CS401: Artificial Intelligence.

Book:- Peter Norwin

03/08/2022

- Automation.
- Goal ; End Result ; Purpose

04/08/2022

- Software Engineering 1960s started.

Current model → Agile model.

→ Documentation - SRS.
→ Design
→ Coding
→ Testing
→ Maintenance
→

Waterfall
Lifecycle
Spiral
Agile

- Why GPUs instead of CPUs?
- Knowledge-based vs. Rule-based systems. (Domain knowledge 1969-85)
- AI in real life: Predictive Analysis, Content Generation, E-commerce, E-mail marketing, Web Design, Online Advertising, Personalised User Experience.

- Introduction → History, definition.

1950 : Turing's 'Computing Machinery and Intelligence'
1956 : Dartmouth meeting 'AI' name adopted. Birth of AI
1964 : Showing computers understand NLP to solve algebra word problems correctly.
1986 : Rise of ML.
1990s : Major advances in all areas of AI
1995 : AI as Science.

- Supervised vs. unsupervised learning.

- AI: concerned with design of intelligence in an artificial device.

– McCarthy, 1956.

- The Turing Test:
- 1997: Deep Blue chess program beats chess champion.

* Agent Classification:

Goal

Static

Dynamic

offline

Key words

Nutch Crawler

Search Engine

IR

.war extension

tomcat 6.0 7.0

wget -r

ant

ant war

Agent and Environment Relation:

- → Static & Dynamic
- → Fully and Partially Observable.
- → Deterministic & Stochastic
- → Episodive vs Sequential.
- → Discrete vs. Continuous.

Characterising a Task Environment:

→ PEAS: performance measure, Environment, Actuators, Sensors.

Examples for Automated Taxi

Performance measure	Environment	Actuators	Sensors
→ Safe, fast, legal	→ Roads, others	→ Steering wheel	→ Camera
→ Comfortable.	traffic, pedestrian	→ Accelerator	→ LIDAR
		→ ~~Brake~~	→ GPS
		→ Signal	→ Speedometer
		→ ~~Horn~~.	→ Odometer
			→ Engine sensor
			→ Keyboard

* Structure of agents:

Agent = Architecture + Program

↓ Program (Agent) Some function that implements the agent mapping = '?'

↓ Sensors & actuators Some sort of computing Device.

↓ Job of ~~Progra~~ AI Agent Program.

Lifecycle Model:

*

* Types of Environment in AI:

- Fully Observable : Chess
  Partially Observable : Maze, Card game
- Deterministic : Chess, Traffic Signal
  Stochastic : Driving, Football, Random Song Playlist
- Competitive : Chess
  Collaborative : Self Driving Cars
- Single Agent : Maze, Brushing Teeth, Restaurant Order
  Multi Agent : Football, Chess, Cards,
- Dynamic : Roller Coaster Ride
  Static : Empty House
- Discrete : Chess
  Continuous : Self driving Cars.
- Episodic : Restaurant Order, Support Bot
  Sequential : Brushing teeth, Chess, Cards, Tennis.

19/08/2022

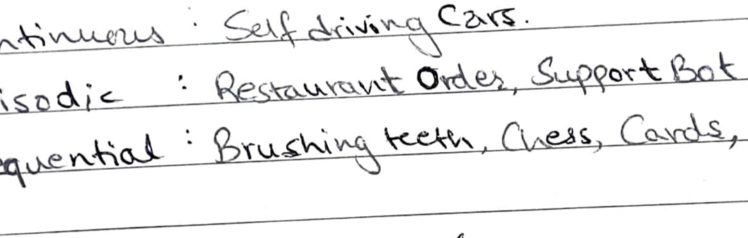
Takes input from the environment.

* Agent Architectures:

- Table Based Agent
- Percept-based / Reflex Agent
- State-based / Model-based Agent
- Goal-based Agent
- Utility-based Agent.
- Learning Agent

Agent → Ideal Agent → Autonomous Agent.

*



29/08/2022

* State Space Search:

* Informed Search:

Search Algorithms

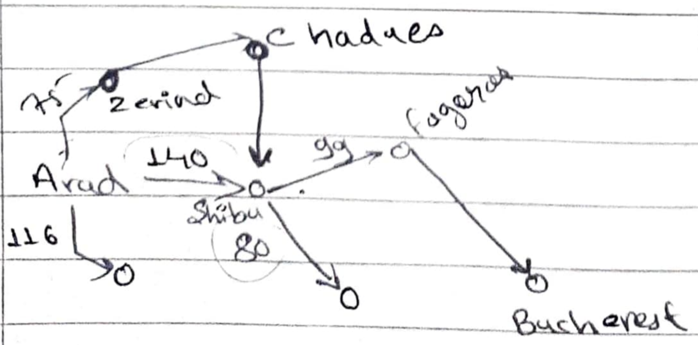
- predefined Uninformed Search (or Blind)
- Informed Search (or Heuristic)

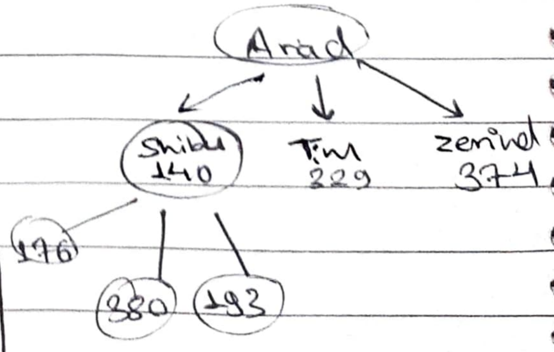
~~Uneffic.~~ Uninformed	Informed.
- Systematically explore the state space search and find the goal.	- Problem Specific knowledge.
- Inefficient in most cases	- May be more efficient.
	- Concept of heuristic function.

- Heuristic means 'rule of thumb' : most promising search path
  estimated

• Informed/ Heuristic Search: • Best first • AO* Search
• A* Search •

- 8-Puzzle : Manhattan Distance.
- Greedy Best-first Search

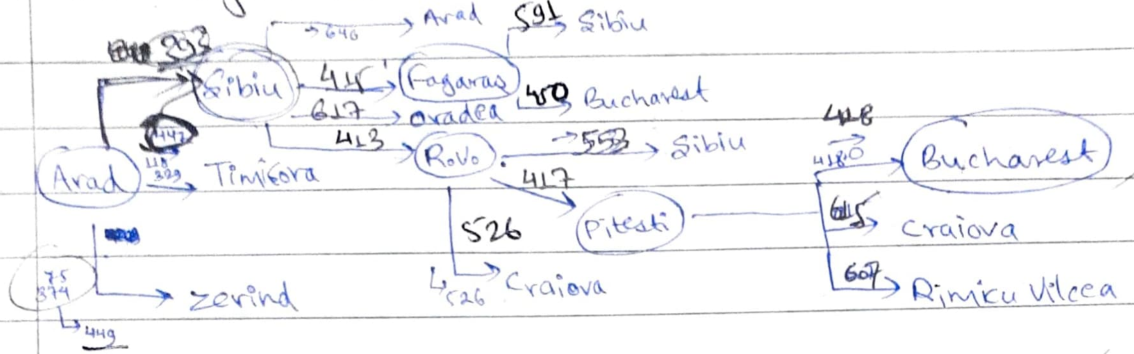




329+118 | $\boxed{\begin{matrix}140\\253\end{matrix}}$ | $\boxed{393}$

__/__/__

A* Search: Starting Node: Arad → Destination: Bucharest



Arad → Sibiu → RV → Pitesti → Bucharest ✓ **418**

↓

~~Fagaras~~

★ 8-puzzle Misplaced Tiles Heuristic: the number of tiles out of place.

Initial State

2	8	3
1	6	4
	7	5

Goal State

1	2	3
8		4
7	6	5

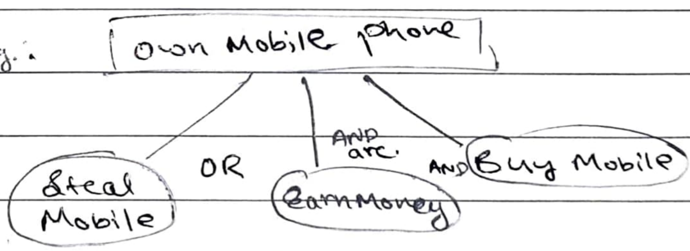
★ AO* Algorithm: Informed search & works as Best First Search

AND Arcs.

Based on problem decomposition (Breakdown problem into Small pieces)

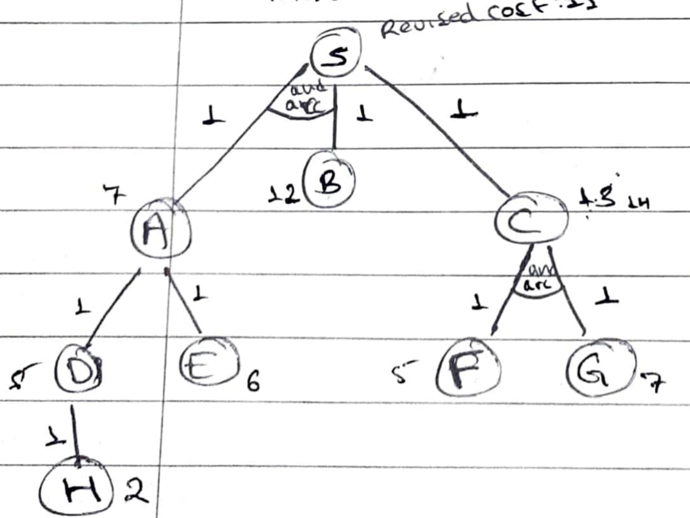
Efficient method to explore a solution path

AND OR Graph: e.g.:



min(14,21) = 14

Revised cost: 15

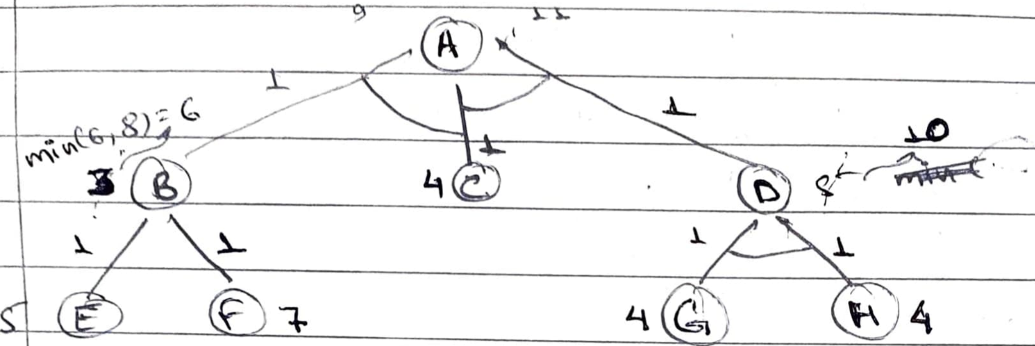


Revised Cost min(12,16) = 12 ✓ final, So we take left path.

min(12,11) = 11

min(9,11) = 9

ABE



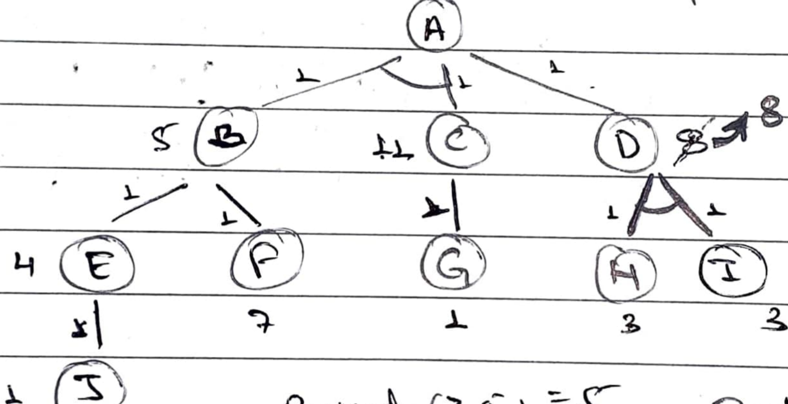
AO* Algorithm: The algorithm does not explore all ~~parallel~~ the solution paths once it finds a solution.

Revised cost min(18,9) = 9 // final.

min(18,9) = 9

path taken — Right Direction

A D(HI)



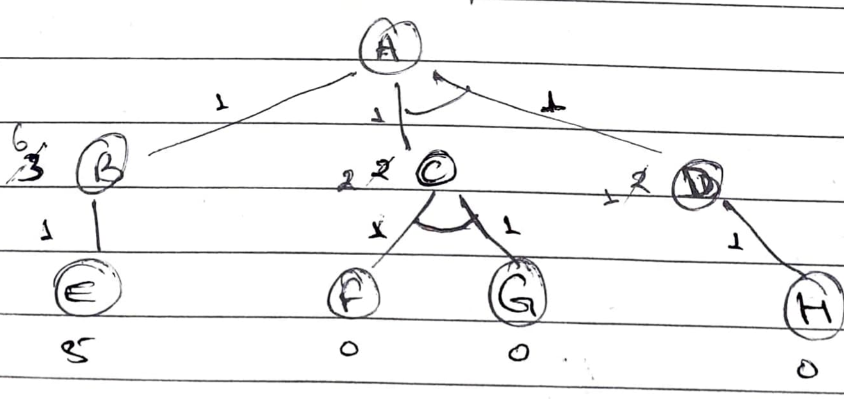
Revised Cost (7,5) = 5

(7,6) = 6

(4,6) = 4

Path: A (CD)(FGH)

Right Direction.

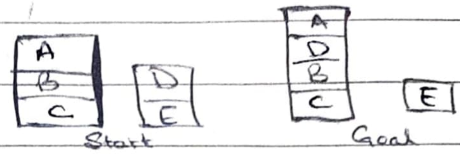


Q. When A* is optimal vs. Admissable?

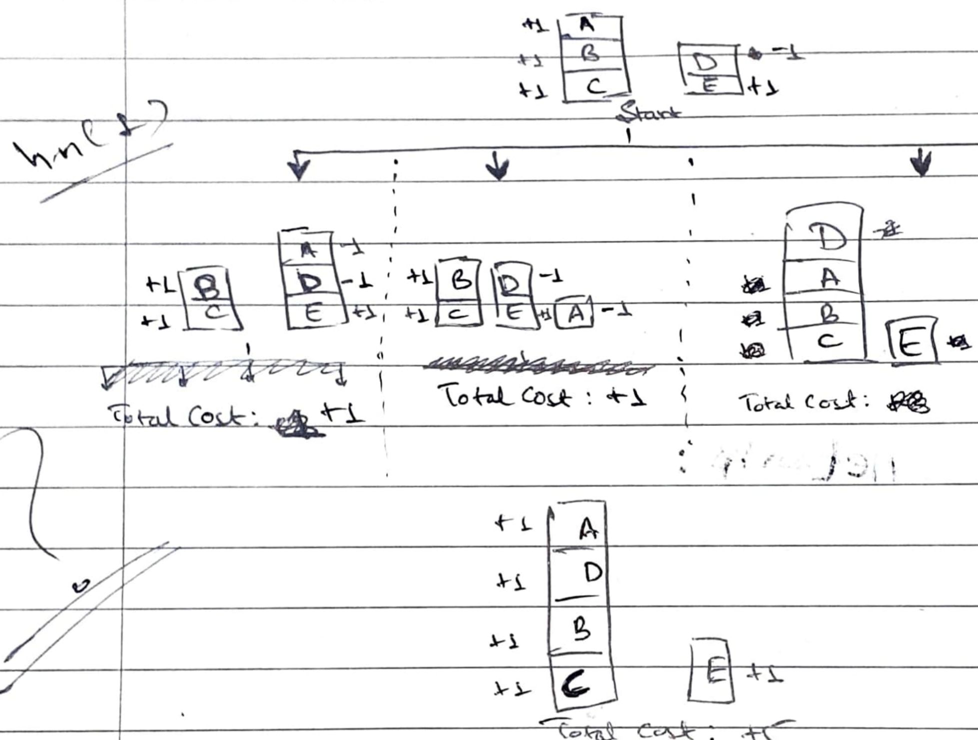
05/09/2022

★ Hill Climbing:

- Local Search Method
- Keep small number of nodes in memory.

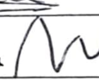


$h_n(1)$



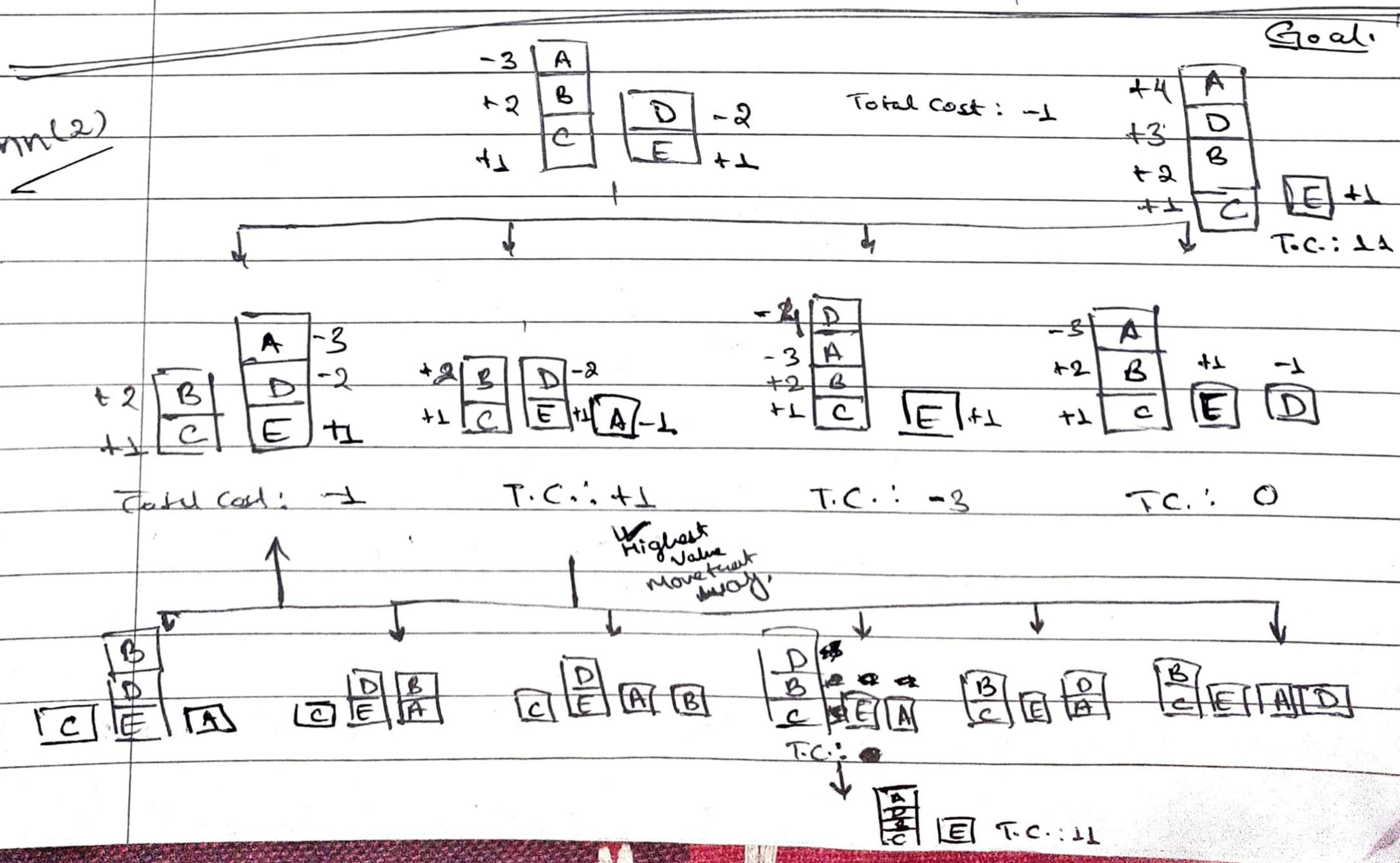
Surface

h_1: Local Maxima



h_2: Global Maxima

$h_n(2)$



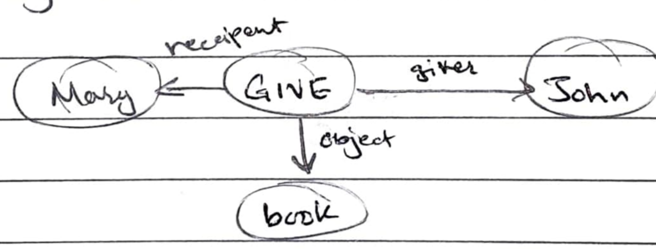
07/09/2022

* Semantic Nets, Frames, Conceptual Graphs :
- Knowledge Representation as a medium for human expression.
- we need to be able to understand ~~otho~~ what the system knows and how it draws its conclusion.

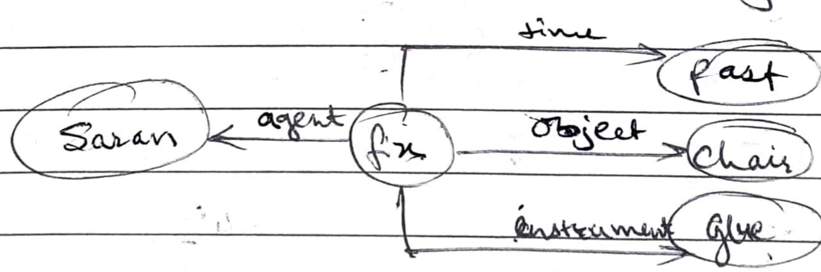
Knowledge Representation
- → Logic
- → Network Representation
- → Structured
- → Issues in KR
- → Advantages/ Disadvantages

- Semantic Networks :

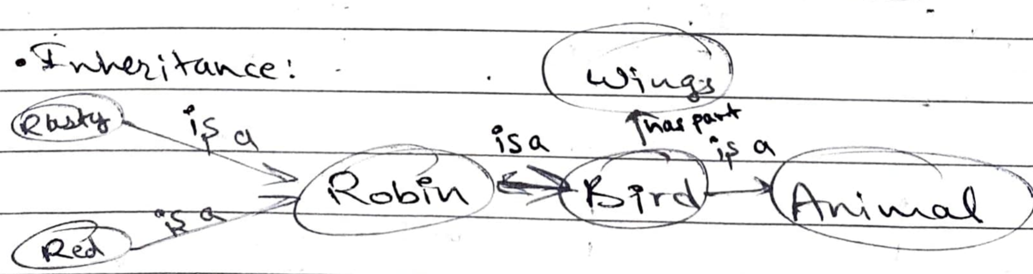
Non-binary Relations:



John gives book to Mary.



- Inheritance:



Relation: ISA (is a) Link: haspart (has part)

08/09/2022

- First Order Logic:
  - Pros Cons of Propositional Logic
- Universal Quantification $\forall$
- Existential Quantification $\exists$
- Nested Quantifiers:

12/09/2022

$\sim(\exists x)\, P(x) \equiv (\forall x)(\sim P(x))$

$\sim(\forall x)\, P(x) \equiv (\exists x)(\sim P(x))$

$\forall x\, [P(x) \wedge Q(x)] \equiv \forall x\, P(x) \vee \forall y\, Q(y)$

$\exists x\, [P(x) \vee Q(x)] \equiv \exists x\, P(x) \wedge \exists y\, Q(y)$

- de-Morgan's law:

  $\sim(x_1 \wedge x_2) \equiv (\sim x_1 \vee \sim x_2)$

  $\sim(x_1 \vee x_2) \equiv (\sim x_1 \wedge \sim x_2)$

- Distributive law:

  $P \wedge (Q \vee S) \equiv (P \wedge Q) \vee (P \wedge S)$

  $P \vee (Q \wedge S) \equiv (P \vee Q) \wedge (P \vee Q)$

- Commutative Laws:

  $P \wedge Q \equiv Q \wedge P$

  $P \vee Q \equiv Q \vee P$

- Associative Law:

  $(P \wedge Q) \wedge S \equiv P \wedge (Q \wedge S)$

  $(P \vee Q) \vee S \equiv P \vee (Q \vee S)$

- Contrapositive law:

  $P \rightarrow Q \equiv \sim Q \rightarrow \sim P$

- AND of ORs
  - $\underbrace{A \vee \neg B \vee \neg C)}_{OR} \underbrace{\wedge}_{AND} \underbrace{(\neg D \vee E \vee F)}_{OR}$
  - $(A \vee B) \wedge C$

_/_/___

- Conversion from FOL (first order logic) to CNF (Conjuctive NF)

Step I: Eliminate Bi-directional / Implication

$$P \to Q \equiv \neg P \vee Q$$

$$P \leftrightarrow Q \equiv (P \to Q) \wedge (Q \to P)$$

$$\equiv (\neg P \vee Q) \wedge (\neg Q \vee P)$$

II: Move all Negations inwards $(\neg, \vee)$

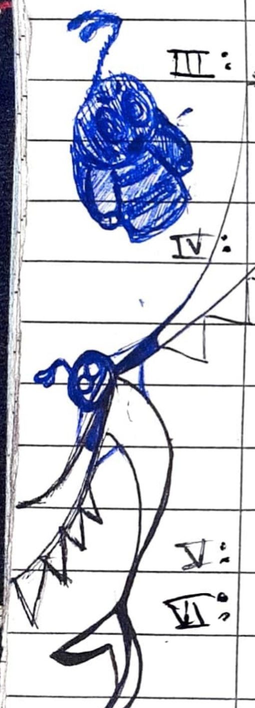
$$\sim (\forall x\, P(x)) \equiv \forall x \sim P(x)$$

$$\neg(\neg P(x)) \equiv P(x)$$

$$\neg(P \vee Q) \equiv \neg P \wedge \neg Q$$

III: Standarise variables apart by renaming them, each ~~quantative~~ quantifier should use a different variable.

$$(\forall x\, P(x)) \vee (\exists y\, Q(y))$$



IV: Skolemise: Each existential variable is replaced by Skolem constant or Skolem function.

$$\exists x\, Rich(x) \equiv Rich(G_1)$$

$$\forall x\, Person(x) \to \exists y\, Accent(y) \wedge Has(x,y)$$

V: Drop Universal Quantifier.

VI: Distribute $\wedge$ over $\vee$

$$P(\wedge Q) \vee S \equiv (P \vee S) \wedge (Q \vee S)$$

- $A \leftrightarrow (B \vee C)$: Converts into CNF

13/09/2022

1. $(A \to B) \to C$
2. $A \to B \to C$
3. $(A \to B) \vee (B \to A)$
4. $(\neg P \to (P \to Q))$
5. $(P \to (Q \to R)) \to (P \to (R \to Q))$
6. $(P \to Q) \to ((Q \to R) \to (P \to R))$

_/_/___

* Horn Clause: A disjunction with at most one positive literal.

$\sim P \vee Q^* \vee S^*$] Not Horn's Clause?

* literal.

$\sim P \vee \sim Q \vee S^*$] Horn's Clause?

- $(x_1 \wedge x_2 \wedge x_3) \rightarrow Y$

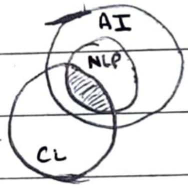
$\equiv \sim(x_1 \wedge x_2 \wedge x_3) \vee Y$

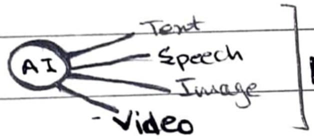
$\equiv (\sim x_1 \vee \sim x_2 \vee x_3) \vee Y$] Horn's Clause.

14/09/2022

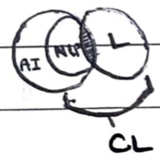
* Lexical Analysis
  - ↳ Syntactic Analysis
    - ↳ Semantic Analysis
      - ↳ Pragmatics and Discussion?

*NLP
* AI
* Linguistics
* Computational Linguistics





Multimodel



Challenges of Text detection:
- Language dependent
- Data dependent
- AI → Rule-based/ Learning based

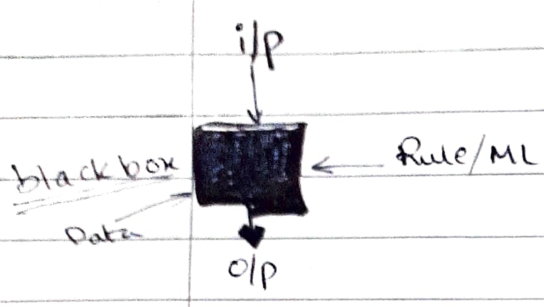
- Is ML/DL itself Rule-based?

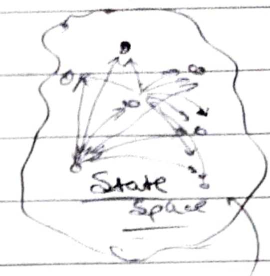
15/09/2022

* what is Rational, Ideal Agent.
* Challenge/Drawback of A* Algorithm.
* Environment Types.

25/10/2022

- Revision: AI → Rule Based
  State Space.





?
MovGen
Who controls?
move from One state to another state.

Rule Based

- Goal Directed or, Backward Chaining
- Forward Chaining or, Data Driven.

- Monotonic Reasoning | • Non-monotonic Reasoning

In montonic, conclusion does not change. (Universally True).

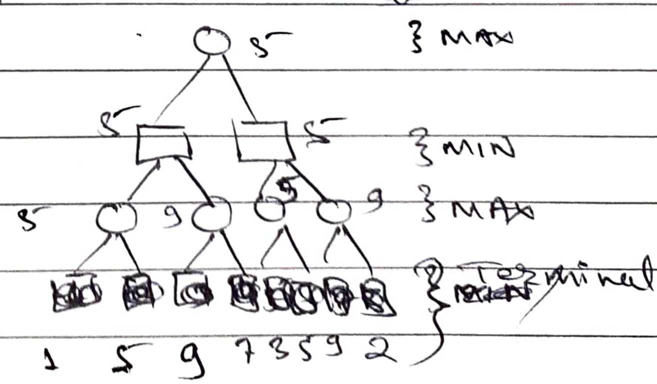
Knowledge Based
• Typically Birds fly • Pengains cannot fly
• Tweety is a bird.

→ It is non-monotonic.

In non-monotonis, conclusion may change depending on addition or subtraction of facts/statements.

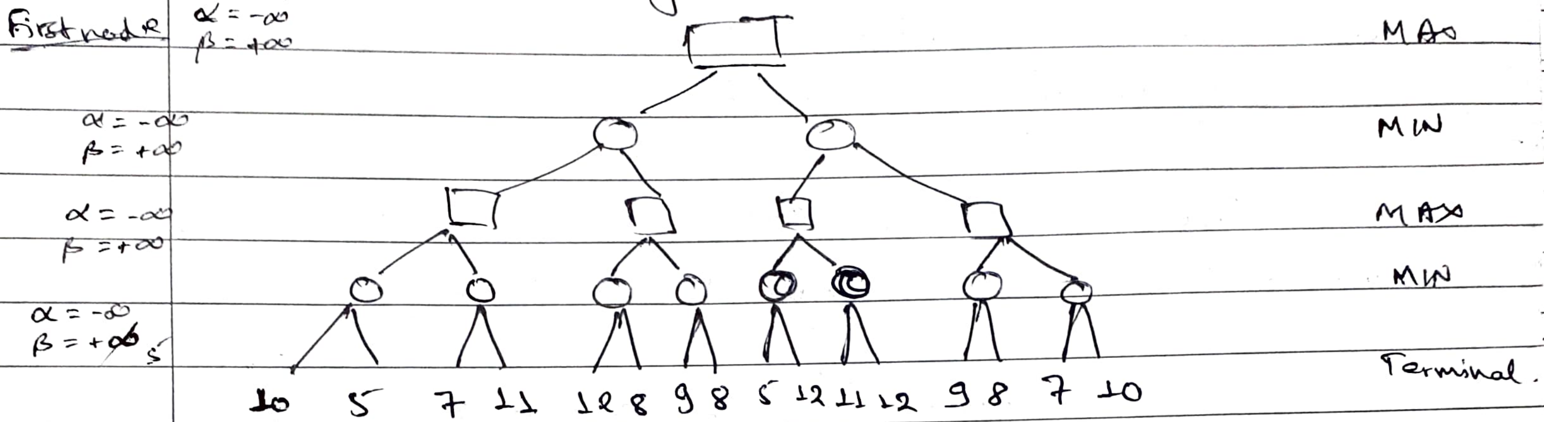
27/10/2022

- Minmax Algo. / Minimax → Disadvantage
  → Time complexity very high
- Alpha-beta pruning.

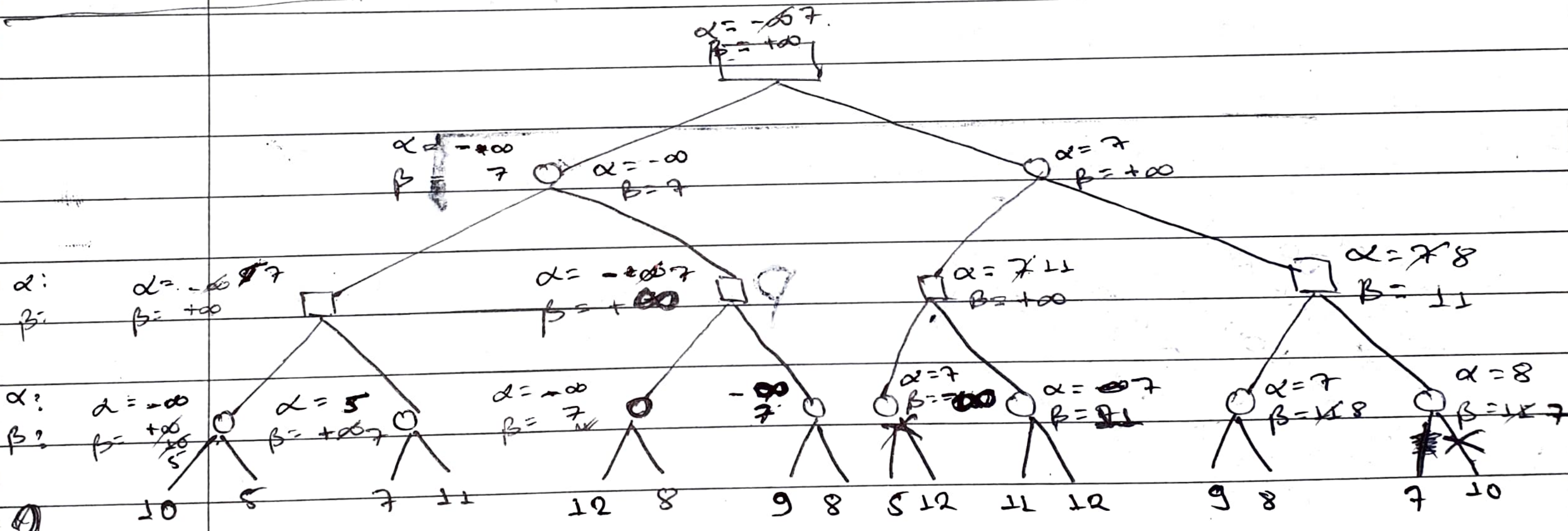


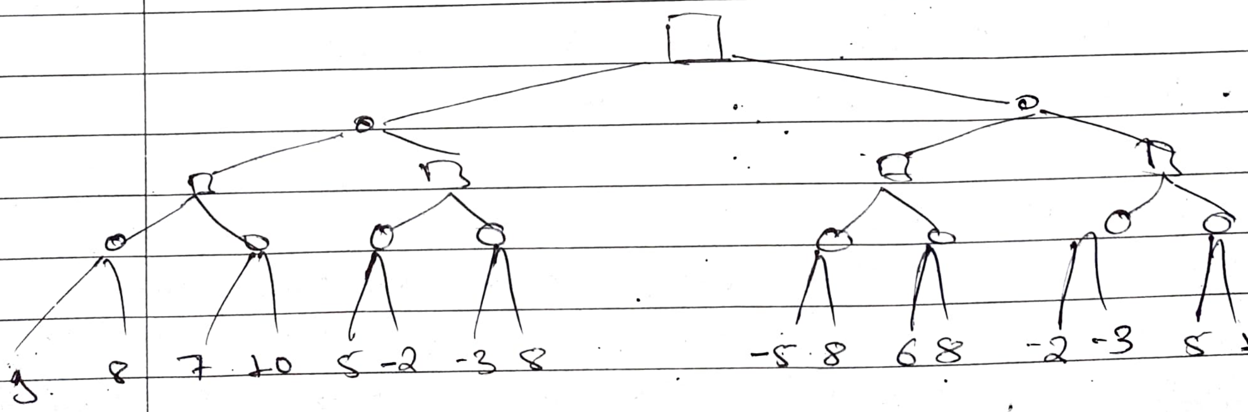
28/10/2022

- Alpha-Beta Pruning



$\boxed{\alpha = \text{MAX} \quad ; \quad \alpha \geq \beta \\ \beta = \text{MIN}}$ at beginning, first node $\alpha = -\infty$, $\beta = +\infty$ infinity





Knowledge Base : Resolution   07/11/20..

* Unit Resolution:
* Input Resolution:
* Linear Resolution:

Derived Clauses (dc)   Clause? Clock? Class?

Knowledge Base (B) or (KB) First order Logic.

Input Resolution: One of the two clauses resolved upon must be from the original set of clauses (KB)

Linear Resolution: After the first resolution step, one of the two clauses resolved upon must be the last clause generate.

Completeness and Incompleteness?

Predicate Calculus.

09/11/2022

* Constraint Satisfaction Problems.

• Standard Search Problem?/State?

* CRYPT-ARITHMETIC

2	1
+ G	1
1 U	2

TO
+ GO
OUT

• No two letters have same value.
• Sum of digits must be shown in problem.
• There should be only one carry forward.

carry is always 1. So, O → 1. 1+1 = 2 → T ⇒ 2 + G = U? U has carry. Possible values of G → 8, 9.

If G = 8 ; 8+2 = 10 ; $\boxed{1_o}$ $\boxed{0_u}$ (Confirmed).

If G = 9 ; 9+2 = 11 ; $\boxed{1_o}$ $\boxed{1_u}$ (O ≠ U Not possible) Two letters should not have same digit

∴ G = 8 . U = 0 .

So, T → 2 . O → 1 ; G → 8 ; U → 0

16/11/2022.

* AI Applications:

Chatbot, Deepfake, Cyberbullying deEPFakE

Automation dEEPFAKE CYBeRBULLYiNG

Crawling means crawling data from the websites, be it online or offline.

Slow Clap

Chatbot Challanges: - multiple questions at once
- Descriptive type questions.
- Short form usage.

chAtBots

Lots of problems!

OPeN

CLOSEd doMAiN!

lOts OF pRoBLeMS!

OPEN dOMAiN!

mOnOLoGue!

REmeMbER

eNGiNE-eR

MONOLOGUe! MONOLOGUe! RASA - 10 miN kiLL! KiLL!

Dialogue MANAGEMENt System. dm Rules

iNtRoVertism

17/11/2022

- Deepfake: ~~evolved the past~~ couple of years as a subset of AI that ~~leverg~~ leverages neural networks to manipulate videos and photos while maintaining an authentic presence.

- fake Dubbing

Tools for voice generation →

- Fields of dubbing / fake budding?

- Identification of Artificially generated deepfake content.

Lots OF AI APPLICATIONS BASED ON that SOCIAL MEdiA!

* CYBERBULLYING:
    - CODEMIXIN DATA
    - FAKE NEWS DETECTION AS PER WIKIPEDIA
    - IDENTIFICATION OF HATE CONTENT

- Fuzzy Reasoning ✗ Robot solving System (very old Systems)

- Bayes Theorem ✓ imp for sem.

Unit 4 - monotonic, nonmonotic, bayes theorem

Other than these, skip.

State Search.

A* AO* may or may not come, but important

~~After~~ 15% from mid sem } Both Theory and Numerical type combined

Rest 85% from after mid sem (all imp)

for ~~theory~~, write examples also.

✓ MCQ Questions - Minor

Crypt Arithmetic (only for addition). } one question guaranteed for End Sem.

CRYPTARITHMETIC

if EXAMPLE is correct, THEN, FULL MARKS!

Subhojit Ghimire, 1912160

CS-401.

09/11/2022

CRYPT-ARITHMETIC.

Q. If, SEND + MORE = MONEY, find the respective values.

		S	E	N	D
+		M	O	R	E
	M	O	N	E	Y.

9567
+1085
10652
Answer clue

Carry → M = 1. (Always)

		S	E	N	D
+		1	O	R	E
	1	O	N	E	Y

S+1 = 1'O' ; S = 9

if S = 9 ; O = 0

∴ O = 0 ; S = 9.

		9	E	N	D
+		1	O	R	E
	1	O	N	E	Y

Again, 9'E' + 10 = 10'N'

Possible values of E = 2, 3, 4, 5, 6, 7, 8

Whatever be the value, E = N, but E != N cannot be.

So, 1 + E + O = N. (∵ it will have carry)

So, Either, N+R = E+10.

OR, N+R+1 = E+10

So, R = 8

So, N + 8 = E ; N, E > 1 and N, E < 8

Now, D + E = Y (must have carry).

S → 9 D → 7 R → 8

E → 5 M → 1 Y → 2

N → 6 O → 0