100 years of AI

# The biggest event

## Q1] Which event in the history of AI has been the most ground-breaking?

In my opinion neural networks have been the most ground-breaking for AI. I say this because it is neural networks that have allowed AI to move from academia towards practical application. The report sites GAN as one of the underlying technologies for these advances. GAN is composed of two components, a generator and a discriminator. The two learn from each other and get better. Furthermore, recent advances in natural language processing are also mostly due to Deep learning models, mostly transformer such as GPT, BERT, mt5. These models have gotten so good that they are able to generate text indistinguishable from human generated text. These models are widely used in language translation, speech recognition, writing aid, and chat bots. Famous examples of use of deep learning in applications are Siri, Google Assistant, and Alexa. Deep learning has also changed the field of computer vision. Current state of the art classification model include, vision transformer, RESNET, ALEXNET, VGG, and efficient net. Furthermore, because of GAN’s the application of deep fakes has taken the world of computer vision by storm. GAN’s are able to generate photorealistic images. The effects of Deep-learning can also be seen in fields like finance and recommendation systems. In the former deep neural networks are used for partially automated lending decision and payment scoring. For the latter, the incorporation of DNN have improved the accuracy and efficiency of the system

## Q2] What are the most promising opportunities for AI?

Most of the opportunities on AI are in artificial weak intelligence. A type of AI that is concerned with specific applications. The area that the Standford report highlighted was AI for augmentation. The rationale given is AI and humans have complementary strengths, so combining both would be a strategic move. AI is better in making decision from a large set of data, whilst a human would be better at understanding the implication of the decision. For example, an autonomous car might injure a human that is jay walking if the alternative is slamming into a tree. However, a human might respond differently. Current research results. However, does not support the idea of human-AI team. An AI only team outperforms an augmented team. Research is being conducted to investigate methods for better human-AI collaboration. In my opinion this is an interesting approach that may lead to researchers drawing some insights for AI general intelligence. By figuring out what human capabilities will make a human-AI collaborative system outperform an AI only system will give us a better understanding of what AI lacks in.

## Q3] What are the most pressing dangers of AI

The view that AI is seen as a solution to all problems. Even though the decision making ability on large data of AI makes it desirable to apply it to all societal problems, but these could lead to even bigger issues. For example, many AI applications face the issue that they are trained on datasets that have inherent biases in them For instance, Amazon had to stop using one of recruiting tool because it showed a bias against women. The simple fact of the matter is that current AI models lack the higher cognitive abilities that a human possess, such as empathy, understanding the concept of equity, implication of an action beyond the scope of the problem at hand, etc. So it’s clear that AI can become discriminatory since the data gathered would be biased.

Even though AI has shown significant promise in the field of medicine. There is still a threat of over reliance on the system. According to the report AI generally does not perform well beyond to the scope of its training data. Which is often limited to few clinics.

Similar dangers of adopting AI are present in the judicial system. AI decision making system may produce biased results. These biases often are discriminatory in nature (racist, sexist, etc.). In 2016 a report noted that AI-driven approaches like PredPol disproportionately predict crime in areas where the population of non-white citizens is more.

## Q4] How much have we progressed in understanding the key mysteries of human intelligence?

An emerging view of human intelligence is that human intelligence is collective. That each individual is a tiny (even negligible) part of the greater system that is collective intelligence. This does make some sense since advances in academia have increased with globalization. Which allows for a greater collective intelligence. Research on collective intelligence reinforces the hypothesis that intelligence is not just the property of individual but of the collective. Interestingly this report suggests that the intelligence property of a group is not dependent on the individual intelligence. They justify this claim by stating that the group intelligence may be determined more accurately with identifiers like how compatible each member of the group is with each other and how empathetic they are towards each other. These identifiers may even perform better than individual IQ’s. This claim of the report does seem rational to me. For instance, a group of students who are all individually intelligent, but they lack empathy. Such a group would likely not perform well in a group assignment. On the flip side, a group in which individual are supportive, and empathic to one another is more likely to perform well in a group task.

## Q5] How do you see AI transforming the society in positive or negative ways? Discuss.

The well-known computer scientist and Stanford University professor, Andrew NG, proclaimed AI as the new electricity. My view of AI is much similar to his. In a few years no one would be able to go about their day to day lives without (knowingly or unknowingly) using AI (in particular deep learning). This is somewhat true even today, when anyone browsing over the internet will use some application that is using AI in the backend. For better or for worse the time we are living is the epoch of AI.

AI will undoubtedly bring many positive changes, for instance through the recent development in the field of computer vision models capable of detecting falls are being used in homes throughout the western world. These system are identifying and preventing falls that can prove fatal for the elderly. The use of probabilistic models (Bayesian networks) in medicine has also proved helpful to doctors. I won’t be shocked if 20 years into the future we have fully functioning autonomous vehicles available for public use.

If we contextualize AI for the problems in Pakistan: AI is known for its ability optimize problems. One such problem could be the sharing of water resources in areas of Pakistan. Currently a team at Habib University is engaged with the research problem of availability of water in Karachi, in the Karachi Water Project. One of the findings of their research was that water is disproportionately shared between regions of Karachi. Using artificial intelligence optimization algorithms like gradient descent may be an interesting fix for it.

In theory this seems like a solution that just might work, but practically this might introduce additional issues. As previously discussed AI models are known to produce biases and discriminatory tendencies towards a group of people. So, if the training data is not organized in a way such that inherent biases I it are removed, the proposed AI solution could turn out to be disastrous.

The above was just one example of how AI could either solve or further complicate an existing problem. It is important to understand that AI is a powerful tool, but like uncle Ben in Spiderman said, “With great power also comes great responsibility”. So, the AI community must understand the responsibility on their shoulder and act ethically. If they do so I do believe AI will have a more positive impact.

# Giants of AI

## Alan Turing

Alan Turing has been dubbed as the father of computing and AI, and the most prestigious award in computer science, Turing Award, is named after him. In 1935, Turing wrote about an abstract computer that had an infinite memory and a scanner that moved symbol by symbol across the memory, reading what it found and recording new symbols. A program of instructions that is also stored in the memory as symbols controls how the scanner behaves. This is Turing's stored-program notion, and it implicitly allows for the prospect of the machine running its own program and maybe enhancing or altering it. He presented the theory of the computer we use today decades before the hardware was ready to implement it. He was truly a genius ahead of his time.

Chess served as a useful source of tough and well-defined issues for Turing to utilize at Bletchley Park to illustrate his ideas on artificial intelligence. These challenges allowed Turing to test out his proposed approaches to problem solving. In theory, a computer could play chess by thoroughly going through every move that is feasible, but in reality, this is not practical because it would need looking at an absurdly enormous number of moves (This would be a brute force approach which was ultimately used by deep blue in his rematch with the chess champion). To direct a more focused, discriminating search, heuristics are essential. Turing experimented with creating chess programs, but in the absence of a computer to execute his programs, he was forced to settle for theory. The first real artificial intelligence (AI) systems had to wait for the development of stored-program digital computers. This is similar to the heuristic searches, such as the A-star search, which is widely used in AI. It is interesting to think what this man would’ve been capable of if only he was not restricted by the technology of his time.

One of his major contribution to AI is the Turing test (originally called imitation game) which postulates that a computer can think if it is able pass the following test: a remote human interrogator, within a fixed time frame, must distinguish between a computer and a human subject based on their replies to various questions posed by the interrogator. By means of a series of such tests, a computer’s success at “thinking” can be measured by its probability of being misidentified as the human subject. Although, the Turing test has some problems associated with it for example it is limited to Human intelligence, but revolutionary paper of 1950 “Computing machinery and test” started a discourse about machine/artificial intelligence.

## John McCarthy

He founded the AI lab at Stanford University and was a co-founder of the first AI lab at MIT. In 1971, the Association for Computing Machinery (ACM) presented him with the Turing Award. 1985 saw the Computer Pioneer Award, 1985 saw the IJCAI Award for Research Excellence, 1988 saw the Kyoto Prize I, 1990 saw the National Medal of Science, and 2003 saw the Benjamin Franklin Medal. Now that it is established that he received many honors in his lifetime let’s move on to why exactly is McCarthy worthy of so much praise by the AI community

The second-oldest programming language after FORTRAN was created by McCarthy in 1958 and is called LISP. The structure of programming code was first faithfully and directly expressed in a standard data structure in the programming language Lisp. Additionally, it was frequently employed at the time as a programming language for AI.

He also developed the concept of computer time-sharing in the late 1950s and early 1960s, an advance that greatly improved the efficiency of distributed computing and predated the era of cloud computing by decades. Distributed computing is widely used in deep learning for training of the models.

Artificial intelligence is a word that was first used by John McCarthy. He outlined AI as the engineering and science of creating intelligent machines. He participated in the Dartmouth Summer Research Project on Artificial Intelligence, a summer workshop that is widely regarded as the catalyst for the development of the science of artificial intelligence. McCarthy coined the phrase "artificial intelligence" in 1955 at Dartmouth and wrote a proposal for a two-month, ten-person summer research conference on the topic.

The basics of McCarthy's programming theory were laid forth in "Programs with Common Sense," which he published in 1960. McCarthy also described "a system which is to develop intelligence of human order." McCarthy later developed the first "hand-eye" computer system, which allowed a computer to see actual 3D blocks through a camera and control a robotic arm to do basic stacking and arrangement tasks. Of course, this was one of the earliest advancements in computer vision.

## Marvin Minsky

Minsky defined AI as “the science of making machine do things that would require intelligence if done by men”. Minsky and McCarthy cofounded, with another pioneer of the field, John McCarthy, the Artificial Intelligence Project in 1959. (now the MIT Computer Science and Artificial Intelligence Laboratory). It swiftly rose to prominence as one of the foremost research and training facilities for the fledgling area of artificial intelligence. Minsky spent the rest of his career at MIT.

Minsky's early accomplishments included developing robotic arms and grippers, computer vision systems, and the first electronic learning system, Snarc, which emulated the operation of a basic neural network fed visual data. Surprisingly, while at Harvard in 1956, he also invented the confocal scanning microscope, which is still widely used in medical and scientific research today. In 1969 he coauthored a book with Seymour Papert called, “Perceptrons”. This book pointed out the problems with the neural networks. This book was blamed for taking the research away from neural networks. Minsky frequently maintained that a solely "connectionist" neural network-focused approach would never be sufficient to instil actual intelligence in computers. Many modern-day AI researchers, including deep learning pioneers, are rapidly embracing this similar perspective.

In the infant years of AI, researchers found it extremely hard to encapsulate the external world in a programming language. For this Minsky developed the concept of frames. The basic idea behind frames was to program general information in the computer before programming specific instruction. For example, if one wishes to program an agent to walk from point A to point B. First the programmer must program the range of motions the agent can perform, i.e. move forward, move backwards, turn right, turn left, and turn around. Frames proved to be a rich concept among AI researchers, though applying it to highly complex situations has proved difficult.

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## Raymond Kurzweil

In the realm of artificial intelligence, Raymond Kurzweil (1948–present) has been a visionary, developing and recognising its use across numerous industries and applications, and frequently taking the initiative and leading the way, advancing the subject with his forecasts and contributions. From an early age, Kurzweil leveraged the idea that pattern recognition was a key component of human mind to develop AI-based applications.

His classical music synthesizer (1965), which was able to create music imitating the styles of classical composers, was one of his earliest inventions to garner attention. In addition, he created a successful college recommendation program that he sold for close to $100,000 USD. His career has been rife with breakthroughs in a wide range of domains since he left MIT in 1970.

With his omni-font Kurzweil Reading Machine, which could recognise an astounding diversity of typefaces at the time, he helped establish the area of optical corrector recognition through the Kurzweil Products Company. Similar to how the Kurzweil Products Company was sold to Xerox, Kurzweil has started and sold other lucrative companies while pioneering advancements in voice recognition, music synthesis, financial analysis, and even AI chatbots. His voice recognition software, a key component of many modern smart gadgets, is what first introduced Microsoft Windows to virtual help.

A sizable number of books by Kurzweil have been produced in which he examines the potential of AI. Many of his forecasts have come true within his lifetime, such as the expansion and significance of the internet, therefore his ideas are frequently given careful consideration (The Age of Intelligent Machines, 1990). Some of his most noteworthy assertions make a solid case for how people and the technology they have developed will eventually converge. He sees how AI will complement human abilities and how "we will finally integrate with our robots, live endlessly, and be a billion times more clever" as a pioneer of several application-specific AI solutions. This does make some sense if we consider the smart phones as an extension of ourselves. Smart phones (and similar devices) are extensions of human memory with them storing a lives worth of pictures and data. Moreover these devices have reduced the human processing time with different problems.

## Judea Pearl

Judia Pearl is one of the pioneers in AI because he led efforts that allowed machines to think probabilistically. He was the scientist that invented the Bayesian Networks. These are acyclic graphs, based on the Markov rule, that allow for mapping of causal relationships using probability theory, in particular, Bayesian inferencing. Judea Pearl created a theoretical and computational foundation for artificial intelligence based on probability theory after seeing the overwhelming occurrence of uncertain information in real-world systems. He has had a significant impact outside of AI as well. His theories have revolutionized the understanding of causality in statistics, psychology, medicine, and the social sciences. His models are used to describe everything from the effects of diseases to the likely behaviour of terrorists. He established links between computer science and statistics where none previously existed.

Unlike, deep learning neural networks, Bayesian networks are a white box approach, i.e. they allow for human comprehension. Pearl believes that in order for a machine to be truly intelligent the machine must be able to comprehend and process causal relationship. They should be able to perform causal reasoning. This does make some logical sense, since most of the dangers associated with AI (As discussed above) was a direct consequence of current AI models being deterministic. They fail to understand the underlying phenomenon in the data (causation). They just are able to find correlation.

He first proposed causal networks in his 2000 book Causality: Models, Reasoning, and Inference. These networks enhance the concept of Bayesian networks by simulating not only the uninterrupted functioning of a stochastic system but also the consequences of all potential interventions. In particular, philosophy, psychology, statistics, econometrics, epidemiology, and social science have been greatly impacted by his work in terms of how causation is perceived and quantified. It is challenging to find a corpus of artificial intelligence (AI) research that has had as much of an impact on these related fields as Pearl's causality research, which culminated in his most recent theories of causal discovery, counterfactuals, and interventions.

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