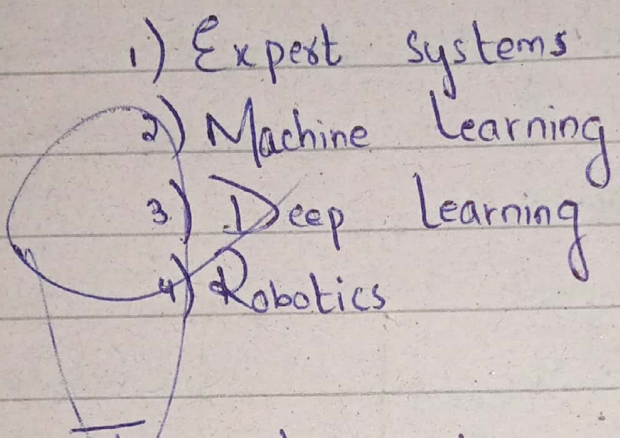
DEFINITION: To develop human behaviour/ intelligence, decision-making power in machines.

BRANCHES:



PURPOSE: To make machine intelligent.

How much intelligent? → Atleast represent human Intelligence

CHARACTERISTICS OF INTELLIGENCE:

There are some characteristics that defines whether the individual is intelligent or not:

- Perceiving
- Decision making with proper reasoning.
- Different behaviours at different situations.
- Quick learning / Responding

- Forecasting / Prediction
- Able to learn from data
- Thinking capability
- Learn from previous situations
- Ability to measure the changes in environment using computer visions.

COMPUTER VISION:

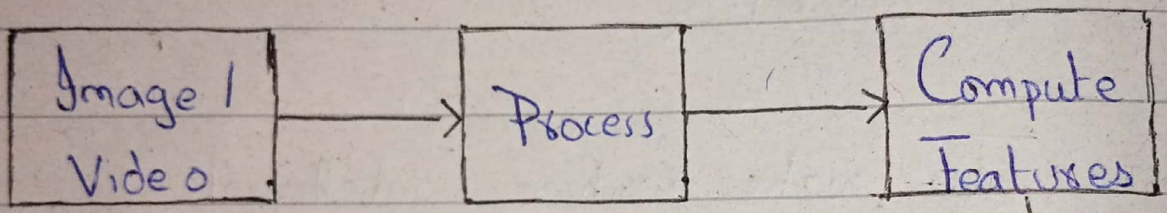
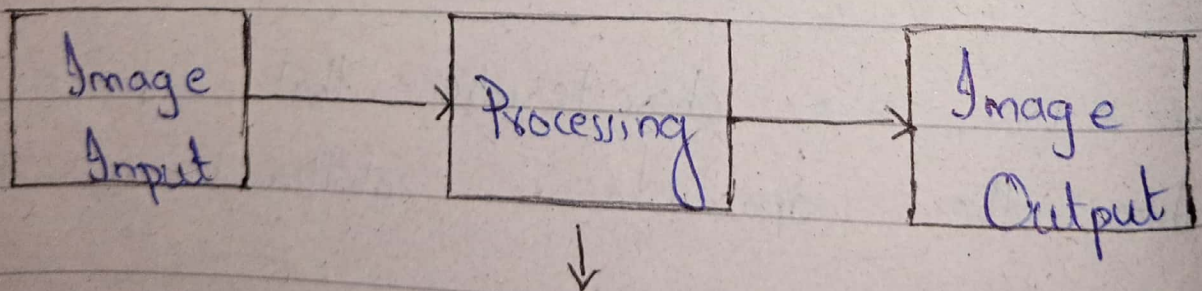
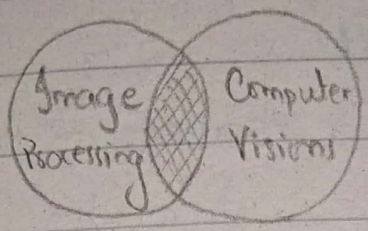
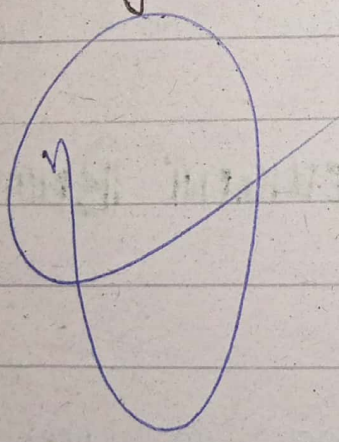


IMAGE PROCESSING:





1- What is Artificial Intelligence?
2- What are the characteristics that shows intelligent behaviour. Write atleast 10 characteristics whereas those are not discussed in class. Justify that they may be programmed in machine.
3- What is the difference blw Image Processing and Computer Vision?



Artificial Intelligence:

Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent human thinks.

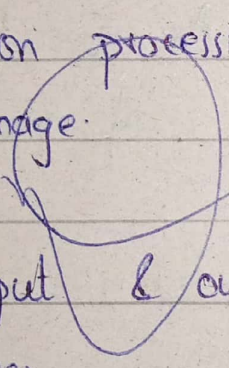
AI is accomplished by studying how human brain thinks, and how humans learn, decide and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

Characteristics Of Intelligent Behaviour:

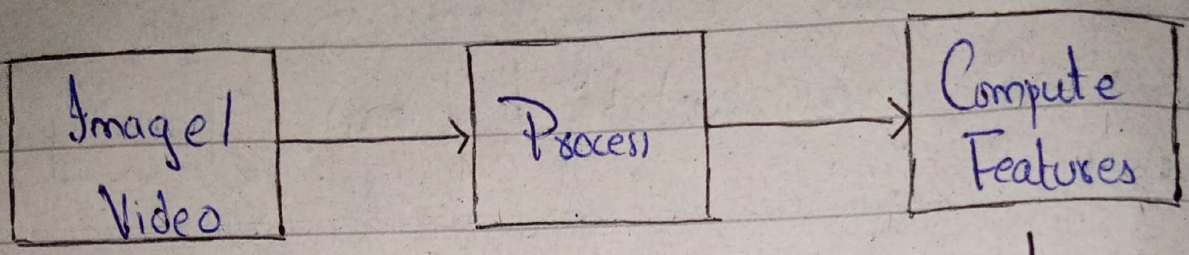
1 - Facial Expressions
2 - Listening with understanding and empathy
3 - Flexibility in thinking (with each and every point of view)
4 - Questioning
5 - Applying past knowledge to new situations
6 - Creativity

7- Checking for accuracy and precision.
8- Accepting your mistakes / Learn from your mistakes.
9- Overcoming Impulsiveness: Planning, clarifying goals, exploring alternative strategies and considering consequences before you begin.
10- Persistence: Not giving up when answers to a problem is not immediately known.

IMAGE PROCESSING VS COMPUTER VISION

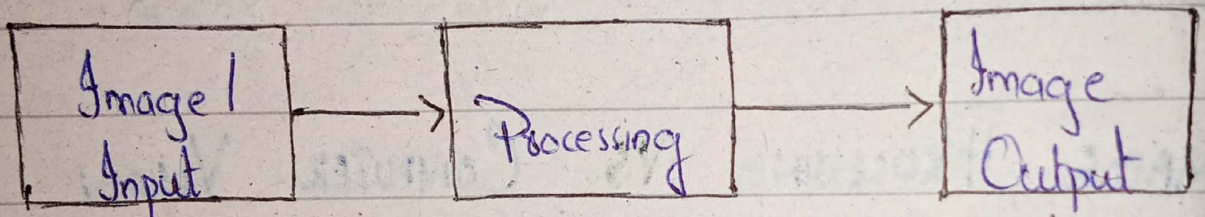


Focuses on processing the image.	Focuses on making sense of what a machine sees.
Both input & output are images.	The system inputs an image and outputs tasks-specific knowledge.
Smoothing & Sharpening, Change contrast & brightness, Highlight edges & regions, Watermarking, compression, Calibration	Labelling, position, identification, measurement, action, projections.



Human, bag, books

Computer Vision



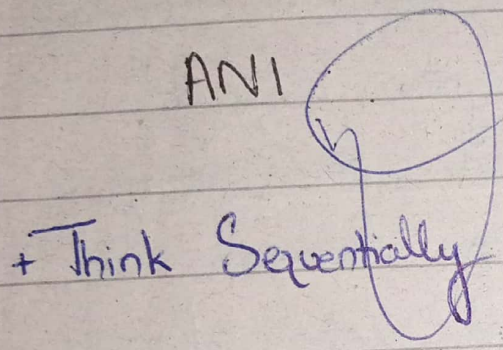
Increase brightness of image

Image Processing

Types Of AI:

1) ANI (Artificial Narrow Intelligence)
Lots Of Progress

2) AGI (Artificial General Intelligence)
Almost no progress



AGI
Think about multiple things
+ Think rationally
+ Act rationally

Q. What do you understand by ANI & AGI?

AI Tasks/Levels Of Development:

1) Basic or Formal Task
2) Expert Task
3) Mundane Task

TYPES OF AI:

1) ARTIFICIAL NARROW INTELLIGENCE (ANI):

ANI, also referred to as "weak AI" or "narrow AI", is application or task specific AI. It is programmed to perform singular tasks such as facial recognition, speech recognition in voice assistants, or driving a car. Narrow AI simulates human behaviour based on limited set of parameters, constraints, and contexts.

EXAMPLE:

1) Speech & language recognition demonstrated by Siri or iPhones.

2) Vision Recognition feature shown-cased by self-driving cars.

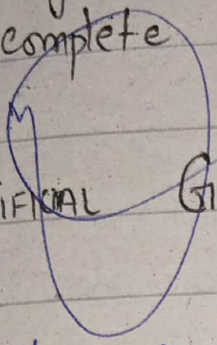
3) Recommendation systems such as Netflix's recommendations.

4) Google's Rank Brain that Google uses to sort results.

5) Chat GPT

Such systems only learn or are trained to complete specific tasks.

2) ARTIFICIAL GENERAL INTELLIGENCE (AGI):



AGI, also referred to as "strong AI" or "deep AI", is the ability of machines to think, comprehend, learn, and apply their intelligence to solve complex problems, much like humans. Strong AI uses a theory of mind AI framework to recognize other intelligent system's emotions, beliefs and thought processes. A theory of mind-level AI refers to teaching machines to truly understand all human aspects, rather than only replicating & simulating the human mind.

There is almost no progress in AGI but in future we can see Progress in AGI. It is a long-term goal in the field of AI research and is still in its development stage.

Quantize -> loss/shrink of data

Machine Learning => Learn from data

Analog Data / Signal --store in computer--> Digital Data / Signal

↓

Quantization

Digital Image: Image stored on computer inform of digits.

imread -> Command is used to read image on Computer.

I = imread('Path\name.ext');

↳ variable

Terminator → computer output show nhi krega. result apny pass rkhy ga

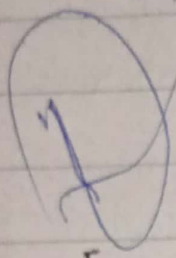
imshow(I) -> shows image

figure, imagesc(I) -> shows image with scale

size(I) -> x and y scale & RGB color

ground truth -> Data collected by user

* Images are stored in form of Matrices in Computer.
  - Row & column Combination
  - generally counted from top to bottom.



[255, 255, 255] RGB value for white color

[255, 0, 0] Pure red color

croping manually

```
C = imcrop(I);
```

-> dikhana nhi store kr k, apne pass rkhlena (;) Terminator

```
imshow(C)
```

Crop by giving values

```
CC = imcrop(I, [x, y, w, h])
```

```
imshow(CC)
```

clear all -> clears all the loaded variables.

ver -> tells version

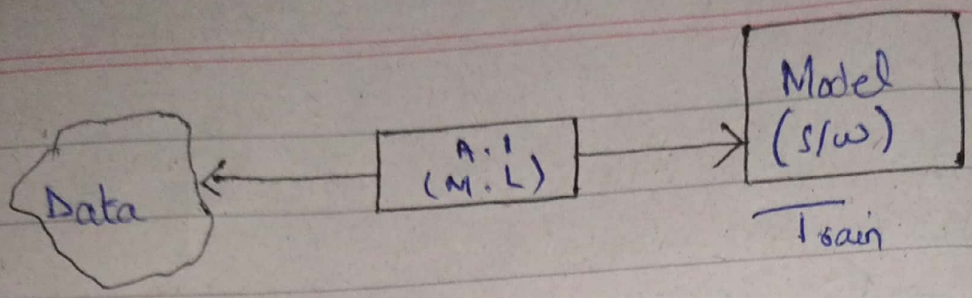
clc -> clear screen

, -> for multiple commands

e.g. Imagesc(I), grid on

% -> Command eg. % Read an image

close all -> close all images



Data could be Image, Text, Voice, motion e.t.c

Understanding of data is very important.

Computer process only

↓

+1.0

① Image vs Digital Image

② Representation Techniques 2^8 & 2^{16} [Matrix]

[0-255] [0-65....]

③ Write MATLAB commands & show outputs. (paste in copy)

④ Image Pixel can be represented as

$I(a_i, a_j)$ — Pixels

Example : $I(45, 20)$

Row Position — Column Position

Gray Image Pixel value range [0-255]

BW Image Pixel value range [0, 1]

Conversion logic of Grey to BW

(Normal vector logic)

Divide the matrix with max value i.e 255 → Divide by magnitude

$\frac{1}{255}$ [x x x ; x x x ; x x x] → points may value either high two

if value < 0.5 = 0

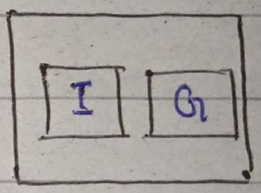
value ≥ 0.5 = 1

Incomplete

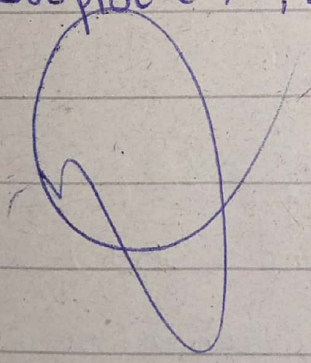
(X, Y) = (101, 249) -> Image pixel

(R, G, B) = (154, 146, 143)

```
% Color change
G = rgb2gray(I);
figure, imshow(G); title('RGB Image')
subplot(1,2,1), imshow(I);
subplot(1,2,2), imshow(G);
```




```
% Black & White
BW = im2bw(I);
subplot(1,3,3), im
```



Object Detection Using Machine Learning:

Detection → without name

Identification → with name

* Dataset → Training Data

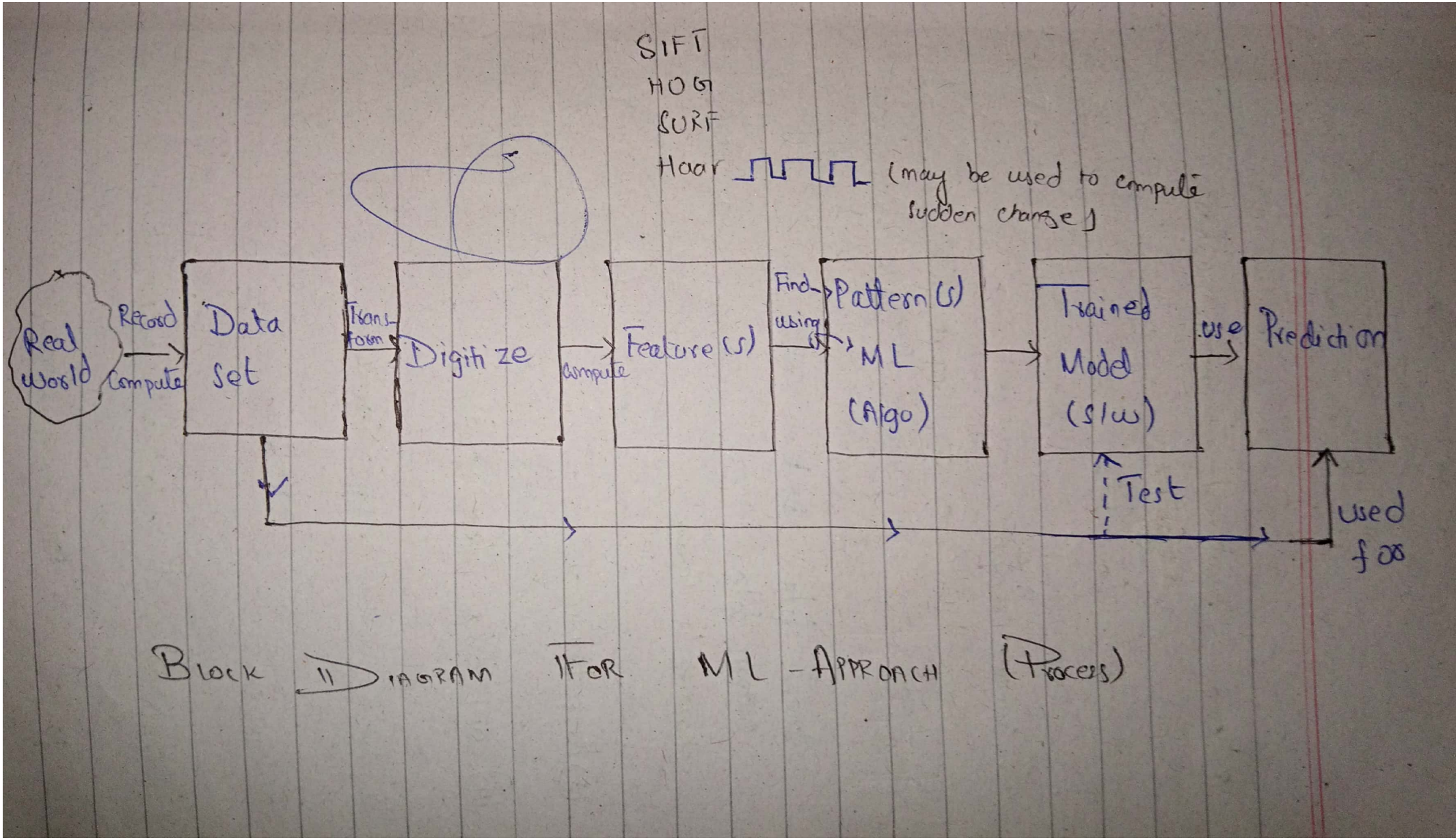
Data that will be used by algo to train models.

Training Data

Set of +ve (Must contain OBJ)

Object of Interest (OBJ): Object for which a model is to be trained.

Set of -ve (must not contain OBJ)



Block Diagram for ML - Approach (Process)

comment

space for values
enter for next img
esc for normal shutdown

① temp -> positives -> object maskes
negatives

rename info file

② samples_creation

change the name of input file
+w -h is range (50 - 70) parameter tuning

Input file .txt
output file .vec

-show -> to show

③ haar_training

④ copy data from cascade

⑤ paste cascade.xml -> data

⑥ convert

⑦ copy converted data file ClassMarch

⑧ paste in test_recognition

9) start

Can You Conribuie In AI Development

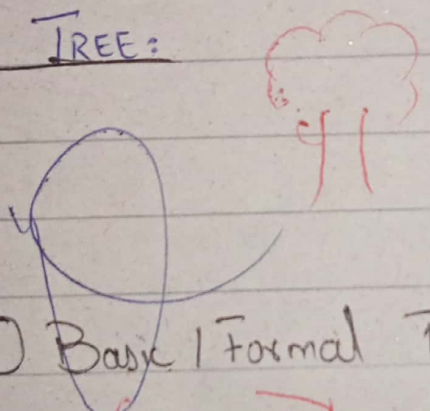
OR

AI Development Stages

OR

AI Tasks (Categorization) Levels

AI Tree:



Mundane Task

Expert Task

Basic Task OR FORMAL TASK

① Basic / Formal Task (Rules & Reg known by ourselves then prog)
- Game Playing (Simple)
- Solve Simple Mathematics Equation

② Expert Task
- Diagonstic System for Malaria / Typhoid

(Knowledge acquired by Domain Expert Then programming)

③ Mundane Task

(Research, Innovation)

• S/w design --> Observe fire through camera
generate alarm

H.w

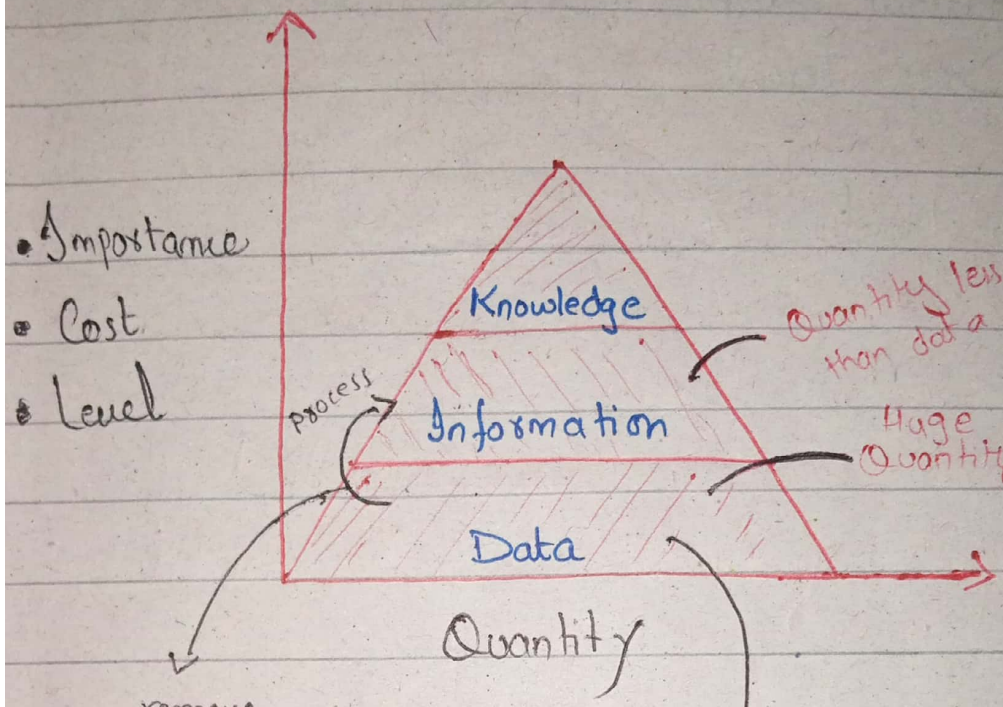
What are development stages. Explain each with example.

• People with knowledge are intelligent.

H.w

Define Knowledge. and its components. Levels, Types.

KNOWLEDGE, COMPONENTS, LEVELS, TYPES:



remove
noise/unwanted gives info.
↳ requires time, & cost efforts

Huge Quantity noise but less level & cost Imp noise.

KNOWLEDGE:

The amount of information to solve particular problem is called Knowledge.

OR

Applied form of Information is called Knowledge.

↓
is used to solve the problem.

Levels Of Knowledge:

1- Shallow Level / Surface Level
2- Deep Level

Shallow Level: (Basic Level)

- Basic Knowledge about a domain is called shallow level.
- It is commonly available. (Adv)
- Complex problems cannot be solved (Disadv)
- No need to be a domain expert.
- Simple problems can be solved.

Example:

- If there is fuel, car can be drove.
- Birds with wings can fly.
- Easy to ~~Program~~.

Deep level: (Advanced Level)

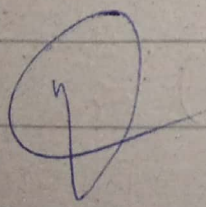
- Relation & connection b/w each comp of info is deep lvl knowledge
- Detailed Knowledge &
- Comprehensive Knowledge.

about a domain is called Deep level.

- People with Deep level Knowledge are domain Expert.
- Not Commonly Available / Rarely Available.
- Solve complex problems of a specific domain (Adv)

Example:

- Doctor knows the relation b/w each symptom. (in Reports)
- Domain expert knows the relation b/w each component of Knowledge.



Types / Categories Of Knowledge:

- Declarative Knowledge:
  - facts, Descriptive Knowledge.
  - Statement, factual Statements.
  - Anything that we declare is declarative Knowledge.
  - Easy to grasp.
  - Either wrong or right.
  - Any statement which is either true or false is declarative Knowledge.

-> These statements are propositions.
-> Represented by boolean.
-> " " PROLOG.

- Declarative Knowledge forms database
- can solve those problems whose solutions are already defined.

neither true or false (instructions) } non-proposition
- What time is it?
- What is your name?

- Procedural Knowledge:
  - Rule, Procedures
  - may get solutions to those problems whose solutions are not predefined by applying rules / procedures.
  - set of rules to perform a task.

Knowledge Base = Declarative Knowledge + Procedural Knowledge

↓

Intelligent

How to program Declarative & Procedural knowledge in computer?

- Prolog
- LISP
- Python

Answer: Using predicate calculus

↓ relation ↓ Computation

PROLOG supports predicate calculus

framework using computation of relationship

SYNTAX of predicate calculus: PROLOG

predicate relation(object).

relation(obj1, obj2).

↓

case sensitive

Example DB:

connect file with db file:
file -> load -> filename

Ali male
Asif male
Sana female
Ali parent Sara
Ali parent Asif

+ male(asif).
+ male(ali).
+ female(sasa).
+ parent(ali, sasa).
+ parent(ali, asif).

// Declarative Knowledge

Who is male?

?- male(X).
male(who).

output => X = ali; press space
X = asif;

parent(asif, X).

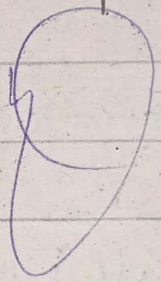
output => X = ali;
X = sara;
X = sama;

% Rule for brother
└ comments %

Then :- If and If and
// Procedural Knowledge
brother(X, Y) :- parent(Z, X) , parent(Z, Y) , male(X).
(and)
└→ in db file

≠(X, Y).

Who is the brother of sara?



brother(who, sara).
output => who = ali;

brother(asif, whom).
output => no.

father(X, Y) :- parent(x, Y) , male(x) , ≠(x, Y)

Basic Task: H.w
sister, brother, father, mother, husband, wife
grandmother, grandfather

Expert Task: H.w
Prolog db domain expert

- HEURISTIC KNOWLEDGE:
  - Knowledge of judgement, tricks, logic, common sense etc.
  - Common, General Knowledge
  - Doesnot give guaranteed solution (either lose or win)
  - How to Program?
    - Algorithm A* (Heuristic Search)

Algorithm A* (Heuristic Algorithm):

$$h(n) = g(n) + f(n)$$

- $h(n)$: Decision function
- $g(n)$: Distance from origin (start) (Increment ++)
- $f(n)$: Distance from/to Goal State (unpredictable may or may not decrease)

If $f(n) = 0$ (goal accomplished)
initial $g(n) = 0$ and inc++

8-Puzzle Game (Application of Heuristic Knowledge)

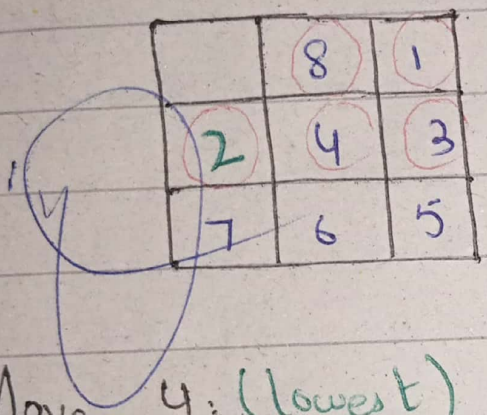
Initial State:

2	8	1
	4	3
7	6	5

1	2	3
8		4
7	6	5

Goal State

Move 2: (lowest)



	8	1
2	4	3
7	6	5

$g(n) = 1$ $h = 5+1 = 6$

$f(n) = 5$

(Minimum goal steps: How many tiles are in their correct position?).

Move 4: (lowest)

2	8	1
4		3
7	6	5

$g(n) = 1$ $h = 5+1 = 6$

$f(n) = 5$

Move 7: (High) → i.e $h = 7$ Ignore.

2	8	1
7	4	3
	6	5

$g(n) = 1$ $h = 6+1 = 7$

$f(n) = 6$

Move 2: continue

- Move 8:

8		1
2	4	3
7	6	5

Move 4: continue

- Move 8:

2		1
4	8	3
7	6	5

- Move 3:

2	8	1
4	3	
7	6	5

Move 6:

2	8	1
4	6	3
7	5	5

Move 4:

2	8	1
	4	3
7	6	5

Homework

1	2	3
	4	6
7	5	8

Initial

1	2	3
4	5	6
7		8

Goal

$g(n) = 3$

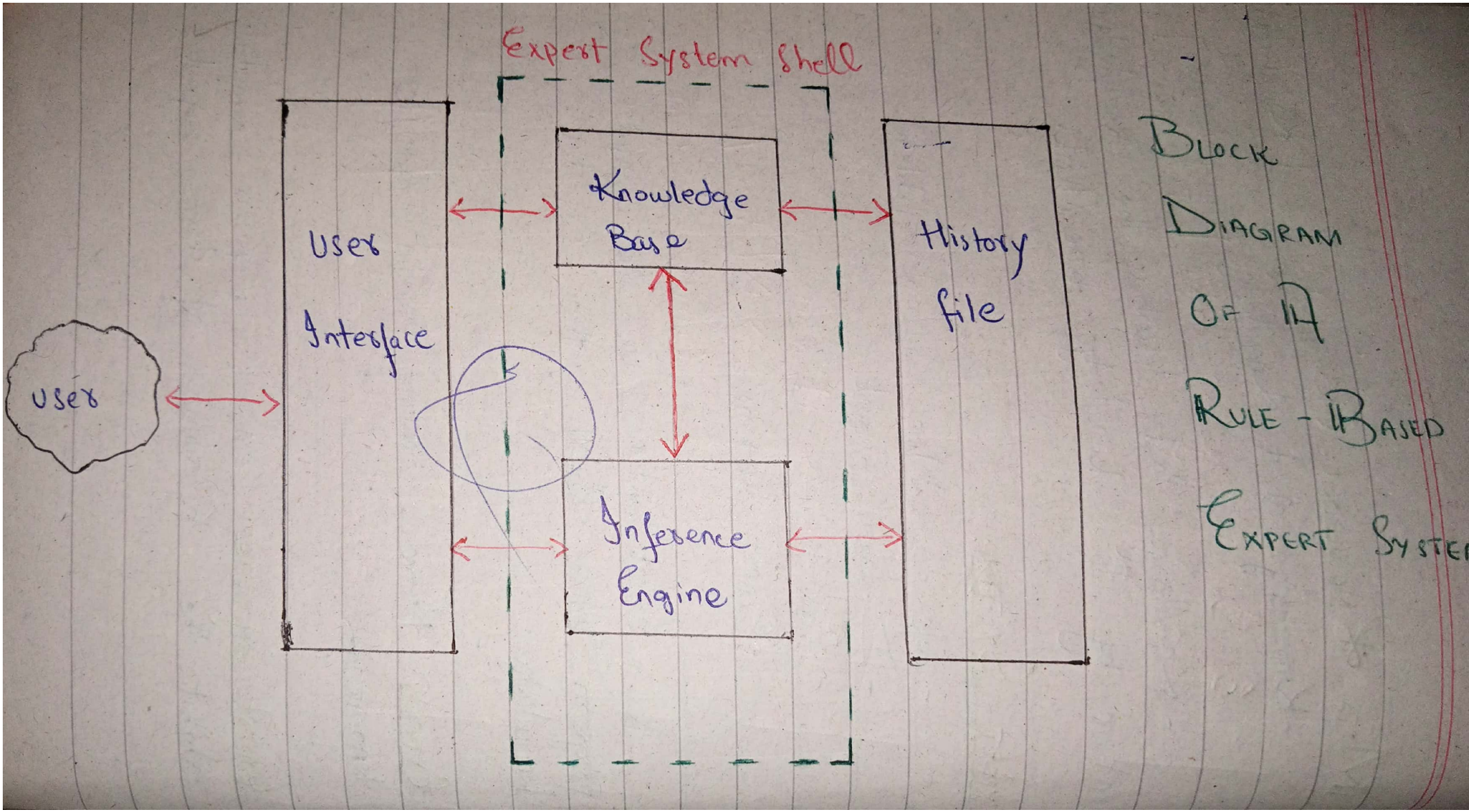
- META KNOWLEDGE: (Knowledge about Knowledge)
  - Knowledge about Knowledge
    Eg: Index page in books [• Easy Navigation • Time saving]
  - Knowledge that describes the knowledge contain by the knowledge base / book.

EXPERT SYSTEM:

- able to solve complex problems.
- Domain Expert
- Experts → Humans
  Expert Systems → Machines / Computer Program
- Expert Systems are the computer program which exhibits the expert's knowledge.
-

Experts: Humans having domain specific knowledge.

Expert Systems: Computer programs simulate / exhibit the behaviour of human expert.


Expert System Shell
User Interface
Knowledge Base
History file
User
Inference Engine
Block Diagram Of A Rule - Based Expert Syste

Major Components Of Expert System:

Prolog family assignment.

1.- User Interface
2 - Knowledge Base
3 - Inference Engine

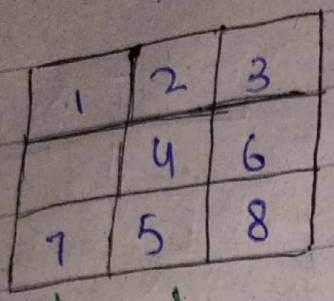
Interface types:
- GUI Based
- Image/Video
- Speech
- Gesture
- CMD
- Text
- Menu Based

- User Interface:
  - Provides communication channel b/w user and system.
  - Bi-directional
  - Intelligent user interface by using Natural Language Processing (NLP)

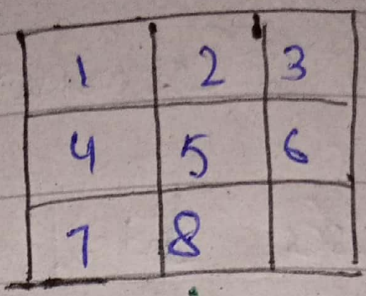
- Knowledge Base:
  - Contains knowledge about the domain. (specific domain) for which the system is being made.
  - Declarative + Procedural Knowledge.

- Inference Engine:
  - Works in 3 steps
    1. Match
    2. Select
    3. Execute
  - runs the expert system
  - works like a human brain.

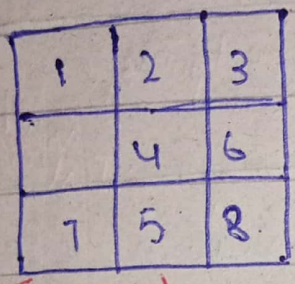
8 - Puzzle Game



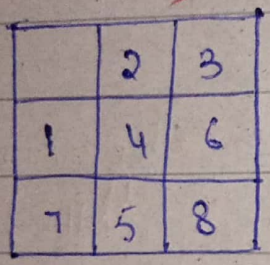
Initial



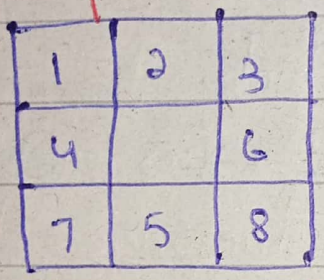
Goal



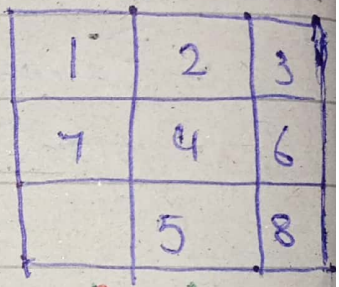
f = 3



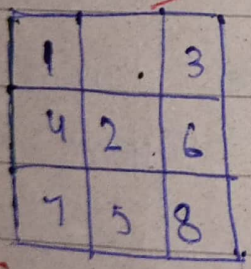
f = 4 g = 1 h = 5



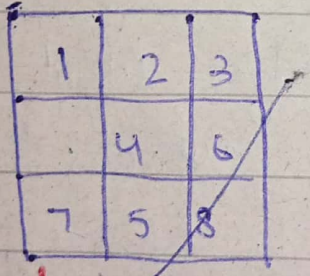
f = 2 h = 3



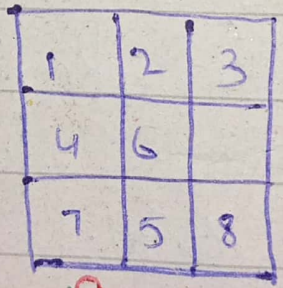
f = 4 h = 5



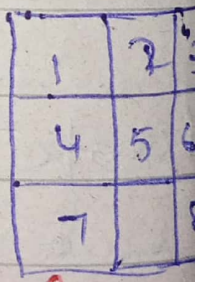
f = 3 g = 2 h = 5



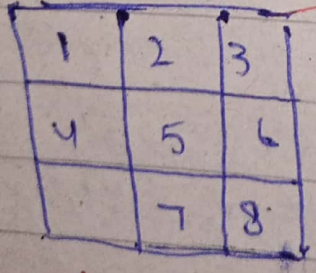
f = 3 h = 5



f = 3 h = 5

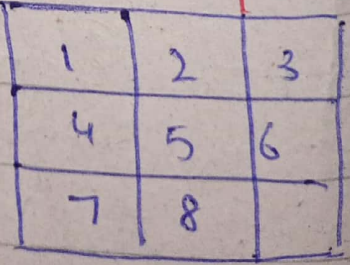


f = 1 h = 3

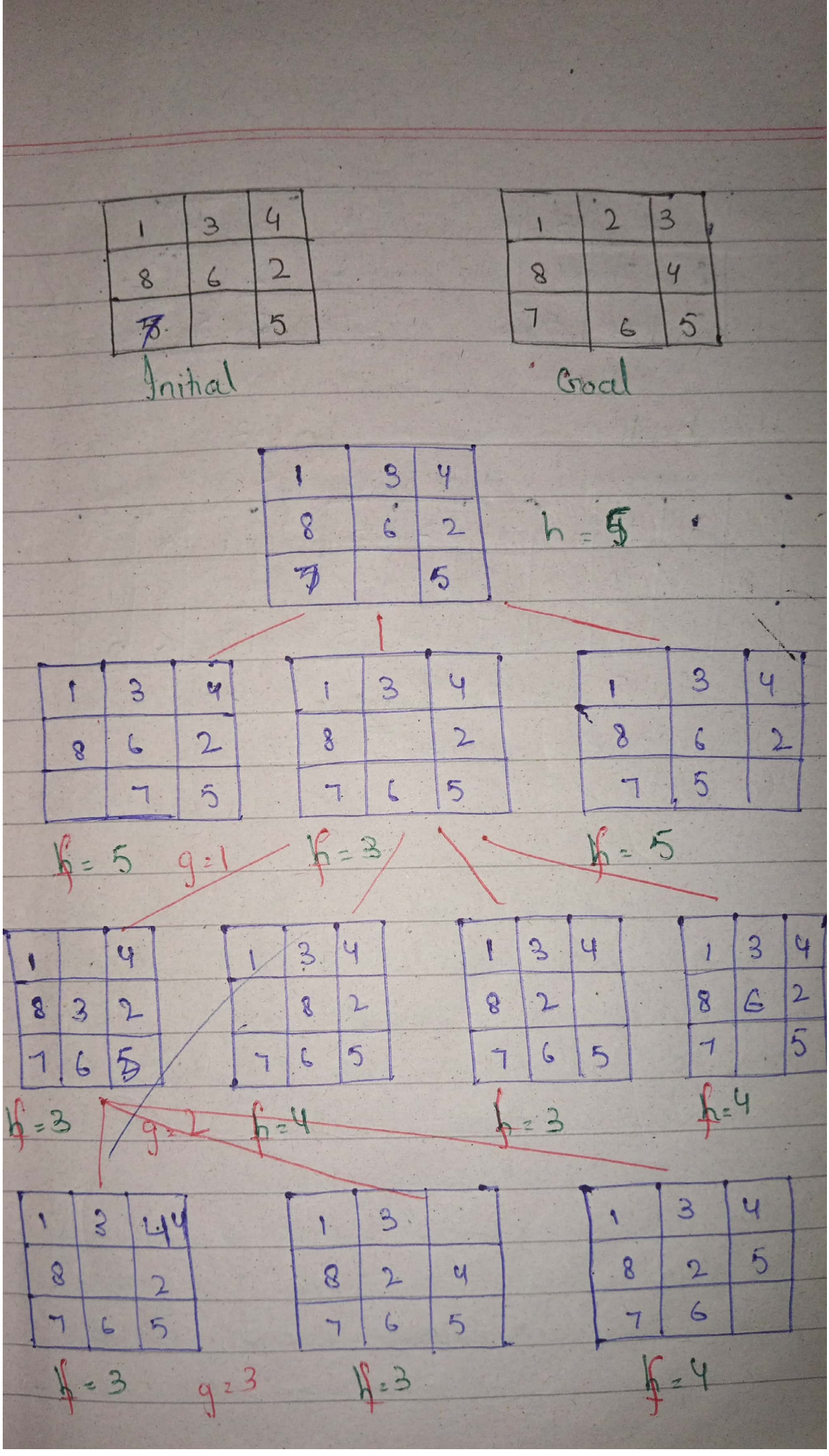


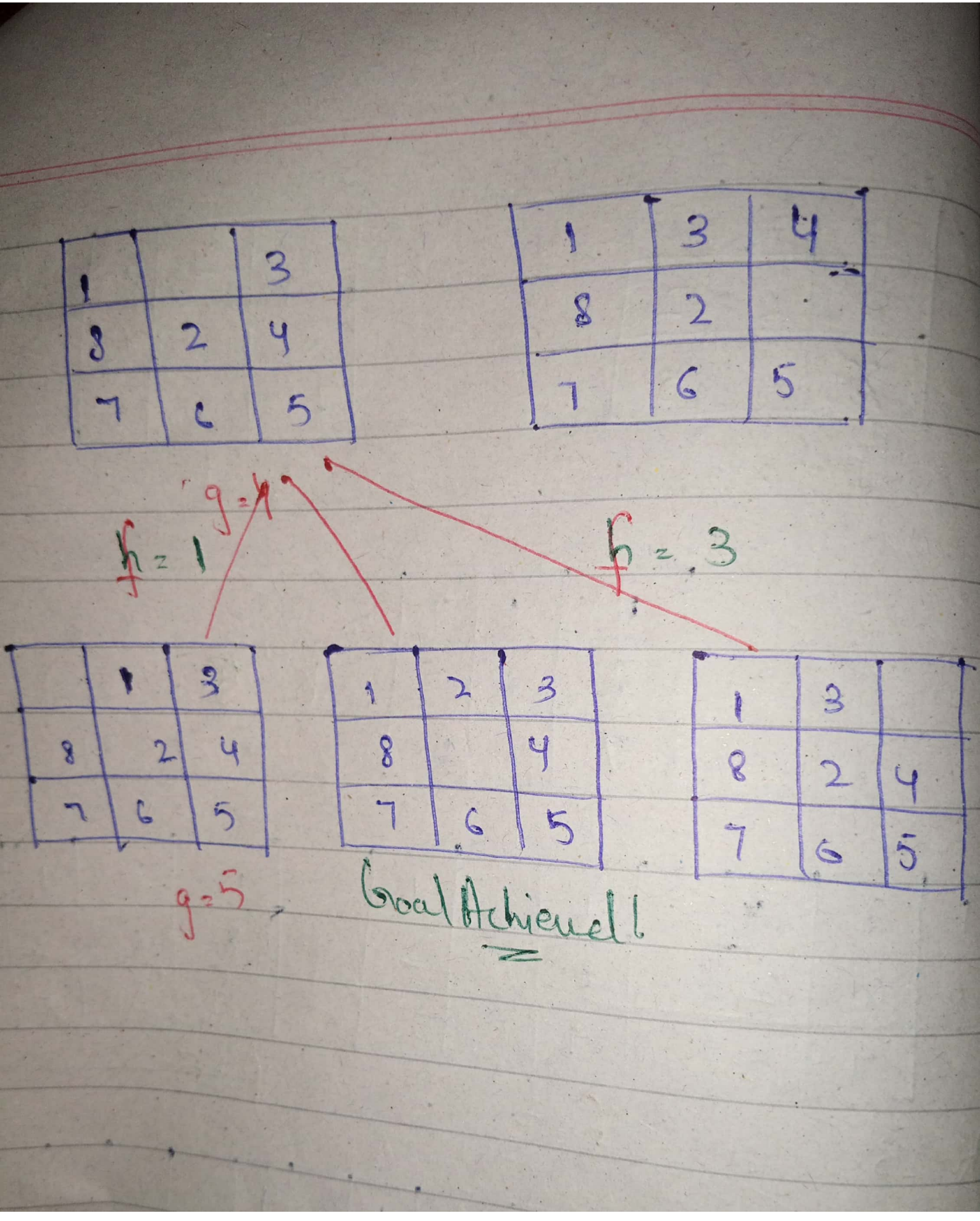
f = 2 h = 5

g = 3



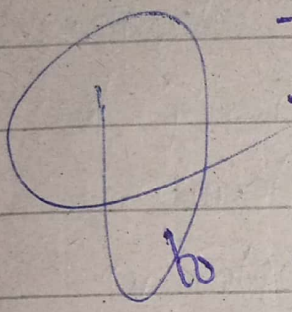
f = 0 h = 3 Goal Achieved


Initial
Goal
h = 5
f = 5 g = 1
f = 3
f = 5
f = 3 g = 2
f = 4
f = 3
f = 4
f = 3 g = 3
f = 3
f = 4


1 3
8 2 4
7 6 5
1 3 4
8 2
7 6 5
g=4
h=1
h=3
1 3
8 2 4
7 6 5
g=5
1 2 3
8 4
7 6 5
Goal Achieved!
1 3
8 2 4
7 6 5

Data Science:

- Extraction, analysis and interpretation of knowledge to gaurke insights and make informed decisions.
- combines various fields mathematics, statistics, programming and domain knowledge
- Use techniques:
  - Data cleaning
  - Data visualization
  - Statistical modeling



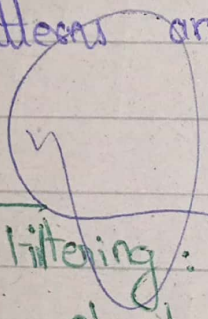
to uncover patterns, trends and correlation in data.

Ecommerce companies use data science to analyze customer behaviour and enhance their shopping experience. By collecting and analyzing vast amount of data, such as browsing history, purchase patterns and demographic information, these companies gain insights into individual preferences. Hence, increasing the chance of making a sale and enhance customer satisfaction.

Keywords:
- Finding patterns, features, characteristics
- Prediction

MACHINE LEARNING:

- Subset of AI
- focus on enabling machine to learn from data & improve their performance without being explicitly programmed.
- Involves development of algorithms and models that can automatically learn and make predictions and decisions based on patterns and examples in the data.



Spam Email Filtering: ML Algo can be trained to classify emails as spam or non-spam based on pattern and characteristics in the email content, headers and senders info.

Object Detection: ML models are trained to identify & locate specific objects within images or videos. Widely used in autonomous vehicles, surveillance systems & facial recognition.

Expert Systems:

- Computer-based systems that emulate the knowledge and decision making abilities of human experts in a specific domain.

- Designed to solve complex problems and provide expert level advice and recommendations.

- Typically consists of:
  - a knowledge base that contains domain-specific knowledge/info,
  - a set of rules or heuristics that guide the system's reasoning
  - Inference engine that applies the rules to make decisions or provide solutions.

Major Components:

1) User Interface
2) Knowledge Base
3) Inference Engine.

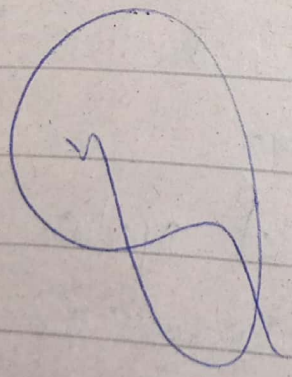
In the medical field, an expert system can analyze:

- patient symptoms
- Medical history
- Diagnostic Data

to generate a list of:

- potential diagnoses
- suggest appropriate tests
- recommend treatement options

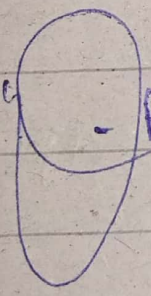
based on established medical guidelines in db.



Reinforcement Learning Models:

- Type of Machine Learning where an agent learns to
  - Interact with an environment
  - Maximize its performance through trial and error.

- Learns by receiving feedback in the form of rewards or penalties based on their actions.



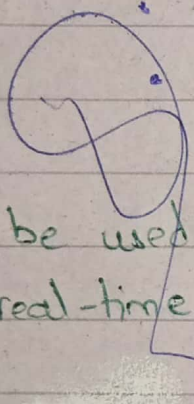
- Agent:
  - Explores the env
  - takes action
  - receives feedback to learn optimal strategies..

RLM can learn to play chess or other games or Go by playing against itself and improving its performance overtime.

Computer Vision:

- Involves the development of algo and techniques to enable computers to understand & interpret visual info from images or videos.

- Encompasses tasks such as.
  - Obj Detection
  - Image Recognition
  - Scene understanding



Can be used to detect & track objects in real-time video footage.

- System inputs an image & outputs task-specific knowledge.

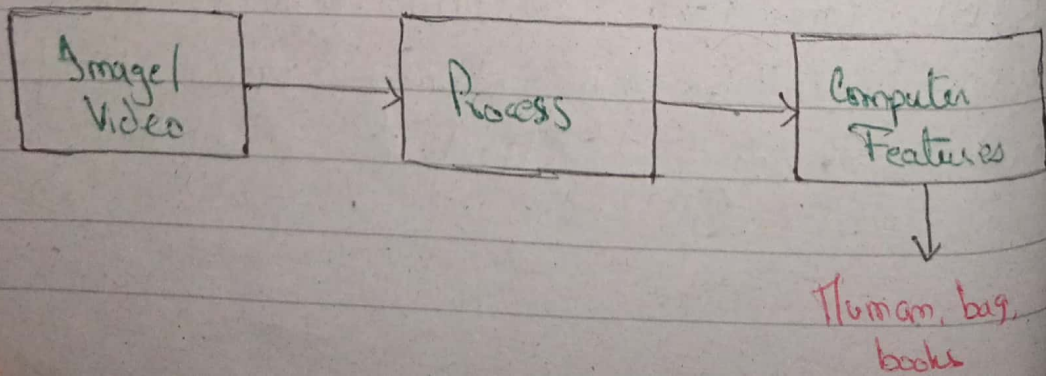


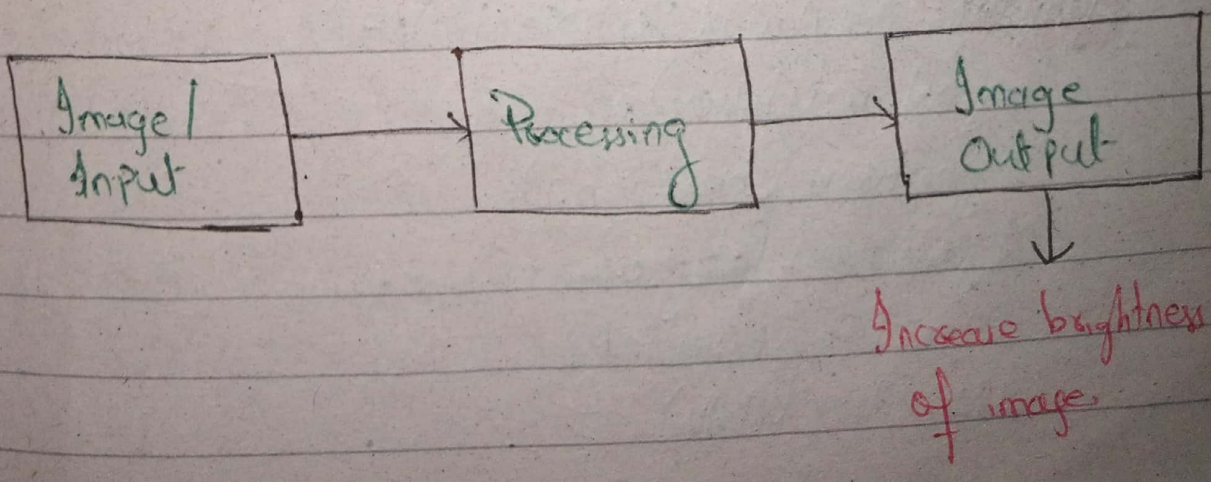
Image Processing:

- Focuses on Manipulation & enhancement of images using various algorithms and techniques.

- Involves operation:
  - Filtering
  - Noise reduction
  - Image compression
  - Image Restoration.

Remove noise from a photograph or enhance the contrast for better visibility

- Both input & output are images



PROLOG MALARIA DIAGNOSIS & TREATMENT:

```
% Dynamic predicate for tests & results
:- dynamic test/2.
:- dynamic symptom/1.

% Facts about symptoms
symptom(fever).
symptom(headache).
symptom(fatigue).
symptom(sweating).
symptom(chills).
symptom(muscle_pain).

% Rules for diagnosing malaria based on test results
diagnose_malaria(TestResult):-
    symptom(fever),
    symptom(headache),
    symptom(fatigue),
    symptom(sweating),
    symptom(chills)
```

```
    symptom(muscle_pain),
    test(microscopic_examination, positive),
    test(rapid_diagnostic_test, positive),
    test(pcr, positive),
    write('Based on the symptoms and
test results, it is likely that you have
malaria.'),
    TestResult = positive.

diagnose_malaria(TestResult):-
    write('Based on symptoms and test
Results, it is unlikely that you have
malaria.'),
    TestResult = negative.

%. Main predicate to start the diagnosis
start_diagnosis:-
    write('Malaria Diagnosis Program'), nl,
    write('Please enter the symptoms:'), nl,
    ask_symptoms,
    write('Please enter Test Results:'), nl,
    ask_test_results(TestResult),
    write('-------------'), nl,
```

```
write('Final diagnosis: '), nl,
write(Test Result), nl.

% Predicate to ask for symptoms
ask_symptoms:-
    symptom(fever),
    write('Do you have fever? (Y/N)'),
    read(Response1),
    (Response1 = Y -> assert(symptom(fever)); retract(symptom(fever))),

    symptom(headache),
    write('Headache? (Y/N)'),
    read(Response2),
    (Response2 = Y -> assert(symptom(headache)); retract(symptom(headache))),

    symptom(fatigue),
    write('Fatigue? (Y/N)'),
    read(Response3),
    (Response3 = Y -> assert(symptom(fatigue)); retract(symptom(fatigue))),
```

```
symptom(sweating),
write('Sweating ? (Y/N)'),
read(Response4)
(Response4 = Y -> assert(symptom(sweating));
retract(symptom(sweating)));

symptom(chills),
write('Chills ? (Y/N)'),
read(Response5)
(Response5 = Y -> assert(symptom(chills));
retract(symptom(chills))),

symptoms(muscle_pain),
write('Muscle_pain? (Y/N)'),
read(Response6)
(Response6 = Y -> assest(symptom(muscle_pain))
retract(symptom(muscle_pain))).
```

% Predicate to ask for test results

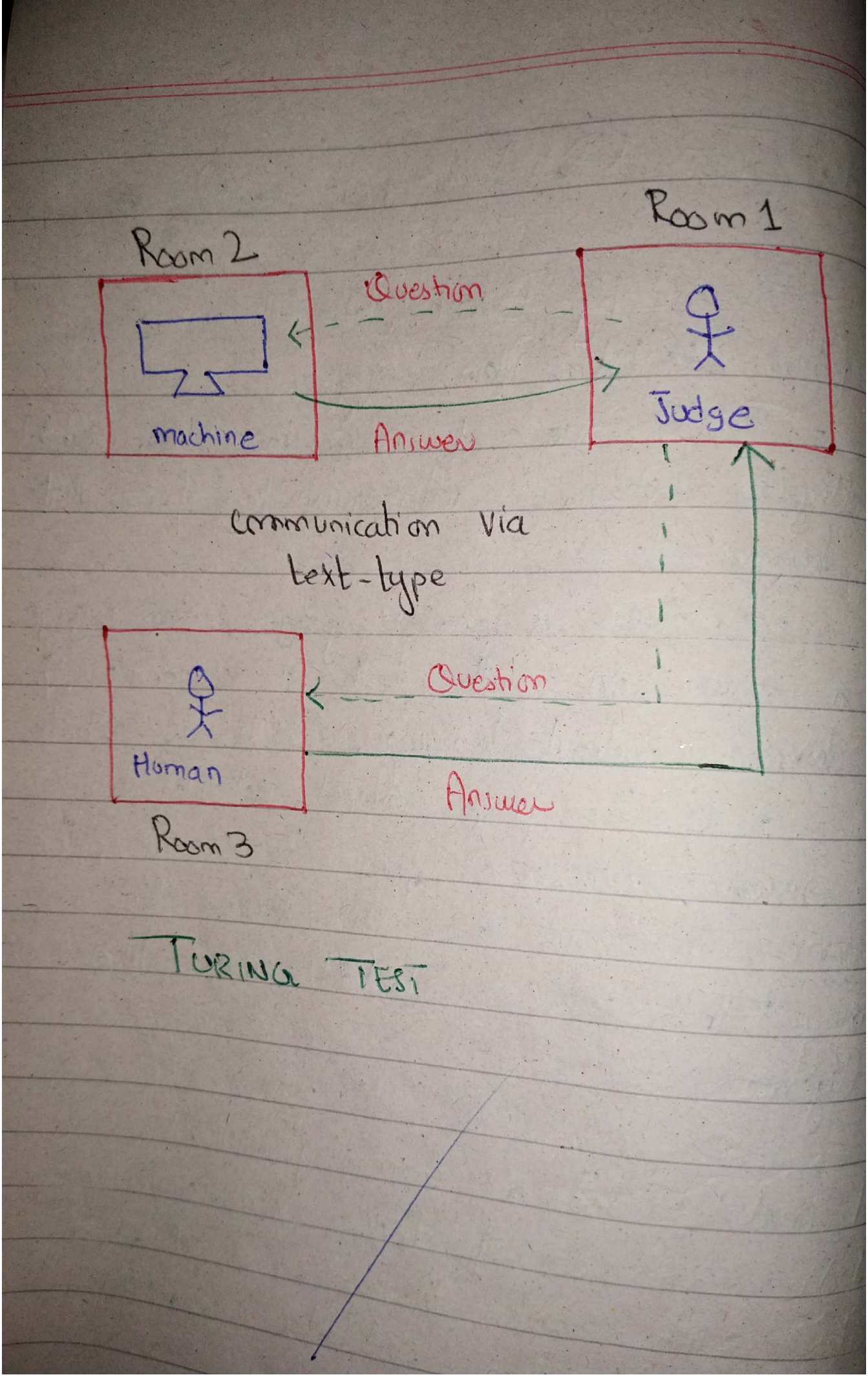
```
ask_test_results(TestResult):-
    write('Microscopic Test: (P/N)'),
    read(Response1),
    (Response1 = P -> assert(test(microscopic_
    examination, positive)); assert(test(
    microscopic_examination, negative))),

    write("Rapid Diagnostic Test: (P/N)'),
    read(Response2),
    (Response2 = P -> assert(test(rapid_
    diagnostic_test, positive)); assert(test(
    rapid_diagnostic test, negative))).

    write("PCR: (P/N)"),
    read(Response3)
    (Response3 = P -> assert(test(pcr,
    positive)); assert(test(pcr, negative))),

    TestResult = Response3.

query -> start_diagnose.
```

TURING TEST (Passed in 2015-2016)

- Proposed by British Mathematician & Computer Scientist Alan Turing.
- To determine if a machine can exhibit intelligent behaviour indistinguishable from that of human.
- Involves a human judge who engages in a conversation with both a machine & a human without knowing which is which.
- If the judge cannot reliably distinguish the machine's response from the human's, the machine is said to have passed the Turing Test and demonstrated human-like intelligence.

How did Turing Test work?

AI chatbot and a human participant. Judge unaware of their identities, communicates with both, through a text-based interface. If the chatbot's responses are so convincing that the judge cannot consistently differentiate them from human's responses, the chatbot pass the Turing Test.


Room 1
Room 2
Question
machine
Answer
Judge
communication via
text-type
Question
Human
Answer
Room 3

TURING TEST

Expert Vs Expert System

Human Vs Computer

An expert is a human possessing extensive knowledge and expertise in a specific domain.

- Expert System is a computer program designed to simulate the behaviour and knowledge of human experts.

Knowledge Source

Experts rely on their personal knowledge, experience and intuition to make decisions.

- Expert systems rely on encoded knowledge, rules and algorithms stored in their knowledge base.

Scalability (Cost)

Have limitations in terms of time & availability.
Cost effective

- Can be easily replicated & scaled to serve multiple users simultaneously.

Consistency & Reliability

May have variations in opinions and decision-making based on personal biases & changing circumstances.

- Can provide consis and reliable result as they follow predefined rules guidelines.

Learning & Adaptability

Have the ability to continuously learn & adapt their knowledge & skills based on new experiences.

- Typically require manual updates to incorporate new knowledge or adapt to changing conditions.

~~Expensive~~ Spends too much time to gain/ knowledge enhance

- Knowledge Enhancement not difficult.

Major Components Of Expert Systems:

User Interface:

- It allows users to interact with expert system, input their queries or problems, and receive responses or recommendations.

- It provides a bidirectional communication channel b/w user & system.

- Interfaces can be:
  1) Text-based interface
  2) GUI based
  3) Image/Video
  4) Gesture
  5) CMD
  6) Menu-based

- Intelligent UI (may be uses NLP)

• Knowledge Base:

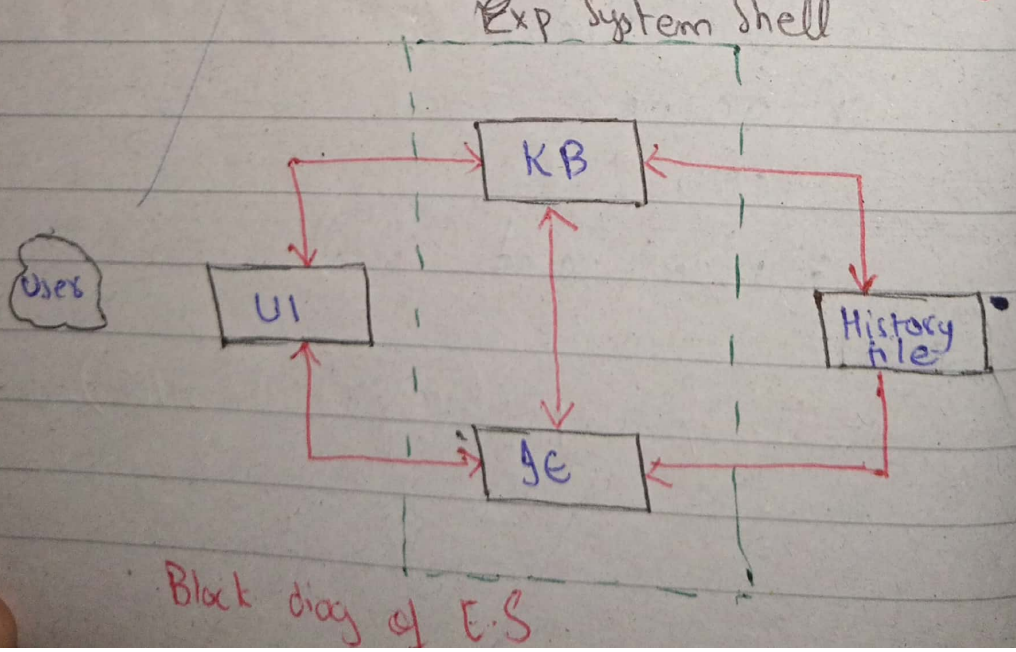
- Contains the domain-specific knowledge & expertise required for problem solving.

- Typically represented in the form of rules, facts, heuristics and relationships blw entities.

- Combination of Declarative and Procedural Knowledge.

Describe them too

Knowledge Base = Declarative Knowledge + Procedural Knowledge



Block diag of E.S

- **Inference Engine:**

- Responsible for reasoning and making inferences based on the knowledge base.

- Applies logical rules to the knowledge base to deduce new information

- Runs the expert system

- Works like human brain.

- Follows 3 steps
  - Match
  - Select
  - Execute

- Brain of Expert System

AI DEVELOPMENT STAGES:

- BASIC TASK (Formal Task)

- Refer to relatively simple & straightforward tasks that can be performed with minimal human interven

- Often Involve:
  - Rule-based Systems
  - Basic Data Processing.

- Tic tac toe, Algebraic Equations, Pattern Recognition.

- Rules & Regulations known by ourselves i.e. donot require domain experts Directly programmed.

- EXPERT TASK:

- Complex ; Knowledge-intensive tasks
- Requires:
  - Deep expertise
  - domain knowledge
  - Nuanced decision making.
- Often Involve:
  - Complex Reasoning
  - Problem Solving
  - Ability to handle ambiguity
- Knowledge acquired by domain expert then programmed.

- Medical Diagonisis, Legal Analysis, Financial Forecasting.

• Mundane Task:

- Tasks whose solution are not available.
- We have to make research then propose solution.
- Mundane tasks and the area of broad knowledge understanding are sometimes referred to as "Commonsense Reasoning".
- Mundane tasks are the ones that we (humans) donot do on regular basis without special training.

- Natural Language Understanding, Generation & Translation
  Robot Control.
  Fire detector
  Thief detector
  Covid detector

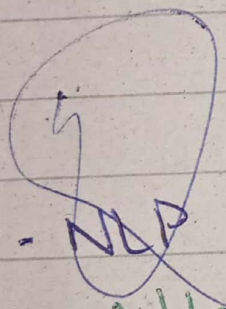
Natural Language Processing (NLP):

Vacuum Tube / CRT 17000 n

BARD

GAN Model (Generating Adhesive Network)

- Concerned with communication
- Language is tool. Different formats:
  - Gesture
  - Spoken
  - Text
  - Graze
- NLP is concerned with only written form of communication with computer.



- Scientist are trying to make computer communicate with people in written form

- Two branches of NLP:
  - Natural Language Understanding
  - Natural Language Generation

NLU Computer able to understand recognize written form given by human.

NLG Natural Language Synthesis

NLU (Understanding Levels)

1- Completely not understand / meaning not known

2- Incomplete understand

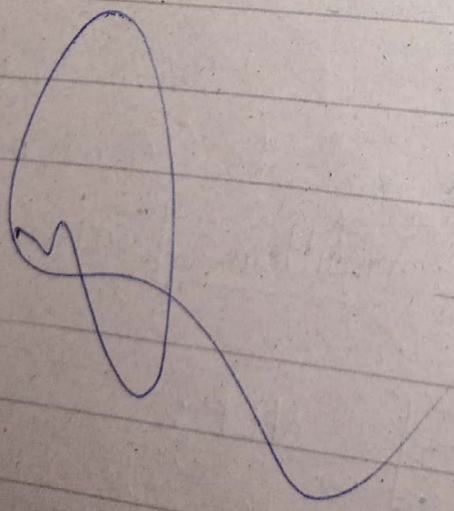
Do you touhen smoking?

output would be something that is not desired by user

اوکو من جانے دو

3- Completely understand

what day today?



Techniques To Understand Language:

Language can be understood by following techniques:

1. Lexical Analysis
2. Keyword Analysis
3. Semantic Analysis
4. Syntactic Analysis
5. Pragmatic Analysis

- Lexical Analysis:

In LA, we try to find the meaning of each word defined in dictionary (Lexicon)

Computer also uses lexical Analysis to understand users instructions.
e.g compiler

- Keyword Analysis:

In KA, we try to find the keywords in sentence and on the basis of

those keywords we interprete/understand the meaning of sentence.

Sometimes we ignore those words whose meanings are unknown to us.

eg: Chat-GPT donot cares the misspelled words. Also try to understand the content of what user is trying to say.

- SEMANTIC ANALYSIS:

To infer meaning from sentence. Don't care about the formation of sentence but we try to infer meaning from sentence.

formation -> either in 1st narration or 2nd narration. present or future etc

eg Computer uses semantic analysis Chat GPT

- SYNTACTIC ANALYSIS:

- Grammar / Structure

eg MS words checks grammar
Sentence structure
Computer also uses syntactic analysis.

- PRAGMATIC ANALYSIS:

eg: you look like fatty potato.
Such much ki potato nhi bngye.
- Meaning change from what is written.
- We understand the meaning of sentence based on in what environment it is written.

eg: idioms.

- Does computer uses pragmatic analysis? Yes
- How do you use ~~pragmatic analysis~~ ?
our brain
relation, database is vast

Camera ← obj
1
2
3
:
5

Natural Language Understanding

Problems:

We human being generally seems perfect in natural language understanding. However, sometimes we misunderstand or feel some difficulty in natural language interpretation.

Following are the major reasons that cause misunderstanding:

1 - Multiple Words Meaning

2 - Ambiguity:
- Syntactic Ambiguity
- Use of Antecends

3 - Imprecision

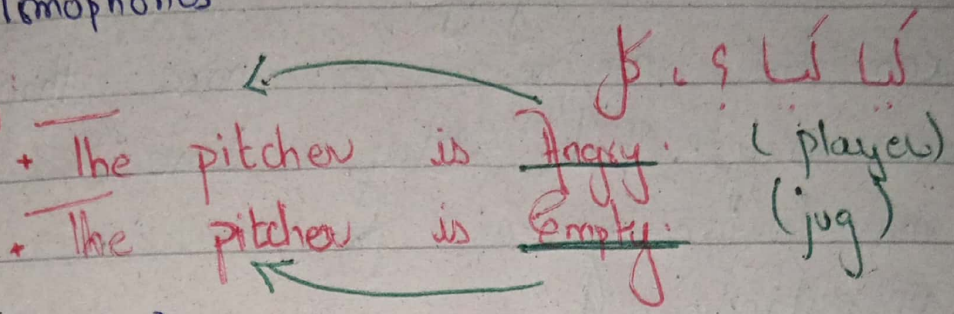
4 - Incompleteness

5 - Inaccuracy

• Multiple Words Meaning:

- Homophones

E.g:



(language)

In English, we use some words which have more than one meaning. The use of such words may cause problem in language understanding.

For example: the word 'pitcher'.

In both of the above sentence, a computer may face problem to recognize the meaning of 'pitcher' - which pitcher is meant in each sentence either player or jug.

Whereas, we human however, may resolve this problem by exploring the / interpreting the meaning of pre or post words against the pitcher.

• Ambiguity:

Due to ambiguity, a sentence can be interpreted in more than one ways, that may cause misunderstanding or problem in understanding.

Ambiguity may occur due to following:

1- Syntactic Ambiguity: (Passing)

Due to syntactic ambiguity, the sentence may interprete more than one way.

Example:

- I hit, the man with the hammer. (hold)
- I hit the man with the hammer. (help)

The computer may have problem to interprete the meaning of the sentence

either I hit the man with the help of hammer.

or I hit the man who was holding a hammer.

Such ambiguity is called Syntactic Ambiguity. which we human generally resolve by reading the pre & posts sentences or analyze the situation. (understanding the context of sentence).

2 - Use Of Antecedants: (Pronouns)

In our daily conversation, we frequently use antecedants i.e Pronouns (He, She, it ...) instead of previously using Proper noun.

Example: Proper noun
P.N P.N
John hit the Bill because he loved Sara.
Pronoun

In the above sentence, a computer may have problem to recognize who loved sara either John or Bill. However, we human may resolve the situation by reading the whole story who is reflecting 'he' either John or Bill.

- Imprecision:

In Language, we use some words whose meanings are vague that is not (measurable / not clear. exactly

E.g: Long time, very high, Painful.

The word 'long time'.

- Muslims ruled Asia for a long time
- I have been waiting for a long time.

A computer may have problem to recognize the exact length of time either 100s of years or few hours. against the word long time.

• Incompleteness:

- Omit the words of common sense.

- We ~~dont~~ share common info. & omit many of details in written communication.

• Implicit Assumptions & Omission Of Common Sense:

"Bring an Umbrella"

The assumption is that it's because of rain without explicitly stating it.

• Shared Background Knowledge & Omission Of Details In Written Communication:

In a professional email discussing a project, omitting specific technical details that are well-known among the team members.

- Inaccuracy:

In daily written communication may have multiple errors. spelling, grammatical mistakes.

Eg. Use of transpose word.

1) Errors in Grammar & Syntax.
2) Spelling Mistakes
3) Incorrect word usage
4) Misinterpretation of context.
5) Misplaced or Missing Punctuation
6) Cultural & langage Differences:
Misunderstanding idiomatic phrases like "It's raining cats & dogs".

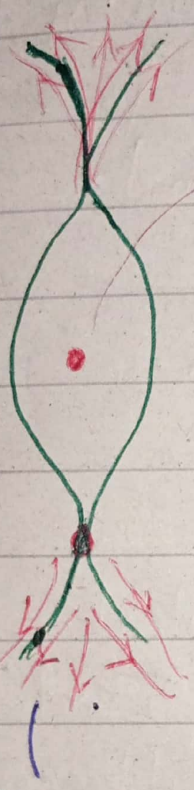
7) Lack of Tone or Non-Verbal Queues:
Misinterpreting the intended emotion or sarcasm in a written message.

8) Incorrect Information or Misrepresentation

Artificial Neural Network (ANN)

Human brain consists of Neuron - 10^11

Single Neuron made of



① Dendrites

Input Channel

(Receive signals from body parts)

② SOMA (Σ)

processing unit

Nucleus

sum the signal

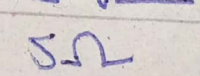
③ Axon Bulb | Synatic Bulb

Threshold

Activation function

Axons

Output channel



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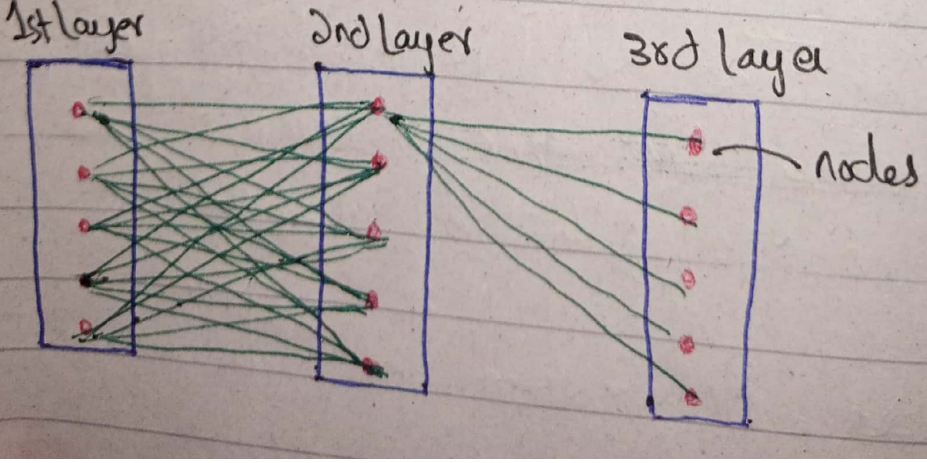


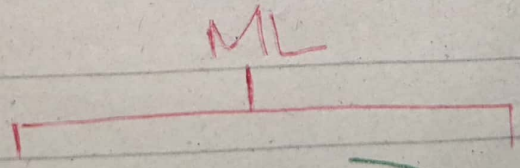
After the inspiration of human brain working (Activity)

Artificial Neural Network (ANN) - designed

ANN - consist of multiple (artifical) neurons (nodes) divided into 3 groups of layers called:

1) Input Layer
2) Hidden layer
3) Output layer

Each layer consist of no. of (multiple) neurons - depending on amount of nature of training data & their desired outcome.



Shallow learning (ML)

Deep learning (For large/Huge Datasets) (CNN, ANN)

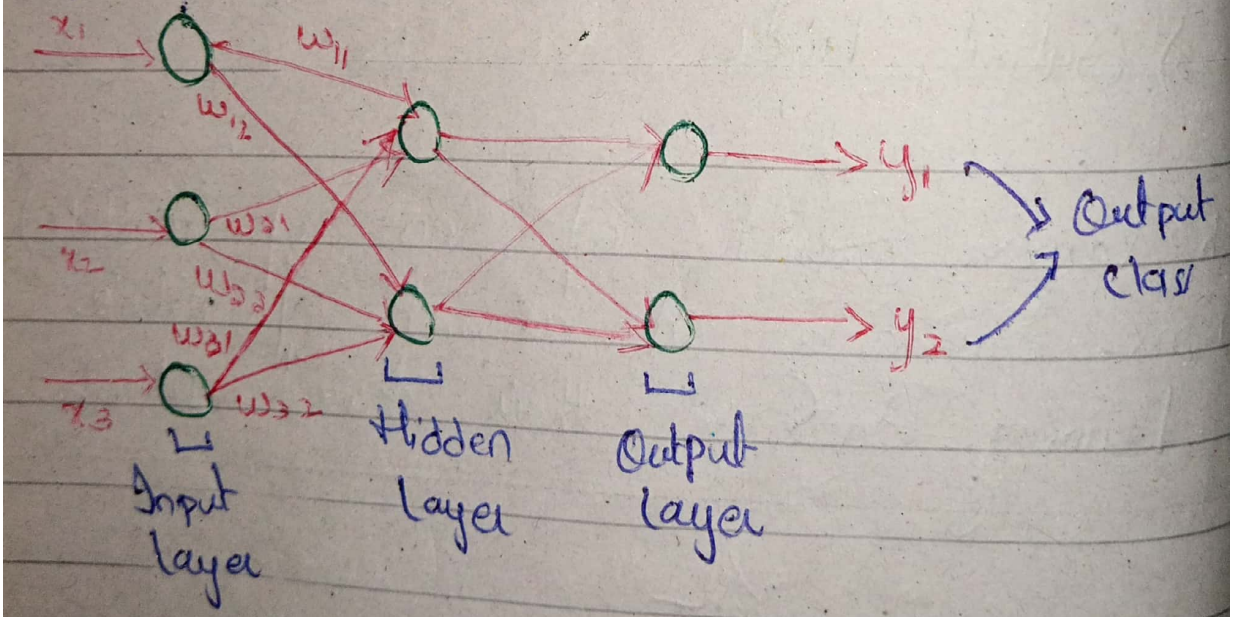
No. of features = No. of neurons in input layer.

No. of features = No. of neurons in input layer

No. of output possibility = No. of neurons in o/p layer.

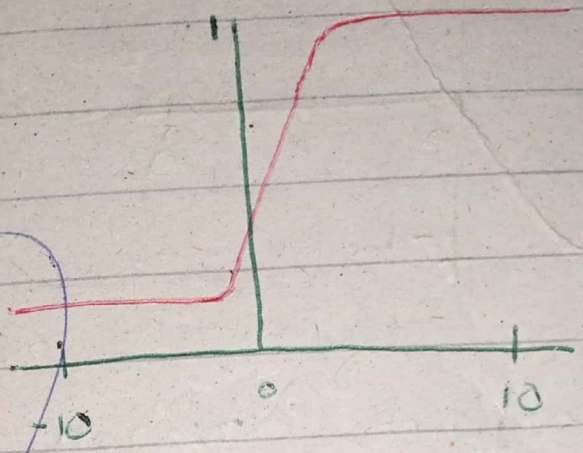
W_{ij} – weights.

(features)
Input Data — Activation function



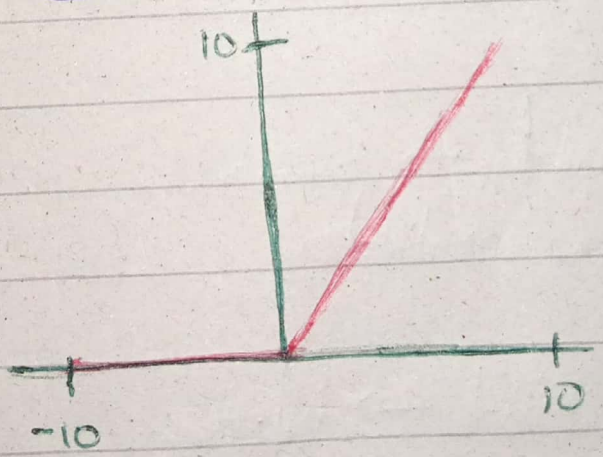
Hidden layer -> can be multiple layers.

Sigmoid function → $\sigma(x) = \frac{1}{1+e^{-x}}$

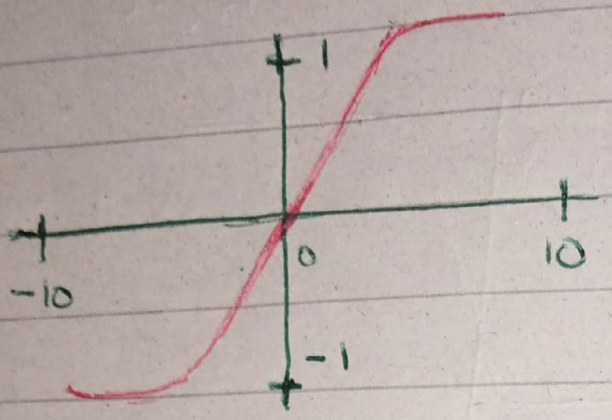


ReLu → $\max(0, x)$

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



Other activation function -> tanh(x)



CNN -> Different Activation function on each hidden layer

$$\sqrt{(ip)^2 + (o/p)^2}$$

##

White box model -> Statistics (well known model)

Black box model -> Machine learning (not known)

To make machine intelligent, it is needed to feed/program knowledge into computer. Sometime that knowledge need to acquire from Domain expert. That knowledge need to write comprehensively for a computer program. Who is responsible to transform that knowledge into computer codes

KNOWLEDGE REPRESENTATION TECHNIQUES:

A.I Scientists describes the following standard Knowledge Representation Techniques which are helpful to computer programmers.

- Frames - object knowledge
- Scripts - Event knowledge
- Semantic Network - Any descriptive knowledge

- FRAMES:

Frames are used to describe knowledge about 'object'. Objects' knowledge are also considered as static database of knowledge.

The term 'frame' coined by (first time use) Marvin Minsky in year 1974.

According to Marvin Minsky the components of frame are:

1) Slot - A complete info about the component / property of object.

2) Attributes:- The name of component or property of object.

3) Value - The description of attribute.

Example:

Frame Chair

slot 1	Purpose : Sitting item	← Value
slot 2	Parts : Seat, Back, Legs, arms, wheel, optional	
slot 3	Size : Seat-2 to 3 ft	← Attribute
	Back - 3ft - 5ft	
	leg - 1 - 4ft	
slot 4	Types: Chair	
	Office chair	
	Dining chair	
	Wheel chair	

Rule:

If 2 arm then
office Chair
If No arm then
Dinning chair

slot 5: Meterial : ~~Material~~
iron
wood

Frame Car

Slot 1 Purpose: travelling
Slot 2 brand: ~~Suzuki~~ Mistubshi lancer
Slot 3 model: 7H4Z
Slot 4 tyre type: Rim-300
Slot 5 Color: Jet black
Slot 6 Engine: Eng-74w
Slot 7 Cost: 800,000
slot 8 Powa: 1800hp
~~Slot 9 Fuel: Diesel, Petrol~~

Rule:

If 1800 hp then
Cost 800,000/-
If 2000 hp then

- SCRIPT:

- are used to describe situation, event e.t.c.

- Event: is set of multiple scenes, involve different roles of characters e.t.c.

- The term 'script' was defined by Schank & Abelson in year

- According to Schank, scripts may be used to describe an event and consider 'Dyamic Database' as involve time indepent situations.

- The major components of scripts are:

1) Opening Condition — The environment / Condition in which event may occur

2) Track - Type of event

3) Roles - The character or people play different roles.

4) Probes - The items required to happen event.

5) Scene - A couple story or chunk of event

6) Result - Outcomes of event.

Script - Dinner in Restaurant

1) Opening Condition:
Hungry, Dinner time, money, res open.

2) Track:
Buffet, Macarde, Takeaway, Chinese, Desi

3) Roles:
Waiter, Manager, Cashier, Chef, Customer

4) Probes:
Menucard, cutlery set, table, chair

5) Scene:

Scene 1: Entry Scene::
- Enter in Restaurant
- Decide where to sit
- Goto the selected table
- Sit there.

Scene 2: Order Scene:
- Take the menu card
- Decide what to eat
- Select the item to order.
- order selected item.

Scene 3. Eating Scene

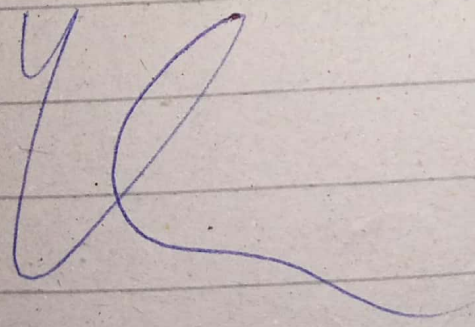
Scene 4: Billing Scene

- Call the bill
- Verify bill
- Pay the bill

6) Result:

Not Hungry anymore
Discuss food quality
Environment.

- The food was good
quality was 8/10
food was expensive.

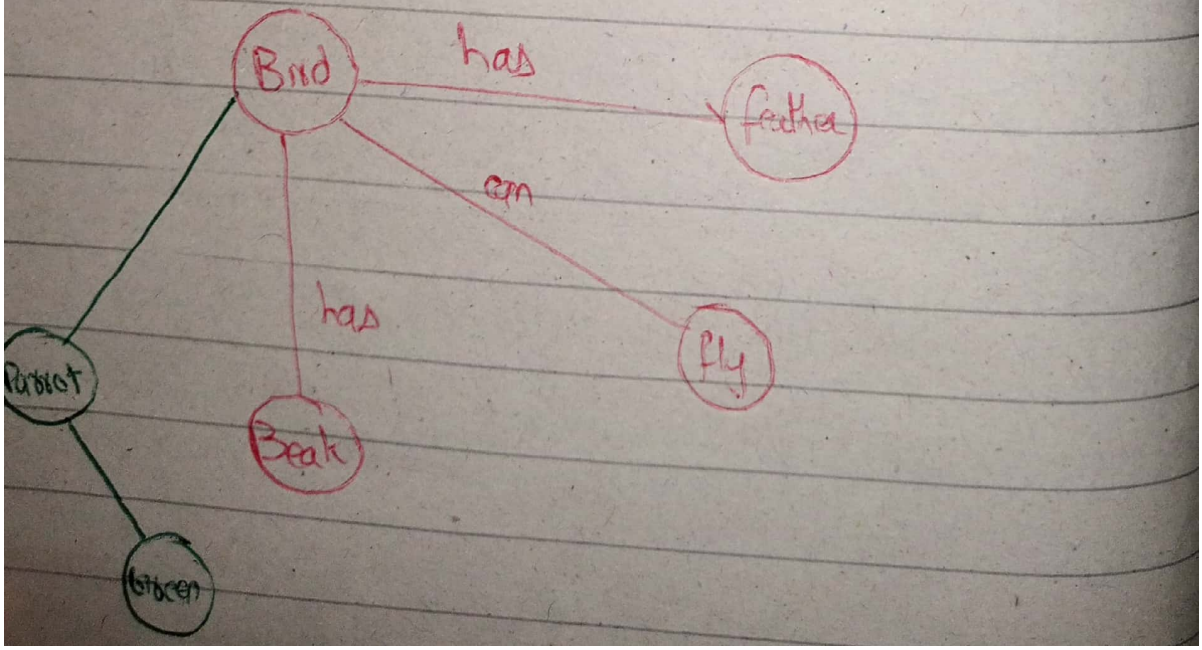


- Semantic Net: Graph G(E, V)

Knowledge Represent in the form of graph using nodes and arcs are called Semantic Net. where node represents object or its property, its component. whereas the arcs represent the relation b/w nodes i-e relation b/w object and its properties.

Example:

Bird can fly, it has feathers & beak.

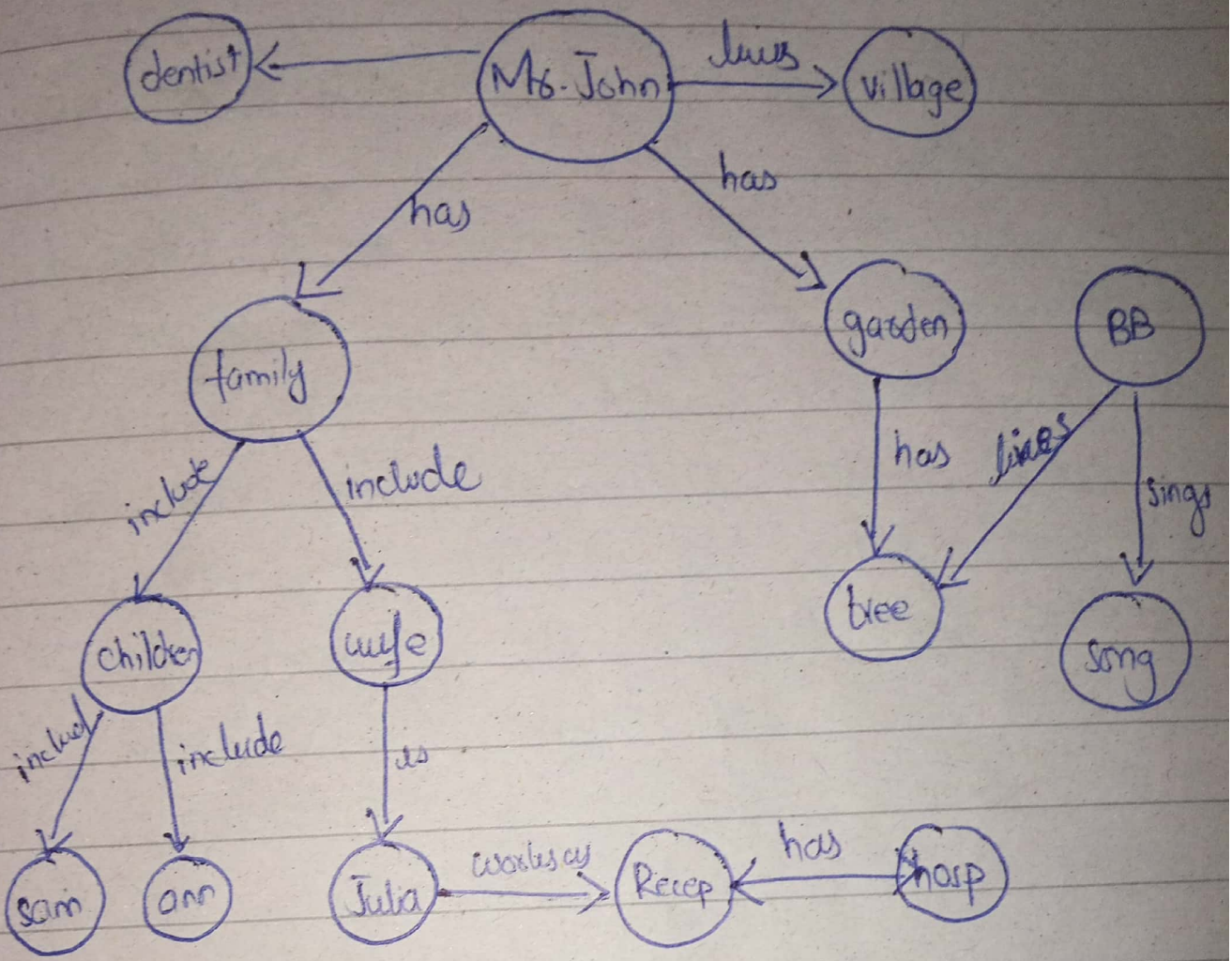


Semantic Network handles redundancy of knowledge i.e, each node should be unique.

Semantic Networks are used to represent descriptive knowledge.

Mr. John lives in a village. He has a garden in backyard. A blue bird lives on a tree in this backyard. Bluebird sings a song. Mr. John has a family and wife Julia. She is Receptionist in a hospital. Mr. John is a dentist. two childrens Sam and Ann

Semantic Networks are used to connect conceptual knowledge



Animals classes

Artificial Narrow Intelligence (ANI)	—	Artificial General Intelligence (AGI)
Definition		
Designed for specific tasks within a limited domain.	-	Aims to process human-like intelligence and cognitive abilities across various domains
Other Names		
Also referred to as "Weak AI" or "Narrow AI".	-	Also referred to as "Strong AI" or "Deep AI".
Intelligence		
Lacks human-like cognitive capabilities.	-	Exhibits higher order cognitive functions, reasoning and decision-making capabilities.

TASK PERFORMANCE

Excels at one particular task but lacks generalization to other domains.

- Demonstrates versatility, adaptability and the ability to handle a wide range of tasks.

FLEXIBILITY

Operates within predefined boundaries and lacks adaptability beyond its intended purpose.

- Possesses self-learning capabilities without explicit human intervention.

EXAMPLE

Virtual assistant (eg, Siri, Alexa), recommendation algorithms, image recognition systems

- As of Now, AGI remains a goal rather than a realized technology.