A Deliberation on the Stages of Artificial Intelligence

Jiran Kurian
CHRIST (Deemed to be University), Bangalore, India

Rohini V
CHRIST (Deemed to be University), Bangalore, India
Corresponding author: Jiran Kurian, Email: jiran.kurian@res.christuniversity.in

Artificial Intelligence (AI) is a technology that can be programmed to mimic humans' natural intelligence, which helps the machines perform the tasks that a human being can do. After a long research period from 1955, the researchers have achieved remarkable achievements like machine learning and deep learning in this field. Other areas like education, agriculture, medical, etc., to name a few, also utilizing these technologies for its improvements. All the achievements made in this field are not even comparable to the actual depth of this technology, where the depth of AI is yet to measure; that is, a long way to go to develop a fully functional AI. To identify the extent of its depth, firstly, the path to the AI's core should be visibly defined, and secondly, the milestones are to be placed in between. There are some general stages and types of AI introduced by other researchers, but it cannot be used for further research due to the inconsistency in the information. So, to bring standardized information in the Stages of AI is as important as setting up a good base in this field. The paper proposes and defines new stages of AI that could help set the milestones. The work also places a general standard, brings more clarity, and eliminates the inconsistencies in the Stages of AI.

Keywords: Logistic Regression, K-Nearest Neighbors Term Frequency-Inverted Document Frequency (TF-IDF), DeepNeural Networks, Bidirectional Encoder Representations from Transformers (BERT)

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1 Introduction

The official birthdate of AI was in 1956, when John McCarthy coined and defined the term "Artificial Intelligence" at the conference in Dartmouth College. Alen Turing placed the foundation of AI by introducing the Turing Machine in 1936. AI is one of the pioneering technologies used in every other field; by 2011, it became a part of everyday life [1]. IBM defines AI as "In Computer Science, the term Artificial Intelligence refers to any human-like intelligence exhibited by a computer, robot, or other machines" [2]. In Britannica, the definition of AI is "The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings" [3]. And J. Frankenfield in Investopedia mentioned, "AI refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions" [4]. All the definitions throw light on a single point: artificially creating intelligence to solve the problems that require human intelligence.

This cutting-edge technology helps shape every other industry, and there will be a significant technological boost in every stage of AI. That is, this evolution will also lead to the rise of industrial standards in all fields. For example, years back, customer support was entirely handled by people. However, with the introduction of chatbots and other Natural Language Processing (NLP) applications, partially, this service is operated by dedicated Artificial Narrow Intelligence applications. Once the second stage (Stage of General Intelligence) is achieved, the customer support service can be entirely handled by AI itself without any human help.

By excluding the inconsistencies in the topic, there are some common types and stages that are generally used. Reactive Machine, Limited Memory, Theory of Mind, and Self-Aware are the traditional types of AI that are classified based on their functionalities. Apart from the types, there are three stages, Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Super Intelligence (ASI). These three stages are very broad and challenging to keep track of AI evolution.

As of now, the third version of Generative Pretrained Transformer (GPT-3) is considered to be the closest General AI. Tiernan Ray explains GTP-3 as a computer program developed in privately held San Francisco start-up Open AI. The program is higher than any earlier program at generating strains of textual content that sound like they may have been written with the aid of using a human. The cause is that any such leap forward will be beneficial to businesses; that is it has an excellent capability for automating tasks. GPT-3 can reply to any textual content that someone sorts into the laptop. That way, GPT-3 can conceivably increase human effort in an extensive type of situation from questions and solutions for customer support to due diligence record seek to document generation [5]. This technology is considered closer to

general AI because it could perform general tasks that deal with the language structure like essay writing, answering questions, summarizing long texts, translating languages, etc., to name a few [6].

Naming and defining the stages and types of AI are done in a different manner by different authors, making it even more challenging to keep track of it. It puts one in a dilemma as to which definitions to follow in defining these stages and types. So, it is necessary to have an accurate description of the stages of AI to help the researchers stick to a standard while doing their research. Thus, the paper focuses on defining the stages of AI and showing how AI will evolve in the future. The defined stages can be set as a standard that can be used in the future development of this field. These stages can also be used as milestones to track the evolution of AI. So, the work helps define a good base in the Stages of Artificial Intelligence and foreseeing the same path. The proposed stages give more clarity and general information to focus on accomplishing AI's complete evolution.

2 Literature Survey

Jagreet Kaur Gill elucidates machine learning, machine intelligence, and machine consciousness are the three stages of AI. Artificial narrow intelligence, artificial general intelligence, and artificial super intelligence as the three types of AI. The stages mentioned in this paper are entirely related to machine learning (ML) and the evolution of ML [7]. Marianne Chrisos defines AI stages differently; according to her, Internet AI, Business AI, Perception AI, and Autonomous AI are the four stages of AI [8].

According to Javatpoint, AI is categorized into two types based on its capabilities and functionalities. Weak AI or Narrow AI, Strong AI or General AI, and Super AI are the types that are categorized based on their capabilities. Reactive machines, Limited memory, Theory of Mind, and Self-awareness are the types that are categorized based on their functionalities [9]. But Brodie O'Carroll mentioned that ANI, AGI, and ASI are AI types [10].

An article published in Technology Magazine mentioned that there are seven stages in the future evolution of AI. Rule-based systems, Context Awareness and Retention, Domain-Specific Expertise, Reasoning Machines, Self-Aware Systems / Artificial General Intelligence, Artificial Super Intelligence, and Singularity & Transcendence are the seven stages mentioned in this article [11].

Clodéric Mars describes the stages of AI based on explainability. "Stage 1 is about leveraging explainability to improve the adoption and performance of AI applications. Stage 2 is about explaining every AI decision to build trust with their users and

supervisors. Stage 3 is about enabling the interoperability of AI systems with each other and other software, thus unlocking new and richer use cases." [12].

Naveen Joshi and Arend Hintze describe the two different classifications of AI types as seven types of AI. The first classification consists of Reactive Machines, Limited Memory, Theory of Mind, and Self-aware. The second classification is more generic: Artificial Narrow Intelligence, Artificial General Intelligence, and Artificial Super Intelligence [13] [14]. According to Zulaikha Lateef, ANI, AGI, and ASI are the AI stages; Reactive Machines AI, Limited Memory AI, Theory of Mind AI, and Self-aware AI are AI types [15]. Arend Hintze, Shubh Wadekar advocate a similar idea about AI stages [14] [16].

It is sometimes hard to differentiate the stages from types; most articles define stages as AI types and types as AI stages, the way defined in "7 Types Of AI" [20]. To bring more clarity to the stages and types, consider that the stages deal with the evolution of AI and the types that deal with AI's properties or abilities. For example, in humans, different age categories like children, teenagers, adults, and veterans will be the stages. The types can be defined as categorizing humans based on their personalities. Therefore, it is possible to say that there are different types of humans, and there are different stages through which humans will evolve. In AI, stages are related to its evolution, and types are related to its properties.

Based on the insight derived from the literature reviews, it is evident that the articles define stages and types differently. Inconsistency in the information makes it more difficult to choose which one to follow; keeping track of the AI's evolution process with conflicting information will be even more challenging.

3 Method

According to the proposed concept, AI's evolution will be happening in four stages; the Stage of Narrow Intelligence, the Stage of General Intelligence, the Stage of Human Intelligence, and the Stage of Supreme Intelligence, and the work focuses on standardizing these stages.

Stage 1: Stage of Narrow Intelligence (SNI)

The first stage of AI will be the Stage of Narrow intelligence. The systems at this stage are developed in a way that they can be used to accomplish only one job. If a system could achieve one complete job intelligently without a human's help, one can say that it is in the Stage of Narrow Intelligence. A few examples for such systems will be a fully functional self-driving car, fully functional chatbots, AlphaGo (AI, which is developed by Google's Deep Mind that defeated the world Go champion.), and Deep Blue (AI, which is developed by IBM which defeated the world chess champion). These systems

can only perform one job; that is, Deep Blue can be only used for chess, and AlphaGo can be only used for Go games.

Figure 1: Apple's Siri, A virtual assistant

Figure 1 is Apple's Siri [29] is an extended example of ANI, where it implements two primary technologies in ANI: Speech Recognition and Natural Language Processing. Siri combines these two methods in ANI to achieve its job. Firstly, it will capture the voice from the user and then convert it into text using the Speech Recognition methods. Then it will send the converted text to the Apple server, where the text will be processed using NLP. After processing the text, the server will respond to the user through Siri. For example, if the user says 'Hey Siri, set the alarm at 9 AM' to Siri, it will first convert the voice to the text and then send it to the server as a request. After processing the request, the server will send the response back. Here the response will be that Siri will set the Alarm at 9 AM. Another technology used in Siri is Contextual Understanding, which helps it understand and respond the way a human does [17] [21].

Deep learning will be a crucial part of achieving this stage; with deep neural networks, this level of AI could be achieved easily. ANI itself got limitless possibilities that have not even been completely implemented yet. The complete implementation of this will significantly impact every field like Agriculture, Education, Medicals, Governance, Surveillance, etc., to name a few. The vast scale of implementation of such technology will boost every industry, but the cost of such implementation will be too lofty and colossal.

AI at this stage can do only one job, and it can do that job much more efficiently than a human. In other words, it could surpass humans at the assigned job; the best example will be AphaGo from DeepMind. Types of AI like Weak AI or Narrow AI, Reactive Machines, and Limited Memory come under this stage.

Stage 2: Stage of General Intelligence (SGI)

The stage of General Intelligence will be the second stage of AI, where the systems will have the ability to do different jobs. In this stage, the system could intelligently accomplish multiple jobs without a human's help. Here the system should achieve the ability to understand its environment along with learning it. For example, the system could use its experience in one job to accomplish another job. This ability of the system could reduce the process of learning every job.

Figure 2: Baymax, A character from the movie Big Hero 6

While the Stage of Narrow Intelligence is on the verge of attaining maturity, the research to the Stage of General Intelligence has already started. Many organizations and Scientists are researching "next-generation AI," also called Artificial General Intelligence; to name one, GTP-3 by OpenAI is a promising technology that can be categorized under this stage, "Stage of General Intelligence".

Currently, this is the stage most scientists are focusing on right now. According to Wikipedia, Mark Gubrud was the first person who used the term 'Artificial General Intelligence,' and Ben Goertzel re-introduced and popularized this term [18]. GTP-3 is the most advanced and newly developed technology from OpenAI, which is closer to Artificial General Intelligence [6]. However, unlike other technologies like a self-driving car or a fully-fledged chatbot system, GTP-3 could be categorized under Stage of General Intelligence because it could perform different jobs.

To achieve this stage, along with all the concepts in the Stage of Narrow Intelligence, new concepts like Deep Understanding need to be implemented. This concept will focus on "applying the experience gained from one job to solve another job." For example, experience from riding a bicycle can be used to accomplish another job like riding a bike. This is the way humans are doing different jobs. Humans usually use their experience of one job for doing other jobs. Unlike the current AI, humans do not have to take different long-term training sessions to do a new job. Instead, they can use their experienced knowledge from their previous job to do a new job. For example, suppose a human is learning to ride a bike. In that case, he can use the experience like cycle balance, braking, etc. from his cycle riding job; he can combine those experiences and newly learned techniques to achieve this new job like motorbike riding.

These new concepts, along with techniques like deep learning, will help us accomplish this stage; which will be a significant push towards the fictional stage "Stage of Human Intelligence." Fully-fledged quantum computers will also be a breakthrough for achieving this stage.

In this stage, one system could play chess, ride vehicles, perform administrative work, or do all the work done by humans. Fig. 2 is the most suitable example of such a system, a character named "Baymax" [28] in the movie "Big Hero 6.". The character called Baymax is a robot that is developed for helping humans as a personal healthcare

companion. According to Disney, Baymax can detect vital status, treat the ailment, and, most of all, the ability to learn from varying situations and act accordingly without any predefined knowledge [23]. Types of AI like Strong AI or General AI come under this stage.

Stage 3: Stage of Human Intelligence (SHI)

The Stage of Human Intelligence will be the third stage of AI. In this stage, the system will ultimately mimic everything of the human brain; so that system can do everything that a human can do, including dreaming, consciousness, subconscious activities, and all other known and unknown abilities of a human brain. This is quite possibly the most challenging stage to be achieved; researchers still lack complete knowledge about the human brain and its working. In other words, at a minimum, it requires a thorough understanding of the human brain and its working to achieve this stage. Achievements in quantum cognition, quantum physics, and other topics that deal with the brain and subatomic particles will be a breakthrough for achieving this stage. These fields are very crucial because it helps to explore the unpredictable behavior of the human mind. This unpredictable behavior of humans can be a reason for their creativity.

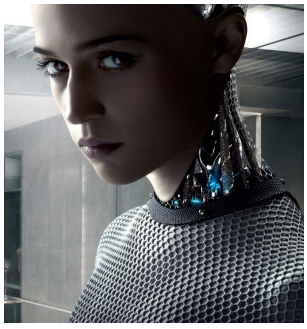

Figure 3: AVA, A fictional character from the movie Ex Machina

Once this stage is achieved, it will be a more significant boost for the entire human race. It might even help us accomplish Type I and pursue Type II according to the Kardashev scale by achieving better technologies that are still fictional for humans. When building a body, the system will have to use organic and biomechatronic body parts as hardware. Human-level consciousness is very much essential at this stage.

This stage is still fictional or hypothetical, but the best suitable examples for such systems will be Fig. 3, a character named "AVA" [27] in the film called "Ex Machina," where the AVA is a robot powered by an advanced AI. The AVA is capable of understanding and manipulating human emotions more than that; it even achieved self-awareness [22]. Types of AI like Super AI, Theory of Mind, and Self-awareness come under this stage. The singularity explained in Britannica will also be happening

in this stage; "The singularity would involve computer programs becoming advanced that AI transcends human intelligence, potentially erasing the boundary between humanity and computers" [19].

Stage 4: Stage of Supreme Intelligence (SSI)

Supreme Intelligence will be the fourth stage of AI. Once this stage is reached, it cannot be called artificial anymore; they will be different species like humans; this stage can also be called Natural Intelligence. In this stage, they will be built with organic materials instead of electronic components, just like other living things around the world. This stage is going to be very helpful to human beings when it comes to extraterrestrial activities.

Figure 4: Model of DNA

Figure 4 is DNA [26]; dramatical advancement in DNA Computing will be a crucial step towards the Stage of Supreme Intelligence because the computation is accomplished in biological molecules (DNA) instead of traditional silicon chips. DNA Computing itself will be a significant step in the field of Computer Science due to its massive performance (hypothetical). In DNA, genetic coding is represented by four different molecules, A (Adenine), G (Guanine), C (Cytosine), and T (Thymine); these molecules could hold a massive amount of data when chained together. The researchers at Washington University so far managed to store 1 GB of data in DNA. The scientists estimate that the DNA could hold 455 EXABYTE of data (1 EXABYTE = 1073741824 GB). Hypothetically, all the information currently on the internet could be stored with the space of a two-liter bottle. The information stored in DNA will be available for a longer time, the half-life of DNA is 500 years, and if the DNA is stored in a cold and dark environment, it could potentially last for hundreds of thousands of years [24] [25].

The possible reason why this stage will bring about a new species like humans is that it may not be using any electronic substance as their body; instead, it should be using natural living organic materials.

In other words, these will be genuinely biological. Usage of such materials will help them to evolve themselves like humans or other living things. Furthermore, these bodies will be designed so that they will not have any limitations like other living beings. Their bodies will be precisely developed to survive in all kinds of environments, and this newly developed species will be the core of AI.

This stage is beyond fictional; it is very challenging to imagine the level of intelligence with our current knowledge and wisdom. Despite the fact that the researchers are pursuing the second stage, the third and fourth stages are still hypothetical.

4 Conclusion

The paper clearly gives an overview of the four stages of AI. It reduces the confusion in the inconsistent information and creates a proper understanding of the difference between types and AI stages. The paper's primary focus is on defining the Stages of AI, the Stage of Narrow Intelligence, the Stage of General Intelligence, the Stage of Human Intelligence, and the Stage of Supreme Intelligence. These will be the stages through which the AI will evolve, and these stages can be considered the standard AI stages. There will be a substantial technological boost in every field whenever we reach a new stage. The third stage is still fictional or hypothetical, and the fourth stage is beyond the imagination; still, it will be the most significant human life achievement once set foot on the fourth stage because it could be the beginning of a new dawn. Future research could bring more clarity to the fourth stage and introduce the stages beyond the fourth.

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