* Thinking Humanly →

Activities that we associate with human thinking

Cognitive Modelling approach
eg chatgpt

* Thinking rationally →

law of thought, logical reasoning

Formal rules & symbolic logic

eg chess player

* Acting Humanly → (Turing Test)

AI systems behaviour resembels human behaviour
Emotions, compassion

eg security features in chatGpt or humanoid robot assisting elderly people

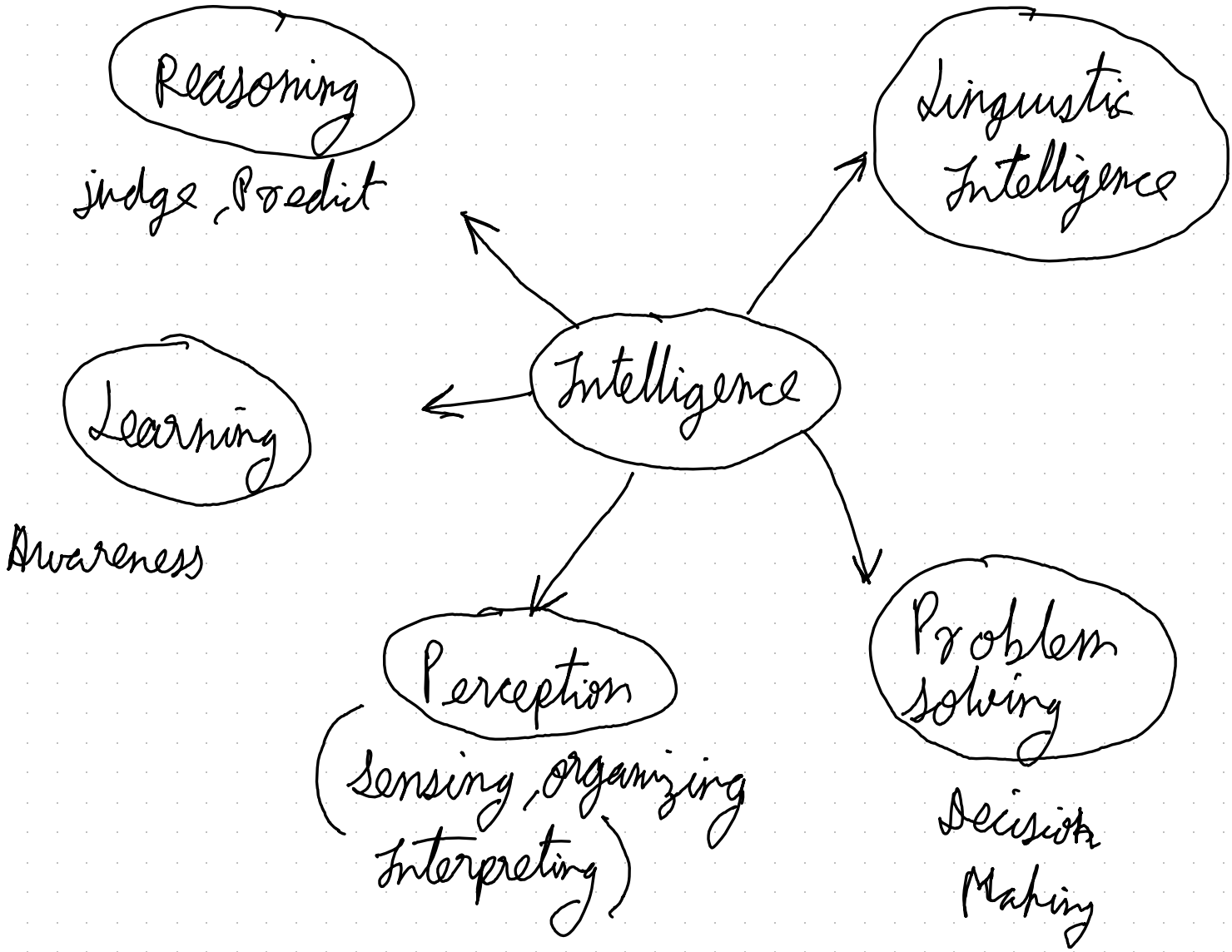
behaviour beyond facts

* Acting rationally →

AI systems behave in a manner that is rational based on their goals and information

eg self driving car

Components of Intelligent system



L P P L R

PEAS

P- Performance
E - Environment
A - Actuator
S - Sensor

Agent Type	Performance	Environment	Actuator	Sensors
Medical diagnosis system	No False Negatives, speed of diagnosis	Patient, hospital staff	Display of question, test, treatment referal	Keyboard entry, patient answers, camera
Part picking Robot	Accuracy, speed	Conveyer belt with parts	Arm & Picker	camera
Refinery controller	Purity, yield safety	Refinery operations	Valves, pumps, heaters displays	Temperature sensor, chemical sensor

Properties of Task environment

D	Dynamic / static
A	Single Agent / Multi Agent
D	Deterministic / Non deterministic
C	Continuous / discrete
O	Partially Observable / Fully Observable
K	Known / Unknown
E	Episodic / Sequential

Static agent	Dynamic agent
Environment does not change	Environment keeps on changing
Calculations can be performed only once	Calculations need to be performed every instant
No time constraints	Time constraints
eg Vaccume cleaner in empty house	eg autonomous car on a busy road

Single agent	Multi agent
Only one agent	Multiple agents
Coordination not required	Coordination or competition required
Needs to focus only on the problem	Needs to focus on other agents & the problem
eg Moving lawn	eg Online poker

Deterministic	stochastic
Next state completely determined by the previous state	Next state not determinable
Best states and their path can be decided at beginning	Need to update path everytime based on results
eg Vaccume cleaner	eg. stock Market trading bot

Continuous	Discrete
Output is a continuous variable	Output is discrete number of actions
Range of outcomes	Number of outcomes
eg Vaccume cleaner may decide to go ahead x distance	eg chess player has only few possible moves

Partially Observable	Fully Observable
Complete state of the environment cannot be mapped	Complete state of the environment can be mapped
Dont have complete knowledge of environment	Complete knowledge of the environment
eg chess solving	eg autonomous car

Known	Unknown
Outcomes for all actions are known	Outcome of a specific action is not known
Knows how the environment functions	Needs to learn how the environment functions
eg Vaccume cleaner	eg stock market trader

Episodic	Sequential
Action is independant of past actions	Action depends on the past actions
Needs no planning	Needs planning
eg part picking robot	eg. chess player

Dynamic/static – Does the environment change?

Single/Multi Agent – Does agent work alone or in colaboration with others

Deterministic/stochastic – Can next state be completely determined by previous state?

Continuous/discrete – Are there number of distinct well defined actions?

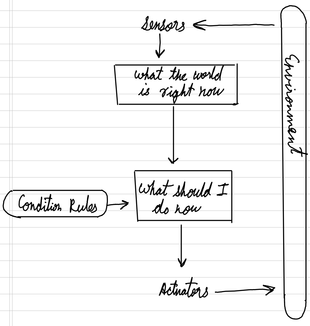
Fully/Partially Observable – Complete environment known?

Known/unknown – Agent knows outcomes of its actions?

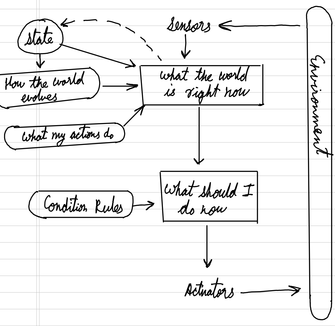
Episodic/Sequential – Can actions be divided into independant episodes?

Types of agents

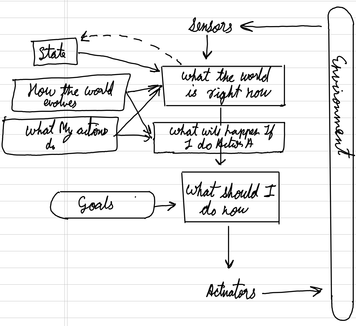
* Simple Reflex



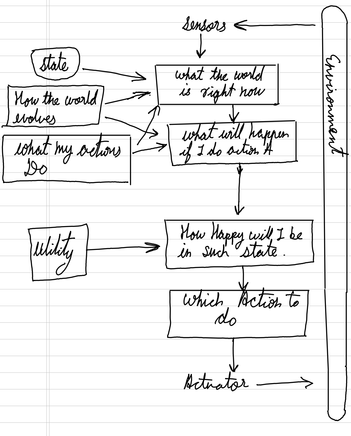
* Model Reflex



* Goal Based

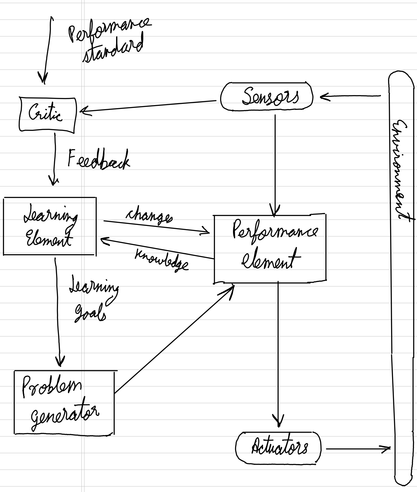


* Utility Based



* Learning Agents

Learning element → responsible for making improvements
Performance element → selecting external actions
Critic → feedback
Problem generator → suggesting actions that lead to new experiances



* Informed Vs Uninformed search

Informed	Uninformed
Huristic search	Blind search
Uses knowledge in form of huristic	Does not use knowledge
Fast	Slow
Performance depends on huristic	Performance depends on strategy
Needs More information	No information apart from problem

Formulation of a problem

G	Goal	
I	Initial state	
T	Transitions	(Explanation of Actions)
A	Actions	(List of possible actions)
S	state space tree	
P	Path cost	

8 tile → G →

1 2 3
4 5 6
7 8 □

I →

1 2 3
4 □ 5
7 8 6

T → Move left means move tile left & left tile right i.e. interchange positions

⋮

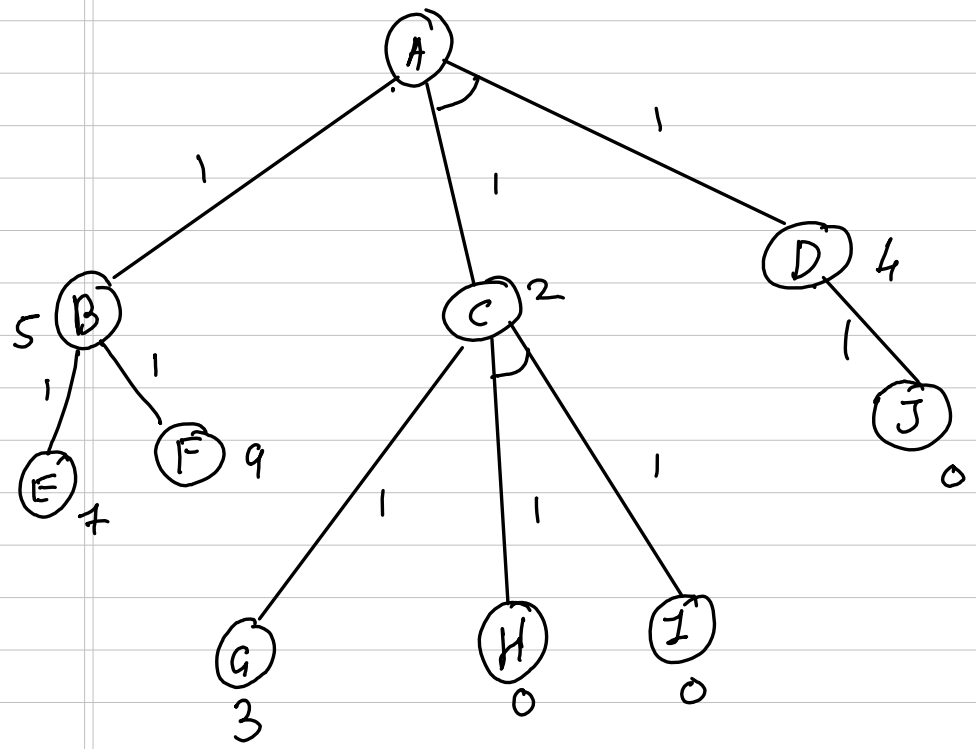
A →

Move Left
Move Right
Move up
Move down

S → all possible combinations

P → 1 for 1 transition

A D*



AB → 1+5 = 6

BE = 1+7 = 8 ✓
BF = 1+9 = 10

AB = 8+1 = 9
update B = 9

ACD → 1+4+2+1 = 8

DJ → 1+0 D = 1 update
CH → 1+1 = 2 ✓ C = 2
CG → 3+1 = 4

A CD = 1+1+2+1 = 5

* What is a heuristic function?

→ Heuristic is a function that is used to estimate the cost of reaching the goal state from the given state

→ Heuristics are rules of thumb or approximation strategies that guide the search for the solution

* Properties of heuristic function

Admissibility → Never overestimate true cost

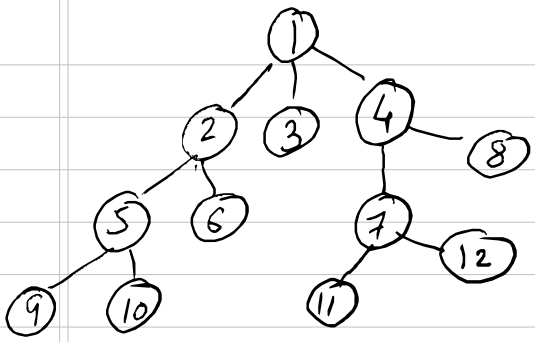
$$h \leq g$$

Consistancy → estimated cost from current state to successor state + heuristic of successor state must be greater than or equal to current heuristic

$$h(n) \leq h(n, n-1) + h(n-1)$$

Greedy Best first Vs A*

Greedy Best	A*
$f(n) = h(n)$	$f(n) = h(n) + g(n)$
Not optimal	Not optimal
Not Complete (△ inequality)	Complete (if admissible heuristic)
less Memory	More Memory
Cant solve complex problems	Can solve complex problems



DFS → 1 2 5 9 10 6 3 4 7 11 12 8

BFS → 1 ... 12

IDDFS → 1

1 2 3 4

1 2 5 6 3 4 7 8

* Learning vs reasoning

Learning → Aquisation of info & rules

Reasoning → Using rules to reach goal state