Artificial Intelligence

Unit 1

what is AI

Artificial Intelligence

man made + thinking power

It is branch of CS by which we can create Intelligent machine, which can behave like human, think like human & is able to make decisions.

- In AI you dont need to preprogram machine to do some work.
- You have to create a machine with a programmed algo which can work with its own Intelligence.

Application of AI

- AI in astronomy :- AI can be very useful to solve complex universe problems. It can be helpful for understanding the universe such as how it works, origin etc.

- AI In Healthcare :- It is used to make better & faster diagnosis than human. It can help doctor with diagnoses & can inform when patients are worsening so that medication can be given to patient before hospitalization.

- AI in gaming : It is used for strategic games like chess where machine needs to think of large number of possible moves

- AI In finance: AI is mainly & widely used in fintech companies, they are implementing automations, algorithm trading, stock forecasting and ML Into financial process.

- AI In Social media: Social media sites such as twitter, snapchat contains billions of user profiles which is to be stored & managed efficiently. AI can store, organize & manage massive amount of data. It can analyse lots of data to identify latest trends, hashtags etc
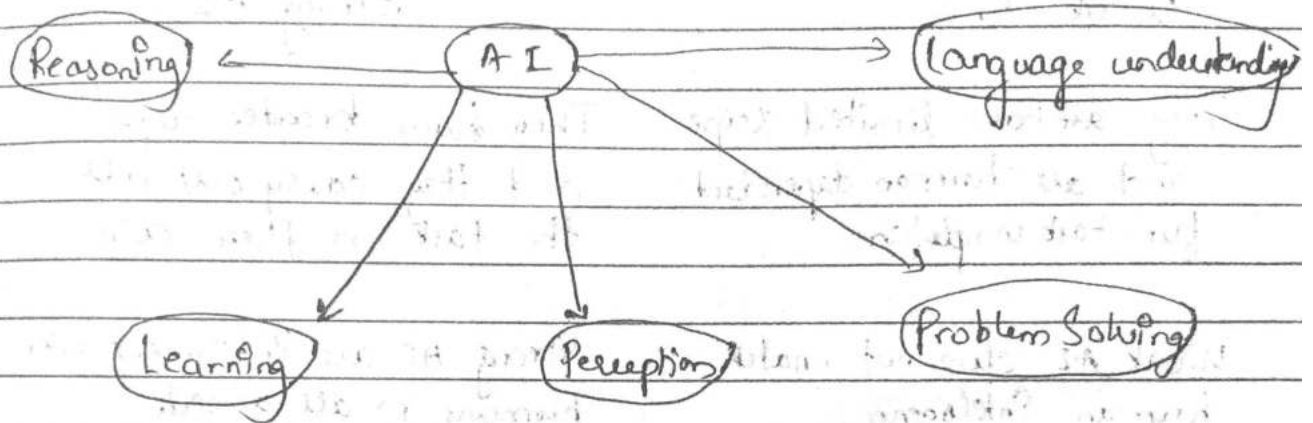
- AI In Travel & Transport: AI is capable of doing various travel related works such as making travel arrangements to suggesting hotels, flights shortest routes etc., Also AI powered chatbots which can make human like Interaction for better & fast response

- AI in Automotive Industry: AI is used to provide virtual assistance to their user. and also used for auto pilot (self driving) vehicles.

- AI In robotics: AI is used to create robots which have Intelligence like human and can make their own decisions according to situations

AI in entertainment: We use AI based applications like netflix, amazon prime which use AI/ML algo & shows recommendations for shows to user.

Components of AI

Reasoning ← A I → Language understanding

A I → Learning

A I → Perception

A I → Problem Solving

Reasoning: It is set of process that enables us to provide basis for judgement, making decisions & predictions.

Learning: It is activity of gaining knowledge or skill by studying, practicing, being taught or experiencing. In ML we test & train the model.

Perception: It is process of acquiring, interpreting, selecting & organizing the sensory information

Problem Solving: It is the process in which one perceives & tries to arrive at a desired solution by choosing optimised path.

Language understanding: It is one ability to use comprehend speak and write the verbal & written language. It is important in interpersonal communication.

Difference b/w Weak AI & Strong AI.

| Weak AI	Strong AI
They are have limited scope and are human dependent for task completion	They have broader scope and they carry out all the task on their own
Weak AI does not match human intelligence	Strong AI are intelligent like humans in all aspects.
Weak AI based system can only simulate human behaviour	Strong AI, have their own intelligence, they can process & make their own decisions
They are good at specific task	They are having incredible human level intelligence so good at wider level of task
Uses supervised & unsupervised learning to process data	Use clustering & association to process data
Eg Siri, Alexa etc.	Eg Advanced Robotics.

Autonomous agent: decide autonomously which action to take in current situation to maximise progress

Agents:

An agent is anything that can perceive its environment through sensors & act upon that environment through actuators
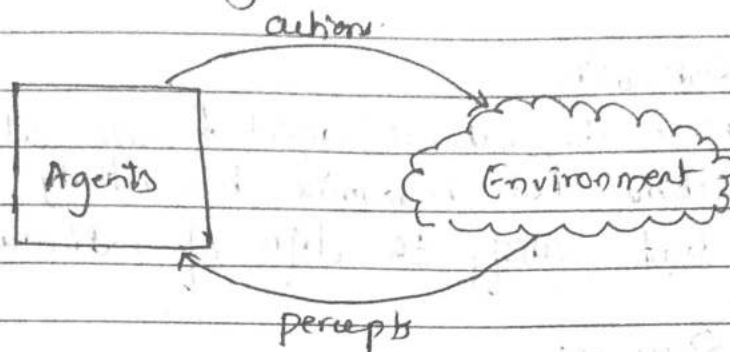
Eg

Humans: eyes, ears, nose etc for sensors
hands, legs, mouth for actuators

Robots: Camera, IR etc (sensors)
wheels, lights, speakers etc (actuators)

Software: functions (sensors)
functions (actuators)

Performance measure: A subjective measure to characterise how successful an agent is (eg speed, accuracy money etc)

Types of Agents

- Intelligent agents
  Must sense
  must act
  must be autonomous
  must be rational

Rational Agent

AI is about building rational agents, agent is something that perceive and acts. A rational agent always does the right thing.

Rationality:

Perfect Rationality

- Assumes that the rational agent knows all & takes that the action that maximise hee utility.
- Humans dont satisfy the def^n of rationality.

Bounded Rationality

Because of limitation of human mind, human must use approximate methods to handle many tasks

Rational action:

The action that maximise the expected value of the performance measure given the percept sequence to date

Rational = Best ?

Yes, to the best of its knowledge.

Omniscience

- It is the state of possessing ultimate knowledge about all things possible.
- The religious aspect suggested omniscience ie attribute of God.

Agent environment

An environment in AI is the surrounding of the agent. The agent takes input from the environment through sensors & deliver the output to environment through actuators

Observability (Properties of Task AI).

- fully observable: when agent's sensor is capable to serve or access the complete state of an environment at each point in time, it is said to be fully observable.
  - Their environments are convenient, since agent is freed from the task of keeping track of the changes in environment
  - Eg: chess

- Partially observable: when agent's sensor is not capable to serve or access the complete state of an environment at each instant of time then it is partially observable
  - Eg: Poker.

Determinism

Deterministic: The next state of the environment is completely described by the current state & the agent's action. Eg Image analysis.

Stochastic: A stochastic environment is random in nature & cannot be determined completely by an agent. Eg: Ludo.

Episodic : An episodic environment means that subsequent episode do not depend on what action occured in previous episodes.

Sequential : Here agent engages in series of connected episodes.

* Static / Dynamic

Static : A static environment does not change while the agent is thinking. Here time is irrelevant.

Dynamic : If the environment can change itself while an agent is thinking. then it is dynamic.

* Discrete / Continuous

Discrete : If the environment has finite number of percepts & actions are performed within it, they are called discrete. Eg Chess

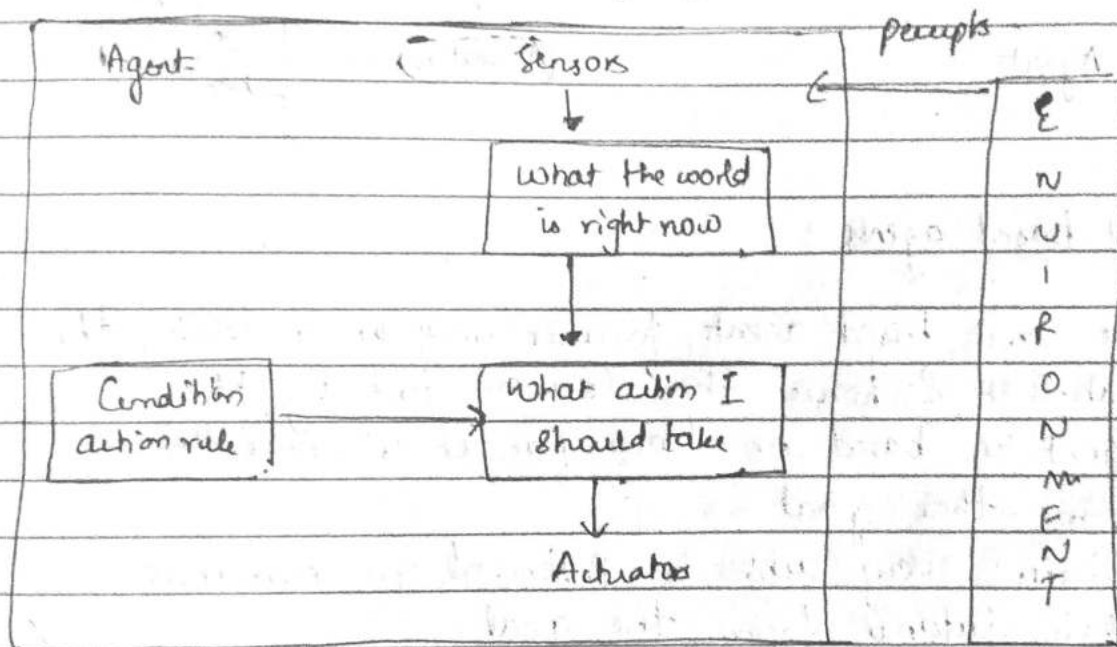Continuous : If the environment has infinite no. of percepts & action are not performed within it. Eg Self driving car

Single / multi

single agent → multi agent

Simple Reflex agents

- It acts only on the basis of current percepts
- It follows condition action rule. A condition action rule is a rule that maps a state (condition) to an action.
- If cond^n is True, then action is taken, else not.
- Their environment is fully observable.

```
Agent                    Sensors                  percepts
                            ↓                              E
                 ┌──────────────────┐                     N
                 │ what the world   │                     V
                 │ is right now     │                     I
                 └──────────────────┘                     R
                            ↓                              O
┌───────────┐    ┌──────────────────┐                     N
│ Condition │ ─→ │ what action I    │                     M
│ action rule│   │ should take      │                     E
└───────────┘    └──────────────────┘                     N
                            ↓                              T
                        Actuators
```

Model based Reflex agents

- It works by finding a rule whose cond^n matches the current situation.
- It can handle partially observable environment
- The agent has to keep track of internal state which is adjusted by each percept that depends on percept history.
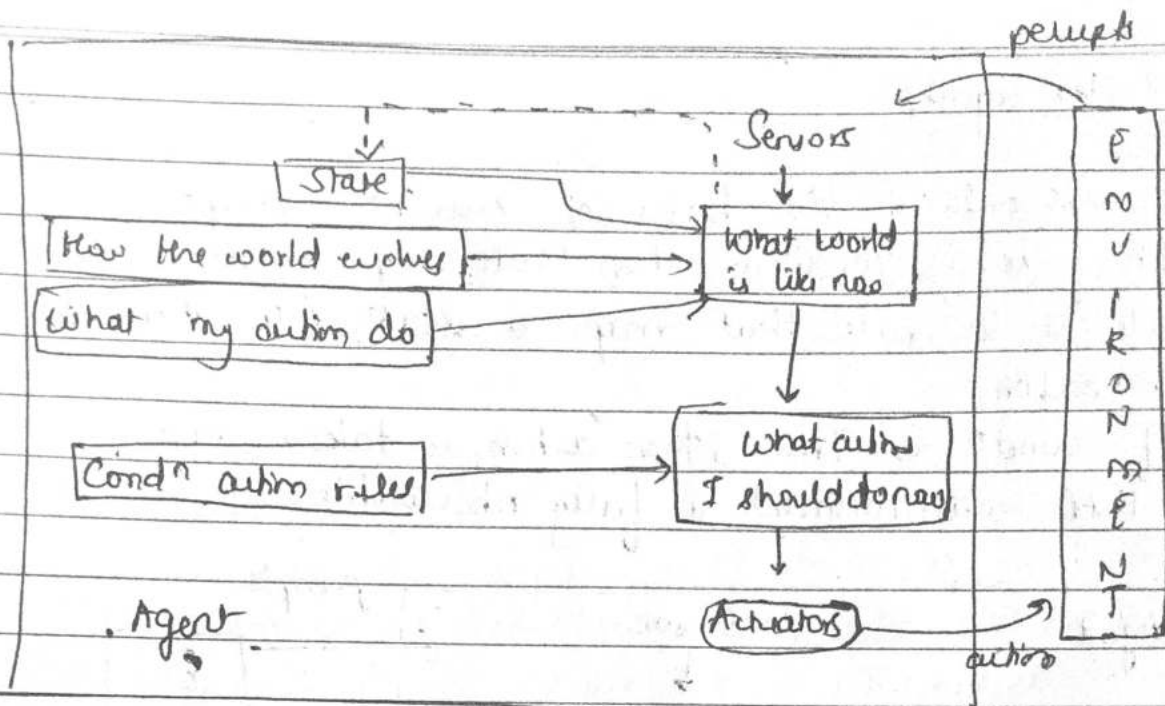
Goal based agents

- The goal based agents focuses only on reducing the goal - set of hence the decision took by the agent is based on how far it is currently from their goal.

- Then every action is intended to minimize their distance from the goal.

- This agent is more flexible, hence by choosing right path it improves its decision making optim
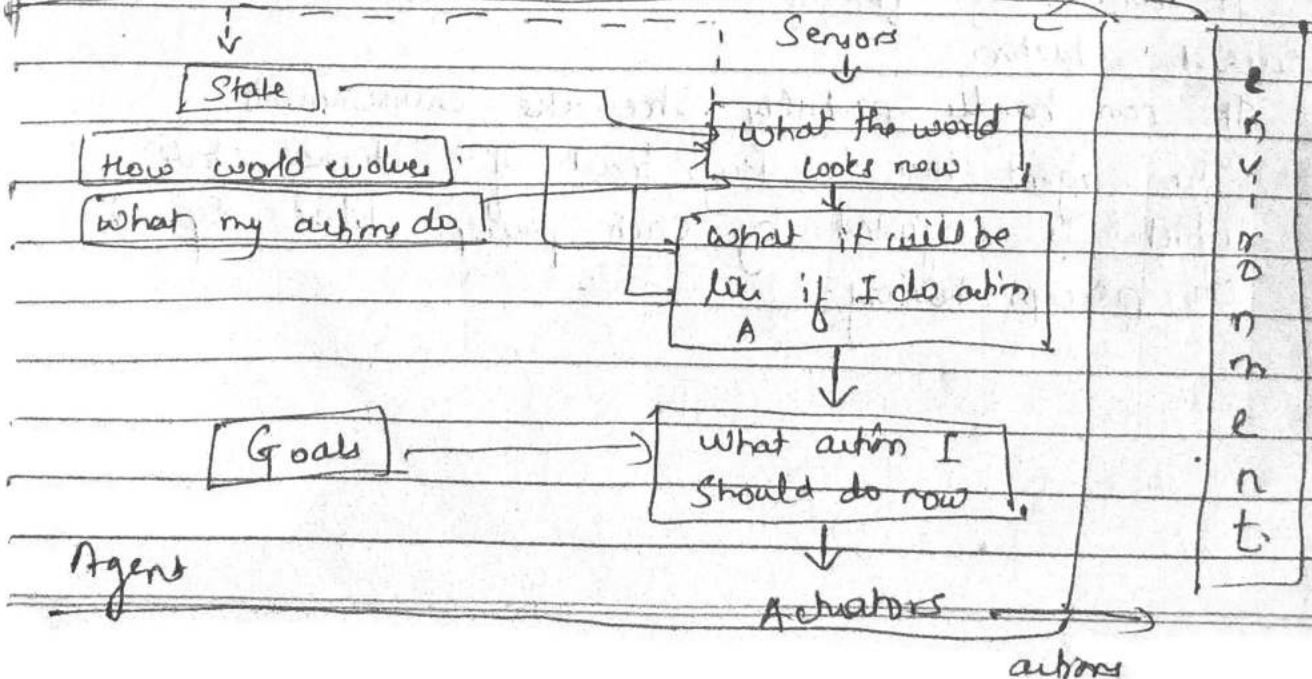
Utility Based Agents

- When there are multiple possible alternatives, then to decide which one is best, utility based agents are used.
- They choose actions based on preferences.
- Sometimes achieving the desired goal is not enough. we may look for quicker, safer, cheaper trip to reach destination
- The UBA is useful when there are multiple possible alternatives, & agent has to choose the best one.

Agents

Actuators

actions
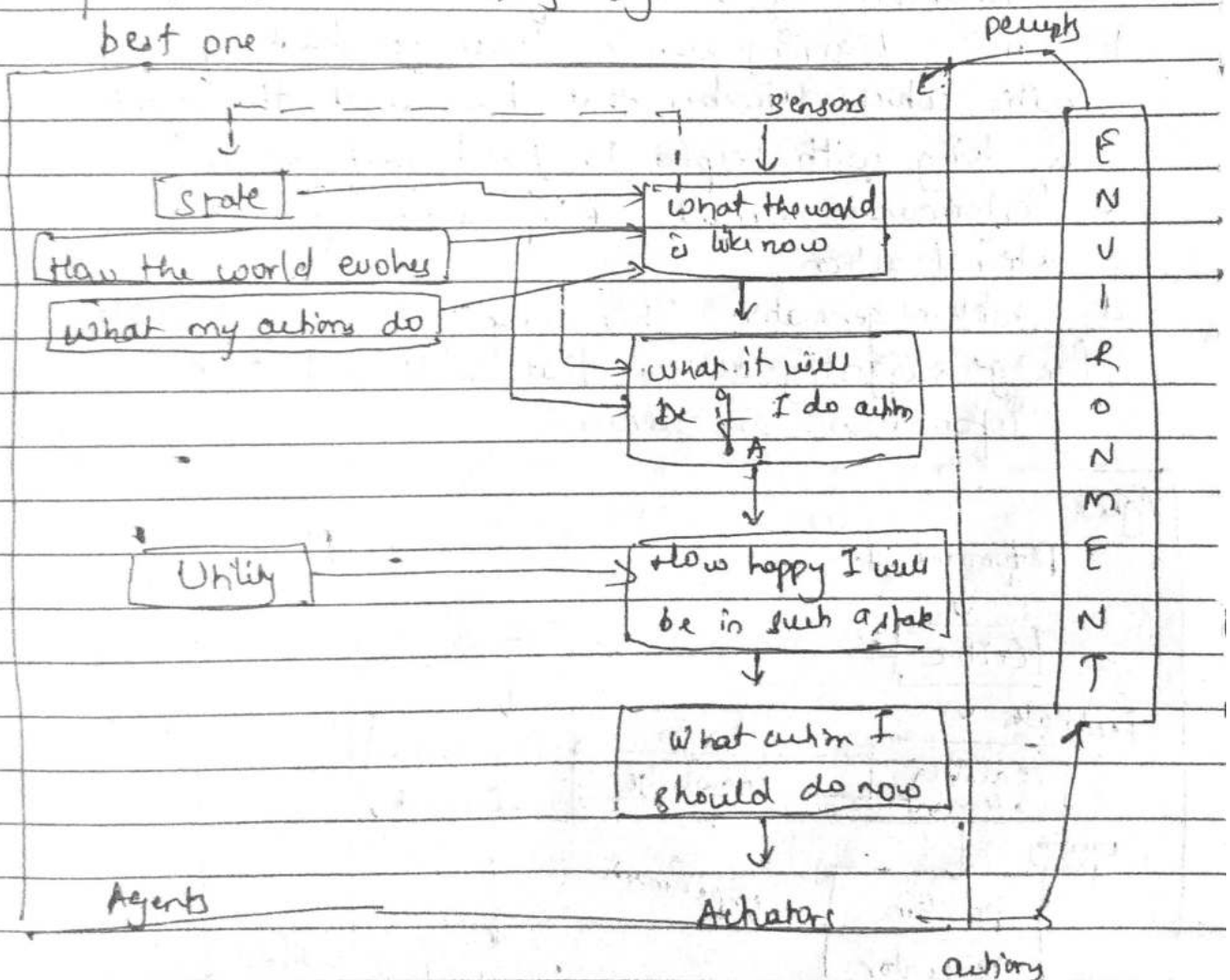
Learning Agent

- A learning agent in AI is type of agent which can learn from its past experience or it has learning capabilities
- It starts to act with basic knowledge and then able to act & adapt automatically through learning
- It has 4 components :

a. Learning element: It is responsible for making improvements by learning from environment.

b. Critic: Learning element takes feedback from critic which describes that how well the agent is doing with respect to fixed performance std.

c. Performance element: Responsible for selecting external action

d. Problem generator: This component is responsible for suggesting actions that will lead to new & informative experience.
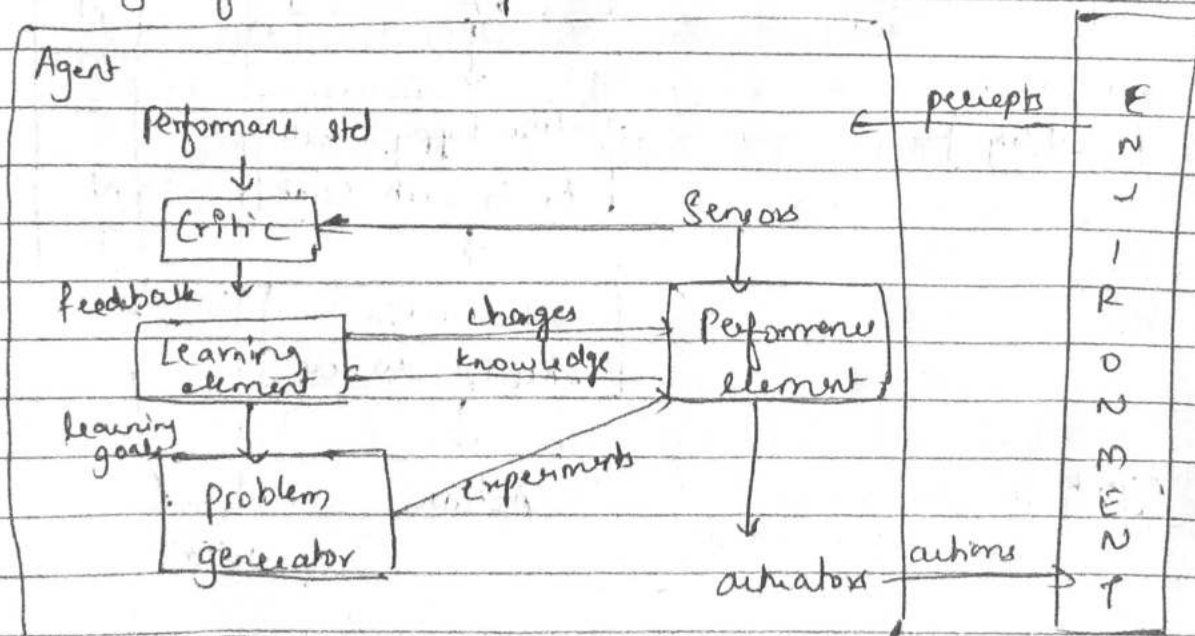
PEAS

PEAS is type of model on which AI agent works upon. When we define AI agent we group its properties under PEAS.

P → Performance measure
E → Environment
A → Actuators
S → Sensors

eg Self Driving car

Performance Measures : Safety, time, comfort, mileage
Environment : Road, other vehicle, road signs, Pedestrian
Actuators : Steering, accelerator, brake, horn, Signal
Sensors : GPS, Camera, Speedometer, Sonar etc.

Refer ppt for eg.

Vacuum cleaner.

Percept Sequence	Action
[A, clean]	Right
[A, dirty]	Suck
[B, clean]	Left
[B, dirty]	Suck
[A, clean], [A clean]	Right
[A, clean], [A dirty]	Suck
[A, clean], [A, clean], [A clean]	Right
[A, clean], [A, clean], [A, dirty]	Suck

function for 2 Room Vacuum cleaner.

if status = Dirty then return Suck
elseif Location = A then return right
else if location = B then return left

Turing Machine Test

- In 1950 Alan Turing introduced a test to check whether a machine can think like human or not. This test is known as turing test
- In this test, turing proposed that computer can be said to be intelligent if it can mimic human response under specific condition
- Imagine a game of 3 players having 2 humans & 1 computer, an interrogator (human) is isolated from other 2 players.
- The interrogator's job is to try & figure out which one is human and which one is computer by asking questions to both of them.
- The computer would try to be indistinguishable from humans as much as possible