

The background of the slide is a light gray gradient. It is decorated with numerous realistic water droplets of various sizes. Some droplets are at the top left, some are scattered in the middle, and a larger cluster of droplets is on the right side. The droplets have highlights and shadows, giving them a three-dimensional appearance.

# SESSION 1

## INTRODUCTION TO AI

# INTRODUCTION

- ❑ Intelligence : “The capacity to learn and solve problems.”
- ❑ Artificial Intelligence : Artificial Intelligence (AI) is the simulation of human intelligence by machines.
  - 1) The ability to solve problems.
  - 2) The ability to act rationally.
  - 3) The ability to act like humans.
- ❑ The central principles of AI include :
  - 1) Reasoning, knowledge, planning, learning and communication.
  - 2) Perception and the ability to move and manipulate objects.
  - 3) It is the science and engineering of making intelligent machines, especially intelligent computer programs



# DEFINITION

- Computers with the ability to mimic or duplicate the functions of the human brain.
- Artificial Intelligence is the intelligence of machines and the branch of computer science which aims to create it.
- "The branch of computer science that is concerned with the automation of intelligent behaviour" (Luger and Stubblefield. 1993).

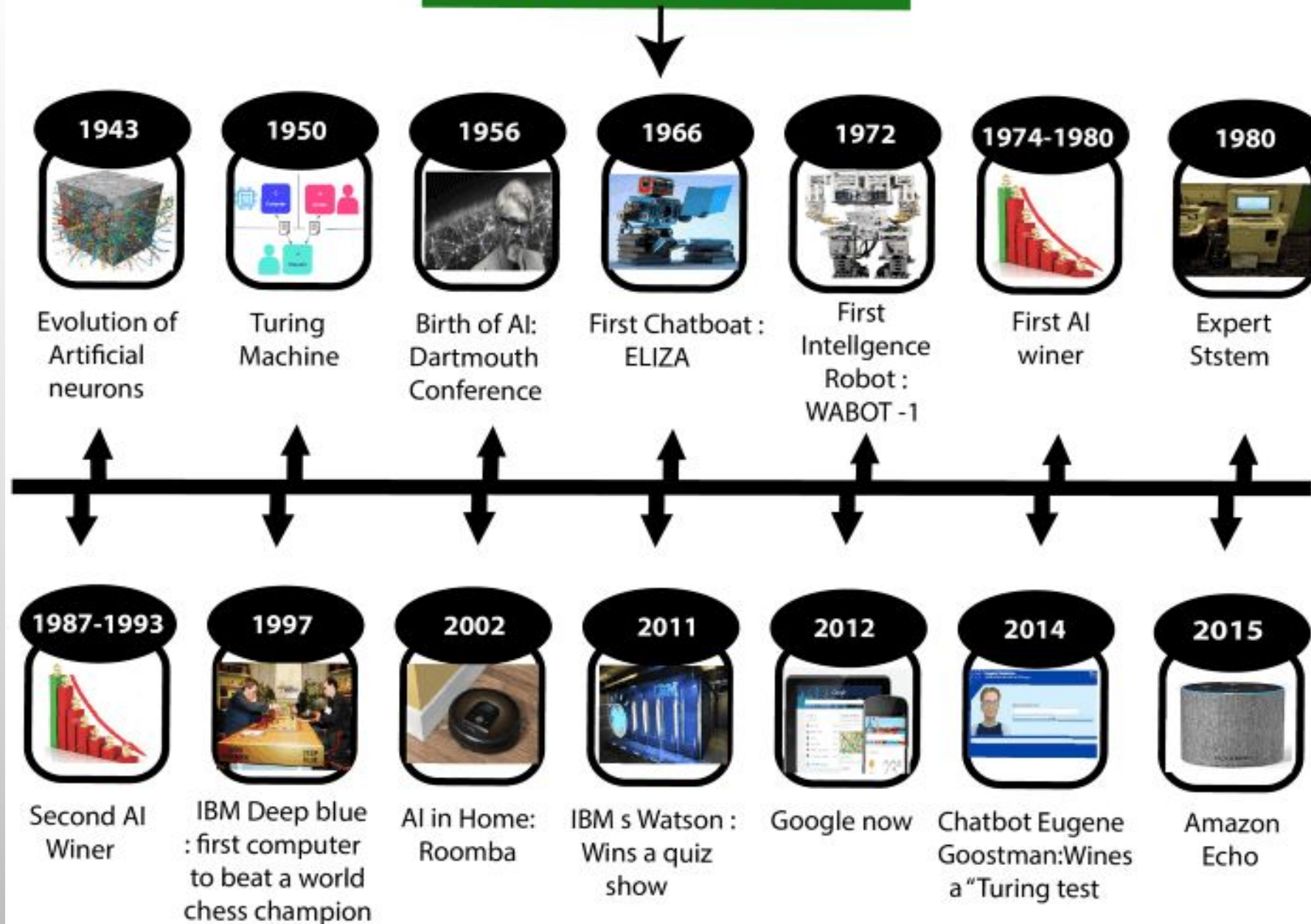
# History of Artificial Intelligence

In 1950 Alan Turing proposed the Turing Test as a measure of machine intelligence and it is still used today to determine a machine's ability to "think" like a human.



*Turing said that if the interrogator couldn't distinguish between them simply by the answers given then we could call the computer intelligent as it "thinks" and answers like a person*

# History of AI





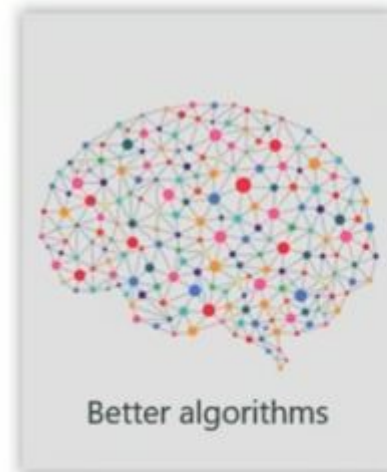
## DEMAND FOR AI



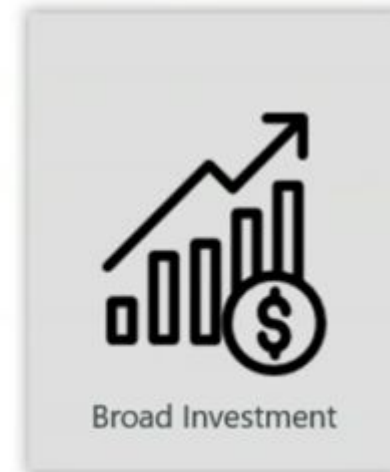
## More Computational Power



More Data



## Better algorithms



### Broad Investment

# AI: GOALS

- AMBITIOUS GOALS:
  - UNDERSTAND “INTELLIGENT” BEHAVIOR
  - BUILD “INTELLIGENT” AGENTS / ARTIFACTS
  - AUTONOMOUS SYSTEMS
  - UNDERSTAND HUMAN COGNITION (LEARNING,  
REASONING, PLANNING, AND DECISION MAKING)
  - AS A COMPUTATIONAL PROCESS.

# Thinking

- A mental activity, is directed at solving a problem, making inferences, judging certain facts, and deciding and choosing between options.
- Base of all cognitive activities or processes and is unique to human beings
- Manipulation and analysis of the information received from the environment.
- Thinking relies on knowledge
- Problem solving is thinking that is goal oriented.
- Process of recall and application of information recalled.



# WHAT IS AI?

Views of AI fall into four different perspectives --- two dimensions:

- 1) Thinking versus Acting
- 2) Human versus Rational (which is “easier”?)

**Human-like  
Intelligence**

**“Ideal” Intelligent/  
Pure Rationality**

**Thought/  
Reasoning**  
 (“modeling thought /  
brain)

**Behavior/  
Actions**

**“behaviorism”  
“mimics behavior”**

<b>2. Thinking humanly</b>	<b>3. Thinking Rationally</b>
<b>1. Acting Humanly</b>	<b>4. Acting Rationally</b>

# 1. ACTING HUMANLY

	Human-like Intelligence	“Ideal” Intelligent/ Rationally
Thought/ Reasoning	2. Thinking humanly	3. Thinking Rationally
Behavior/ Actions	1. Acting Humanly <input type="checkbox"/> Turing Test	4. Acting Rationally

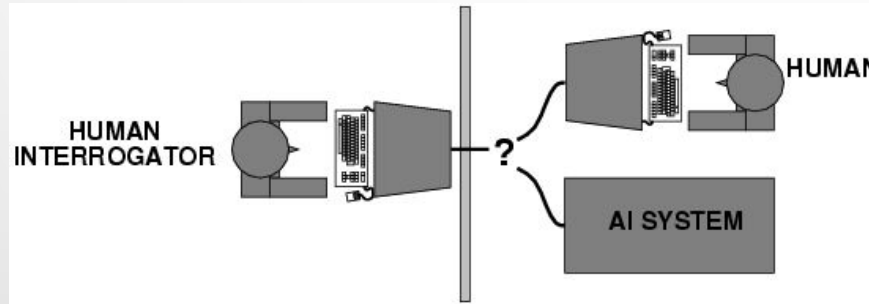


Alan Turing

# ACTING HUMANLY: TURING TEST

Turing (1950) "Computing machinery and intelligence"

- "Can machines behave intelligently?"
  - Operational test for intelligent behavior: the imitation game

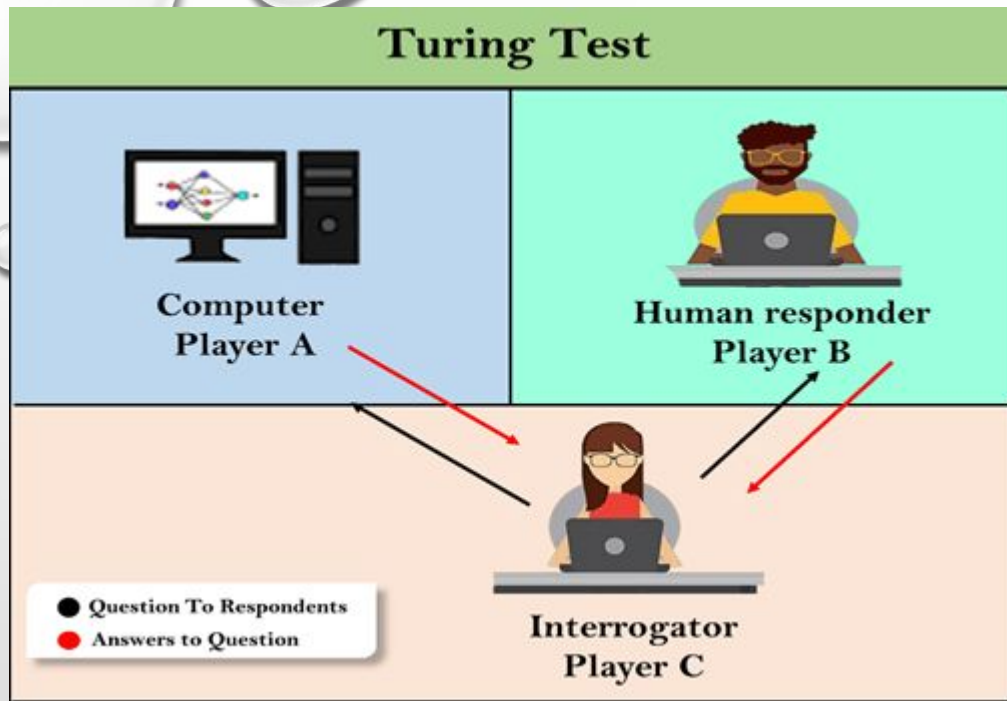


*AI system passes  
if interrogator  
cannot tell which one  
is the machine.*

(interaction via written questions)

**No computer vision or robotics or physical presence required!**

- Predicted, a machine might have a 30% chance of fooling a lay person for 5 minutes.
- But, by scientific consensus, we are still several decades away
- From truly passing the turing test (as the test was intended).



The questions and answers can be like:

Interrogator: Are you a computer?

PlayerA (Computer): No

Interrogator: Multiply two large numbers such as  
(256896489\*456725896)

Player A: Long pause and give the wrong answer.

In this game, if an interrogator would not be able to identify which is a machine and which is human, then the computer passes the test successfully, and the machine is said to be intelligent and can think like a human.

# CHATBOTS TO ATTEMPT THE TURING TEST:

- ELIZA: ELIZA was a natural language processing computer program created by joseph weizenbaum. It was created to demonstrate the ability of communication between machine and humans. It was one of the first chatterbots, which has attempted the turing test.
- Parry: parry was a chatterbot created by kenneth colby in 1972. Parry was designed to simulate a person with paranoid schizophrenia(most common chronic mental disorder). Parry was described as "ELIZA with attitude." Parry was tested using a variation of the turing test in the early 1970s.
- Eugene goostman: eugene goostman was a chatbot developed in saint petersburg in 2001. This bot has competed in the various number of turing test. In june 2012, at an event, goostman won the competition promoted as largest-ever turing test content, in which it has convinced 29% of judges that it was a human.Goostman resembled as a 13-year old virtual boy.

# THE CHINESE ROOM ARGUMENT

- There were many philosophers who really disagreed with the complete concept of Artificial Intelligence. The most famous argument in this list was "Chinese Room."
- In the year 1980, John Searle presented "Chinese Room" thought experiment, in his paper "Mind, Brains, and Program," which was against the validity of Turing's Test. According to his argument, "Programming a computer may make it to understand a language, but it will not produce a real understanding of language or consciousness in a computer."
- He argued that Machine such as ELIZA and Parry could easily pass the Turing test by manipulating keywords and symbol, but they had no real understanding of language. So it cannot be described as "thinking" capability of a machine such as a human.



# ELIZA: IMPERSONATING A ROGERIAN PSYCHOTHERAPIST

1960s ELIZA Joseph  
Weizenbaum

www-ai.ijs.si/eliza/eliza.html

**ELIZA - a friend you could never have before**

Eliza: Hello. I am ELIZA. How can I help you?

Submit Query

**You: Well, I feel sad**

**Eliza: Do you often feel  
sad?**

**You: not very often.**

**Eliza: Please go on.**



## 2. THINKING HUMANLY

	Human-like Intelligence	“Ideal” Intelligent/ Rationally
Thought/ Reasoning	2. Thinking humanly <input type="checkbox"/> <b>Cognitive Modeling</b>	Thinking Rationally
Behavior/ Actions	Acting Humanly <input type="checkbox"/> Turing Test	Acting Rationally

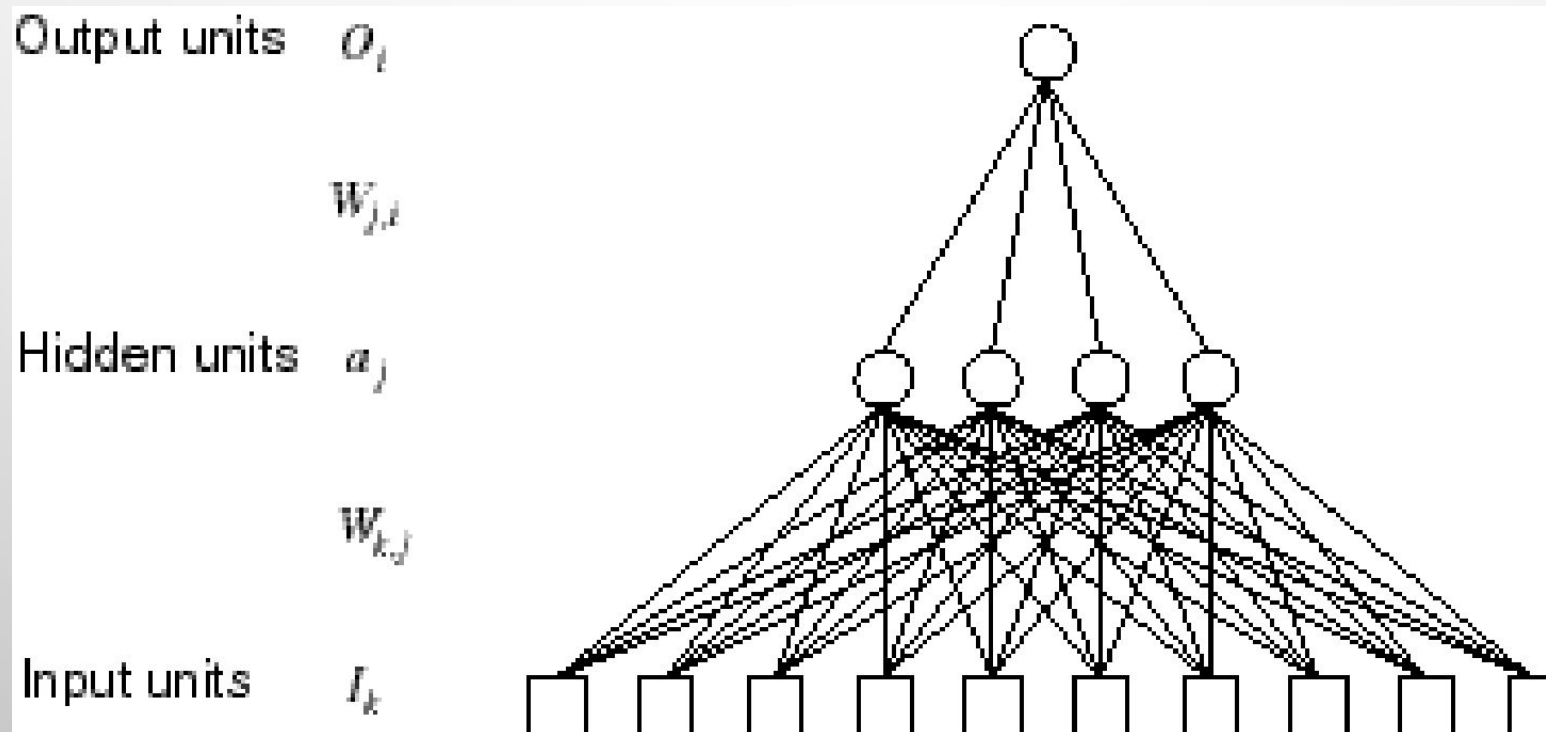
# THINKING HUMANLY

- Cognitive Revolution (1960s)
- Information-processing Psychology Replaced
- Prevailing Orthodoxy Of Behaviorism
- Requires Scientific Theories Of Internal Activities Of The Brain . . .
- – What Level Of Abstraction?
- – “Knowledge” Or “Circuits”?
- And Validation
- – Predicting And Testing Behavior Of Human Subjects (Top-down)
- ⇒ Cognitive Science
- – Direct Identification From Neurological Data (Bottom-up)
- ⇒ Cognitive Neuroscience

- So,
- In near future, we can have computers with as many processing elements as our brain, but:
  - Far fewer interconnections (wires or synapses)
  - Then again, much faster updates.
- Fundamentally different hardware may
- Require fundamentally different algorithms!
- Still an open question.
- Neural net research.
- Can a digital computer simulate our brain?

# AN ARTIFICIAL NEURAL NETWORK (PERCEPTRONS)

Output Unit



Input Units

# 3. THINKING RATIONALLY

	Human-like Intelligence	“Ideal” Intelligent/ Rationally
Thought/ Reasoning	Thinking humanly <input type="checkbox"/> Cognitive Modeling	<b>3. Thinking Rationally</b> <input type="checkbox"/> <b>formalizing “Laws of Thought”</b>
Behavior/ Actions	Acting Humanly <input type="checkbox"/> Turing Test	Acting Rationally



# 3. THINKING RATIONALLY

- The Study Of Mental Faculties Through The Use Of Computational Models; That It Is, The Study Of Computations That Make It Possible To Perceive Reason And Act. Several Greek Schools Developed Various Forms Of Logic:
  - – Notation
  - – Rules Of Derivation (Syllogisms)
- Direct Line Through Mathematics And Philosophy To Modern Ai
- Eg
- “SOCRATES IS A MAN. ALL MEN ARE MORTAL. THEREFORE SOCRATES IS MORTAL”

# Rational Agents

## Agent

- An entity that perceives and acts
- A useful way to think about building AI programs is in terms of designing (and implementing) rational agents
- Abstract definition
- An agent is a function from percept histories to actions:
- $f : P^* \rightarrow A$

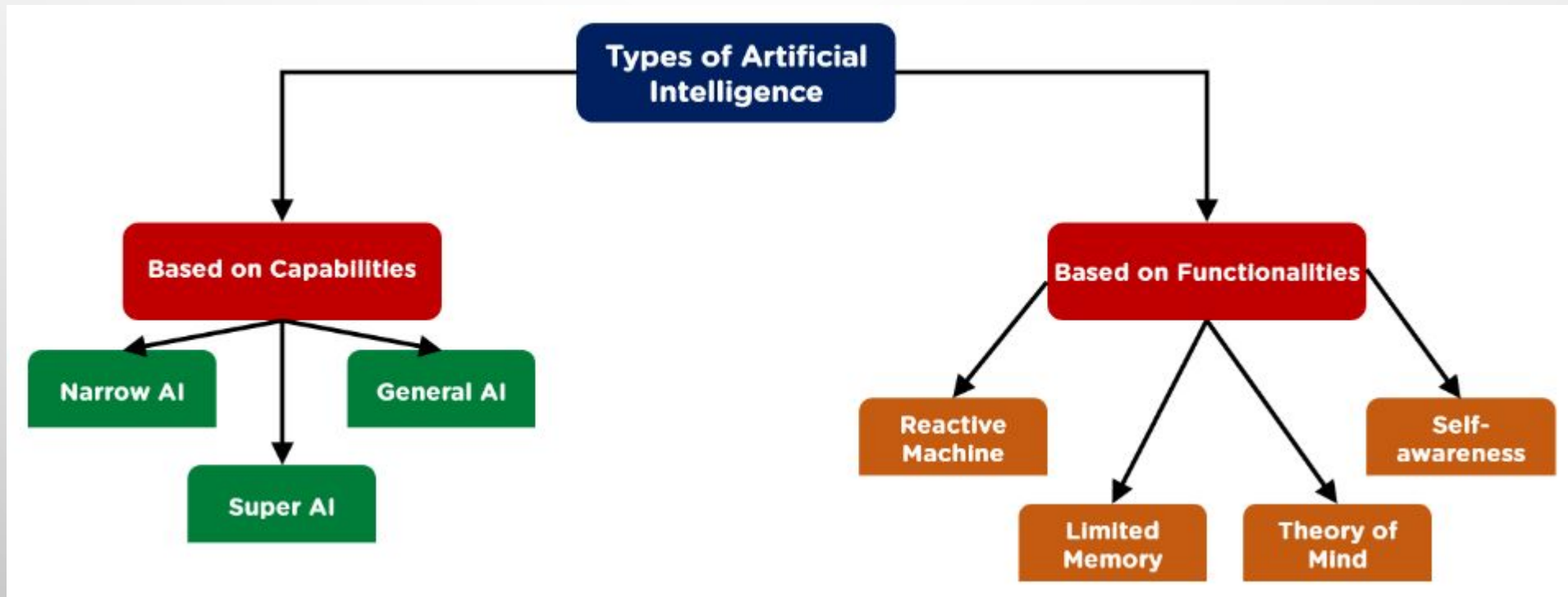
# 4. ACTING RATIONALLY

	Human-like Intelligence	“Ideal” Intelligent/ Rationally
Thought/ Reasoning	Thinking humanly <input type="checkbox"/> Cognitive Modeling	Thinking Rationally <input type="checkbox"/> formalizing ”Laws of Thought”
Behavior/ Actions	Acting Humanly <input type="checkbox"/> Turing Test	<b>Acting Rationally</b>

# Acting Rationally

- Acting Rationally Means Acting To Achieve One's Goals, Given One's Beliefs Or Understanding About The World.
- When Constructing An Intelligent Agent, Emphasis Shifts From Designing The Theoretically Best Decision-making Procedure To Designing The Best Decision-making Procedure Possible Within The Circumstances In Which The Agent Is Acting.
- Logical Approaches May Be Used To Help Find The Best Action, But There Are Also Other Approaches.
- Achieving So-called “Perfect Rationality”, Making The Best Decision Theoretically Possible, Is Not Usually Possible Due To Limited Resources In A Real Environment (E.G., Time, Memory, Computational Power, Uncertainty, Etc.).
- The Trick Is To Do The Best With The Information And Resources You Have. This Represents A Shift In The Field Of AI From Optimizing (Early AI) To Satisfying (More Recent AI).

# TYPES OF ARTIFICIAL INTELLIGENCE



# TYPES OF ARTIFICIAL INTELLIGENCE-TYPE 1

- Narrow AI is a type of AI which is able to perform a dedicated task with intelligence. The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.
- Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.
- Apple Siri a good example of Narrow AI, but it operates with a limited pre-defined range of functions.
- IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.
- Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.



# WEAK AI VS STRONG AI

Weak AI	Strong AI
Weak AI is simply the view that intelligent behavior can be modeled and used by computers to solve complex problems.	Strong AI refers to a hypothetical machine that exhibits human cognitive abilities.
Weak AI refers to systems that are programmed to accomplish a wide range problems but operate within a pre-defined range of functions.	Strong AI refers to machines with the mind of their own and which can think and accomplish complex tasks on their own.
Weak AI-powered machines do not have mind of their own.	Strong AI-powered machines can exhibit strong human cognitive abilities.
Alexa and Siri are the best examples of weak AI programs.	Strong AI is a hypothetical concept which does not exist yet in its true form.

# TYPES OF ARTIFICIAL INTELLIGENCE-TYPE 1

## 2. General AI:

- General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.
- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.

## • 3. Super AI:

- Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI.
- Some key characteristics of strong AI include capability include the ability to think, to reason, solve the puzzle, make judgments, plan, learn, and communicate by its own.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.

# TYPES OF ARTIFICIAL INTELLIGENCE-TYPE 2

## 1. Reactive Machines

- Purely reactive machines are the most basic types of Artificial Intelligence.
- Such AI systems do not store memories or past experiences for future actions.
- These machines only focus on current scenarios and react on it as per possible best action.
- IBM's Deep Blue system, Google's AlphaGo is also an example of reactive machines.

## 2. Limited Memory

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

# TYPES OF ARTIFICIAL INTELLIGENCE-TYPE 2

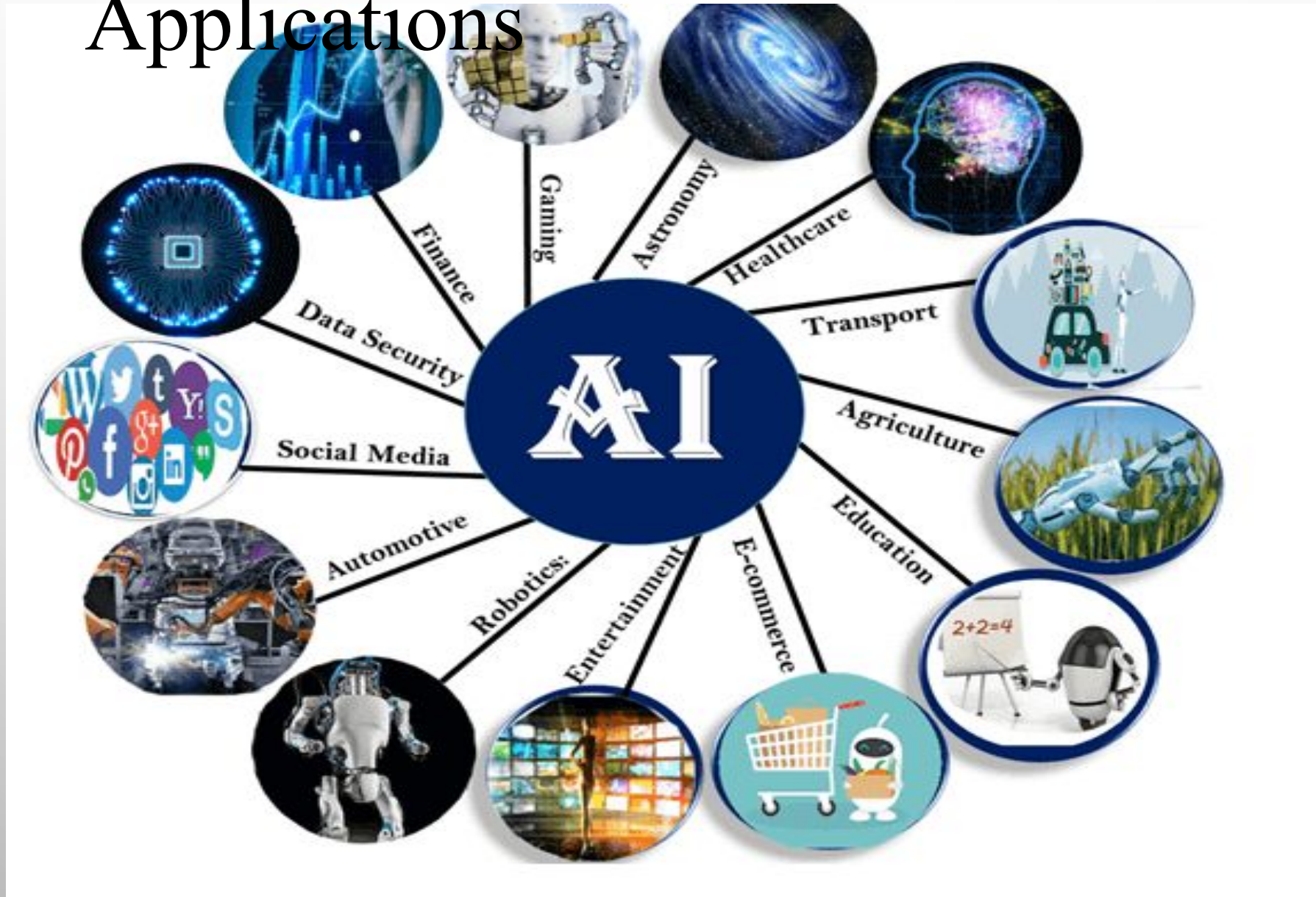
## 3. Theory of Mind

- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.
- Eg One real-world example of the theory of mind AI is Kismet, Sophia from Hanson Robotics

## 4. Self-Awareness

- Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

# Artificial Intelligence Applications





# TRANSPORT

## Driverless Cars



## Google's Driverless Car



## Google's Driverless Car (2011)



## Driverless Cars

### DARPA Grand Challenges

DARPA Grand Challenge I  
Barstow to Primm  
March 13, 2004



142 miles  
10 hours

DARPA Grand Challenge II  
Desert Classic  
October 8, 2005



132 miles  
10 hours

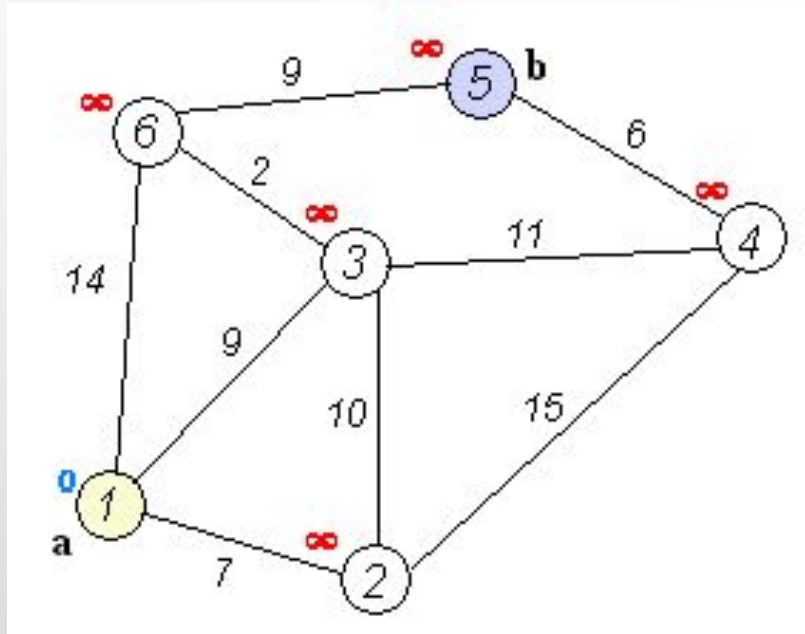
DARPA Grand Challenge III  
Urban Challenge  
November 3, 2007



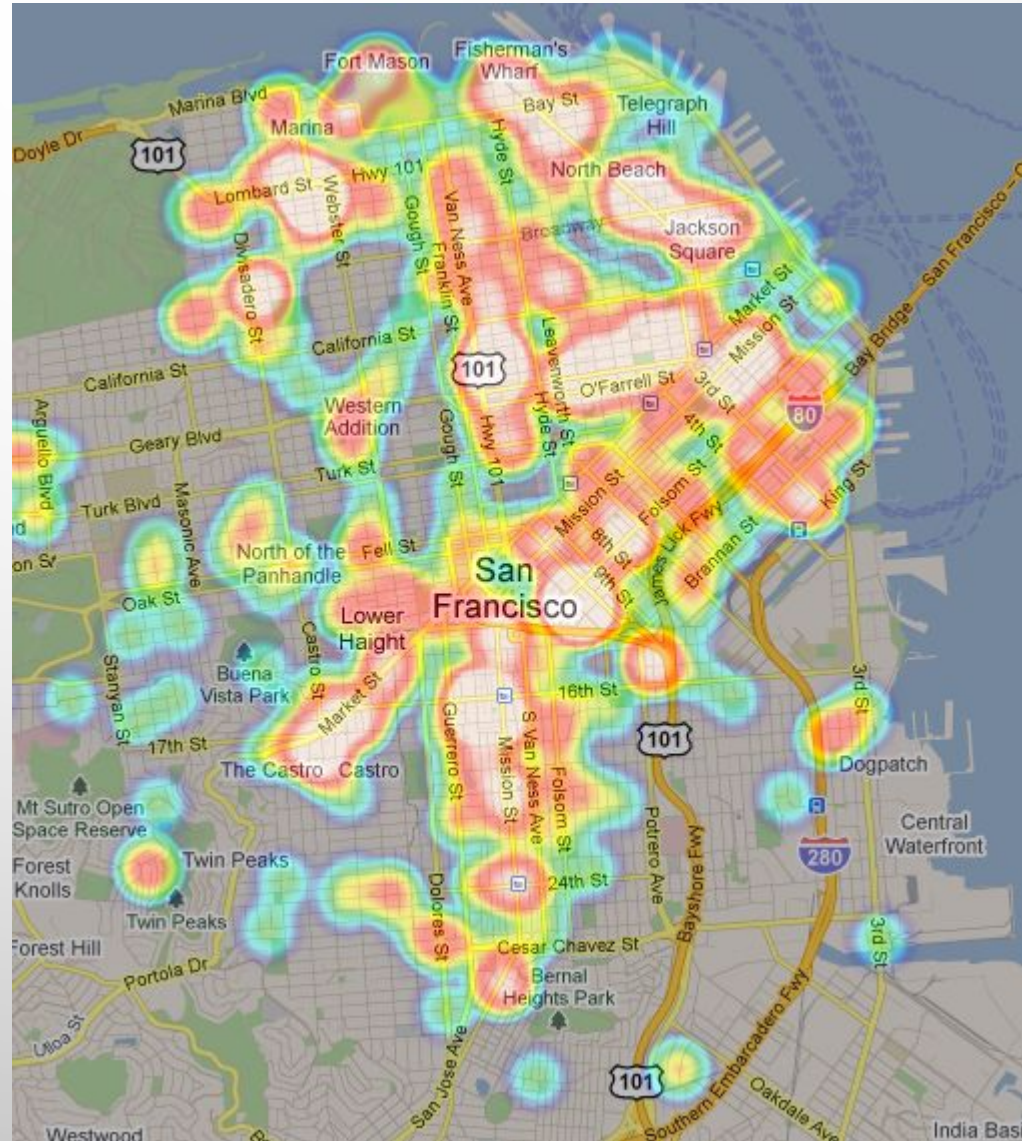
60 miles  
6 hours



# TRANSPORT



Google's AI-Powered Predictions



# Smart Personal Assistants

## Artificial Intelligence Applications



IBM Watson, a natural language question answering computer, competes on Jeopardy! and defeats two former champions.

## Question Answering Systems

### Apple Siri



Speech recognition and language understanding

# Smart Personal Assistants

Amazon Expanded Upon This Model With The Announcement Of Complimentary Hardware And Software Components:

- Alexa, An Ai-powered Personal Assistant That Accepts Voice Commands To Create To-do Lists, Order Items Online, Set Reminders, And Answer Questions (Via Internet Searches)
- Echo (And Later, Dot) Smart Speakers That Allow You To Integrate Alexa Into Your Living Room And Use Voice Commands To Ask Natural Language Questions, Play Music, Order Pizza, Hail An Uber, And Integrate With Smart Home Devices.
- Microsoft Has Followed Suit With Cortana, Its Own AI Assistant That Comes Pre-loaded On Windows Computers And Microsoft Smartphones.



# GAMING

## Artificial Intelligence Applications



Google DeepMind's **AlphaGo** defeats Go champion **Lee Sedol** which AI researcher thought was not possible to achieve in next 20 years

Tactics used by **AlphaGo** are taught to GO players during their training



### Robots Playing Soccer



# FINANCE

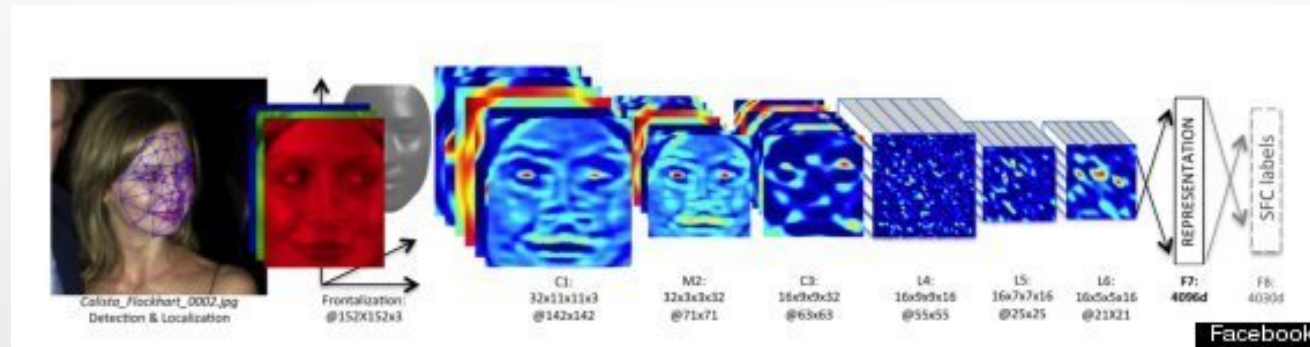


Mobile Check Deposits  
Fraud Prevention  
Credit Decisions



- *Algorithmic Trading*
- *Market Analysis and Data Mining*
- *Personal Finance*
- *Portfolio Management*
- *Underwriting*

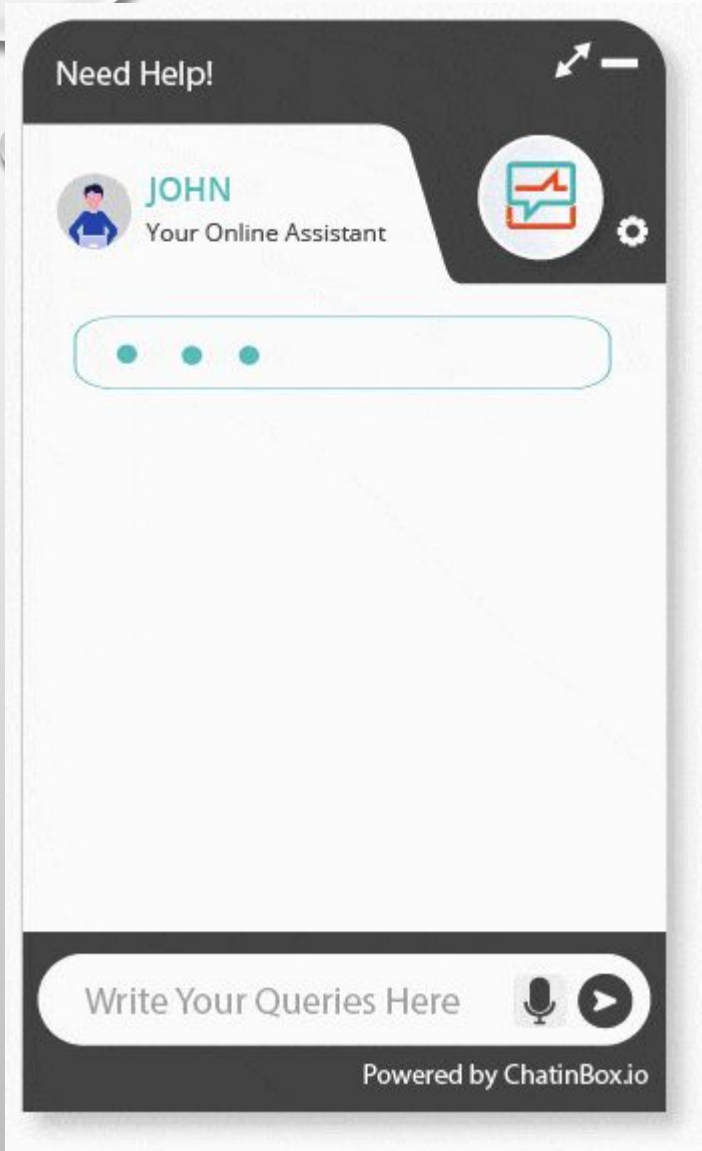
# SOCIAL MEDIA



- Facebook's facial recognition
- Pinterest: automatically identify objects in images (or “pins”) and then recommend visually similar pins. Other applications of machine learning at Pinterest include spam prevention, search and discovery, ad performance and monetization, and email marketing.
- Instagram: to identify the contextual meaning of emoji, which have been steadily replacing slang
- snapchat: filters track facial movements, allowing users to add animated effects or digital masks that adjust when their faces moved.

# ONLINE SHOPPING

- Search
- Recommendations
- Fraud Protection



# Grading and Assessment

- Plagiarism Checkers

Many high school and college students are familiar with services like *Turnitin*, a popular tool used by instructors to analyze students' writing for plagiarism.

- Robo-readers

Essay grading is very labor intensive, which has encouraged researchers and companies to build essay-grading AIs.

The Graduate Record Exam (GRE), the primary test used for graduate school, grades essays using one human reader and one robo-reader called *e-Rater*.





# Health Sector

A deep learning model named COVID-19 detection neural network (COVNet), was developed to extract visual features from 4,356 computed tomography (CT) exams from 3,322 patients for the detection of COVID-19.

- Early detection and epidemic analysis
- Containment
- Triage and diagnosis

# SOME AI PROBLEMS ARE VERY HARD


## CAPTCHA

Completely Automated Public Turing test to tell Computers and Humans Apart



## CAPTCHA

- The "anti-Turing test"
- Tell human and machines apart, *automatically*
  - Deny spam-bots free email registration
  - Protect online poll from vote-bots
- By asking an "AI-complete" question

Random string  
oamg →  → What do you see?

- Also audio Captcha's, e.g., superimposed speakers
- <http://www.captcha.net/>

[Luis von Ahn, IAAI/CAI 2003 keynote]

# HUMANOID ROBOT

- Sophia is a social humanoid robot developed by Hong Kong based company Hanson Robotics.
- Sophia was activated on April 19, 2015.
- She made her first public appearance at South by Southwest Festival in mid-March 2016 in United States.
- In October 2017 Sophia became a Saudi Arabian citizen, the first robot to receive citizenship in any country.



# ADVANTAGES N DISADVANTAGES

## □ Advantages :

- More powerful and more useful computers.
- New and improved interfaces.
- Solving new problems.
- Better handling of information.
- Relieves information overload.
- Conversion of information into knowledge.

## □ Disadvantages :

- Increased costs
- Difficulty with software development - slow and expensive
- Few experienced programmers
- Few practical products have reached the market as yet.

# KEY RESEARCH AREAS IN AI

- Problem Solving, Planning, And Search --- Generic Problem Solving Architecture Based On Ideas From Cognitive Science (Game Playing, Robotics).
- Knowledge Representation – To Store And Manipulate Information (Logical And Probabilistic Representations)
- Automated Reasoning / Inference – To Use The Stored Information To Answer Questions And Draw New Conclusions
- Machine Learning – Intelligence From Data; To Adapt To New Circumstances And To Detect And Extrapolate Patterns
- Natural Language Processing – To Communicate With The Machine
- Computer Vision --- Processing Visual Information
- Robotics --- Autonomy, Manipulation, Full Integration Of AI Capabilities