ARTIFICIAL INTELIGENCE

Unit - 1

Introduction: history, Is, applications, foundations, game playing AI languages, current trends, tic-tac-toe game

Unit - 2

- **Problem Solving**
  - state space search,
  - Searches
    - exhaustive
    - hewistic
    - iterative
- **Problem Reduction & Game playing**
  - alpha-beta pruning,
  - two-player perfect info games

Unit - 3

Logic Concepts: propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau, resolution refutation, predicate logic.

Unit - 4

- **Knowledge (KR) Representation**
  - semantic n/w
  - extended Semantic n/w
  - KR using frames
- **Advanced Knowledge Representation Techniques**
  - semantic web
  - case grammers
  - CYC theory
  - conceptual dependency
  - theory script st

Unit - 5

- **Expert system & application**
  - expert System v/s traditional systems
  - building expert system
- **Uncertainly measures**
  - dempster shafer theory
  - probability
  - Bayesian belief n/w
  - certainty factory theory
- **fuzzy sets & fuzzy logics**
  - fuzzy sets, operations, fuzzy systems

UNIT-I

INTRODUCTION

Introduction; History; Intelligent Systems; Foundations of AI; applications, Tic-Tac-Toe game playing; Development of AI languages; current trends.

- **Introduction:**

Artificial Intelligence is a study of how to make computers do things which at the moment people do better.

Definition: It is a branch of computer science by which we can create intelligent machines which can behave like human; think like human & able to make decisions.

→ With AI we don't need to preprogram the machine to do some work.

but

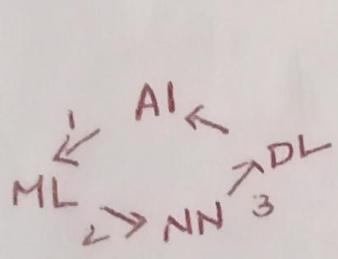
→ We have to create the nonpregrammed machice with programmed algorithm which can work with own intelligence.

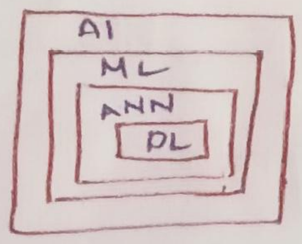
/* The machine that work like human */

Artificial + Intelligence

↓ ↓

manmade thinking power.





- **History of AI:**

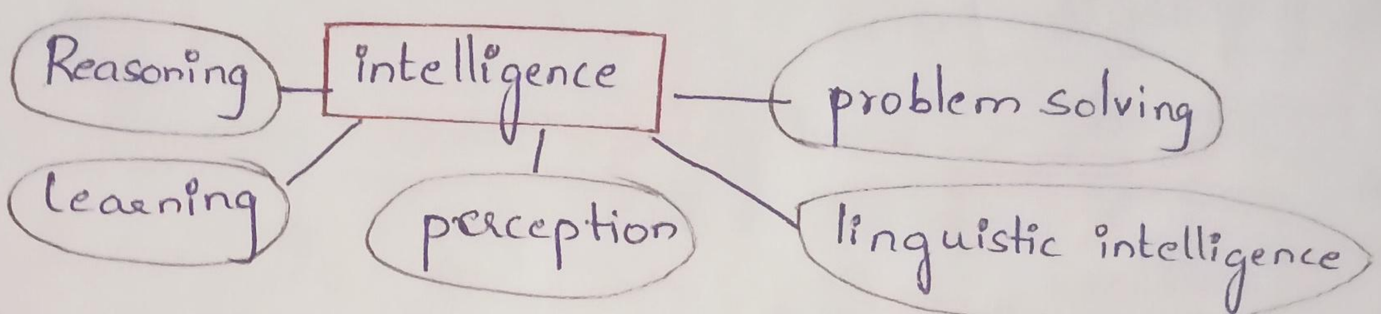
* 1943: early beginnings
  - McCulloch & Pitts: Boolean circuit model of brain.
* 1950: Turing
  - Turing's "Computing Machinery & intelligence.
* 1956: Birth of AI
  - Dartmouth meeting: "Artificial Intelligence" name adopted.
* 1950s: initial promise
  - Early AI programs, including
  - Samuel's checkers program
  - Newell & Simon's Logic Theorist

* 1955-65: "great enthusiasm"
  - Newell & Simon: GPS, general problem solver
  - Gelernter: Geometry Theorem Prover
  - McCarthy: invention of LISP.
* 1966-73: Reality dawns
  - Realization that many AI problems are intractable
  - limitations of existing neural network methods identified
    ↳ Neural network research almost disappears.
* 1969-85: Adding domain knowledge
  - Development of knowledge based systems
  - Success of rule based expert systems
    - Eg: DENDRAL, MYCIN
    - But were brittle & did not scale well in practice
* 1986: Rise of machine learning
  - Neural network return to popularity
  - Major advances in ML algorithms & applications
* 1990: Role of uncertainty
  - Bayesian networks as a knowledge representation framework.
* 1995: AI as Science
  - Integration of learning, reasoning, knowledge representation
  - AI methods used in vision, language, data mining etc.)
* 2003: Human level AI back on the agenda.

- Sucess Stories of AI:
  - Deep Blue defeated reigning world chess champion in 1997
  - proved an unsolved mathematical conjecture
  - Controlled spacecraft operation
  - Provab solves crossword puzzle
  - Robot Driving
  - face recognition challenge
  - Social network behaviour....

- Intelligent Systems:
  - Intelligence: The ability of a system to calculate, reason, perceive relationships & analogies, learn from experience, store & retrieve information from memory, solve problems, comprehend complex ideas, use natural language fluently, classify, generalize and adopt new situations.
  - Types – linguistic, musical, logical-mathematical, spatial, intrapersonal, interpersonal ...,

If a machine is equipped with atleast one (or) at most all intelligences in it is artificial intelligent system
Intelligence is intangible & composed of



- Categorization of Intelligent Systems:

In order to design intelligent systems, it is important to categorize these systems. There are four possible categories:

* System that thinks like human:
- Requires cognitive modelling approaches. It is an area of cognitive science.
- Most of the time it is a black box where we are not clear about our thought process
- He should know the functioning of brain & its mechanism for processing information. The stimuli are converted into mental representation & cognitive (thinking) processes manipulate this representation to build new representation that is used to generate actions.
- Neural networks is a computing model for processing information similar to brain.

* System that acts like human:
- It requires that overall behaviour of the system should be human like which could be achieved by observation. Turing test is an example. (which specifies m/c can think like human/not)

* System which thinks rationally: (logical | reasonable)
- Relies on logic rather than human to measure correctness.

- For thinking rationally & logically, logical formulae & theories are used for synthesizing outcomes

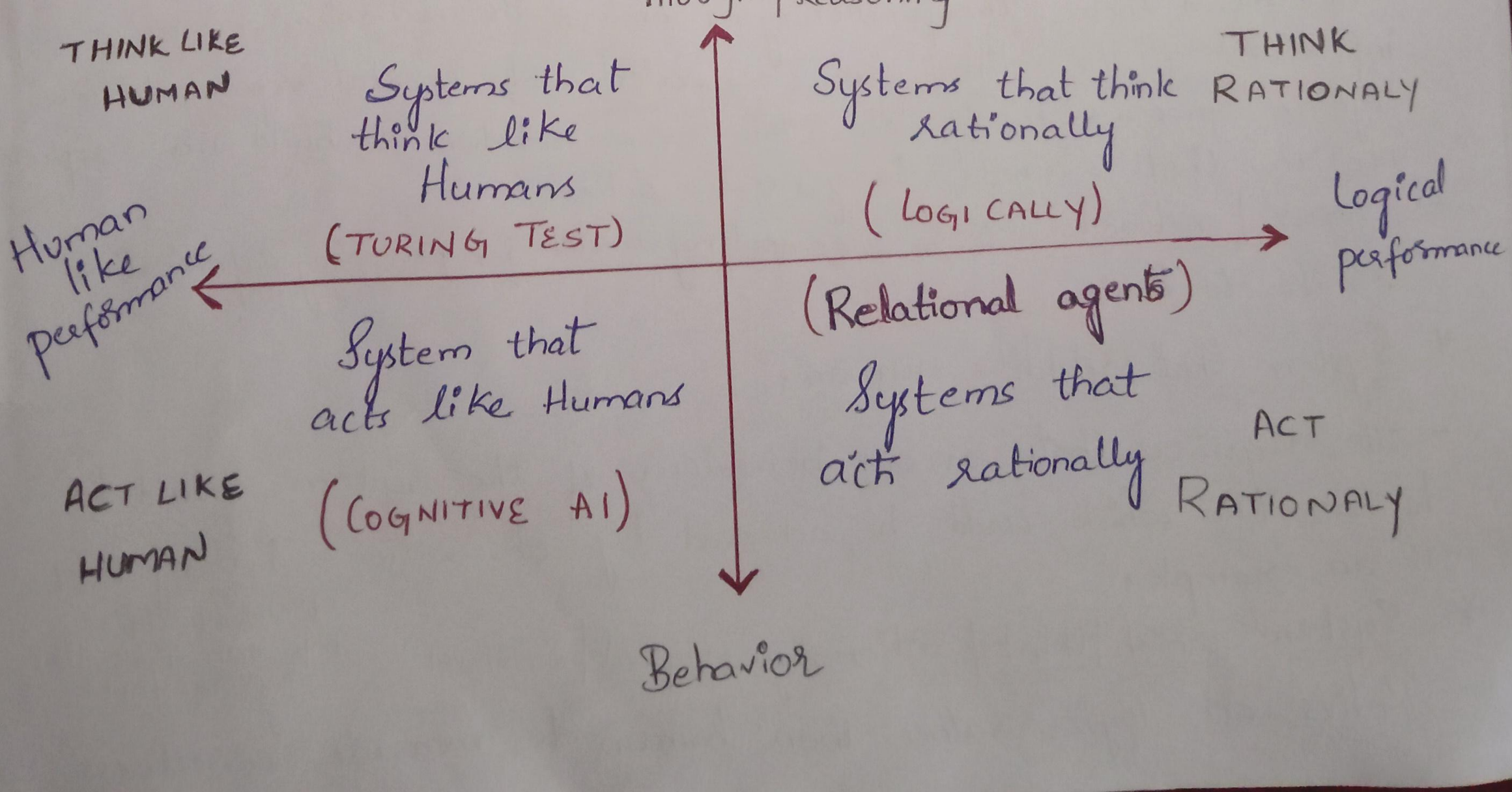
* Systems that acts rationally:

- Final category of intelligent systems where by rational behavi -our we mean doing the right thing.
- Even if the method is illogical, the observed behaviour must be rational.

/* Intelligence is the propety of mind which encompasses many related mental abilities. */

Some capabilities are

- Reason & draw meaningful conclusion.
- Plan sequences of actions to complete a goal.
- Solve problems.
- Think abstractly.
- Comprehend ideas & help computers to communicate in Natural language (NL)
- Store knowledge provided before (or) during interrogation.
- Learn new ideas from enviroment & new circumstances.
- Offer advice based on rules & situations
- Learn new concepts & tasks that require high level intelligence.



- Foundations of AI:

– Commonly used AI techniques and theories are rulebased, fuzzy logic, neural networks, decision theory, statistics, probability theory, genetic algorithms, etc..,

– Since AI is indisciplinary in nature, foundations of AI are in various fields such as:

- Mathematics: AI systems use formal logical methods and boolean logic (Boole, 1847), analysis of limits to what can be computed, probability theory, uncertainty that forms the basis for most modern approaches to AI, fuzzy logic etc..,
- Neuroscience: This science of medicine helps in studying the functioning of brains. We use accurate sensors to correlate brain activity to human thought. Reasearches are working to know how to have mechanical brain. So AI systems require parallel computation, remapping & interconnection to a large extent.
- Control Theory: Machines can modify their behavior in response to the environment (sense/action loop). In early 1950's control theory could only describe linear systems, but AI largely rose as a respo -nse to this shortcomings.
- Linguistics: Speech demonstrates so much of human intelligence. Analysis of human language reveals thought taking place in ways not understood in other settings. Languages & thought are believed to be tightly intertwined.

* Sub areas of AI:

As we already mentioned earlier that AI is an interdisciplinary area having numerous diverse subfields. Each of these fields is an area of research in AI itself. Some of these are listed below:

- Knowledge representation methods
- Theorem proving mechanisms
- Game playing methodologies
- Common sense reasoning dealing with uncertainty & decision making

- learning models, inference techniques, pattern recognition, search & matching, etc.;
- Logic (fuzzy, temporal, modal)
- Planning & scheduling
- Natural language understanding, speech recognition & understanding spoken utterances.
- Computer vision, robotics, data mining, Web agents.
- Neural networks, AI tools, Expert problem solving, Models for intelligent tutoring systems.

— philosophy, economics, psychology, computer engineering, cybernetics

- Applications:

AI finds applications in almost all areas of real-life. Broadly speaking business, engineering, medicine, education, manufacturing are the main areas. Some of them are:

- Business: financial strategies, give advice.
- Engineering: check design, offer suggestions to create new product, expert systems for all engineering applications.
- Manufacturing: assembly, inspection & maintenance.
- Medicine: monitoring, diagnosing & prescribing
- Education: in teaching
- Fraud detection:
- object identification
- Space shuttle scheduling
- information retrieval..

And some common applications are finance, music, transportation, toys & games, hospitals, expert systems, medical diagnosis, video games

- Scope of AI:

Theorem proving | Game playing | Natural language processing | Speech processing | Computer Vision | Robotics | Expert Systems.

- Game Playing:

It is a search problem defined by
→ initial state | → successor function | → Goal test | → pathcost | utility | pay off function

AI has continued to improve, with aims set on a play being unable to tell the diffference between computer & human play players.

- A game must 'feel' natural
  - L obey laws of the game
  - L characters aware of the environment
  - L path finding (A* algorithm)
  - L Decision making
  - L planning
- The Game AI is about the illusion of human behaviour.
  - L Smart to certain extent
  - L non repeating behaviour.
  - L emotional influences (irrationality, 'personality')
  - L Being integrated in the environment.
  - L Body language to communicate emotions
- Game AI needs various computer science desciplines
  - L knowledge based systems
  - L machine learning
  - L multi agent systems
  - L Computer graphics & animation
  - L Data structures
- Computer Game Types:
  - Strategy Games (Real Time strategy | Turn Based strategy | Helicopter View)
  - Role playing Games (single player | multiplayer)
  - Action Games (First person shooters (FPS) | First person sneakers)
  - Sports Games
  - simulations
  - Adventure Games
  - Puzzle Games

Tic Tac Toe playing:

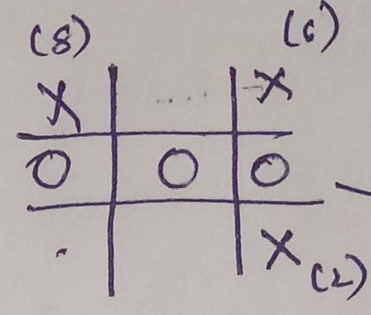
problem solving

Has 3 cases/chances - x } two play
- 0 }

max (x varient) (+1)

draw

min (o varient) (-1)



O won the game

the m/c understands that O won game using magic square.

8	1	6
3	5	7
4	9	2

vertically

horizontally

diagnolly

magic square

if we get +15 (x) won the game
-15 (o) won the game.
min

$3 \times (-1) + 5 \times (-1) + 7 \times (-1) = -3 + (-5) + (-7)$
$= -3 - 5 - 7 = \boxed{-15}$

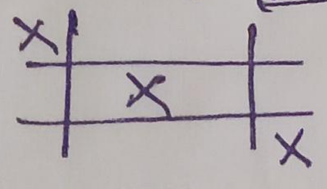
Zero (o) won the game

$8 \times (+1) + 6 \times (+1) + 2 \times (+1) = 16$

$15 \neq 16$

the possible chances

8(x1 + 5x1 + 2x1 are = +15



+in

X may win (+15)

O may win (-15)

draw

if o/p ≠ 15 it is draw

- Development of AI languages:

For the development of intelligent system, we require some languages, which has its own strengths & weaknesses. Some of main main AI languages are

* PYTHON: ideal choice for machine learning process. provides customized AI solutions. Can easily integrates. Simple & open source.
* LISP: Oldest language used for AI. Lisp is considered as tool for most leading companies in AI with its enlarged scope of tuning thought into reality. Well-known for implementing wonders & still used for logical solutions.
* R: performs statistical processing. Highly efficient. Extended packages helps in machine learning processes. Used to solve more complex AI problems.
* PROLOG: Completely designed by LOGIC. has special approach for providing solutions to AI. uses fact, rules & relationships. flexible & powerful.
* C++: Has high processing speed. Complex automated problems can run efficiently. Cost efficient
* JAVA SCRIPT: Widely used framework for deeplearning.
* JAVA: uses virtual machine technology. (JVM) eases implementation process. low processing speed.
* JULIA: Well-known for numerical analysis.
* HASKEL: safest programming language used for AI processes. Has no room for errors. Has features like build in memory & code reusability
* SMALLTALK: General purpose object oriented programming language with no primitives & control structures.

In addition to this LOLC, ADA .... are also used

All the disussed above languages are best programming languages for AI projects. It is just the choice of a project that suits requirements best.

• Current Trends:

AI is the current trending technology used by all around the world. We are using hundreds of applicatims till date like Siri, alexa, Gmail, Tesla, Netflix..... AI is becomi -ng increasingly important. Top trends in AI are

↳ Greater cloud & AI collaboration — Deploying AI it is possible to monitor & manage cloud resources & vast amount of available data

↳ AI solutions for IT — Usage of AI reduced downtime & allow the teams in an organisation to work on high complexity projects.

↳ AIOps becomes more popular — IT operations & other teams can improve key processes, decision making & tasks with AIOps solutions and improved analysis of the volumes of data. AIOps will empower the cross team collaboration through end-to -end digital experiences, data correlation & integration.

↳ AI will help in structuring data — With AI unstructured data can easily be converted into structured data to provide easy output.

↳ AI talent will remain tight :- There has been a persistent gap in AI talent & organisations have finally realised this potential.

↳ Large scale adoption of AI in the IT industry — AI is used in organisatims in productions & applies in Real time application to reduce cost.

↳ AI ethics in the focus — AI ethics become more important to organisa tions, transparency of data & algorithm fairness are major issues.

↳ Augmented processes become increasingly popular — Companies will go a step further in optimising their augmented business & development process -es. Using AI, s/w development processes can be optimized.

↳ AI will become more explainable — This involves m/c learned model & the result will be very clear.

↳ Voice & Language Driven intelligence — in customer care centers, the increase in remote working has driven a great opportunity to adopt NLP / ASR (automated speed recognition) capabilities.

Why AI?

- With the help of AI, we can create such s/w or device which can solve real-world problems very easily & accuracy such as health issues, marketing, traffic issues.
- With the help of AI, you can create your personal virtual assistant, such as Google assistant, Siri etc..,
- With the help of AI, you can build such robots which can work in env where survival of human can be at risk.
- AI opens a path for new technology, new devices & new opportu-nities.

Goals of AI:

- Replicate human intelligence
- Solve knowledge-intensive tasks
- An intelligent connection of perception & action
- Building a m/c which can perform that requires human intelligence such as providing a theorm, playing chess, plan some surgical operation, driving a car in traffic..,

Agents in AI?

AI – study of rational agent & its environment

The agents [scence] the enrironment through sensors & act on their env

for human eyes, ears, nose, tongue & skin — sensors ... through actuators (is a device)

for [human] agent — device is hand, legs ...

Eg: [Car] agent — [sensors / GPRS ....] actuators

AI agents has mental properties like knowledge, belief, intension etc..,

What is Agent? Agent can be anything that perceive environment through sensors & act upon that environment through actuators.

- [Human Agent] ⟹ eyes, ears & other organs which work for sensors
  ⟶ hands, legs works for actuators
- [Robotic agent] → camera, infrared range finders ....
- [S/w agent] → key strokes (i/p to o/p)

Sensors

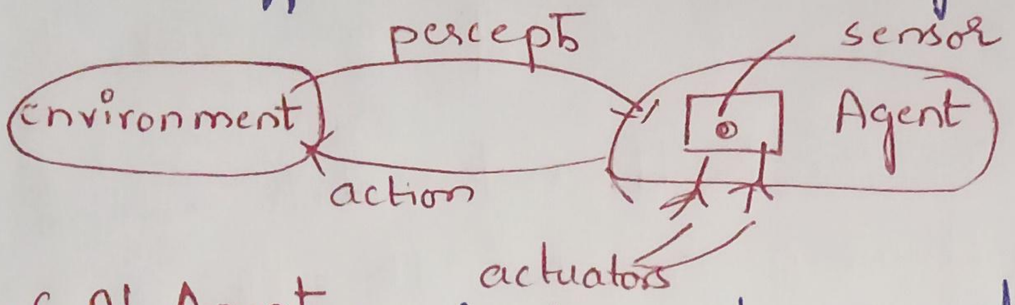
Agents Device which detects the change in the environment & sends the info to the other electronic device. Observes the env through sensors

Actuators — moving

It is a component of m/c that convats energy into motion

Effectors

Device which effect the environment (legs, wheels, arms, fingers, display screen)



Types of AI Agents : Agents can be grouped into five classes based on their degree of perceived intelligence capacity

↳ Simple Reflex Agents
↳ Model based reflex agents
↳ Goal based agents
↳ Utility based
↳ learning agent

Agents environment in AI : It is everything in the world which surrounds the agent but not the part of an agent itself. It is described as a situation in which agent is present.

- Features :
  - fully observable v/s partially observable
  - static v/s dynamic
  - discrete v/s continous
  - deterministic v/s stochastic
  - Single agent v/s multiagent
  - Episodic v/s sequential
  - known v/s unknown
  - Accessible v/s inaccessible