UNIT-1

BASICS OF ARTIFICIAL INTELLIGENCE

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WHAT IS AI

- ARTIFICIAL INTELLIGENCE (AI) REFERS TO THE SIMULATION OF HUMAN INTELLIGENCE IN MACHINES THAT ARE PROGRAMMED TO THINK LIKE HUMANS AND MIMIC THEIR ACTIONS.

HISTORY OF AI

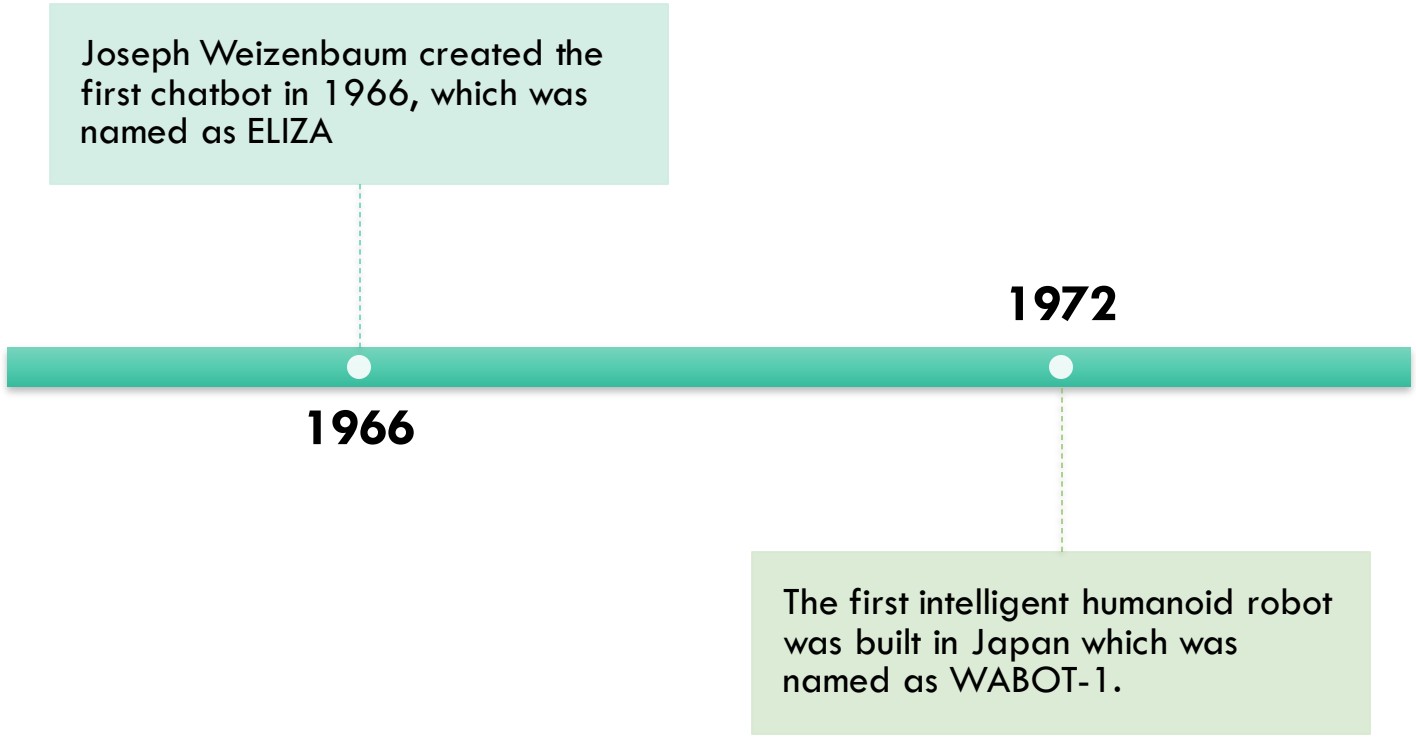
- THE FIRST WORK WHICH IS NOW RECOGNIZED AS AI WAS DONE BY WARREN MCCULLOCH AND WALTER PITS IN 1943. THEY PROPOSED A MODEL OF **ARTIFICIAL NEURONS**.
- DONALD HEBB DEMONSTRATED AN UPDATING RULE FOR MODIFYING THE CONNECTION STRENGTH BETWEEN NEURONS. HIS RULE IS NOW CALLED **HEBBIAN LEARNING**. (1949)
- ALAN TURING PUBLISHES **"COMPUTING MACHINERY AND INTELLIGENCE"** IN WHICH HE PROPOSED A TEST. THE TEST CAN CHECK THE MACHINE'S ABILITY TO EXHIBIT INTELLIGENT BEHAVIOR EQUIVALENT TO HUMAN INTELLIGENCE, CALLED A **TURING TEST**.(1950)

THE BIRTH OF ARTIFICIAL INTELLIGENCE (1952-1956)

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. (1955)

The word "Artificial Intelligence" first adopted by American Computer scientist **John McCarthy** at the Dartmouth Conference. (1956)

THE GOLDEN YEARS-EARLY ENTHUSIASM (1956-1974)



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.

A BOOM OF AI (1980-1987)

AI came back with "Expert System". Expert systems were programmed that emulate the decision-making ability of a human expert.

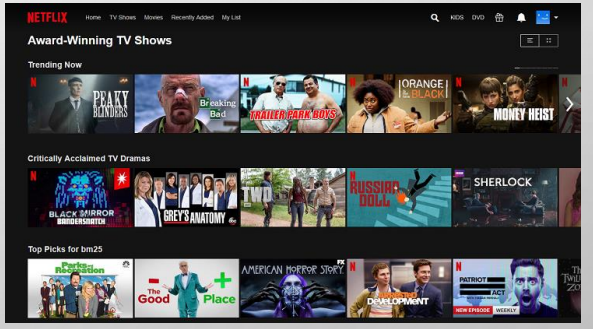
the first national conference of the American Association of Artificial Intelligence **was held at Stanford University**. (1980)

THE SECOND AI WINTER (1987-1993)

- 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.

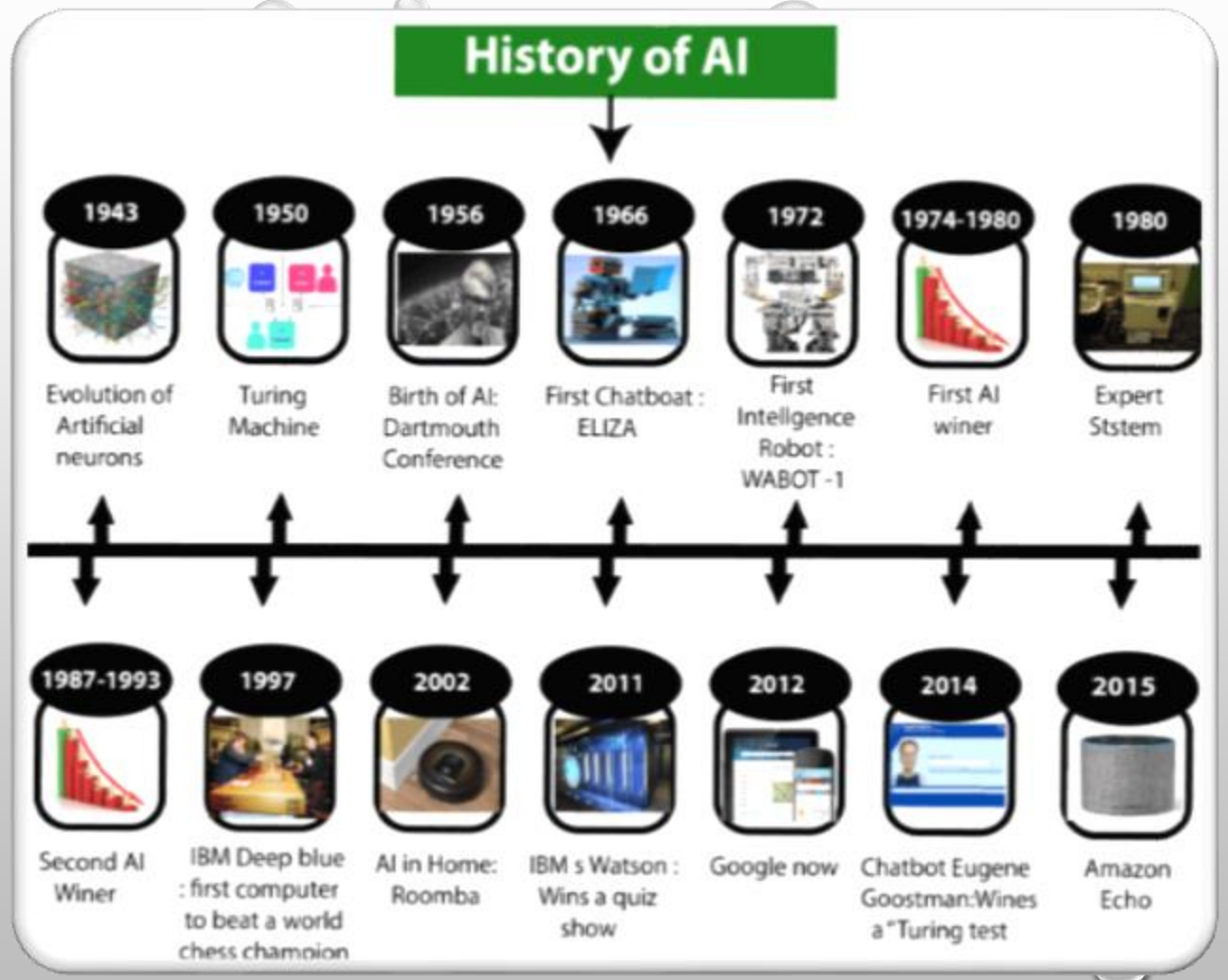
THE EMERGENCE OF INTELLIGENT AGENTS (1993-2011)

- IBM DEEP BLUE BEATS WORLD CHESS CHAMPION, GARY KASPAROV, AND BECAME THE FIRST COMPUTER TO BEAT A WORLD CHESS CHAMPION. (1997)
- AI ENTERED THE HOME IN THE FORM OF ROOMBA, A VACUUM CLEANER. (2002)



DEEP LEARNING, BIG DATA AND ARTIFICIAL GENERAL INTELLIGENCE (2011-2018)

- 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. (2011)
- GOOGLE HAS LAUNCHED AN ANDROID APP FEATURE "GOOGLE NOW", WHICH WAS ABLE TO PROVIDE INFORMATION TO THE USER AS A PREDICTION. (2012)
- CHATBOT "EUGENE GOOSTMAN" WON A COMPETITION IN THE INFAMOUS "TURING TEST." (2014)
- THE "PROJECT DEBATER" FROM IBM DEBATED ON COMPLEX TOPICS WITH TWO MASTER DEBATERS AND ALSO PERFORMED EXTREMELY WELL. (2018)



HISTORY OF AI

CURRENT STATUS OF AI

- THE INTERNATIONAL CORPORATE INVESTMENT IN ARTIFICIAL INTELLIGENCE ALMOST HIT 68 BILLION USD IN 2020

  - **MEDICAL TREATMENTS AND VACCINE RESEARCH**
  - **LANGUAGE PROCESSING**
  - **IMAGE AND VIDEO PROCESSING AND GENERATION**
  - **AUTONOMOUS DRIVING**

MEDICAL TREATMENTS AND VACCINE RESEARCH

- MEDICAL LABORATORIES AND HEALTH CORPORATIONS MANAGED TO CREATE VACCINES FOR THE COVID-19 PANDEMIC THAT AFFECTED US ALL ON A GLOBAL SCALE IN JUST A FEW MONTHS WITH HELP OF AI
- IN 2021, RESEARCHERS AND BIOLOGISTS AT MIT'S DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE STARTED USING AI TO TRY TO REPURPOSE EXISTING DRUGS TO FIGHT COVID-19.
- ARTIFICIAL INTELLIGENCE HAS NOW ALSO BEEN PROVEN TO HAVE THE POTENTIAL TO REVOLUTIONIZE THE MEDICAL WORLD, BOTH IN HOW VACCINES ARE DEVELOPED AND HOW TREATMENTS ARE CREATED.

LANGUAGE PROCESSING

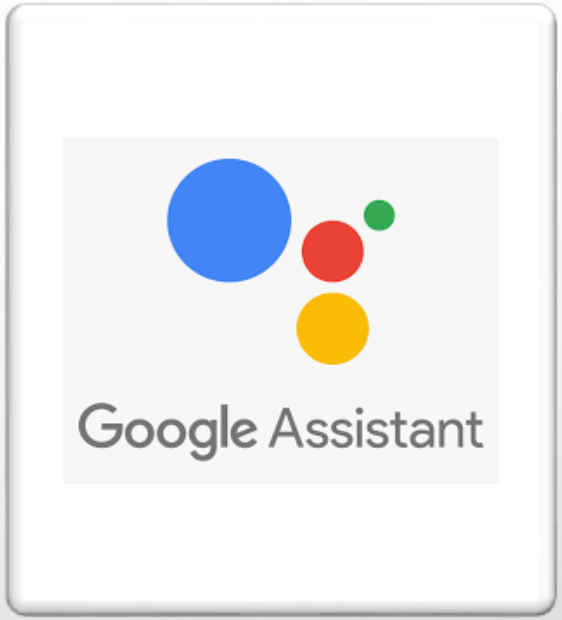
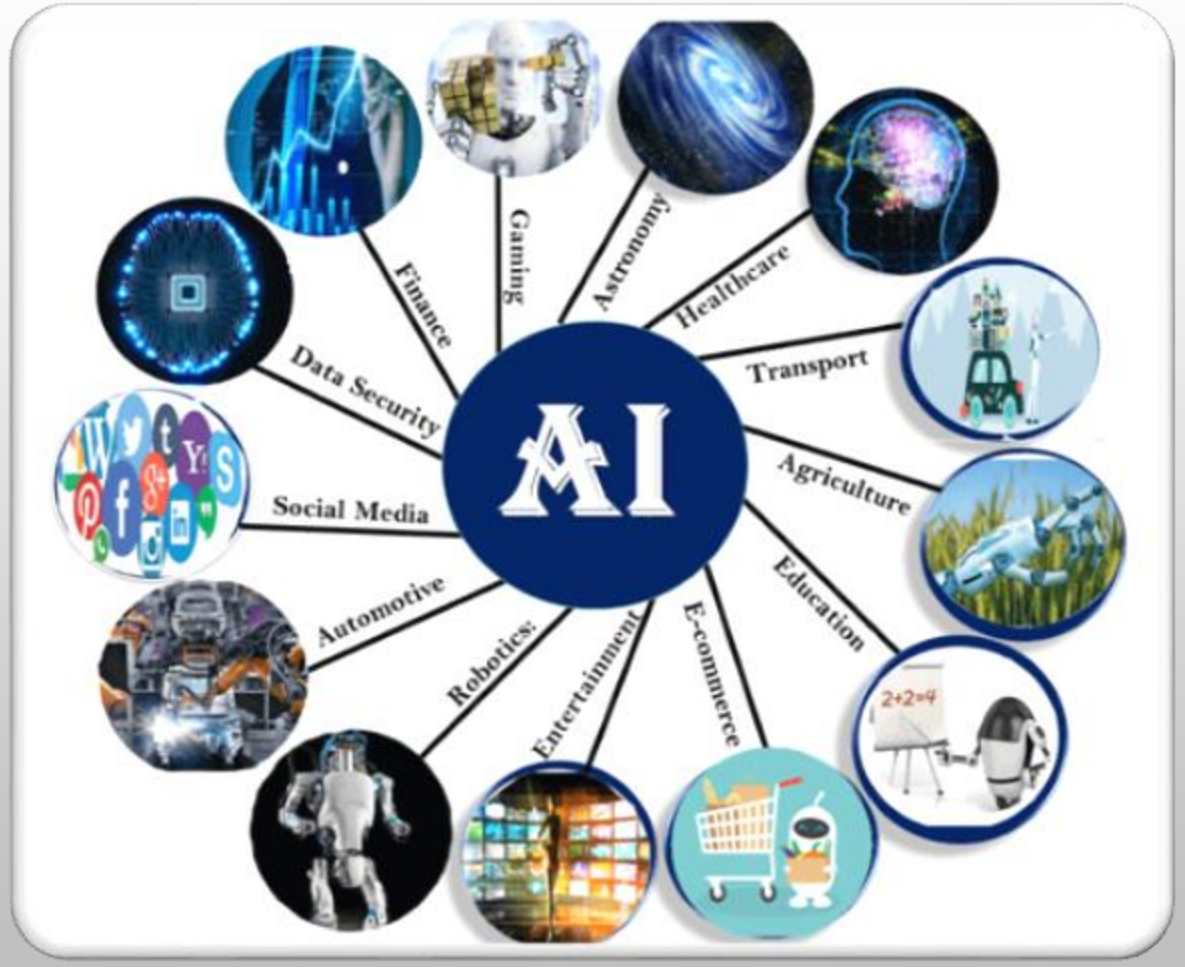


IMAGE AND VIDEO PROCESSING AND GENERATION

AUTONOMOUS DRIVING

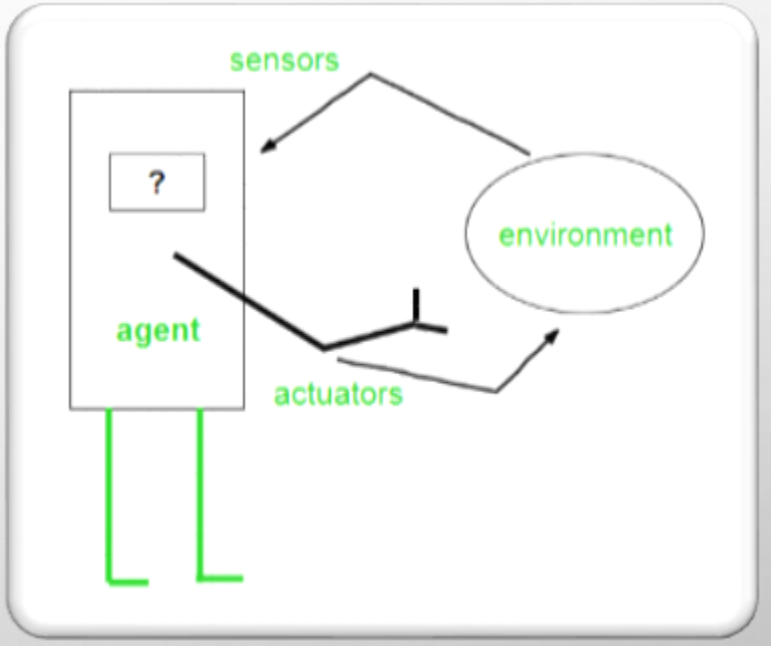
- PRACTICALLY, THE ONLY SIGNIFICANT PLAYER IN THE FULLY AUTONOMOUS DRIVING INDUSTRY IN 2021 IS WAYMO, WHICH IS LICENSED AND OPERATES VEHICLES WITHOUT A SAFETY DRIVER IN CALIFORNIA.


AI
Finance
Gaming
Astronomy
Healthcare
Transport
Agriculture
Education
E-commerce
Entertainment
Robotics
Automotive
Social Media
Data Security
2+2=4

AI SCOPE

AI AGENT

- AN AGENT CAN BE ANYTHING THAT PERCEIVE ITS ENVIRONMENT THROUGH SENSORS AND ACT UPON THAT ENVIRONMENT THROUGH ACTUATORS. AN AGENT RUNS IN THE CYCLE OF **PERCEIVING, THINKING,** AND **ACTING**.
- AGENT COULD BE ANYTHING THAT MAKES DECISIONS, AS A PERSON, FIRM, MACHINE, OR SOFTWARE.
- IT CARRIES OUT AN ACTION WITH THE BEST OUTCOME AFTER CONSIDERING PAST AND CURRENT PERCEPTS
- *AGENT = ARCHITECTURE + AGENT PROGRAM*



WHO IS AGENT?

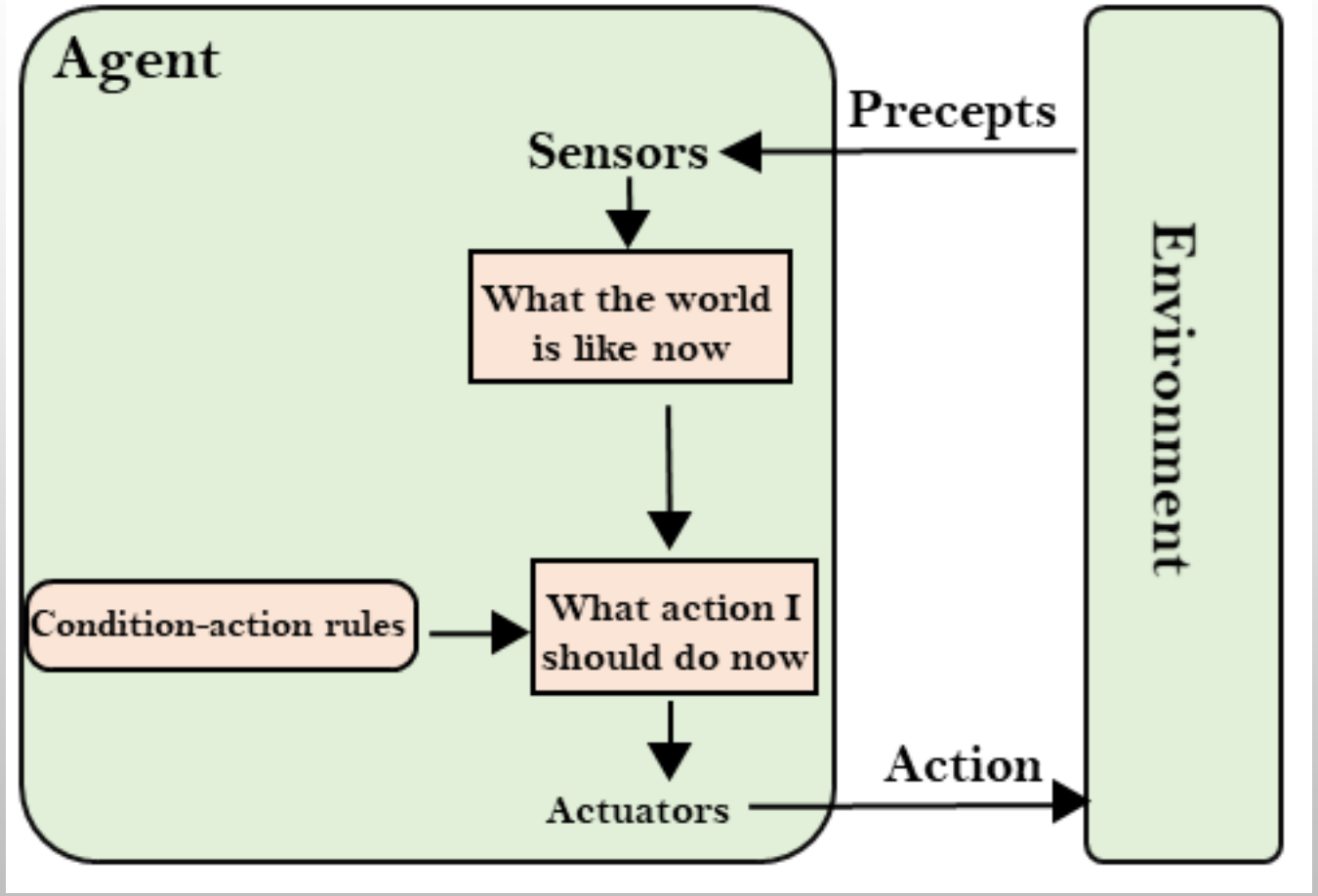
Human-Agent: A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.

Robotic Agent: A robotic agent can have cameras, infrared range finder, NLP for sensors and various motors for actuators.

Software Agent: Software agent can have keystrokes, file contents as sensory input and act on those inputs and display output on the screen.

TYPES OF AGENTS

- SIMPLE REFLEX AGENT
- MODEL-BASED REFLEX AGENTS
- GOAL-BASED AGENTS
- UTILITY-BASED AGENTS
- LEARNING AGENT



SIMPLE REFLEX AGENT

- SIMPLE REFLEX AGENTS IGNORE THE REST OF THE PERCEPT HISTORY AND ACT ONLY ON THE BASIS OF THE **CURRENT PERCEPT.**
- THE AGENT FUNCTION IS BASED ON THE **CONDITION-ACTION RULE.**

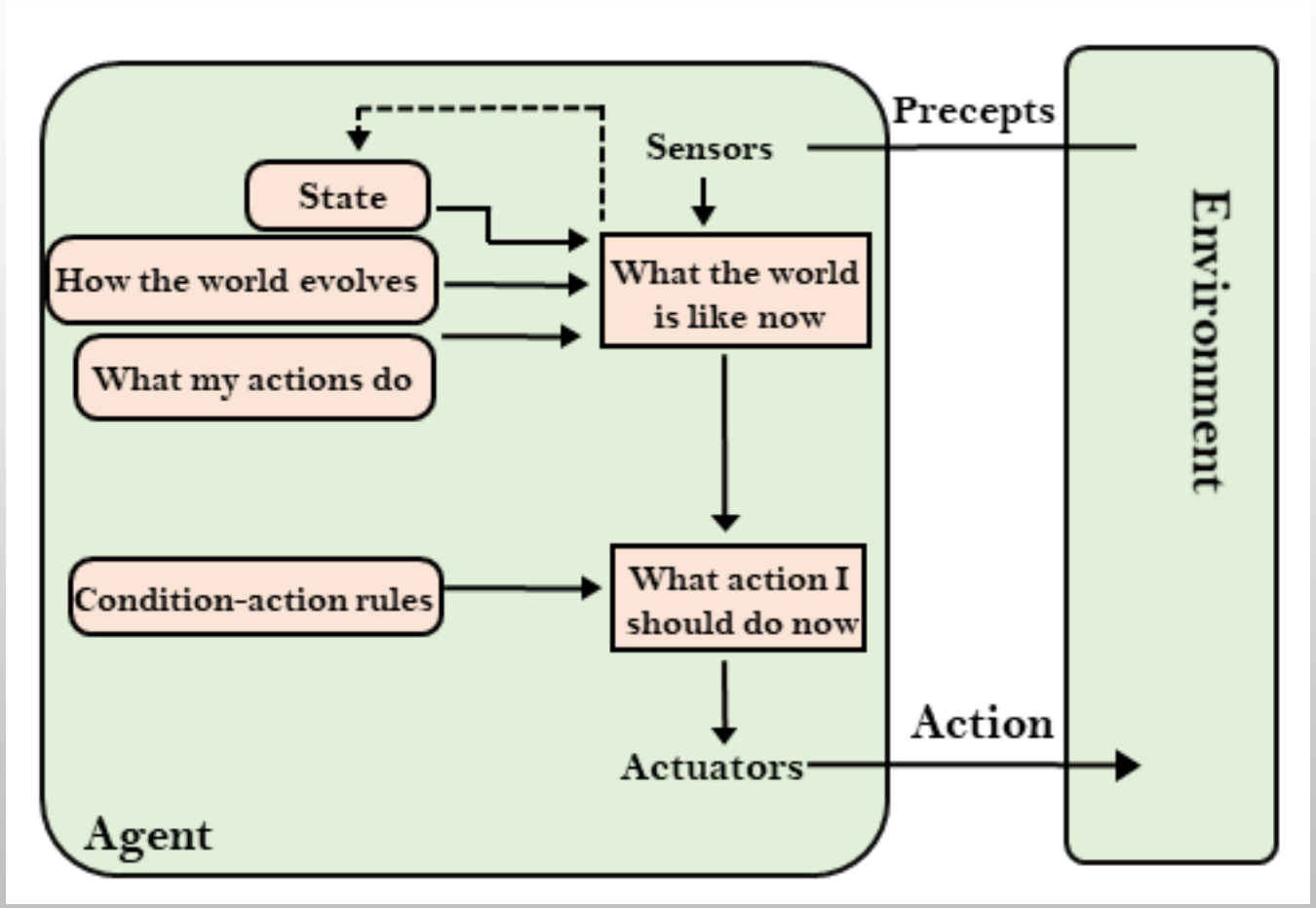
SIMPLE REFLEX AGENT

These agents only succeed in the fully observable environment.

Problems for the simple reflex agent design approach:

They have very limited intelligence	They do not have knowledge of non-perceptual parts of the current state	Not adaptive to changes in the environment.

MODEL-BASED REFLEX AGENTS



- THE MODEL-BASED AGENT CAN WORK IN A PARTIALLY OBSERVABLE ENVIRONMENT, AND TRACK THE SITUATION.
- A MODEL-BASED AGENT HAS TWO IMPORTANT FACTORS: MODEL AND INTERNAL STATE

GOAL-BASED AGENTS

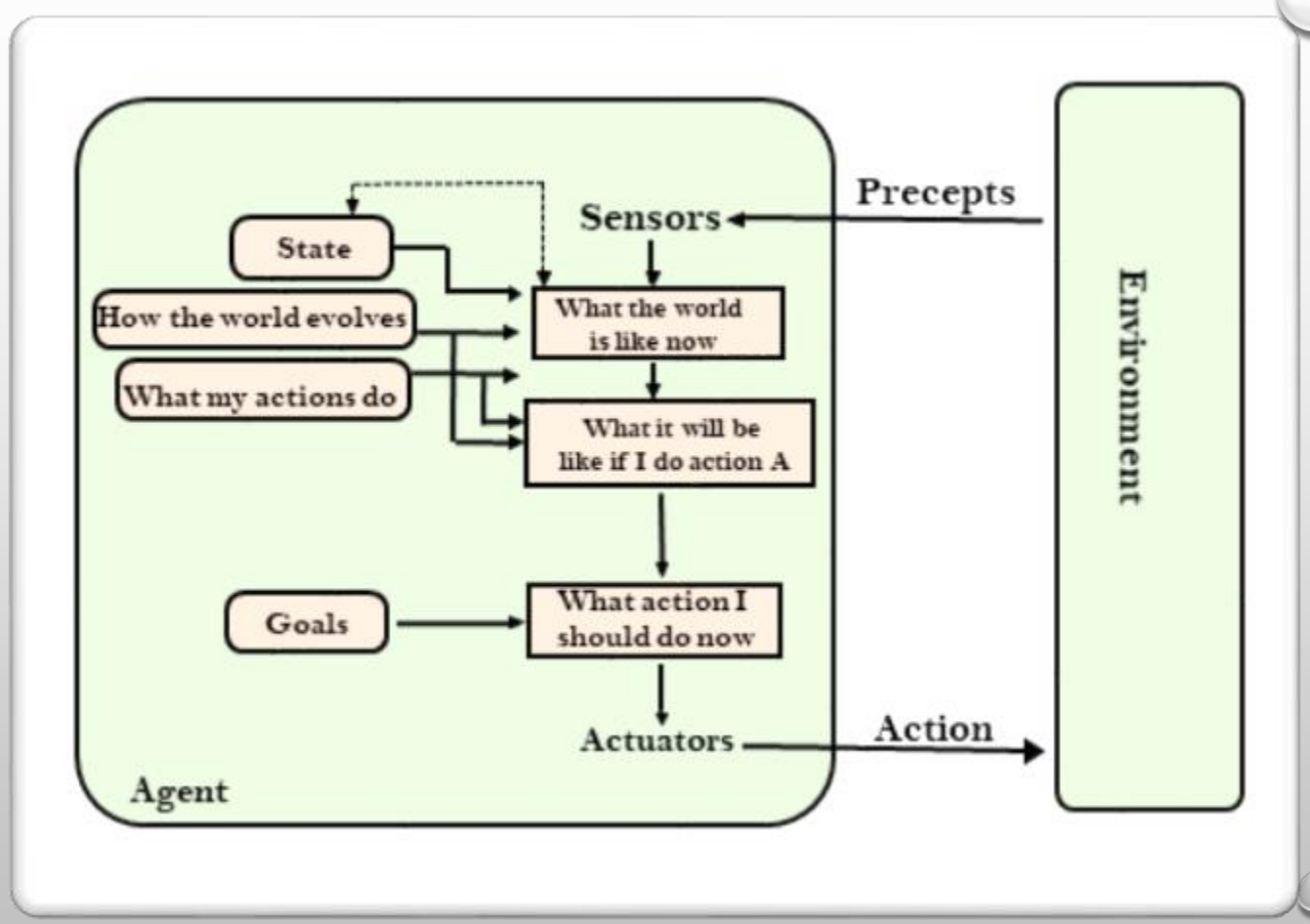
The knowledge of the current state environment is not always sufficient to decide for an agent to what to do.

The agent needs to know its goal which describes desirable situations.

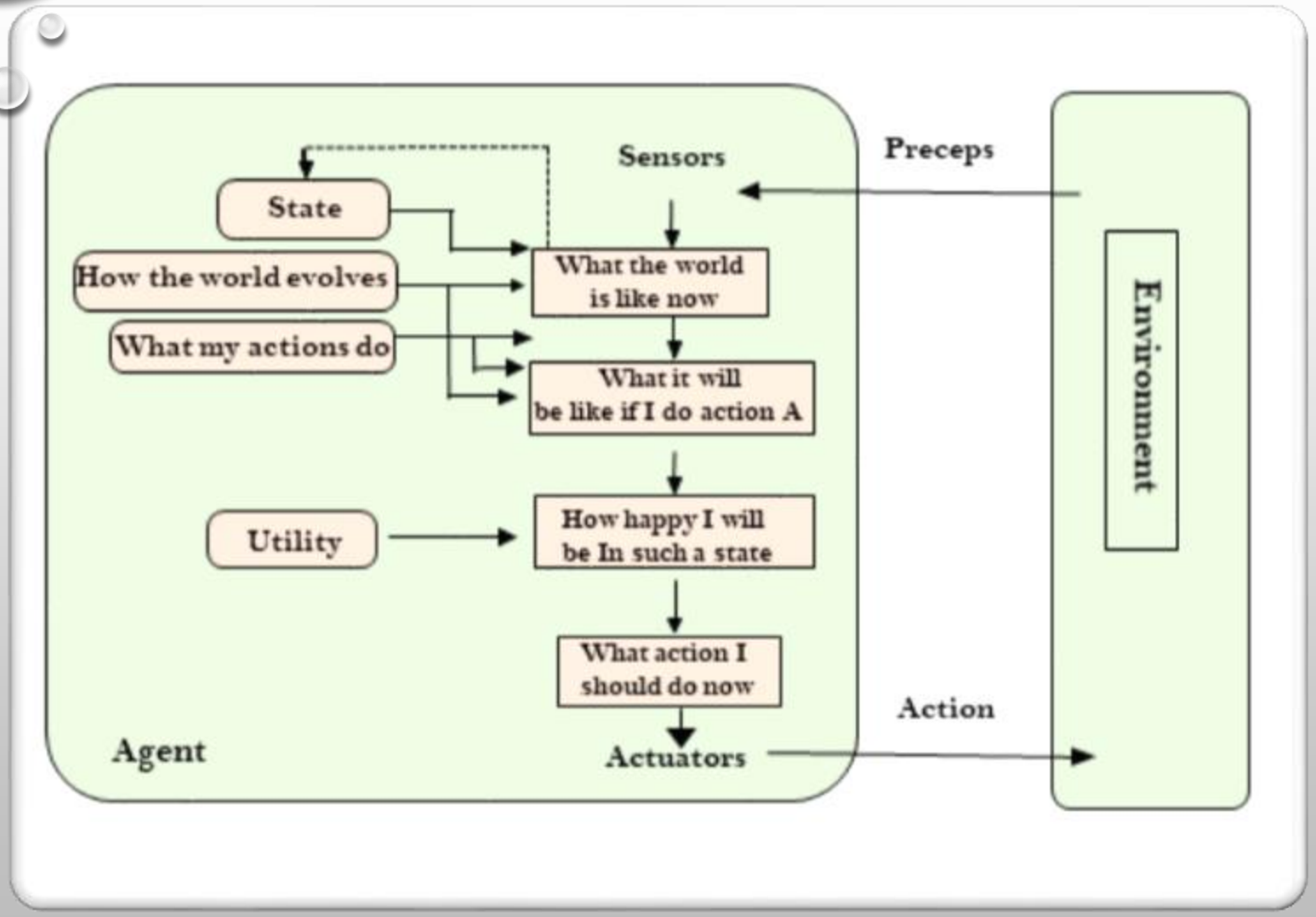
Goal-based agents expand the capabilities of the model-based agent by having the "goal" information.

They choose an action, so that they can achieve the goal.

These agents may have to consider a long sequence of possible actions before deciding whether the goal is achieved or not. Such considerations of different scenario are called searching and planning, which makes an agent proactive.



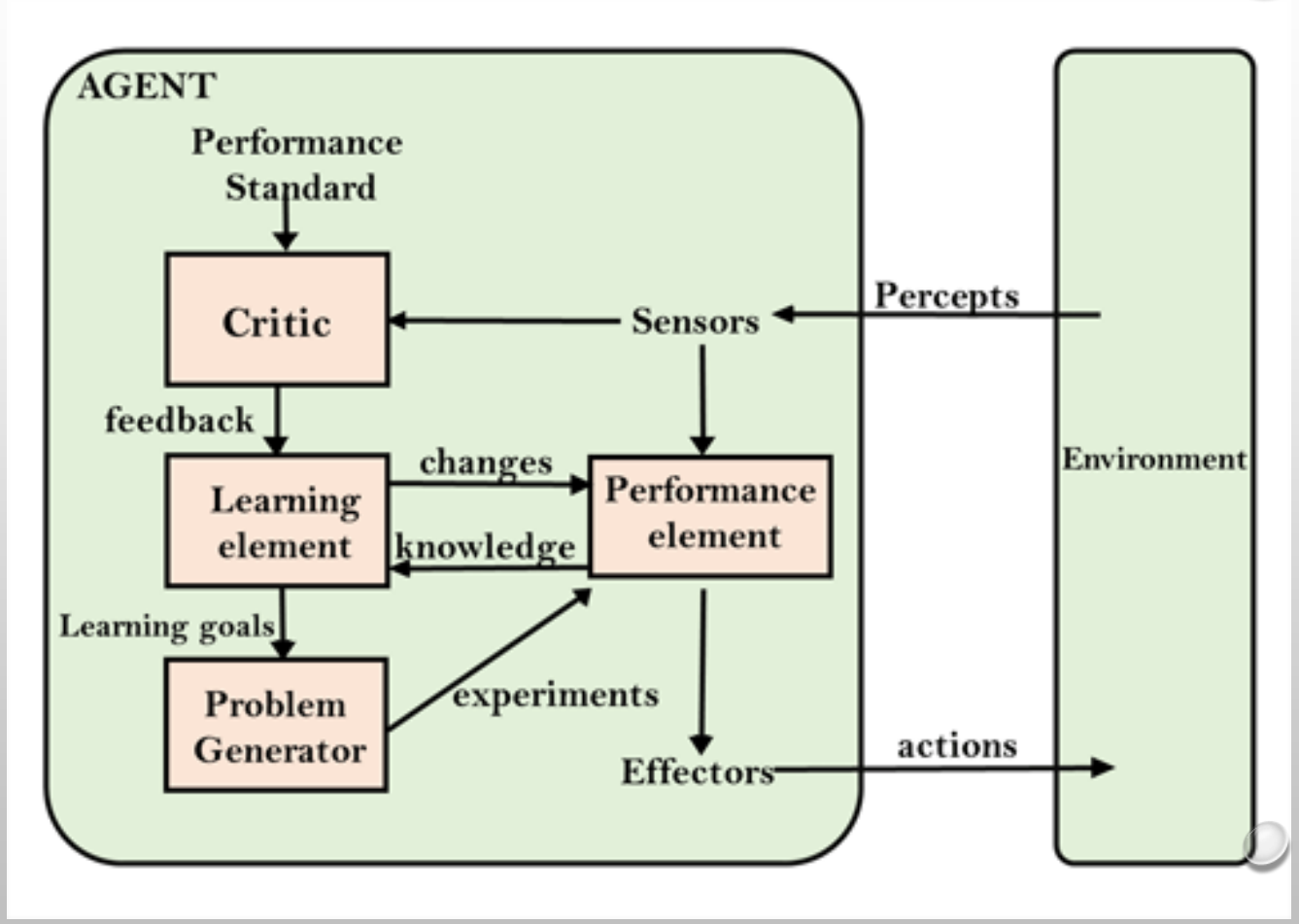
UTILITY-BASED AGENTS

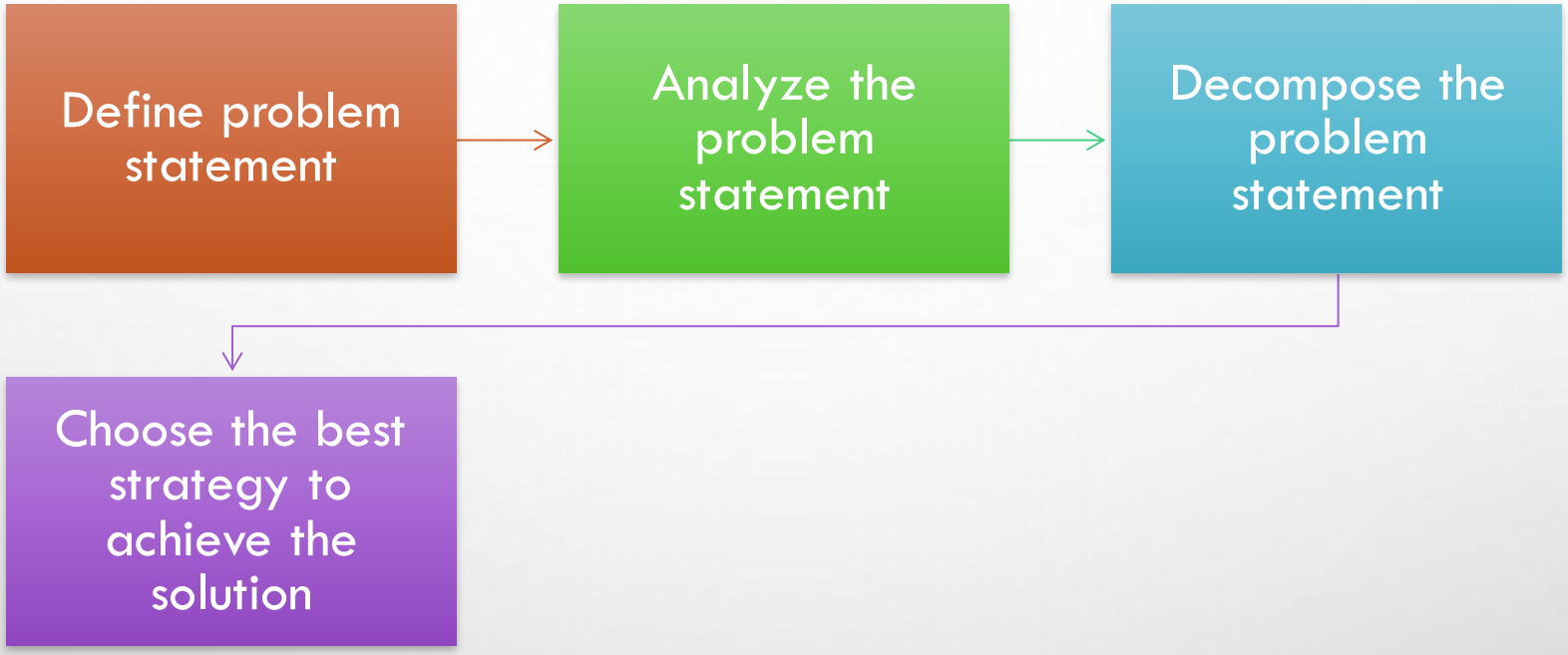


- WHEN THERE ARE MULTIPLE POSSIBLE ALTERNATIVES, THEN TO DECIDE WHICH ONE IS BEST, UTILITY-BASED AGENTS ARE USED.
- UTILITY-BASED AGENT ACT BASED NOT ONLY GOALS BUT ALSO THE BEST WAY TO ACHIEVE THE GOAL.

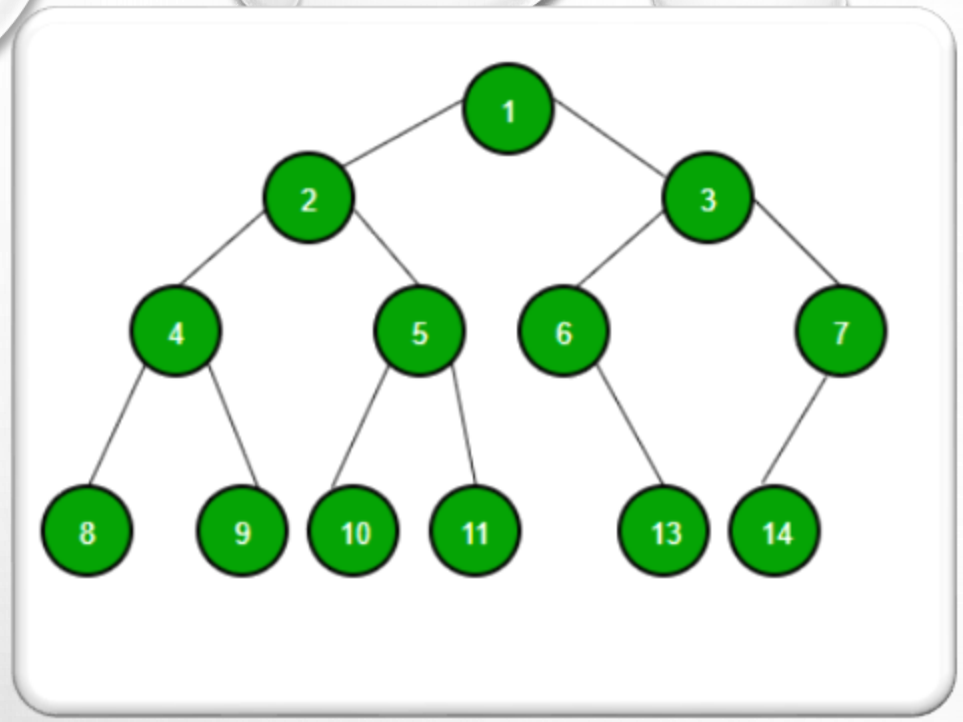
LEARNING AGENTS

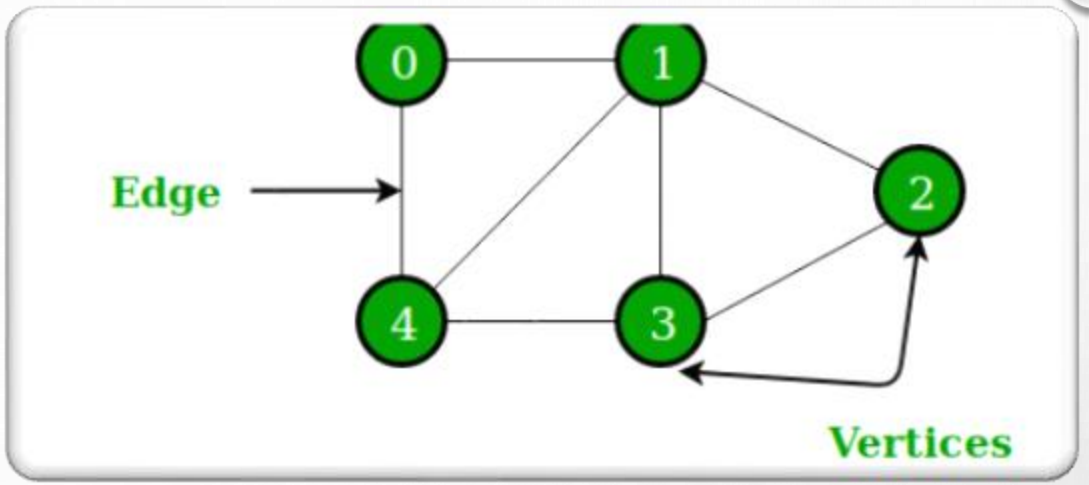
- A LEARNING AGENT IN AI IS THE TYPE OF AGENT WHICH CAN LEARN FROM ITS PAST EXPERIENCES, OR IT HAS LEARNING CAPABILITIES.
- IT STARTS TO ACT WITH BASIC KNOWLEDGE AND THEN ABLE TO ACT AND ADAPT AUTOMATICALLY THROUGH LEARNING.





KEY STEPS IN AI TO DERIVE SOLUTION FOR A PROBLEM



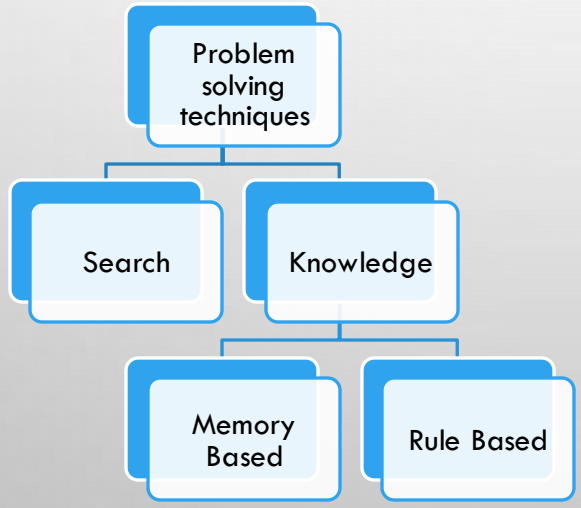


REVIEW OF TREE AND GRAPH STRUCTURES

Basis of comparison	Graph	Tree
Structure	It is a collection of vertices/nodes and edges.	It is a collection of nodes and edges.
Edges	Any number of edges	No. Of nodes -1
Types of Edges	They can be directed or undirected	They are always directed
Root node	There is no unique node called root in graph.	There is a unique node called root(parent) node in trees.
Loop Formation	Yes	No
Applications	For finding shortest path in networking graph is used	For game trees, decision trees, the tree is used.

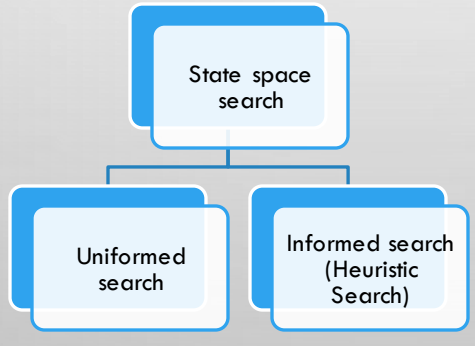
PROBLEM SOLVING

- PROBLEM SOLVING DEALS WITH HOW STATE IS TRANSFORMED FROM GIVEN STATE TO GOAL STATE
- MAIN TASK IS HANDLING THE DECISIONS



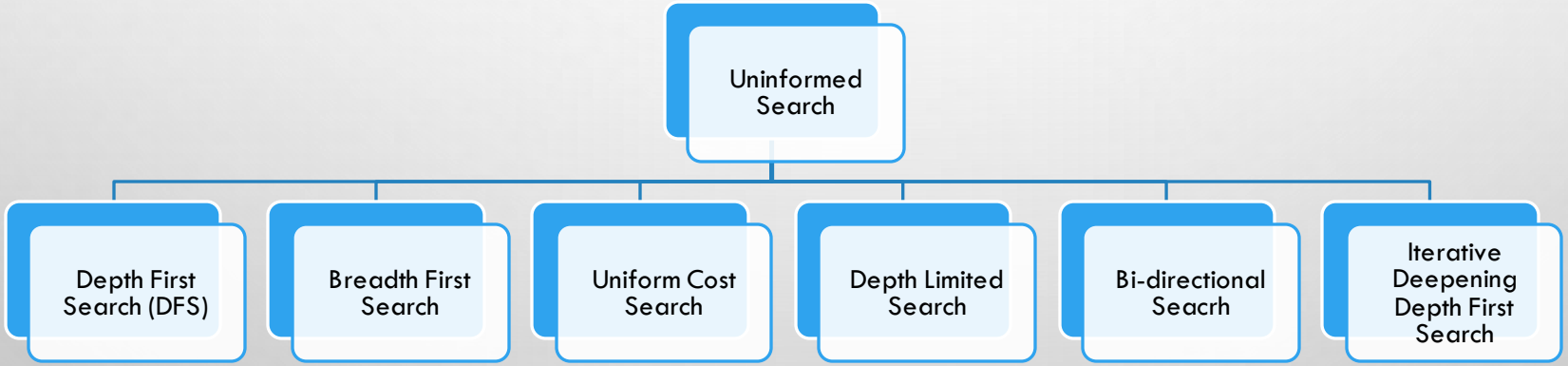
STATE SPACE SEARCH

- THE MAIN GOAL OF STATE SPACE SEARCH IS TO FIND A GOAL STATE THAT SATISFIES CERTAIN CONSTRAINTS AND DESIRED PROPERTIES
- EACH POSSIBLE SITUATION IN THE PROBLEM IS DEFINED AS STATE
- COLLECTION OF STATES IN A SET FORM A GRAPH
- THE SOLUTION FOR STATE SPACE SEARCH IS A PATH FROM START STATE TO GOAL STATE



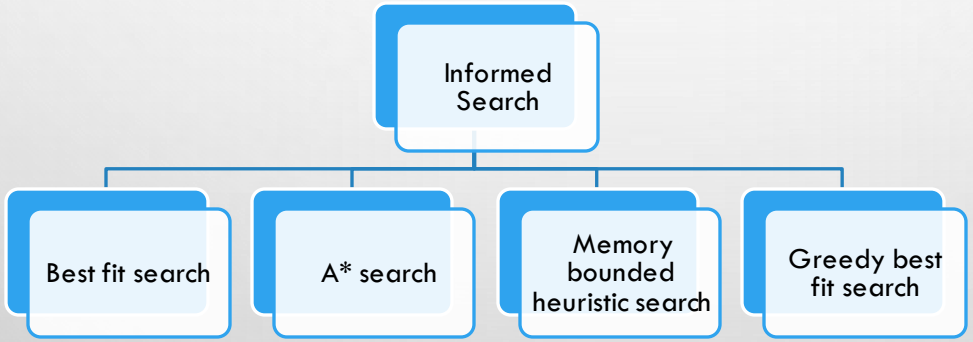
UNINFORMED SEARCH

- IT IS ALSO KNOWN AS UNGUIDED OR BLIND SEARCH, WORKS BASED ON BRUTE FORCE
- DOMAIN OF THE PROBLEM IN UNKNOWN



INFORMED SEARCH

- HAVE SPECIFIC KNOWLEDGE ABOUT THE PROBLEM, HENCE THIS METHOD IS MORE EFFICIENT FOR SEARCHING THAN UNINFORMED SEARCH
- IT IS ALSO CALLED AS HEURISTIC SEARCH



TERMINOLOGY IN STATE SPACE SEARCH

- **START STATE (S):** THIS IS ALSO KNOWN AS GOAL DRIVEN AGENT. THIS IS THE STATE IN WHICH THE PROGRAM STARTS TO FIND SOLUTION. IT IS INITIAL CONDITION OF AGENT
- **GOAL STATE(G):** THIS IS OUTPUT OF SEARCH
- **STATE SPACE(S):** SET OF ALL STATES THAT CAN BE REACHED FROM START STATE WITH SERIES OF ACTIONS
- **ACTION SPACE(A):** THIS IS LIST OF ALL POSSIBLE ACTIONS DONE BY AGENT
- **TRANSITION MODEL:** THIS GIVES US DESCRIPTION OF THE OUTCOMES OF EACH ACTION PERFORMED IN A STATE
- **GOAL TEST:** THIS IS METHOD USED TO CHECK WHETHER CURRENT STATE IS A GOAL OR NOT
- **PATH COST:** THIS IS THE FUNCTION THAT IS USED IN ASSIGNING THE VALUE TO EACH PATH, IT REPRESENTS COST WITH RESPECT TO PERFORMANCE

WATER JUG PROBLEM IN ARTIFICIAL INTELLIGENCE

- IN THE **WATER JUG PROBLEM IN ARTIFICIAL INTELLIGENCE,** WE ARE PROVIDED WITH TWO JUGS: ONE HAVING THE CAPACITY TO HOLD 3 GALLONS OF WATER AND THE OTHER HAS THE CAPACITY TO HOLD 4 GALLONS OF WATER. THERE IS NO OTHER MEASURING EQUIPMENT AVAILABLE AND THE JUGS ALSO DO NOT HAVE ANY KIND OF MARKING ON THEM. SO, THE AGENT'S TASK HERE IS TO FILL THE 4-GALLON JUG WITH 2 GALLONS OF WATER BY USING ONLY THESE TWO JUGS AND NO OTHER MATERIAL. INITIALLY, BOTH OUR JUGS ARE EMPTY.

S.No.	Initial State	Condition	Final state	Description of action taken
1.	(x,y)	If x<4	(4,y)	Fill the 4 gallon jug completely
2.	(x,y)	if y<3	(x,3)	Fill the 3 gallon jug completely
3.	(x,y)	If x>0	(x-d,y)	Pour some part from the 4 gallon jug
4.	(x,y)	If y>0	(x,y-d)	Pour some part from the 3 gallon jug
5.	(x,y)	If x>0	(0,y)	Empty the 4 gallon jug
6.	(x,y)	If y>0	(x,0)	Empty the 3 gallon jug
7.	(x,y)	If (x+y)<7	(4, y-[4-x])	Pour some water from the 3 gallon jug to fill the four gallon jug
8.	(x,y)	If (x+y)<7	(x-[3-y],y)	Pour some water from the 4 gallon jug to fill the 3 gallon jug.
9.	(x,y)	If (x+y)<4	(x+y,0)	Pour all water from 3 gallon jug to the 4 gallon jug
10.	(x,y)	if (x+y)<3	(0, x+y)	Pour all water from the 4 gallon jug to the 3 gallon jug

RULES

S.No.	4 gallon jug contents	3 gallon jug contents	Rule followed
1.	0 gallon	0 gallon	Initial state
2.	0 gallon	3 gallons	Rule no.2
3.	3 gallons	0 gallon	Rule no. 9
4.	3 gallons	3 gallons	Rule no. 2
5.	4 gallons	2 gallons	Rule no. 7
6.	0 gallon	2 gallons	Rule no. 5
7.	2 gallons	0 gallon	Rule no. 9

SOLUTION

REFERENCES

- HTTPS://WWW.GEEKSFORGEEKS.ORG/AGENTS-ARTIFICIAL-INTELLIGENCE/
- HTTPS://WWW.JAVATPOINT.COM/TYPES-OF-AI-AGENTS