in 2001.

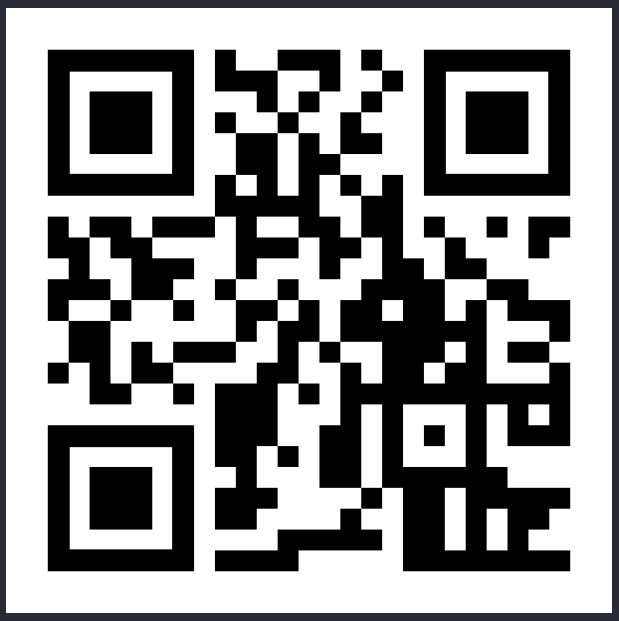

Fig. 5. Find PET Bot

He had already helped to create ABC earlier in his career and he had seen some issues with ABC but liked most of the features. The chatbot was created by developer Rollo Carpenter in 1988. It aimed to simulate a natural human conversation in an entertaining way. [4]

Jabberwacky has led to other technological growth. Some individuals use it for academic research purposes through its webpage since its origin. The chatbot is considered to use an AI technique called "contextual pattern matching."

VII. Natural Language Libraries

A.L.I.C.E. is a universal language processing chatbot that uses heuristic pattern matching to carry conversations. In 1995, Richard Wallace pioneered the construction of ALICE. It was formerly known as Alicebot because it was first to run on a computer by the name of Alice.

The program works with the XML schema known as artificial intelligence markup language (AIML), which helps specify conversation rules. In 1998, the program was edited in Java, and in 2001 Wallace printed an AIML specification. From there, other developers drafted free and open sources of ALICE in different programming languages and a variety of foreign languages. [4]

The program simulates chatting with a real person over the Internet. Alice is a young-looking woman in human years and tells a user her age, hobbies and other fascinating facts, as well as answering to the user's dialog.

Siri was formed by Apple for iOS in 2010; it is an intelligent personal assistant and learning navigator that uses a natural language UI. It paved the system for all AI bots and PAs after that.

A patent application by the United States Patent and Trademark Office details a new Apple service where users could make inquiries and conversation with Siri through Messages [5]. The new patent is similar to a published late last year, but now includes deeper integration with audio, video, and image files.

Similar to other texting and Facebook Messenger Apple's patent describes a Siri that could perform current duties without the user having to chat aloud. That could be helpful in several public spheres.

They could reply to a text, audio, images, and video when transferred to it by the user [6]. Apple said this would result in more fruitful interactive experience among a consumer and a digital assistant. The patent provides a few examples of a conversation held between Siri and a user in Messages, with the user asking questions.

VIII. Chat Assistants

Google Now was launched at Google Inch in 2012. It answers questions, performs actions through requests made to a set of web services and makes recommendations.

It was part of a package of updates and UI modifications for mobile search, which included a female-voiced portable assistant to compete with Apple's Siri.

Google Now was initially a way to get contextually appropriate information based on location and time of the day. It evolved to become much more complicated and elaborate [2], with a broad range of content categories delivered on cards.

Sometimes it refers to us as predictive search. Currently, it's built for use in smartphones and has been upgraded to accommodate several features.

Google Now was replaced by Google Assistant in 2017. Today, the assistant is part of a more aggressive Google search growth strategy. The idea is simple [7], Google wants to provide information in an easy-to-read format before you even know you need it.

Cortana was first demonstrated at Microsoft's Build 2014 developer conference, and it became directly integrated into both Windows phone devices and Windows 10 PCs.

This program uses voice recognition and relevant algorithms to get and respond to voice commands.

For someone to get started, he or she must type a question in the search box, or select the microphone and talk to Cortana. If a person is not very sure of what to say, he or she will see suggestions on the lock screen, [6] as well as in Cortana home by selecting the search box on the taskbar.

Cortana can perform tasks like reminders based on time, places, or people, send emails and texts, create and manage lists, chit-chat, and play games, find facts, files, locations, and info among others.

IX. Automation

Alexa is an intelligent personal assistant developed by Amazon. It was introduced in 2014 and is now built in to devices such as the Amazon Echo, the Echo Dot, the Echo Show and more. There is also an AI app and more devices from third-party manufacturers that have Alexa built in to them.

All you have to do is say "Alexa, play some music" or "Alexa, find me an Italian restaurant" and she will help you out. Using nothing but the sound of your voice, you can search the Web, play music, create to-do or shopping lists, set alarms, stream podcasts, play audiobooks, get news or weather reports, control your smart-home products and more.

To add to the capabilities of any Alexa-enabled device, Amazon allows developers to build and publish skills for Alexa using the Alexa Skills Kit (ASK). [1] You can download skills for free with the Alexa app.

Python is a widely used general-purpose, high-level programming language. It was initially designed by Guido van Rossum in 1991 and developed by Python Software Foundation. It was mainly developed for emphasis on code readability, and its syntax allows programmers to express concepts in fewer lines of code.

In the late 1980s, history was about to be written. It was that time when working on Python started. Soon after that, Guido Van Rossum began doing its application based work in December of 1989 by at Centrum Wiskunde & Informatica (CWI) which is situated in Netherland. [3] It was started firstly as a hobby project because he was looking for an interesting project to keep him occupied during Christmas.

Conclusions

While supervised and unsupervised learning, and specifically deep learning, are now widely used for modeling human language, there's also a need for syntactic and semantic understanding and domain expertise that are not necessarily present in these machine learning approaches.

Our PET BOT NLP is important because it helps resolve ambiguity in language and adds useful numeric structure to the data for many downstream applications, such as speech

Fig. 6. Find PET Bot

recognition or text analytics. [8] be taken and each message letter enciphered by using its corresponding key row [7].

Natural language processing includes many different techniques for interpreting human language, ranging from statistical and machine learning methods to rules-based and algorithmic approaches. We need a broad array of approaches because the text- and voice-based data varies widely, as do the practical applications.

Basic NLP tasks include tokenization and parsing, lemmatization/stemming, part-of-speech tagging, language detection and identification of semantic relationships [6]. If you ever diagramed sentences in grade school, you've done these tasks manually before.

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