



# **Artificial Intelligence (Course Code – CS180)**

1. To describe the basic fundamental concepts of Artificial Intelligence, Agents, and Environment.
2. Comparing traditional solutions to different problems and their expected AI-based solutions.
3. Demonstrating problem-solving methods with various AI-based technologies.
4. Correlating awareness of informed search and uninformed search techniques.
5. Designing AI-based problem-solving strategies for intelligent applications in the real world

You all are expected to attend all the lectures. The lecture notes cover all the topics in the course, but these notes are concise. The lectures will consist of slides, spoken material and additional examples.

**In order to understand the subject and the reasons for studying the material, you will need to attend the lectures and take notes to supplement lecture slides.** This is your responsibility. If there is anything you do not understand during the lectures, then ask, either during or after the lecture. If the lectures are covering the material too quickly, then say so. If there is anything you do not understand in the slides, then ask.

In addition you are expected to supplement the lecture material by reading around the subject; particularly the course text .

## Reference Books:

1. Artificial Intelligence: A Modern Approach-2nd Edition, Stuart Russel, Peter Norvig, Pearson Education
2. Introduction to Artificial Intelligence & Expert Systems by Dan W. Patterson, Englewood Cliffs, NJ, 1990 (Prentice Hall International)
3. Artificial Intelligence by Elaine Rich, Kevin Knight, Shivashankar B Nair, (McGraw-Hill)

## Relevant Websites:

1. <http://www.cs.utexas.edu/~novak/cs381kcontents.html>
2. <https://www.udacity.com/course/intro-to-artificial-intelligence--cs271>
3. <http://nptel.ac.in/courses/106105077>

# Lecture Objectives

**By the end of this lecture, you will be able to :**

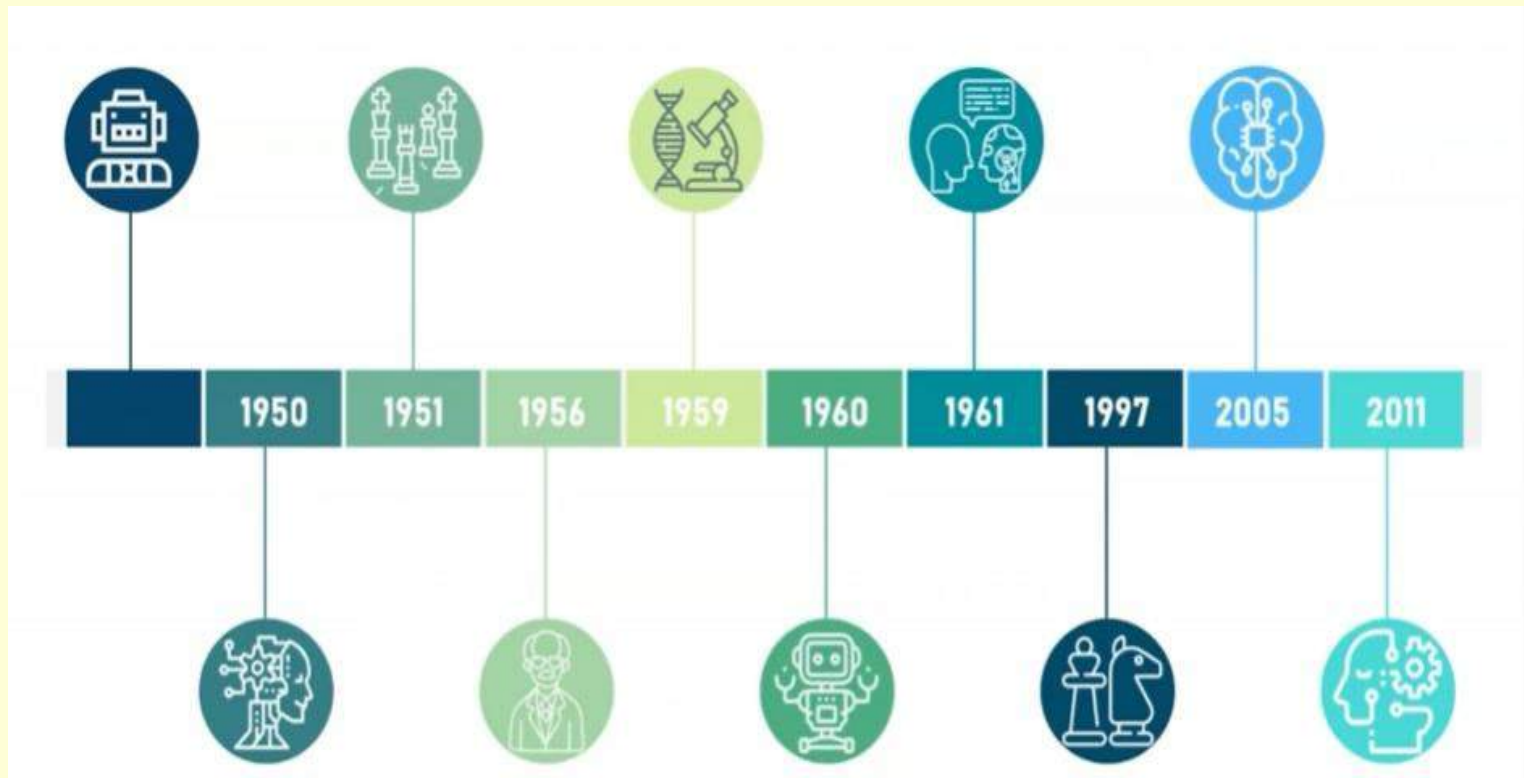
- 1. Define artificial intelligence.**
- 2. Define history of intelligence.**
- 3. Explain applications of artificial intelligence in briefly with suitable examples.**
- 4. Define future of Artificial Intelligence**



# Chapter 1

## Introduction

# History of AI



Important research that laid the groundwork for AI:

In 1931, Goedel laid the foundation of Theoretical Computer Science 1920-30s:

He published the first universal formal language and showed that math itself is either flawed or allows for unprovable but true statements.

In 1936, Turing reformulated Goedel's result and Church's extension thereof.

In 1956, John McCarthy coined the term "Artificial Intelligence" as the topic of the **Dartmouth Conference**, the first conference devoted to the subject.

In 1957, The **General Problem Solver (GPS)** demonstrated by Newell, Shaw & Simon

In 1958, John McCarthy (MIT) invented the Lisp language.

In 1959, Arthur Samuel (IBM) wrote the first game-playing program, for checkers, to achieve sufficient skill to challenge a world champion.

In 1963, Ivan Sutherland's MIT dissertation on Sketchpad introduced the idea of interactive graphics into computing.

In 1966, Ross Quillian (PhD dissertation, Carnegie Inst. of Technology; now CMU) demonstrated semantic nets



# History of AI

In 1967, Dendral program (Edward Feigenbaum, Joshua Lederberg, Bruce Buchanan, Georgia Sutherland at Stanford) demonstrated to interpret mass spectra on organic chemical compounds. First successful knowledge-based program for scientific reasoning.

In 1967, Doug Engelbart invented the mouse at SRI

In 1968, Marvin Minsky & Seymour Papert publish Perceptrons, demonstrating limits of simple neural nets.

In 1972, Prolog developed by Alain Colmerauer.

In Mid 80's, Neural Networks become widely used with the Backpropagation algorithm (first described by Werbos in 1974).

1990, Major advances in all areas of AI, with significant demonstrations in machine learning, intelligent tutoring, case-based reasoning, multi-agent planning, scheduling, uncertain reasoning, data mining, natural language understanding and translation, vision, virtual reality, games, and other topics.

In 1997, Deep Blue beats the World Chess Champion Kasparov.

In 2002, iRobot, founded by researchers at the MIT Artificial Intelligence Lab, introduced **Roomba**, a vacuum cleaning robot. By 2006, two million had been sold



So What Is AI?

## 1. AI as a field of study

Computer Science, Cognitive Science, Psychology, Philosophy, Linguistics, Neuroscience as shown in fig 1.1 of next slide.

## 2. AI is part science, part engineering

## 3. AI often must study other domains in order to implement systems e.g., medicine and medical practices for a medical diagnostic system, engineering and chemistry to monitor a chemical processing plant

## 4. AI is a belief that the brain is a form of biological computer and that the mind is computational

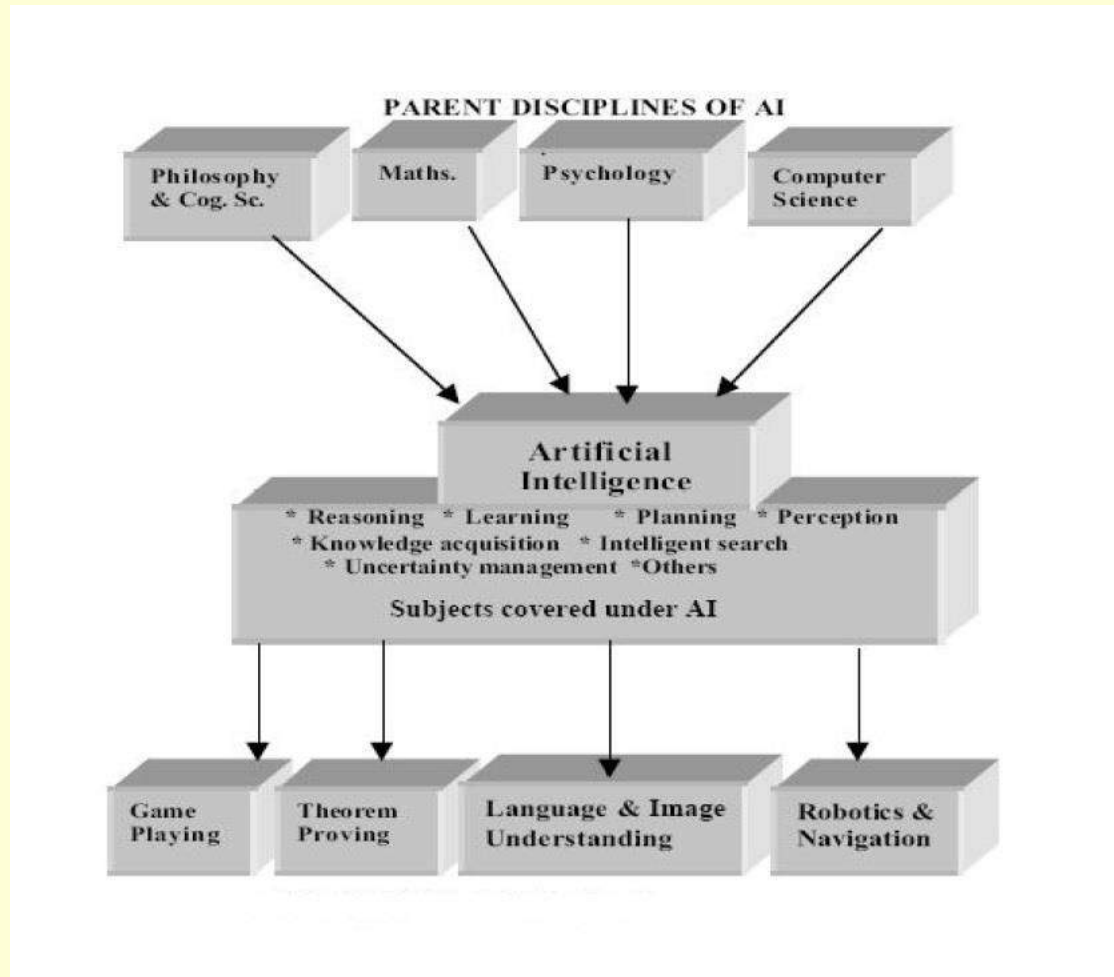
## 5. AI has had a concrete impact on society but unlike other areas of CS, the impact is often

- felt only tangentially (that is, people are not aware that system X has AI)
- felt years after the initial investment in the technology

- ❑ Is there a “holistic” definition for intelligence?
- ❑ Here are some definitions:
  - ❑ *the ability to comprehend; to understand and profit from experience*
  - ❑ *a general mental capability that involves the ability to reason, plan, solve problems, think abstractly, comprehend ideas and language, and learn*
  - ❑ *is effectively perceiving, interpreting and responding to the environment*
- ❑ None of these tells us what intelligence is, so instead, maybe we can enumerate a list of elements that an intelligence must be able to perform:
  - ❑ perceive, reason and infer, solve problems, learn and adapt, apply common sense, apply analogy, recall, apply intuition, reach emotional states, achieve self-awareness
- ❑ Which of these are necessary for intelligence? Which are sufficient?
- ❑ Artificial Intelligence – should we define this in terms of human intelligence?
  - does AI have to really be intelligent?
  - what is the difference between being intelligent and demonstrating intelligent behavior?



something that is simulated or made by humans, not by nature. So making the machine intelligent by human.



**Fig 1.1: Parent Discipline of AI**



## Let us define Artificial Intelligence now

- ❑ Artificial Intelligence (AI) is a branch of *Science* which deals with helping machines find solutions to complex problems in a more human-like fashion.
- ❑ This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way.
- ❑ A more or less flexible or efficient approach can be taken depending on the requirements established, which influences how artificial the intelligent behavior appears.
- ❑ The automation of activities that we associate with human thinking (e.g., decision-making, learning...)
- ❑ A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes
- ❑ The branch of computer science that is concerned with the automation of intelligent behavior



**Artificial intelligence can be viewed from a variety of perspectives: -**

- ❑ From the perspective of **intelligence** artificial intelligence is making machines "intelligent" -- acting as we would expect people to act.
- ❑ From a **business** perspective AI is a set of very powerful tools, and methodologies for using those tools to solve business problems.
- ❑ From a **programming** perspective, AI includes the study of symbolic programming, problem solving, and search.
  - Typically AI programs focus on symbols rather than numeric processing.
  - Problem solving - achieve goals.
  - Search - seldom access a solution directly. Search may include a variety of techniques.





- LISP(LISP, an **acronym for list processing**, is a programming language that was designed for easy manipulation of data strings. Developed in 1959 by John McCarthy, it is a commonly used language for artificial intelligence (AI) programming)

- The second language strongly associated with AI is PROLOG.

PROLOG was developed in the 1970s. PROLOG is based on first order logic(Prolog is a programming language for symbolic, non-numeric computation. It is specially well suited for solving problems that involve objects and relations between objects).

- Object-oriented languages are a class of languages recently used for AI Programming.

Object-Oriented languages are Smalltalk, Objective C, C++. Object oriented extensions to LISP (CLOS - Common LISP Object System) and PROLOG (L&O - Logic & Objects) are also used.

- Most Popular language of today associated with AI is Python.

Python is widely used for artificial intelligence, with packages for several applications including General AI, Machine Learning, Natural Language Processing and Neural Networks. The application of AI to develop programs that do human-like jobs and portray human skills is Machine Learning.



## ❑ **Game Playing**

You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation--looking at hundreds of thousands of positions. To beat a world champion by brute force and known reliable heuristics requires being able to look at 200 million positions per second.

## ❑ **Speech Recognition**

In the 1990s, computer speech recognition reached a practical level for limited purposes. Thus United Airlines has replaced its keyboard tree for flight information by a system using speech recognition of flight numbers and city names. It is quite convenient. On the other hand, while it is possible to instruct some computers using speech, most users have gone back to the keyboard and the mouse as still more convenient.



## ❑ Understanding Natural Language

Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

## ❑ Computer Vision

The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views. At present there are only limited ways of representing three-dimensional information directly, and they are not as good as what humans evidently use.

## ❑ Expert Systems

A "knowledge engineer" interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task. One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed. Namely, its ontology included bacteria, symptoms, and treatments and did not include patients, doctors, hospitals, death, recovery, and events occurring in time. Its interactions depended on a single patient being considered. Since the experts consulted by the knowledge engineers knew about patients, doctors, death, recovery, etc., it is clear that the knowledge engineers forced what the experts told them into a predetermined framework. The usefulness of current expert systems depends on their users having common sense.



## ❑ **Heuristic Classification**

One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it (e.g., about whether there have been previous credit card frauds at this establishment).users having common sense.

## 1. Consumer Marketing

- Have you ever used any kind of credit/ATM/store card while shopping?
- if so, you have very likely been “input” to an AI algorithm
- All of this information is recorded digitally
- Companies like Nielsen gather this information weekly and search for patterns
  - general changes in consumer behavior
  - tracking responses to new products
  - identifying customer segments: targeted marketing, e.g., they find out that consumers with sports cars who buy textbooks respond well to offers of new credit cards.
- Algorithms (“data mining”) search data for patterns based on mathematical theories of learning



## 2. Identification Technologies

- ID cards e.g., ATM cards
- can be a nuisance and security risk: cards can be lost, stolen, passwords forgotten, etc
- Biometric Identification, walk up to a locked door
  - Camera
  - Fingerprint device
  - Microphone
  - Computer uses biometric signature for identification
  - Face, eyes, fingerprints, voice pattern
  - This works by comparing data from person at door with stored library
  - Learning algorithms can learn the matching process by analyzing a large library database off-line, can improve its performance



## 3. Intrusion Detection

- Computer security - we each have specific patterns of computer use times of day, lengths of sessions, command used, sequence of commands, etc
  - would like to learn the “signature” of each authorized user
  - can identify non-authorized users
- How can the program automatically identify users?
  - record user’s commands and time intervals
  - characterize the patterns for each user
  - model the variability in these patterns
  - classify (online) any new user by similarity to stored patterns





## 4. Machine Translation

- Language problems in international business
  - e.g., at a meeting of Japanese, Korean, Vietnamese and Swedish investors, no common language
  - If you are shipping your software manuals to 127 countries, the solution is ; hire translators to translate
  - would be much cheaper if a machine could do this!
- How hard is automated translation
  - very difficult!
  - e.g., English to Russian
  - not only must the words be translated, but their meaning also!





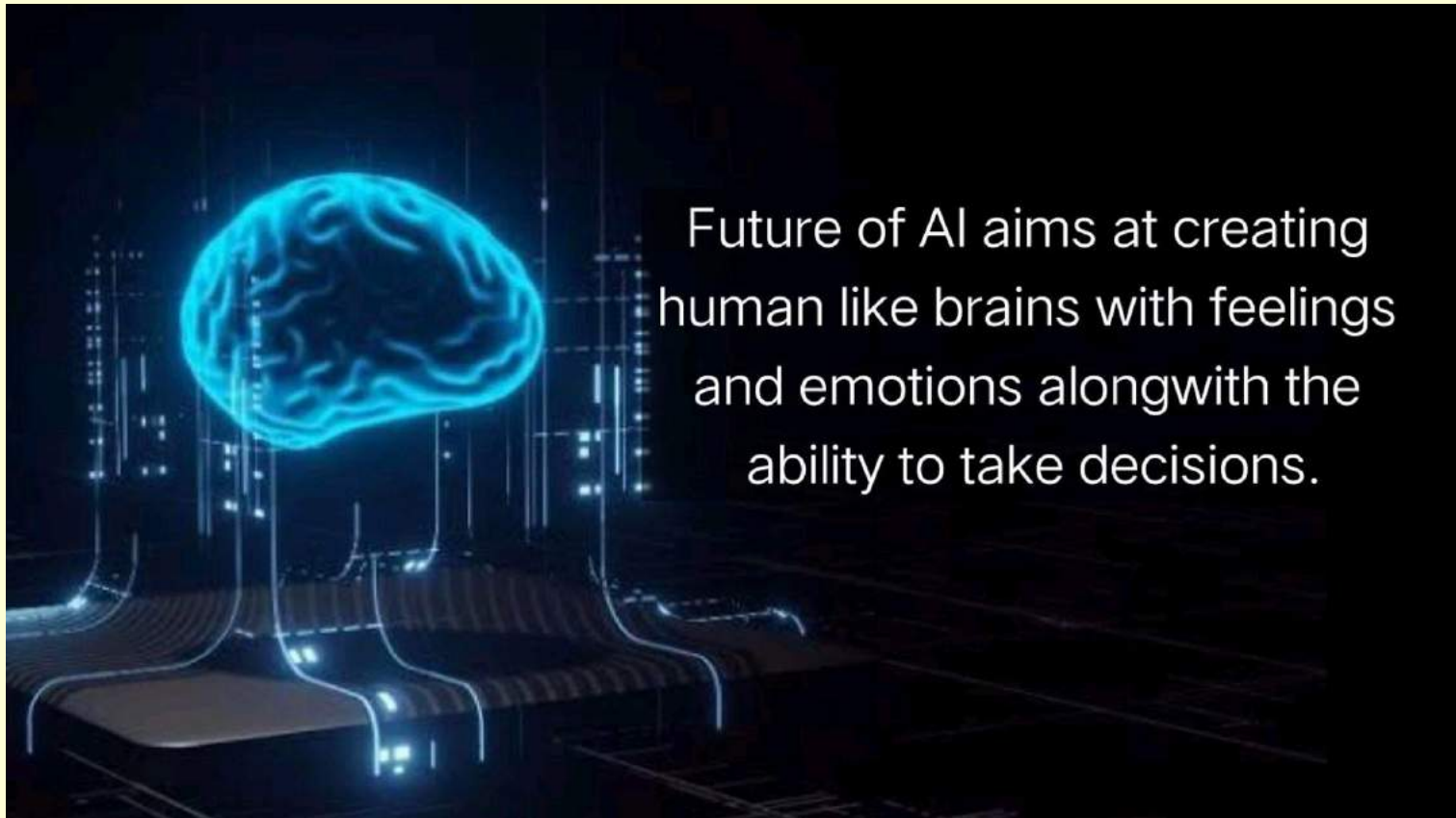
**Artificial intelligence has acted as the main driver of emerging technologies like - big data, robotics and IoT etc. including other sectors impacting us.**

- ❑ **Transportation:** Although it could take a decade or more to perfect them, autonomous cars will one day ferry us from place to place.
- ❑ **Manufacturing:** AI powered robots work alongside humans to perform a limited range of tasks like assembly and stacking, and predictive analysis sensors keep equipment running smoothly.
- ❑ **Healthcare:** In the comparatively AI-nascent field of healthcare, diseases are more quickly and accurately diagnosed, drug discovery is sped up and streamlined, virtual nursing assistants monitor patients and big data analysis helps to create a more personalized patient experience.



- ❑ **Education:** Textbooks are digitized with the help of AI, early-stage virtual tutors assist human instructors and facial analysis gauges the emotions of students to help determine who's struggling or bored and better tailor the experience to their individual needs.
- ❑ **Media:** Journalism is harnessing AI, too, and will continue to benefit from it. Bloomberg uses Cyborg technology to help make quick sense of complex financial reports. The Associated Press employs the natural language abilities of Automated Insights to produce 3,700 earning reports stories per year — nearly four times more than in the recent past.
- ❑ **Customer Service:** Last but hardly least, Google is working on an AI assistant that can place human-like calls to make appointments at, say, your neighborhood hair salon. In addition to words, the system understands context and nuance.

# Future of AI



Future of AI aims at creating human like brains with feelings and emotions alongwith the ability to take decisions.



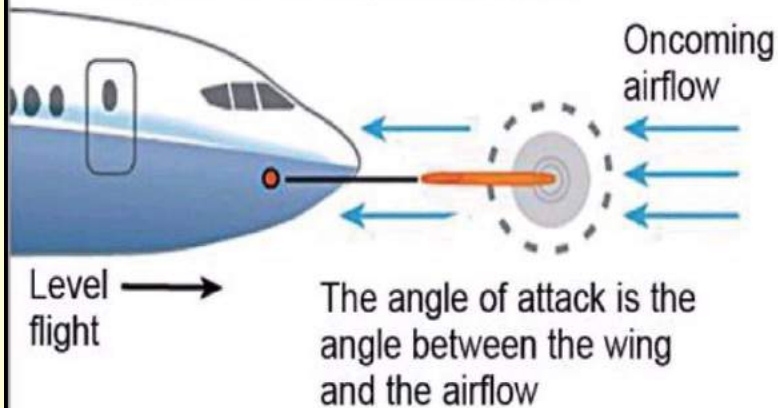


*The future of AI in health care could include tasks that range from simple to complex—everything from answering the phone to medical record review, population health trending and analytics,*

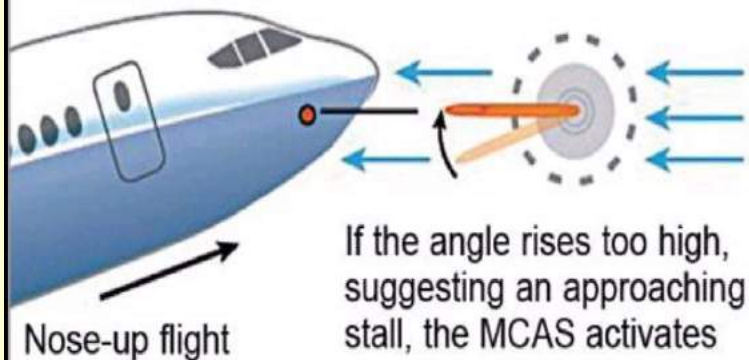
*therapeutic drug and device design, reading radiology images, making clinical diagnoses and treatment plans, and even talking with patients.*

# Future of AI

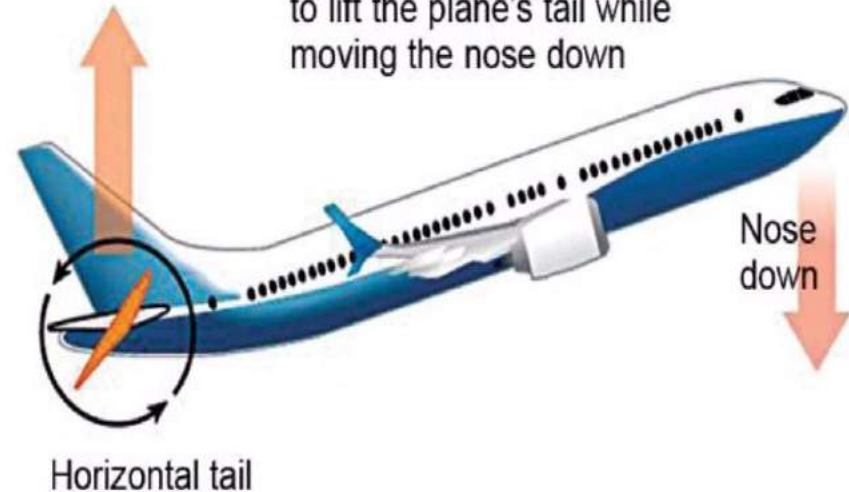
1. The angle-of-attack sensor aligns itself with oncoming airflow



2. Data from the sensor is sent to the flight computer



3. MCAS automatically swivels the horizontal tail to lift the plane's tail while moving the nose down



*AI can take airlines to next level in future*



## AI in Media

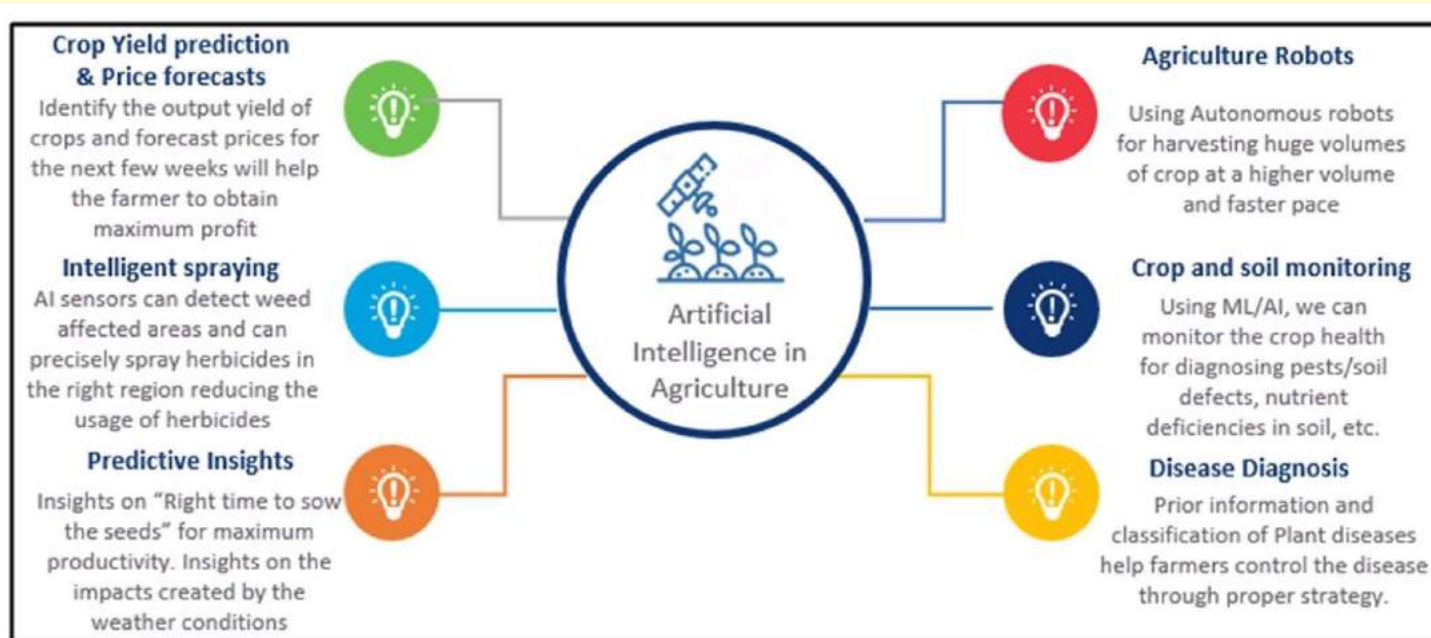


*AI is not currently in a position to create content on its own, even though we do have such examples available. (In the movie “Zone Out,” AI was responsible for everything from script writing to video editing).*





## AI in Agriculture



*Role of AI for agricultural development:  
now and in future*



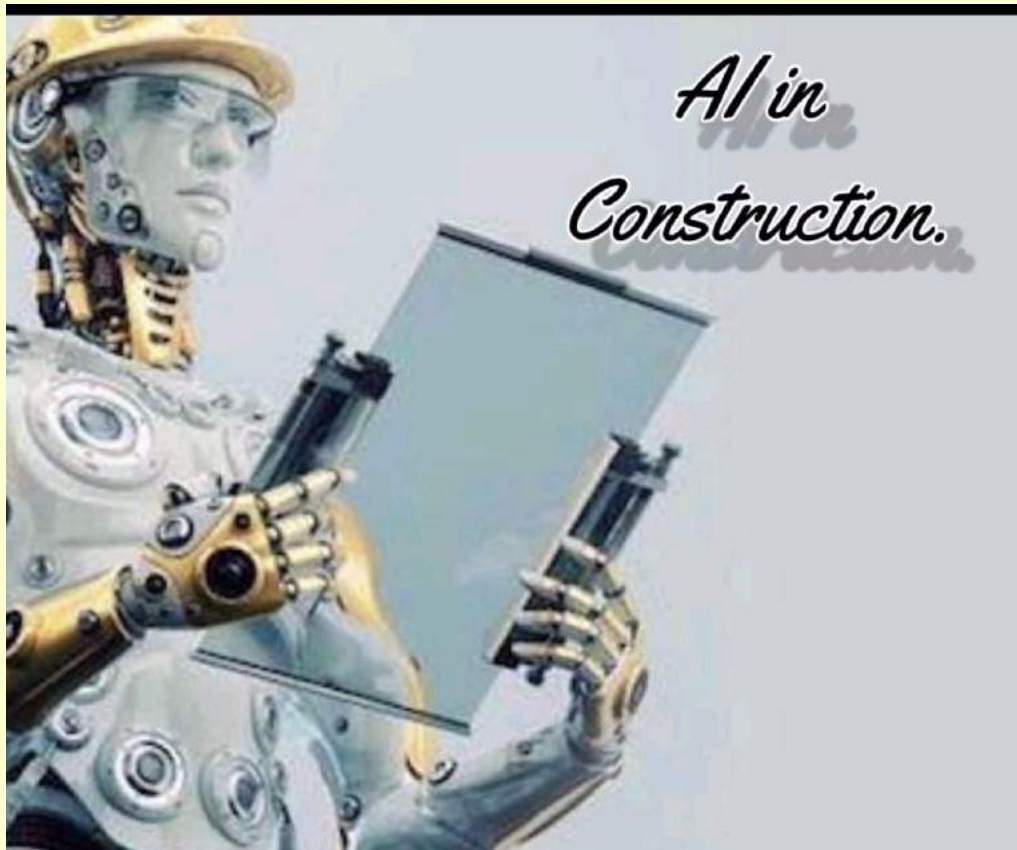
## AI in Transportation

Technology making driving safer. ... Using AI-powered facial technology, these systems can alert the driver or even control the vehicle if it detects that the driver





## AI in Construction



*A recent  
McKinsey study  
called  
artificial  
intelligence  
“construction  
technology’s next  
frontier.”*

# Future of AI in education





## AI in Customer Service

### *AI in Customer service*

*AI technologies must be able to understand human speech and emotional nuances at a deeper level to solve complex customer problems.*





## AI will outperform human

*Future of privacy & human rights.*

*Many AI experts believe  
that AI will outperform  
humans in next 45 years*





## Parallel Universe

### *Concept of Parallel Universe*



*Artificial intelligence (AI)  
supports the idea  
of parallel universes  
beyond our own.*

*However, more research  
is needed in order to  
discover the hidden  
secrets of the multiverse*



## Metaverse

*The concept of metaverse : Future scope*

*The multiverse was coined by American philosopher William James in 1895.*

*a virtual-reality space in which users can interact with a computer-generated environment and other users*





THANK YOU