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Artificial Intelligence in Pharmacy

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ABSTRACT

Definition: AI the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Artificial intelligence use in pharmaceutical technology has increased over the years, and the use of technology can save time and money while providing a better understanding of the relationships between different formulations and processes parameters.

- History of AI
- Devices worked on AI
- AI in science
- AI in pharmacy
- Applications of AI
- Application of AI in Pharmacy
- Future scope of AI

Conclusion: AI is at the center of a new enterprise to build computational models of intelligence.

Keywords: Artificial intelligence, Pharmacy, Machines.

INTRODUCTION

Designed by Newell and Simon in 1995, it may be considered the first AI program.

The person who finally coined the term artificial intelligence and is regarded as father of AI is John McCarthy.

When was AI introduced?

- In 1956, the beginning of AI can be traced to classical philosopher's attempts to describe human thinking as a symbolic system.
- But the field of AI wasn't formally founded until 1956, at a conference at Dartmouth College, in Hanover, New Hampshire, where the term AI was coined.

HISTORY OF AI

Maturation of AI (1943-1952)

- Year 1943-The first work which is now recognized as AI was done by Warren McCulloch and Walter pits in 1943.They proposed model of artificial neurons.
- Year 1949-Donald Hebb demonstrate an updating rule for modifying the connection strength between neurons. His rule is now called Hebbian learning.
- Year 1950-The Alan Turing who was an English mathematician and pioneered machine learning in 1950. Alan Turing publishes "Computing machinery and intelligence "In which he proposed at a test. The test can check the machine ability to exhibit intelligent behavior equivalent to human intelligence, called a Turing test.

The birth of AI (1952-1956)

- Year 1955-An Allen Newell and Herbert A. Simon created the first artificial intelligence program which was named as "Logic theorist". This program had proved 38 of 52 mathematics theorems, and find new and more elegant proofs for some theorems.
- Year 1956-The word AI first adopted by American computer scientist John McCarthy at Dartmouth conference. For the first time, AI coined as an academic field [1,2].

The golden years-early enthusiasm (1956-1974)

- Year 1966-The researchers emphasized developing algorithms which can solve mathematical problems. Joseph Weizenbaum created the first chatbot in 1966, which was named as ELIZA.
- Year 1972-The first intelligent humanoid robot was built in Japan which was named as WABOT-1.

The first AI winter (1974-1980)

- The duration between years 1974 to 1980 was the first AI winter duration. AI winter refers to the time period where computer scientist dealt with a severe shortage of funding from government for AI researches.
- During AI winter, an interest of publicity on AI was decreased [3].

A boom of AI (1980-1987)

- Year 1980-After AI winter duration, AI came back with "Expert system ". Expert system was programed that emulate the decision-making ability of human expert.
- In the year 1980, the first national conference of the American association of AI was held at Stanford University.

The second AI winter (1987-1993)

- The duration between the years 1987 to 1993 was the second AI winter duration
- Again, investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective.

The emergence of intelligent agents (1993-2011)

- Year 1997-In this year, IBM deep blue beats world chess champion, Gary Kasparov, and became the first computer to beat a world chess champion.
- Year 2002-for the first time, AI entered the home in the form of Roomba, a vacuum cleaner.
- Year 2006 – AI came in the Business world till the year 2006. Companies like Facebook, Twitter, and Netflix also started using AI [4,5]

Deep learning, big data and artificial general intelligence (2011-present)

- Year 2011-In the year 2011, IBM's Watson won jeopardy, a quiz show, where it had to solve the complex questions as well as riddles. Watson had proved that it could understand natural language and can solve tricky questions quickly.

- Year 2012 – Google has launched an Android app feature "Google now ", which was able to provide information to the user as a prediction.
- Year 2014 – In the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test".
- Year 2018 – The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well.
- Google has demonstrated an AI program "Duplex" which a virtual assistant was and which has hairdresser appointment on call, and lady on other side didn't notice that she was talking with the machine [6] (Figure 1).

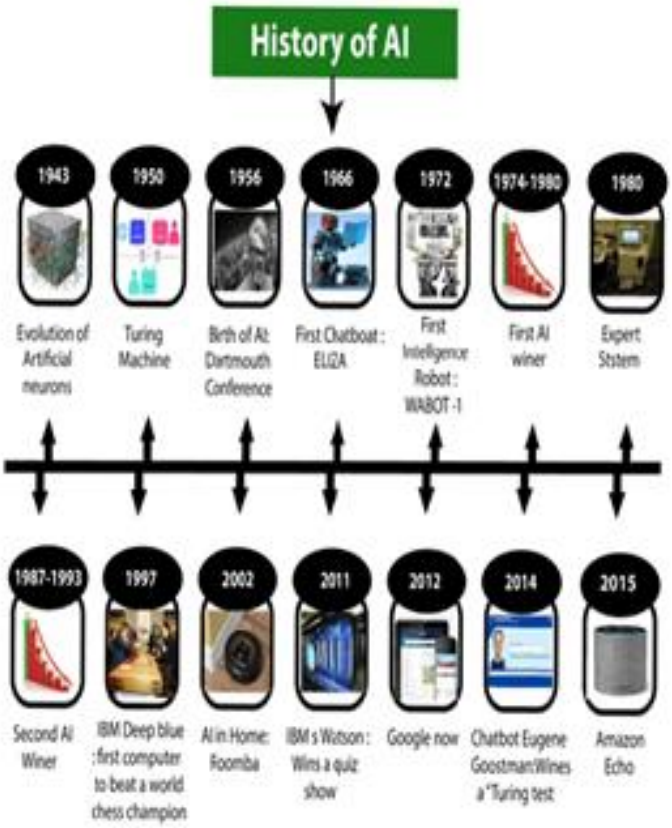

Figure 1: History of AI.

TYPES OF AI

There are 4 types of artificial intelligence:

- Reactive machines.
- Limited memory.
- Theory of mind.
- Self-awareness.

AI was first applied in

- In 1960's researchers emphasized developing algorithms to solve mathematical problems and geometrical theorems.
- In the late 1960's computers scientists worked on machine vision learning and developing machine learning in robots, were built

in Japan in 1972 [7,8].

DEVICES WORKED ON ARTIFICIAL INTELLIGENCE

1. Smart phones.
2. Smart cars and drones.
3. Social media feeds (FB, TWITTER, and INSTA).
4. Music and Media streaming services.
5. Video games.
6. Online adds network.
7. Navigation and travel.
8. Banking finance.
9. Search engines (GOOGLE, BING, YAHOO etc.).
10. Siri Link 7.
11. Alexa.
12. Tesla.
13. Cogito.
14. Boxever.
15. John Paul.

AI IN SCIENCE

AI technologies are now used in a variety of scientific research fields.

For example:

- Using genomic data to predict protein structure understanding the role it plays in the body...machine learning can p bridge the gap between these two types information.
- AI is wide ranging branch of computer sciences concerned with building smart machine capable of performing tasks that typically required human intelligence.
- It is the endeavor to replicate or simulate human intelligence in machines [9,10].

AI IN PHARMACY

AI mainly used in pharmaceutical industries for:

1. Drug discovery
2. Clinical research
3. Disease diagnosis
4. Novel medication
5. Prediction
6. Data analysis

AI in pharma refers to use of automated algorithms to perform tasks which traditionally rely on human intelligence.

Over the last five years the use of AI in pharma and biotech industries have redefined how scientists develop new drugs, tackle disease and more [11,12].

AI applied in top pharma companies in the world

- Pfizer: immune oncology.
- Roche: diabetic macular edema.
- Novartis: decode cancer pathology images.
- Johnson Johnson: stroke related death, skin scanner Merck & co MSD: emphasis on diabetic at cancer prevention.
- Sanofi: drug repurposing identifies new uses of some of its clinical strength molecule for genetic disease.
- GlaxoSmithKline: drug discovery has artificial intelligence unit, In silico drug discovery unit.
- Amgen: precision medicine in GNS health care medical research.
- Gileadsciences: drug discovery in April 2019.

APPLICATIONS

Following are some sectors which have the applications of artificial intelligence, (LIINK 13) [13-16]:

1. Astronomy
2. Healthcare
3. Transport
4. Agriculture
5. Education
6. E-commerce
7. Entertainment
8. Robotics
9. Automotive
10. Social media
11. Data security
12. Finance.
13. Chatbots.
14. AI to improve workplace communication.
15. Human resource management.
16. Gaming.
17. Law (Figure 2).

Figure 2: Applications of AI.

APPLICATION OF AI IN PHARMACY

Application of artificial intelligence in the pharmaceutical industries:

1. Research development.
2. Drug development.
3. Diagnosis.
4. Disease prevention.
5. Epidemic prediction.
6. Remote monitoring.
7. Manufacturing.
8. Marketing.
9. Rare diseases and personalized medicine.
10. Processing biomedical and clinical data.
11. Identifying clinical trial candidates.

R&D

Pharma companies around the world are leveraging advanced ML Algorithms and AI-powered tools to streamline the drug discovery process. These intelligent tools are designed to identify intricate patterns in large datasets, and hence, they can be used to solve challenges associated with complicated biological networks [17].

Drug development

AI holds the potential to improve the R&D process. From designing and identifying new molecules to target-based drug validation and discoveries AI can do it all [18].

Diagnosis

Doctors can use advanced machine learning system to collect,process, and analyze vast volumes of patients' healthcare data. Healthcare providers around the world are using ML technology to store sensitive patient data securely in the cloud or a centralized storage system. This is known as electronic medical records (EMRs) [19].

Disease prevention

Pharma companies can use AI to develop cures for both known diseases like Alzheimer's and Parkinson's and rare diseases. Generally, pharmaceutical companies do not spend their time and resources on finding treatments for rare diseases since the ROI is very low compared to the time and cost it takes to develop drugs for treating rare diseases [20].

Epidemic prediction

AI and ML are already used by many pharma companies and healthcare providers to monitor and forecast epidemic outbreaks across the globe. These technologies feed on the data gathered from disparate sources in the web, study the connection of various geological, environmental and biological factors on the health of the population of different geographical locations, and try to connect the dots between these factors and previous epidemic outbreaks. Such AI/ML models become especially useful for underdeveloped economies that lack the medical infrastructure and financial framework to deal with an epidemic outbreak.

Remote monitoring

It is a breakthrough in the pharma and healthcare sectors. Many pharma companies have already developed variables powered by AI algorithms that remotely monitor patients suffering from life-threatening diseases.

Manufacturing

Pharma companies can implement AI in manufacturing process for higher productivity, improved efficiency, and faster production of life-saving drugs. AI can be used to manage and improve all aspects of the manufacturing process, including:

- Quality control.
- Predictive maintenance.
- Waste reduction.
- Design optimization.
- Process automation.

Marketing

Given the fact that the pharmaceutical industry is a sales-driven sector, AI can be a handy tool in pharma marketing. With AI, pharma companies explore and develop unique marketing strategies that promise high revenues and brand awareness.

FUTURE SCOPE OF ARTIFICIAL INTELLIGENCE

- AI in science and research.
- AI in cyber security.
- AI in data analysis.
- AI in transport.
- AI in home.
- AI in health care etc.

AI in science and research

AI is making lots of progress in the scientific sector. Artificial intelligence can handle large quantities of data and processes it quicker than human minds. This makes it prefect for research where the sources contain high data volumes. AI is already making breakthroughs in this field [21].

AI in cyber security

Cyber security is another field that's benefitting from AI. As organizations are transferring their data to IT networks and cloud, the threat of hackers is becoming more significant.

AI in data analysis

Data analysis can benefit largely from AI and ML. AI algorithms are capable of improving with iteration, and this way, their accuracy, and precision increase accordingly. AI can help data analysts with handling and processing large datasets.

AI in transport

The transport sector has been using AI for decades. Airplanes have been using autopilot to steer them in the air since 1912. An autopilot system controls the trajectory of a plane, but it isn't restricted to aircraft alone. Ships and spacecraft also use autopilot to help them maintain the correct course.

AI in home

AI has found a special place in people's homes in the form of Smart Home Assistants. Amazon Echo and Google Home are popularsmart home devices that let you perform various tasks with just voice commands.

AI in healthcare

The medical sector is also using this technology for its advantages. AI is helping medical researchers and professionals in numerous way [22] (Figure 3).

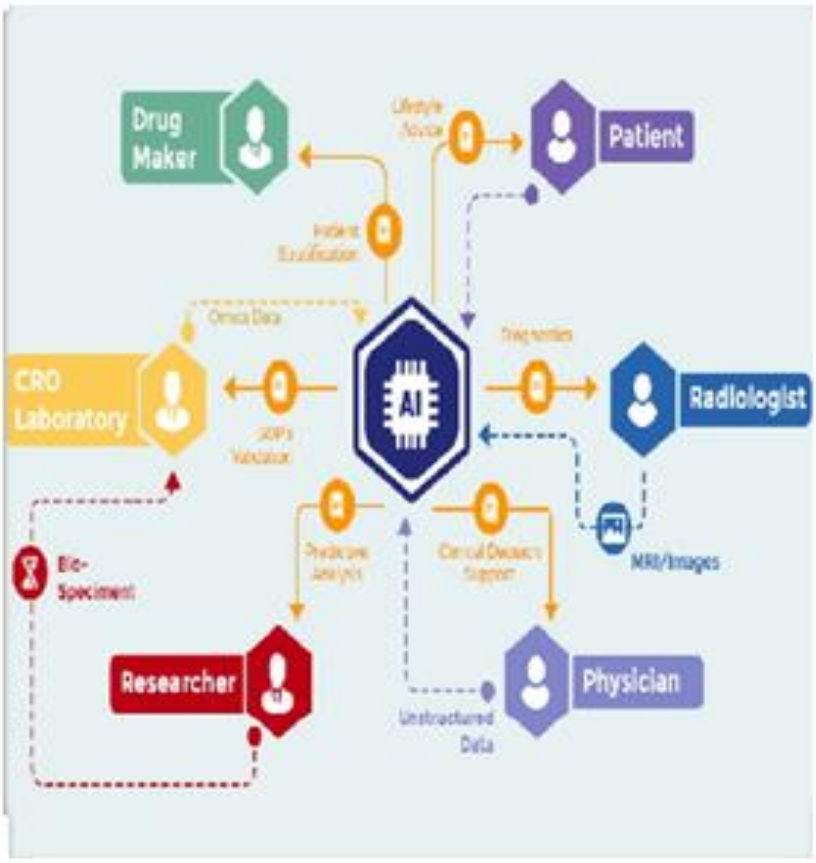

Figure 3: Future scope of artificial intelligence.

CONCLUSION

AI is at the center of a new enterprise to build computational models of intelligence. The main assumption is that intelligence (human or otherwise) can be represented in the terms of symbol structures and symbolic operations which can be programed in a digital computer. There is much debates as to whether such an appropriately programmed computer would be a mind, or would merely simulate one, but AI researchers need not wait for the conclusion to that debate, nor for the hypothetical computer that could model all of human intelligence. Aspects of human intelligent behavior, such as solving problems, making references, learning, and understanding language, have already been coded as computer programs, within very limited domains, such as identifying diseases of soybean plants, AI programs can outperform human experts. Now the great challenge of AI is to find ways of representing the commonsense knowledge and experience that enables people to carry out every day activities such as holding a wide-ranging conversation, or finding their way along a busy street.

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