Multimedia

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Q-1. Explain global structure of multimedia.

OR

Multimedia system in terms of application domain, system domain and device domain

Ans:-

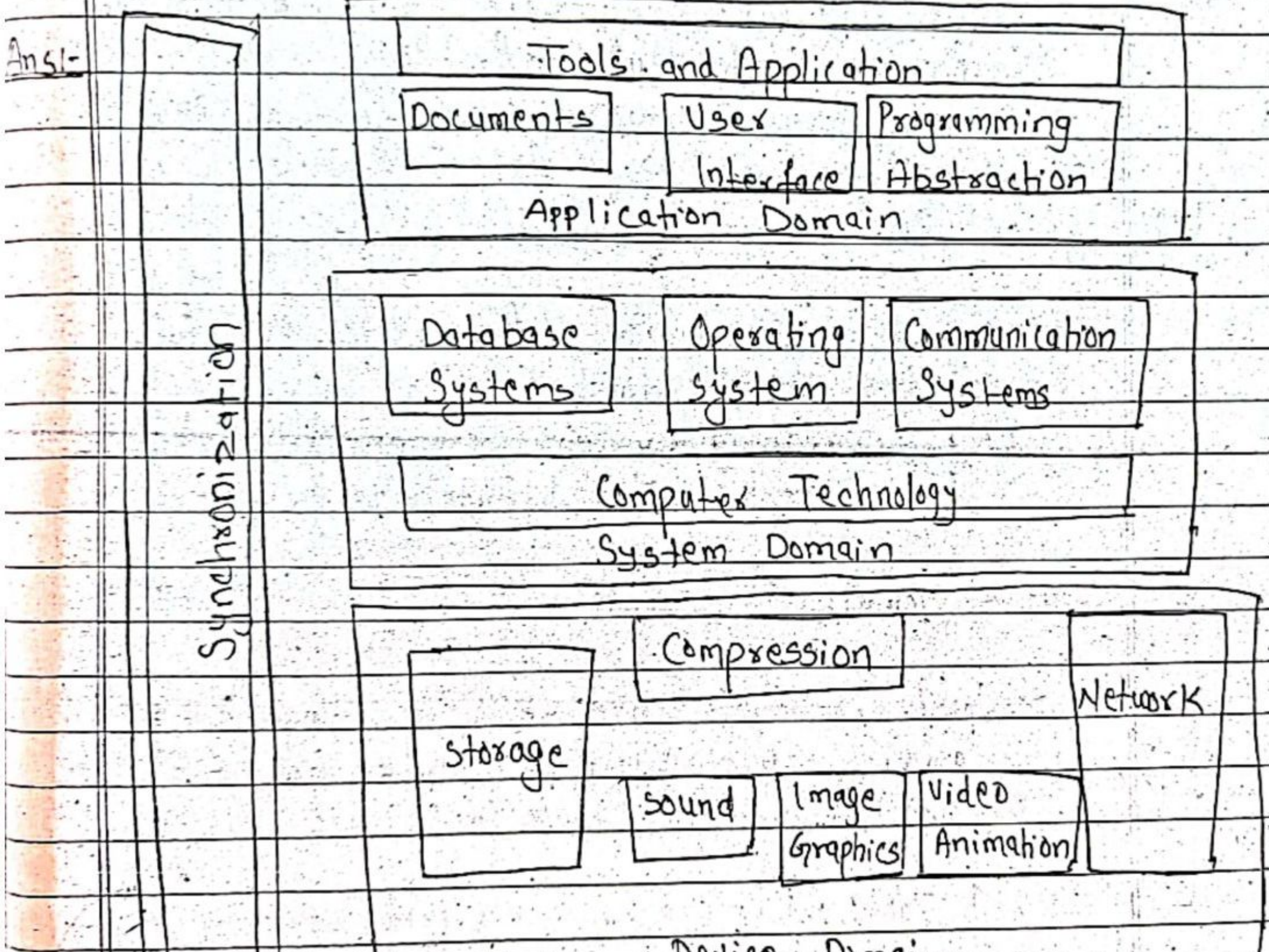


Fig: Multimedia Global Structure

(1) Application Domain:

→ provides functions to the user to develop and present multimedia projects. This includes Software tools, and multimedia projects development methodology.
→ services of system domain, document handling
→ presented to user through user interface

(2) System Domain

→ including all supports for using the functions of the device domain
eg: operating systems, communication systems (networking) and database systems

(3) Device Domain

→ basic concepts and skill for processing various multimedia elements and for handling physical device (storage device).

- Operating system serves as an interface between comp
hardware / system software and all other software compon
- Database system allows a structured access to data or
a management of large database
- Communication system is responsible for data transmissi
according to the timing and reliability requirement of m
multimedia application.

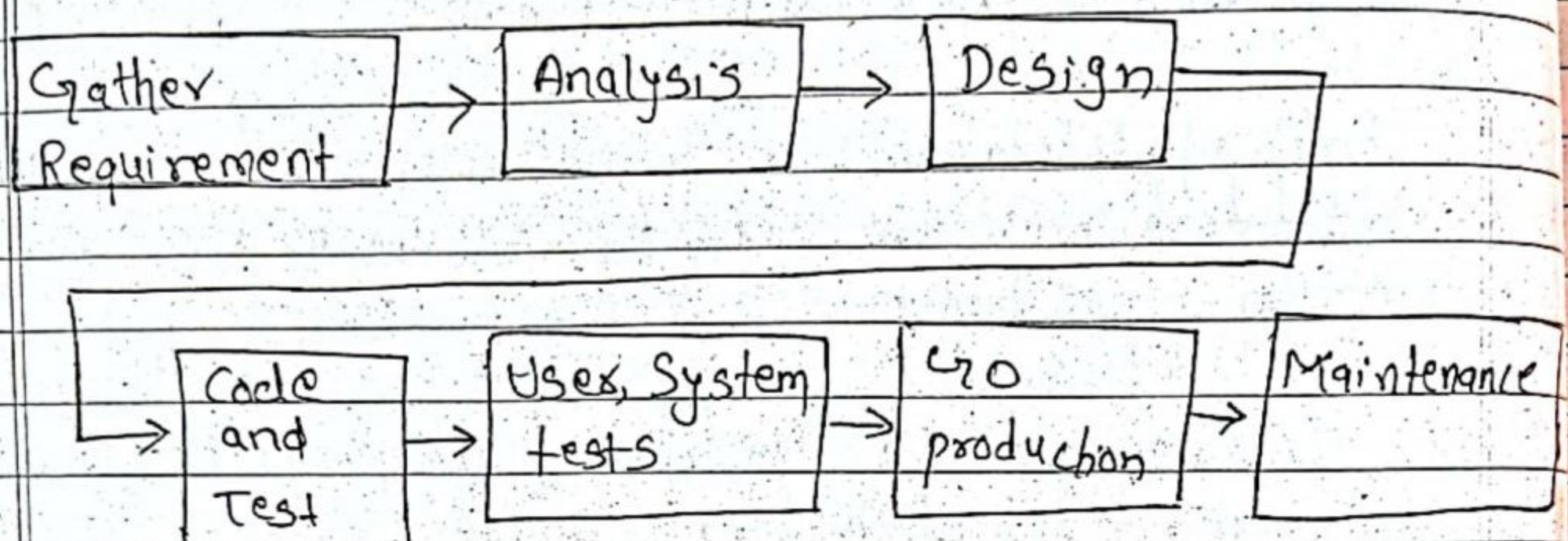
Q. What is the different stages in multimedia application development? Explain with example.

→ An application is a collection of programs that satisfies certain specific requirements (resolves certain problems).

A multimedia application development is usually composed of the following phases:

(1) Design phase
(2) Gather requirement
    (i) User, hardware and software requirement
    (ii) Perform analysis.
    (iii) Develop the design in its various iterations
        (a) High-level design
        (b) Detailed design
(3) Code and test application
(4) Perform user tests.
(5) Perform system tests
(6) Go into production - hand off to operation
(7) Ensure that all documentation is in place.
(8) Maintenance phase - on going day-to-day changes and enhancements to application.

Fig 1: Application development Life cycle



Summary:

Multimedia systems development cycle

(i) Planning and costling
(ii) Designing
(iii) Developing and producing
(iv) Testing and debugging
(v) Delivering

(i) Planning and costling:

→ To capture the ideas and requirements of you or your clients
→ To identify the potential audience and users of the application
→ To findout the benefit that will gain from developing the application

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→ To evaluate the feasibility and costs of the entire project, including all tasks of production, testing and delivery

(ii) Designing:

Design is a creative activity

→ It requires the knowledge and skill with computer

→ It requires the talent in graphics arts, video and music.

→ It also requires the knowledge of the subject area of the application

(iii) Developing and producing:

→ Producing is the phase when your multimedia project is actually rendered.

→ The tasks to be performed in this phase are:

(a) Acquiring all media elements

(b) Composing the elements according to the story board

→ This is the phase when your artistic talent and your technical knowledge are in high demand

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(iv) Testing and debugging:-

→ Like all other software, testing and debugging is an important and time-consuming phase.
→ Alpha testing is typically an internal activi
→ The product is tested by in-house team
→ Beta testing involves a wider range of teste
→ They should be representative of real users

(v) Delivering:

→ You should plan how to deliver the product very early in the development process.
→ Now a days, CD-ROM and Internet are the two most popular means of delivering multimedia applications.

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Q: What are the properties of a multimedia system? Explain.

A multimedia system is characterized by computer control, integration production, manipulation, presentation storage and communication of independent information which is encoded at least through a continuous (time dependent) and a discrete (time independent) medium.

Properties of multimedia system (CIID)

(1) Combination of media

According to the definition of multimedia system, a multimedia system must be composed with the help of different mediums and devices and all together when works or comes in function then it forms the multimedia system.

(2) Independence:

In the multimedia system different media should be independent from each other whereas there should be inherently tight connection between different media to work together also.

(3) Computer supported integration (computer control)

The different independent media are combined in arbitrary forms to work together as a

system with the support of computers. Computer supported integration also called control through the computer in media system.

Communication System:

Communication capable multimedia system must be approached. Multimedia information not only be created, proceed and stored but also be distributed above the single computer boundary which makes the multimedia application much popular and useful in distributed environment.

Integrated:

Multimedia systems must be (are) integrated. At least one discrete and one continuous media combined for information presentation and sharing.

Interactive:

The interface to the final presentation of media is usually interactive. User is able to navigate, interact, create & communicate

Digitalize:

The information they handle must be represented digitally. consists of various form of media i-e text, graphics, audio, video and animations; created, stored, processed and transmitted digitally.

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Differentiate between MIDI and digital audio.

	MIDI		Digital Audio
1.	Stands for Musical Instrument Digital Interface	1.	Digitalized Audio.
2.	A MIDI file is a file that records music and controls the notes of each instrument, what note of the scale is, etc.	2.	Digital audio files are the files that records or reproduce sound. It is like a tape recorder
3.	Defn: A MIDI file is a software for representing musical information in a digital format	3	A digital audio refers to the reproduction & transmission of sound stored in a digital format
4.	Format Type: Compressed	4.	Compressed
5.	Advantages: → Files are tiny often less than 10K → Download from a webpage in no time → Fit easily on a floppy disk → The files are any time ideal.	5.	Advantages: → They produce the exact sound files → It reproduce better than CD quality
6.	Contain: Donot contain a recording of sound.	6.	Contain recording of sound.

	MIDI	Digital Audio
7.	Disadvantage: → They sound little different from the original sounds.	7. Disadvantages: → They take upto 10MB or more per minute. → It could take several min to download. → When combined with video file can cause problem.
8.	Storage: No actual sound stored in MIDI file	8. Actual sound stored in digital audio file

Q. Explain about audio hardware and audio software.

Ans:- Audio hardware is an important component of a complete multimedia system. Audio hardwares are the devices that helps in recording, digitalizing etc.

(A) Recording and Digitizing sound
→ An analog-to-digital converter (ADC) converts the analog sound signal into digital samples.
→ A digital signal processor (DSP) processes the sample e.g filtering, modulation, compression, and so on.

(B) Play back sound:
A DSP processes the sample i.e decompression

demodulation as well.
→ A DAC converts the digital samples into sound samples signals.
→ All these hardware devices are integrated into a few chips on a sound card with varying processing capability.

Audio software:
These are the sound drivers or audio drivers which controls hardware devices.

Windows device driver - controls hardware device.
Many popular sound card are plug and play.
→ Windows has drivers for them and can recognize them automatically.
→ For cards the Windows doesn't have drivers, you need to get the driver from the manufacturer and install it with the card.

Device-manager: the user interface to the hardware for configuring the devices.
Some audio software are mixers, recorder, editor, etc.

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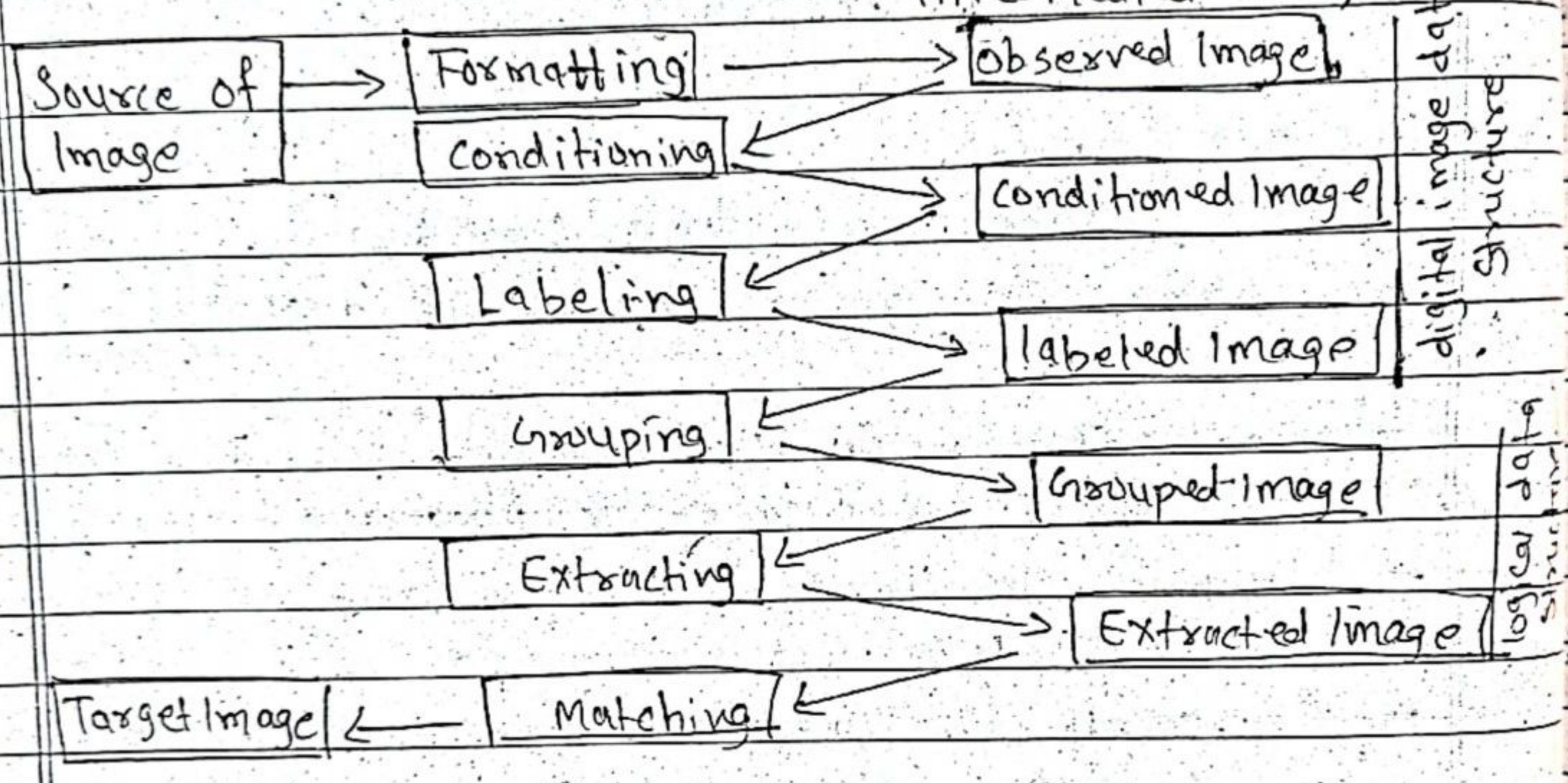
Explain the Image recognition steps in detail.

An image recognition pay attentions to each of the following steps: image formatting, conditioning, labeling, grouping, extraction and matching. (FCLGEM)



① Formatting
- capturing an image from a camera and bringing it into digital form.
- Digital represetation of an image in the form of pixels.

② Conditioning
- Conditioning suppresses, or normalizes, the uninteresting variations in the image, effectively highlighting the interesting parts of image

- applied uniformly and in context-independent

(3) Labeling
- Informative patterns in an image have structure
- Patterns are usually composed of adjacent pixels which share some property such that it can be inferred that they are part of same structure (e.g edge)
- Edge detection techniques focus on identifying continuous adjacent pixels which differ greatly in intensity or color, because these are likely to mark boundaries, between objects, or an object and the background, and hence form edge.
- After the edge detection process is complete, many edges will have been identified. Thresholding filters out insignificant edges - The remaining edges are labeled.

(4) Grouping:
- Grouping can turn edges into lines by determining that different edge belong to same spatial event.
- A grouping operation, where edges are grouped into lines, is called line-fitting
- After grouping, digital image structure is stored in a logical data structure.

(5) Extracting:
- Grouping only records the spatial event(s) to which pixels belong. Feature extraction involves generating

a list of properties for each set of pixels in a spatial event.

- These may include a set's centroid, area, etc.
- If it is a region, then the number of holes might be useful.
- In case of an arc, the average curvature of arc might be useful to know.
- Feature extraction can also describe the topographic relationships between different groups.

(6) Matching:

- Finally, once the pixels in the image have been grouped into objects and the relationship between the different objects has been determined, the final step is to recognize the objects in the im
- Once an object or set of object parts has been recogn measurements (distance between two part, angle between two lines or area) can be made..
- Matching involves comparing each object in the image with previously stored models and determining best match templete matching.

$S = R \times b/8 \times C \times D$

- S: file size
- R: Sampling rate
- b: Resolution
- C: Channels (1 = mono, 2 = stereo)
- D: recording duration

Q. Suppose if we record the 5 seconds of stereo music at 44.1 KHz with 32 bits. Calculate the file size? (2066 Magh Q. No. 6)

Given,

Sampling frequency (R) = 44.1 kHz
= 44100 Hz

Resolution (b) = 32 bits

Recording duration (D) = 5 seconds

Channel (C) = stereo type so 2
= 2

Now we know,

$S(\text{File size}) = R \times \frac{b}{8} \times C \times D$

$= 44100 \times \frac{32}{8} \times 2 \times 5$

$= 1764000$ bytes

$= \frac{1764000}{1024}$ K byte

$= 1722.65$ Kbyte

$= \frac{1722.65}{1024}$ M byte

$= 1.682$ M byte

Q- Calculate the file size if we record the 10 second of stereo music at 44.1 kHz with 16 bits. (2069 Bhadra Q-No. 3)

Given,

Sampling rate (R) = 44.1 kHz
= 44100 Hz

Duration time (recording) (D) = 10 second

channel (C) = 2 for stereo-music

Resolution (b) = 16 bit

file size (S) = ?

We know

$S = R \times \frac{b}{8} \times C \times D$ $\quad \frac{8 \text{ bit}}{8} = 1 \text{ byte}$

$= 44100 \text{ Hz} \times \frac{16}{8} \text{ byte} \times 2 \times 10 \text{ second}$

$= \frac{44100}{\text{sec}} \times \frac{16}{8} \text{ byte} \times 2 \times 10 \text{ sec} \quad \left[f = \frac{1}{T}\right]$

$= 1764000 \text{ byte}$

$= \frac{1764000}{1024 \times 1024} \text{ mbyte}$

$= 1.682 \text{ mbyte}$

Q. A bitmap image has resolution 640 x 480 pixels. Each pixel is 32 bit deep. What is the size of the bitmap in bytes? (2068 Chaitra Q.No.5)

Soln

Given,

Resolution (b) = 640 x 480 pixel

Resolution bit (R) = 32 bit

Bitmap size (S) = ?

We know

S = Resolution x Resolution bit

= 640 x 480 x 32 bit

= $640 \times 480 \times \frac{32}{8}$ byte

= 1228800 byte

= $\frac{1228800}{1024}$ Kbyte

= 1200 Kbyte

= $\frac{1200}{1024}$ Mbyte

= 1.17 Mbyte.

(1 byte = 8 bit)

$\frac{1}{8}$ byte = 1 bit

$\frac{1}{8} \times 32$ = 32 bit

Q. The table on the left below represents an indexed image. The table on the right is colour index table. What is the colour of the following pixels: (2072 Ashwin Q.NO.3)

(0,2), (1,1), (1,3) (2,1) (2,2), (3,0)

	0	1	2	3
0	2	3	(i) 0	3
1	7	(ii) 2	1	5
2	5	6	4	4
3	2	7	5	0

Fig: Indexed image

	R	G	B	
0	0	255	0	→ Green
1	255	0	0	→ Red
2	0	0	255	→ Blue
3	0	0	0	→ Black
4	255	255	0	→ Yellow
5	127	127	127	→ Light & G
6	255	0	255	→ Magneta
7	255	255	255	→ White

Fig: Colour index table

Soln:

	Pixel	Indexed image	Colour (From colour index table)
i	(0,2)	0	Green
ii	(1,1)	2	Blue
iii	(1,3)	5	Light & Gray
iv	(2,1)	6	magnetum
v	(2,2)	4	Yellow
vi	(3,0)	2	Blue

A certain source emits symbols {A, B, C, D, E} with corresponding probabilities

- P(A) = 0.06
- P(B) = 0.48
- P(C) = 0.02
- P(D) = 0.20.
- P(E) = 0.24.

Create a Huffman code tree and also derive the Huffman code for each symbol. (2074 Bhadra Q-NO-5)

Sol^{n}

① P((CA) = 0.02 + 0.06 = 0.08

P(C) = 0.02 P(A) = 0.06

② P((AD) = 0.28

P((A) = 0.08 P(D) = 0.20

③ P(E(CAD) = 0.52

P(E) = 0.24 P(CAD) = 0.28

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Q.

(4) P(BECAD) = 1

P(B) = 0.48 P(ECAD) = 0.52

Now, constructing Huffman Tree:

P(ABCDE) = 1

0 1

P(B) = 0.48 P(ECAD) = 0.52

0 1

P(E) = 0.24 P(CAD) = 0.28

0 1

P(A) = 0.08 P(D) = 0.20

0 1

P(C) = 0.02 P(A) = 0.06

Final Answer

From Huffman tree,

Symbol	Huffman code
A	1101
B	0
C	1100
D	111
E	10

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Q. Calculate file size in byte for 30 seconds recording at 44.1 kHz, 8 bits resolution stereo sound.

Given

Sampling rate (R) = 44.1 kHz
= 44100 Hz

Duration (Recording Time) (D) = 30 seconds

Channel (C) = 2 for stereo

Resolution bit (b) = 8 bits

file size (S) = ?

We know,

$$S = R \times \frac{b}{8} \times C \times D$$

$$= 44100 \times \frac{8}{8} \times 2 \times 30$$

$$= 2646000 \text{ byte}$$

$$= \frac{2646000}{1024 \times 1024} \text{ Mbyte}$$

$$= 2.523 \text{ Mbyte}.$$

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Explain the computer representation of sound and MIDI software.

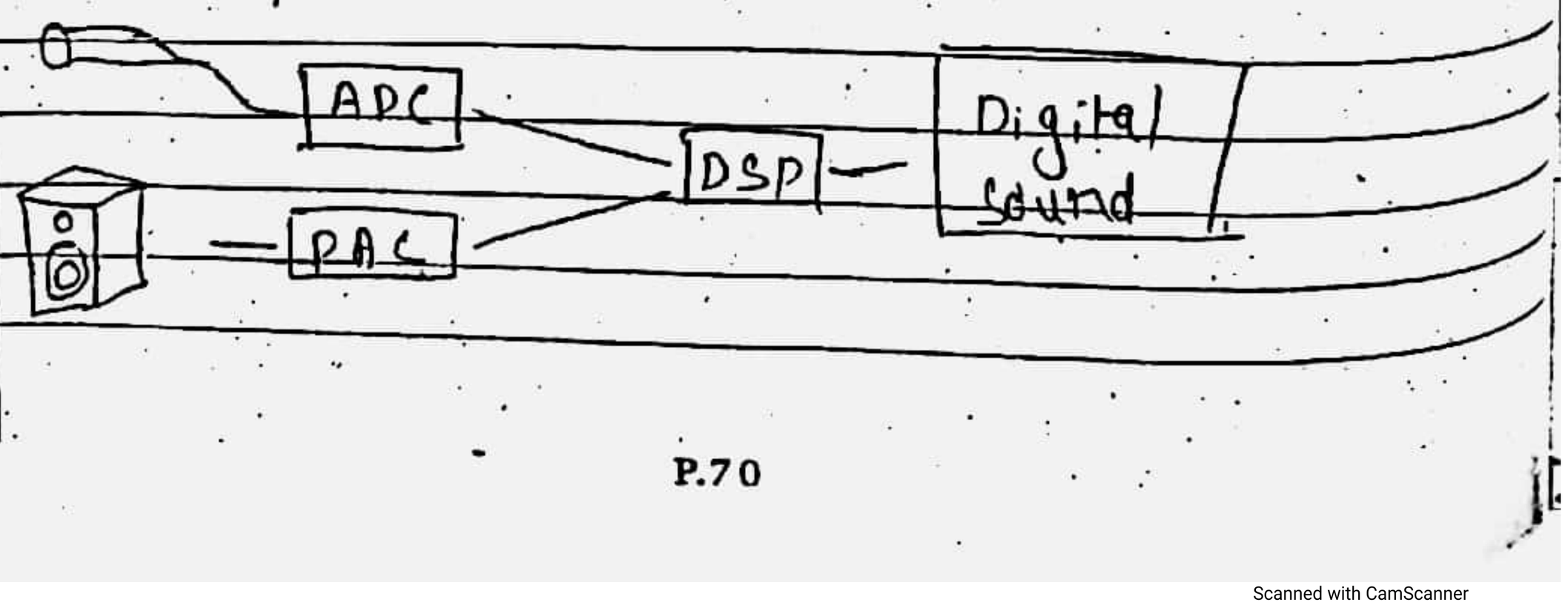
Ans:- Sound is a physical phenomenon caused by vibration of material. In multimedia we are concerned with sounds in the audiosonic range.

Audio representation on computers

A computer measures the amplitude of the waveform at regular time intervals it then generates a series of sampling values. The mechanism that converts an audio signal into digital sample is the analog-to-digital converter (ADC). A digital-to-analog converter (DAC) is used to achieve the opposite conversion.

Audio Sampling:

1. Determine number of samples per second
2. At each time interval determine the amplitude
3. Stored the sample rate and the individual amplitudes



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MIDI (Musical Instrument Digital Interface)

The MIDI is a small piece that plugs directly into the computer's sexial port and allows the transmission of music signals.

Note that: MIDI doesnot produce sound, only produce the parameters that are needed to be sent to the device that translates those numbers into sound

Data format has instrument specification, notion of beginning and end of note, frequency and sound volume. This data grouped into MIDI messages that specify a music event.

A message contains 1 or 2 or 3 bytes
1. First byte is status byte used to transmit message to a specific channel.
2- Remaining bytes are data bytes

The number of data bytes is dependent on status byte.

MIDI standard specifies 16 channels and identifies 128 instruments. For example, 0 is for piano, 40 for violin, 73 for flute, etc

Q- Explain in detail the process of speech recognition & gen

Speech Recognition: (CIP LAST)

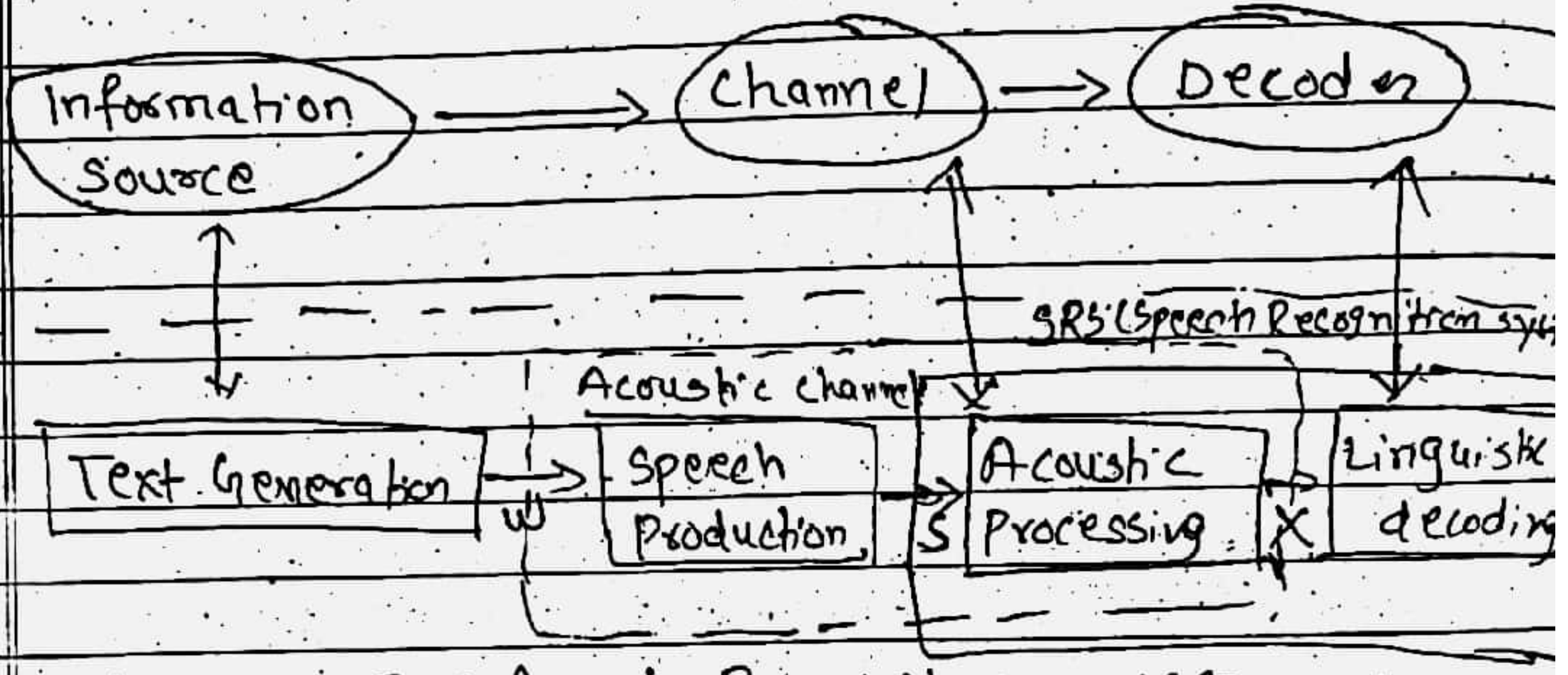

Fig: Speech Recognition process.

Speech Recognition is the ability to translate a dictation or spoken word to text.

→ It is also known as Speech-to-Text and Voice Recognition.

→ It is achieved by following certain steps and the software responsible for it is known as 'Speech Recognition System'.

→ SR system are usually implemented in the form of dictation software and intelligent assistants in personal computers, smartphones, web browsers and many other devices

Signal Analyzer / Speech Analyzer :-

Analyzes the speech signal and removes the background noise thus focusing only on the speaker's speech.

Acoustic model :

Identifies phonemes from the speech sample using a probability based mathematical model. In figure $W \rightarrow X$, represent acoustic model. i.e $P(X|W)$.

Language model : → i.e $P(W)$

Identifies words and thus sentences uttered by the speaker from the phonemes by making use of a dictionary file and grammar file.

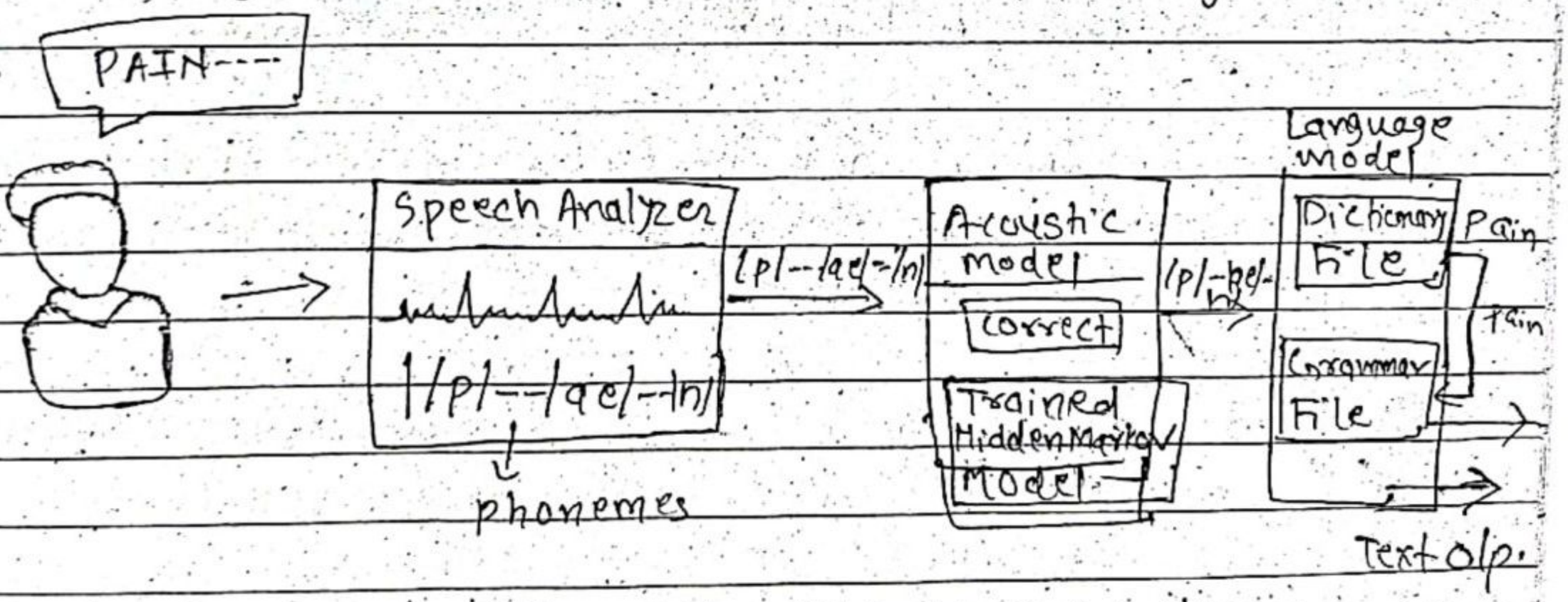

Fig: Process of speech Recognition

Chapter 3: Images and Graphics

Q- What are bitmap images? Explain the advantages and disadvantages of bitmap over vector images

Ans: Bitmap (or Raster) images are stored as a series of tiny dots called pixels. Each pixel is actually a very small square that is assigned a colour, and then arranged in a pattern to form the image.

→ When you zoom in on a bitmap image you can see the individual pixels that makeup that image.

→ Bitmap graphics can be edited by erasing or changing the color of individual pixels using a program such as Adobe Photoshop.

Advantages of bitmap over vector images

1. Bitmap formats are best for images that need to have a wide range of color graduation, such as most photographs.

2. Bitmap file can be easily created from existing pixel data stored in an array in memory.

3. Pixel values may be modified individually or as large groups by altering a palette if present

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4. Allows you to create any image, regardless of its complexity. In contrast, vector graphics cannot accurately convey the effect of the transition from one colour to another without a loss in file's size
5. Bitmap image are easier to render.

Disadvantages of bit-map over vector images

1. In vector image, any particular element of the image could be scaled out without quality loss.
2. The parameters of objects are stored and can be quickly changed which means moving, scaling, rotation, etc doesnot degrade the picture quality in vector.
3. Vector images are independent of the actual size of the depicted image
4. Bitmap can take up a lot if room. Compression can reduce the size of file.
5. Bitmaps when they are enlarged too much, they look un-natural and blocky.

Q. Explain different colour model.

RGB Colour Model.

→ RGB colour model is an additive colour model.

→ In this case red, green and blue light are added together in various combinations to reproduce a wide spectrum of colors.

→ The RGB colour model comprises of 24-bits

per pixel with 8 bits assigned to red, 8 bits to green and 8-bit to blue.
→ The amount of values available with 8 bits is 256 (2^8) ranging from 0-255.
→ The primary purpose of RGB colour model is for the display of images in electronic systems, such as on television screens and computer monitors and it's also used in digital photography.
→ In order to create a colour with RGB, three coloured light beams (one red, one green, and one blue) must be superimposed.
→ With no intensity, each of the three colour is perceived as black, while full intensity produces white.

2. CMYK - colour Model

→ CMYK colour model (four-color process) is a subtractive color model.
→ Primarily used in printing, CMYK works by partially or completely masking colours on a white background.
→ The printed ink reduces the light that would otherwise be reflected. That's why this model is called subtractive because inks 'subtract' brightness from a white background

from four colors: cyan, magenta, yellow and black.
→ It is frequently suggested that the 'K' in CMYK comes from the last letter in 'black' and was chosen because 'B' already refers to blue.
→ Actually, 'K' in CMYK stands for 'key' since in four-colour printing cyan, magenta, and yellow printing plates are carefully keyed or aligned with the key of black key plate.
→ Black is used because the combination of the three primary colors (CMY) doesn't produce a fully saturated black.
→ CMYK is able to produce the entire spectrum of visible colors due to the process of half-toning.
→ In this process, each color is assigned a saturation level and miniscule dots of each of the three colours are printed in tiny patterns. This enables the human eye to perceive a specific color made from the combination.

3 HSB colour model

→ The HSB (Hue, Saturation, Brightness) colour model defines a colour space in terms of three constituent components:

(i) Hue: the color type (such as red, blue or yellow)
→ ranges from 0 to 360° in most applications.

(Each value corresponds to one color: 0 is red, 45 is a shade of orange and 55 is a shade of yellow).

(ii) Saturation: intensity of the color.
→ ranges from 0 to 100% (0 means no color that is a shade of grey between black and white; 100 means intense color).
→ also sometimes called as "purity".

(iii) Brightness (or value): the brightness of colour.
→ ranges from 0 to 100% (0 is always black; depending on the saturation, 100 may be white or a more or less saturated color).

4. YUV color model:

→ The YUV model defines a colour space in terms of one luma and two chrominance component.
→ YUV model is used in PAL, NTSC composite colour video standards.
→ YUV models human perception of colour more closely than the standard RGB model used in computer graphics hardware.
→ The YUV color model stands for
(i) Y, the luma component, or brightness
→ ranges from 0 to 100% in most applications.

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(ii) U and V are the chrominance components (blue-luminance and red-luminance difference components)
→ expressed as factors depending on the YUV version you went to use.

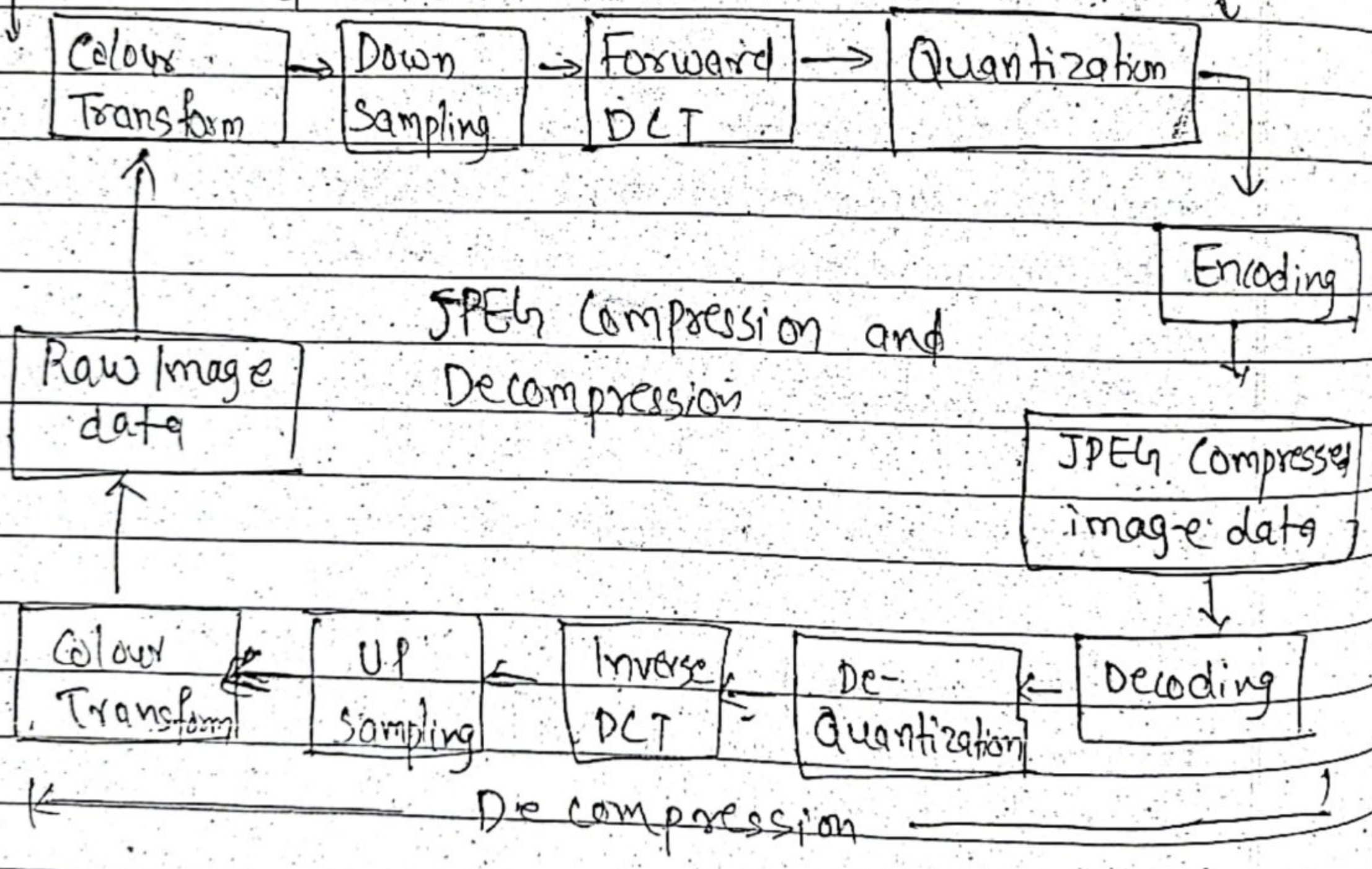
Q. Differences between bitmap and vector.

	Bitmap	Vector
1.	A type of graphics that represent a rectangular grid of pixels, viewable via a monitor, paper or another display medium.	A type of graphics defined in terms of 2D points that are connected by lines, curves to form polygon and other shapes.
2.	Uses pixels	Uses basic geometric shapes
3.	.jpg, .gif, .png are some type	.ps, .eps, .svf and .svg are type
4.	Resolution dependent, so they are not resizable without reducing picture quality.	Resolution independent so they are resizable without reducing picture quality
5.	File size is more	File size is less
6.	Possible to edit image to some extent.	Possible to edit images without reducing quality.
7.	Suitable for photographs.	Suitable for logos, clipart, icons

Q. Explain the steps of JPEG compression process in detail.

Ans:

JPEG is commonly used method of lossy compression for digital images. The degree of compression can be adjusted, allowing a selectable trade off between storage size and image quality.
- JPEG typically achieves 10:1 compression with little perceptible loss in image quality.



JPEG Compression and Decompression

Steps:

(1) Splitting:

The input image is divided into smaller blocks having 8 * 8 dimensions, summing up to

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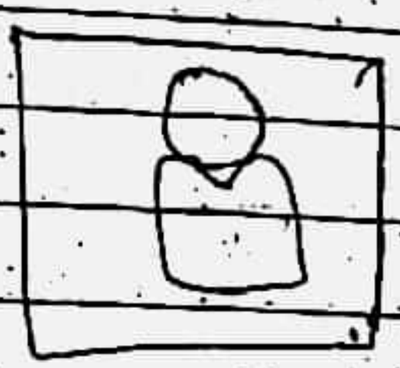
64 units in total. Each of these units of any image (PS) called a pixel, which is the smallest unit of any image.



Original Image

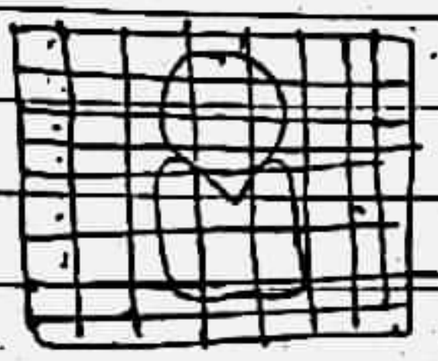


Image Splitting

(2) RGB to Ycb Cr Conversion

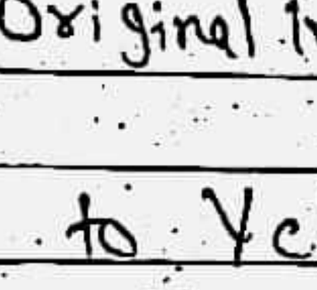
JPEG make use of [Y, Cb, Cr] model instead of [R, G, B] model

Y → brightness

Cb → Colour blueness

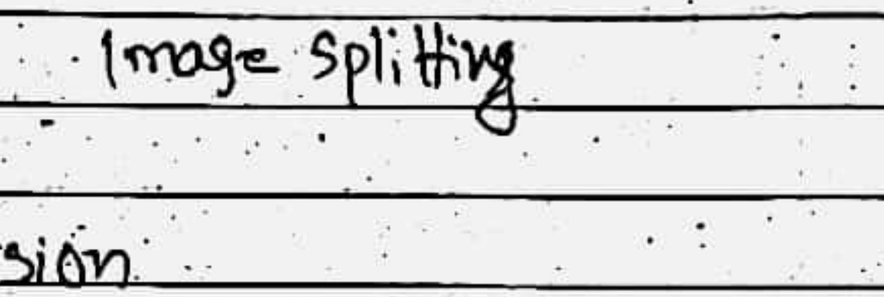
Cr → Colour redness

(a) Color Transform



8X8 pixel

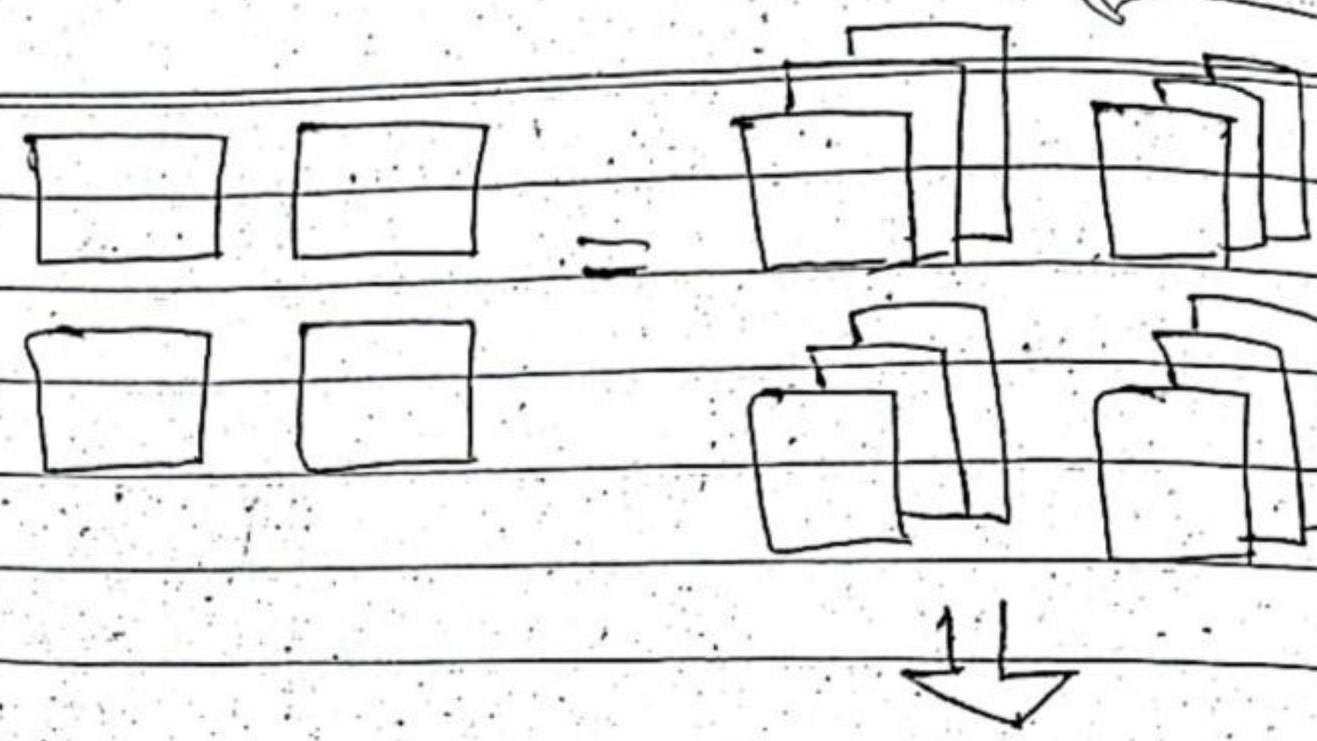
1 pixel = 3 components



M(1) with sampling factor (1,1,1)

(b) Down Sampling:

Y is taken for every pixel and Cb, Cr are taken for a block of 2*2 pixels.



* MCU ⇒ Minimum Coded Unit

(3) Forward DCT:

The DCT uses the cosine function, therefore not interacting with complex numbers at all.
- DCT converts the information contained in a block (8x8) of pixels from spatial domain to the frequency Domain.

(4) Quantization:

The next step is quantization process which is the main source of lossy compression.

→ The values in the quantization table are chosen to ~~preserve~~ preserve low frequency

information and discard high frequency details as human are less critical to the loss of information in this area.

Formula:

$$\hat{F}(u,v) = \text{round}\left(\frac{F(u,v)}{Q(u,v)}\right)$$

where $F(u,v)$ = represent DCT coefficient

$Q(u,v)$ = represents a quantization matrix.

Encoding:

This is the final steps in JPEG compressed image and this method uses Huffman coding and it reduces a large amount of memory without losing any detail of the image.

→ Most of the times it saves 70% of memory.

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Differentiate between Animation and Video

	Animation	Video
1.	Animation is an art concerned with drawing sketches of an object and showing them in a sequence so as to make them look like a moving and living thing.	Video is a recording of still or moving objects.
2.	Animation is a video which is created by an artist who makes lots of sketches which are shown with help of a camera at high rate.	Videos are made with video camera.
3.	Animation is an imagination, skill, art.	Video means reality recorded by camera.
4.	Making animation is more difficult than creating a video	It is easier somehow.
5.	Animation is a production technique to make a moving images from individually drawn frames.	Video is a medium referred to analog-video-tape technology extended to digital video capture technology.

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Differentiate between Lossy and lossless Compression

Basis	Lossy Compression	Lossless Compression
Basic	Lossy compression is the family of data encoding method that utilizes imprecise estimates to represent content.	lossless compression is a group of data compression algorithm that permits original data to be accurately rebuilt from compressed data.
Algorithm	Transform coding, DCT, DWT, fractal compression, RSSMS	RLE (Run-length Encoding) RLE0, LZW, Huffman encoding, ~~Shannon~~ Shannon-Fano coding
Used in	Images, audio and video	Text or program, image, sound
Application	JPEG, GIF, MP3, MP4, etc	RAW, BMP, PNG, WAV, etc.
Data-holding capacity	It has more data holding capacity of channel.	less compared to lossy method
Data Qlty	Data quality is compromised	No compromise in data qlty
Size	Reduce size of data	doesnot reduce size of data
Restore	doesnot restore original form	Restore original form

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Explain data compression methods with example.

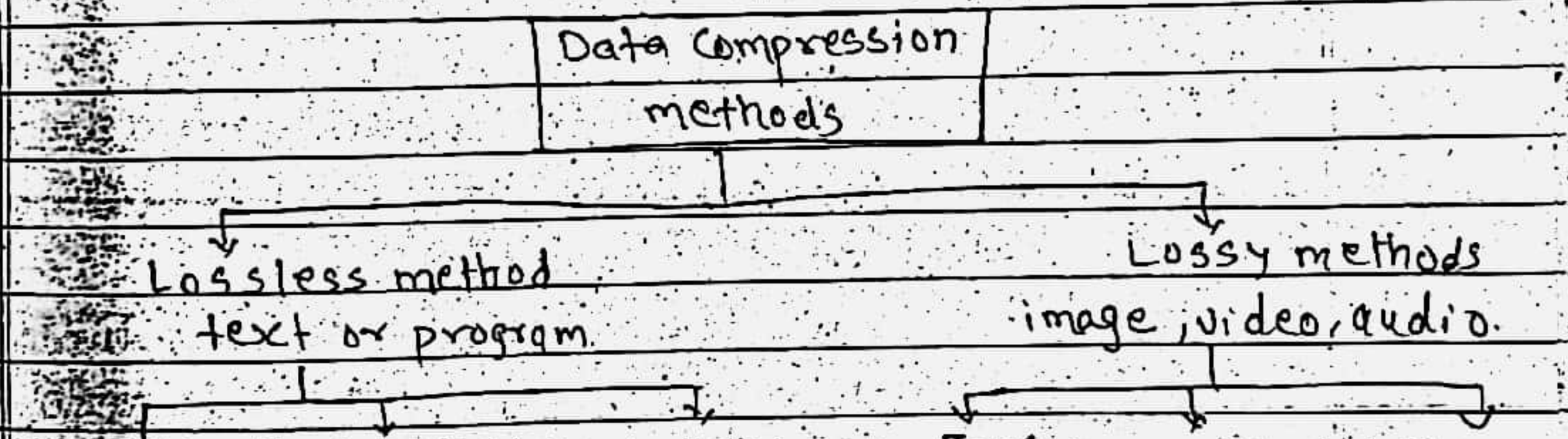
Data compression implies sending or storing a smaller number of bits.

The act of representation of information in a compact form is called data compression

Data Compression Techniques/methods are of two types:

① Lossless compression.

② Lossy compression



a) Lossless method:

- As per its name No data loss.
- Reconstruct the original message exactly from the compressed message.
- Generally used for text. files, spreadsheet files, important documents.
- Some examples are RLE, Huffman coding

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(i) RLE- Run Length Encoding

- Simple compression technique
- Replace all consecutive numbers or alphabets by first the number of times an alphabet was used followed by the alphabet itself

Example:

Original data: aaaabbbccddddd
Compressed data: 4a3b2c5d

(ii) Huffman Coding

- Uses certain method for selecting representation for each symbol which gets certain code which is called as huffman code.
- Infact, assigns fewer bits to symbols that occur more often and more bit to symbols occur less in data
- It follows certain algorithm which is described below
  1. Make a base node for each code symbol.
  2. Count their occurences.

E.g:

If we have a sentence like following
"thie essential feature"

By counting we can find 12 different symbols:

	A	E	F	H	I	L	N	R	S	T	U	space
Occurence →	2	5	1	1	1	1	1	1	2	3	1	2

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Represent E=5 with small bit followed by T, S, A, spare and remaining ones.

iii) Lempel Ziv Welch (LZW) Coding.

- LZW (LZ77) compression works by finding sequence of data that are repeated.
- It introduces a term called "sliding window", which means at any point of time, there is re-occurence of same word or character.

Example:

Let Distance (D): how far back into the window the sequence start.

(L) Length: the number of characters for which the sequence is identical.

e.g. 1 2 3 4 5 = D W

blah blah blah blah blah

Here you see that, data is repeated after another b, and hence our first compression would be like

⇒ blah b[D=5, L=5]

(B) Lossy Compression

→ Unlike Lossless, this method reduces data by eliminating specific information.

- It can achieve very high compression ratios through data removal.

- Comparatively, These methods are less time taking, cheaper as well as it can reduce more space.

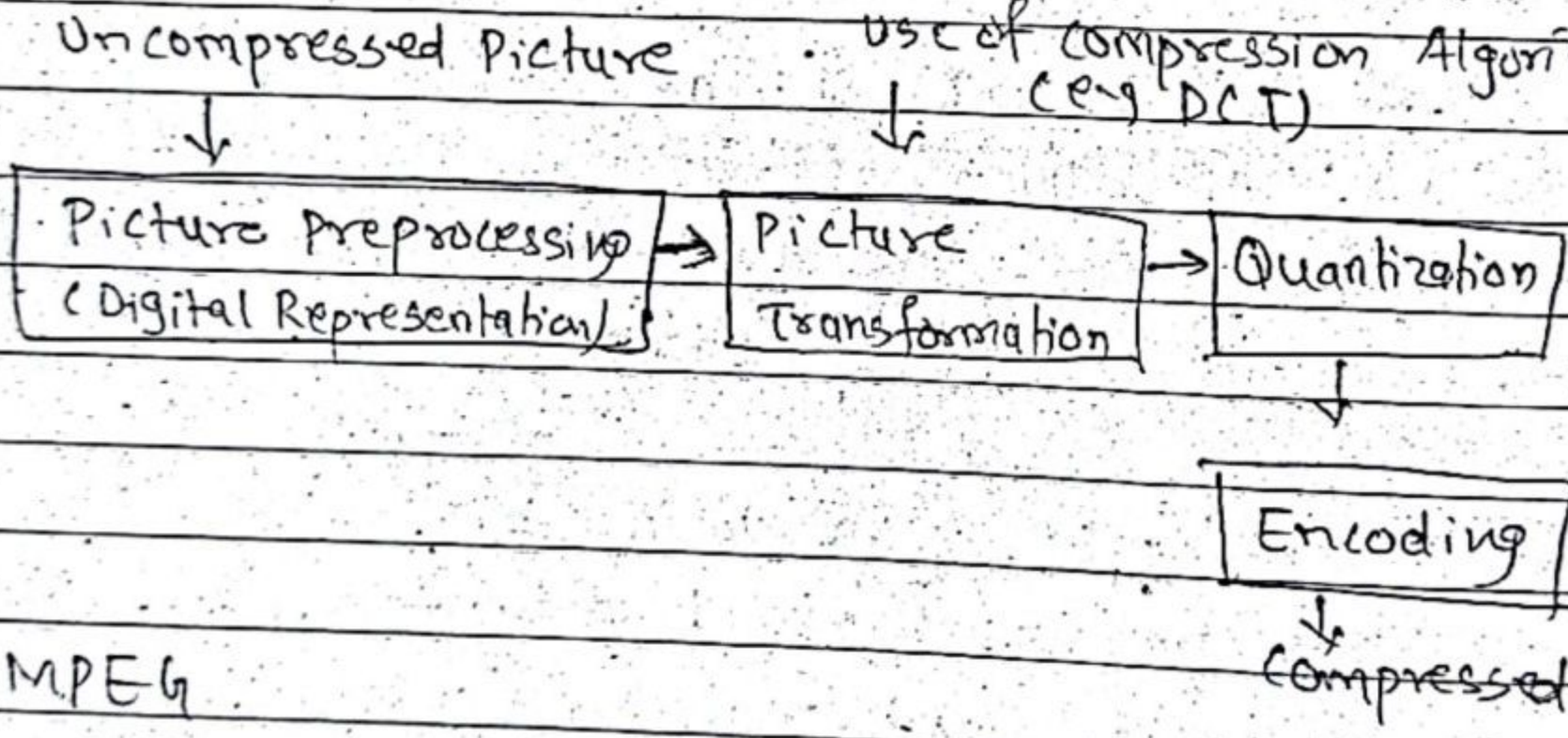
Methods based on lossy compression

JPEG - Used for pictures and graphics

MPEG - used for video compression.

Audio compression

(i) JPEG Compression:



(ii) MPEG

- Ultimately it uses JPEG compression technique only. Each frame of it are spatially compressed by JPEG.
- To know this compression, three frames are necessary to understand.
  1. I-Frame (intra coded)
  2. B-frame (Forward prediction)
  3. P-frame (Interframe coded)

(iii) Audio compression.

- As name suggest, it is used for speech or music compression.

Using Application:

(1) Zip
(2) CSO
(3) RAR

For MULTIMEDIA:

(1) GIF
(2) JPEG
(3) MP3
MPEG and soon.

Q. Differentiate between JPEG and MPEG.

	JPEG	MPEG
1.	JPEG stands for Joint Photographic Expert Group.	MPEG stands for Moving Picture Expert Group
2.	JPEG is mainly used for image compression.	MPEG is used for audio and video compression.
3.	JPEG typically achieves 10:1 compression with little perceptible loss in image quality	Compression ratio in MPEG is 30:1 for general video
4.	JPEG normally stands for an Digital Image Format.	MPEG is a video and audio codec
5.	Extension: .jpg, .jpeg	extension: .mpe, .mpeg, .mp4

Q. What are the steps to create the Huffman code tree? Explain with example how Huffman code reduce the file size?

Ans: Steps:

(1) Two characters with the lowest probabilities are combined to form a binary tree.
(2) The two entries in the probability table is replaced by a new entry whose value is the sum of the probabilities of the two characters.
(3) Repeat the step (1) and (2).
(4) Assign 0 to left branch and 1 to the right branches of binary tree.
(5) The Huffman code of each character can be read from the tree starting from root.

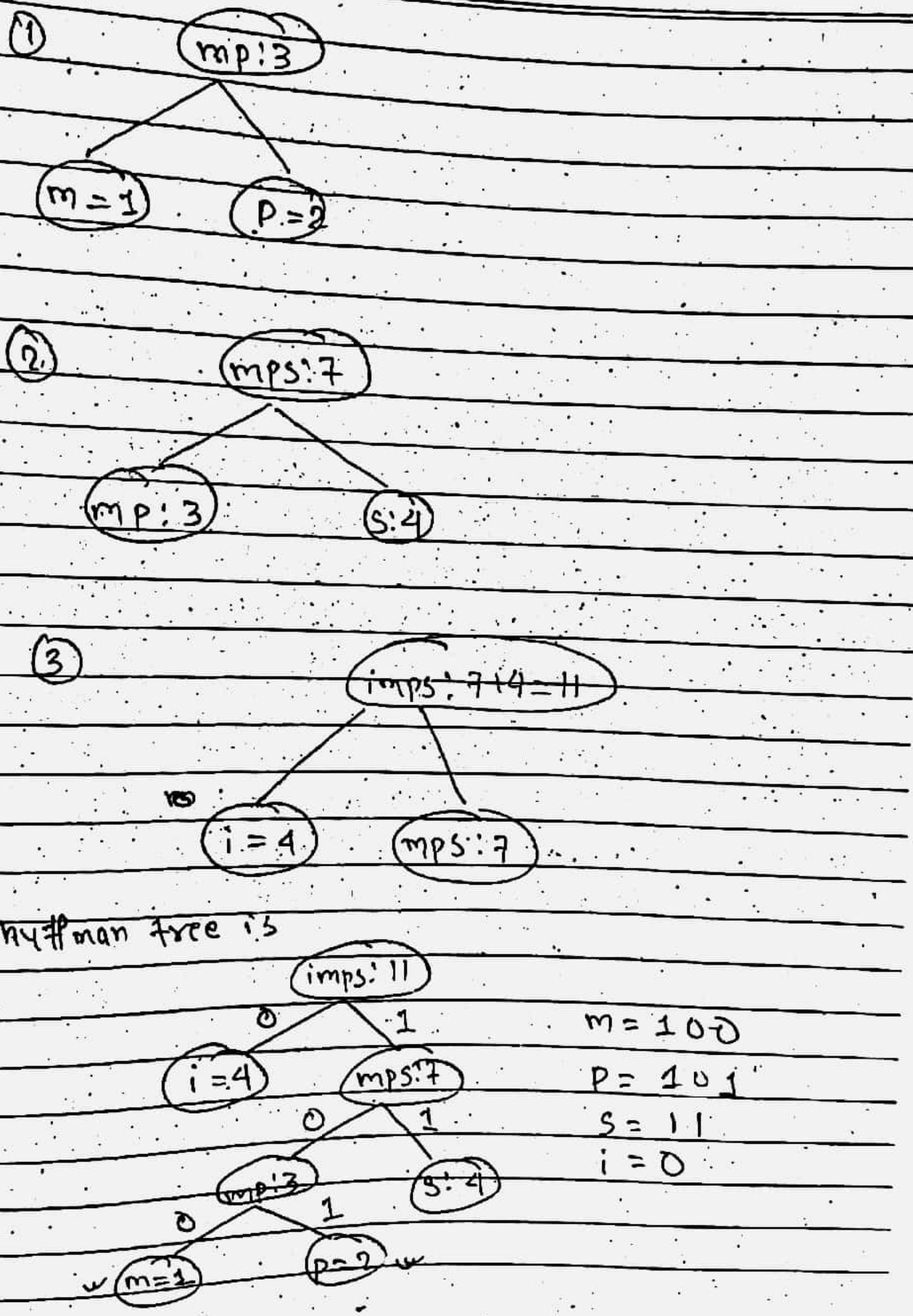
Example:
Let we encode message 'mississippi' using Huffman coding.

Sol^{n}:-

Following is the frequency table of characters in 'mississippi' in non-decreasing (ascending) order.

Character	frequency
m	1
p	2
s	4
i	4

Now,



So, huffman tree is

m = 100

p = 101

s = 11

i = 0

Following are the codes

Character	Frequency	Code	Codelength
m	1	100	3
p	2	101	3
s	4	11	2
i	4	0	1
	N = 11		

Now, Total number of bit using Huffman.

= freq(m) * codelength(m) + freq(p) * codelength(p) + freq(s) * codelength(s) + freq of (i) * codelength(i)

= 1x3 + 2x3 + 4x2 + 4x1

= 3 + 6 + 8 + 4

= 21 bits

If we havenot use Huffman then,

1 character = 1 byte = 8 bits

Total number of bits = N x 8 bit

= 11 x 8

= 88 bits

Bits saved = 88 - 21 = 67 ✓

Hence, in this way Huffman code reduce file size.

Q Why lossy data compression is sometimes preferred over lossless.

Reason:

(1) Very small file size (Significantly reduce file size)
(2) Lots of tools, plugins, and software support it.
(3) Lossy compression is generally used for video a sound, where certain amount of information loss will not be detected by most users.

Chapter 6: User Interface Design

Q. Discuss the user interface design process for multimedia with block diagram.

Ans: UI design is an iterative process involving co liaisons between users and designers.

The 3 core activities in this process are.

(1) User analysis:

Understand what the users will do with the system.

(2) System Prototyping:

Develop a series of prototypes for experiment.

(3) Interface evaluation:

Experiment with these prototypes with users.

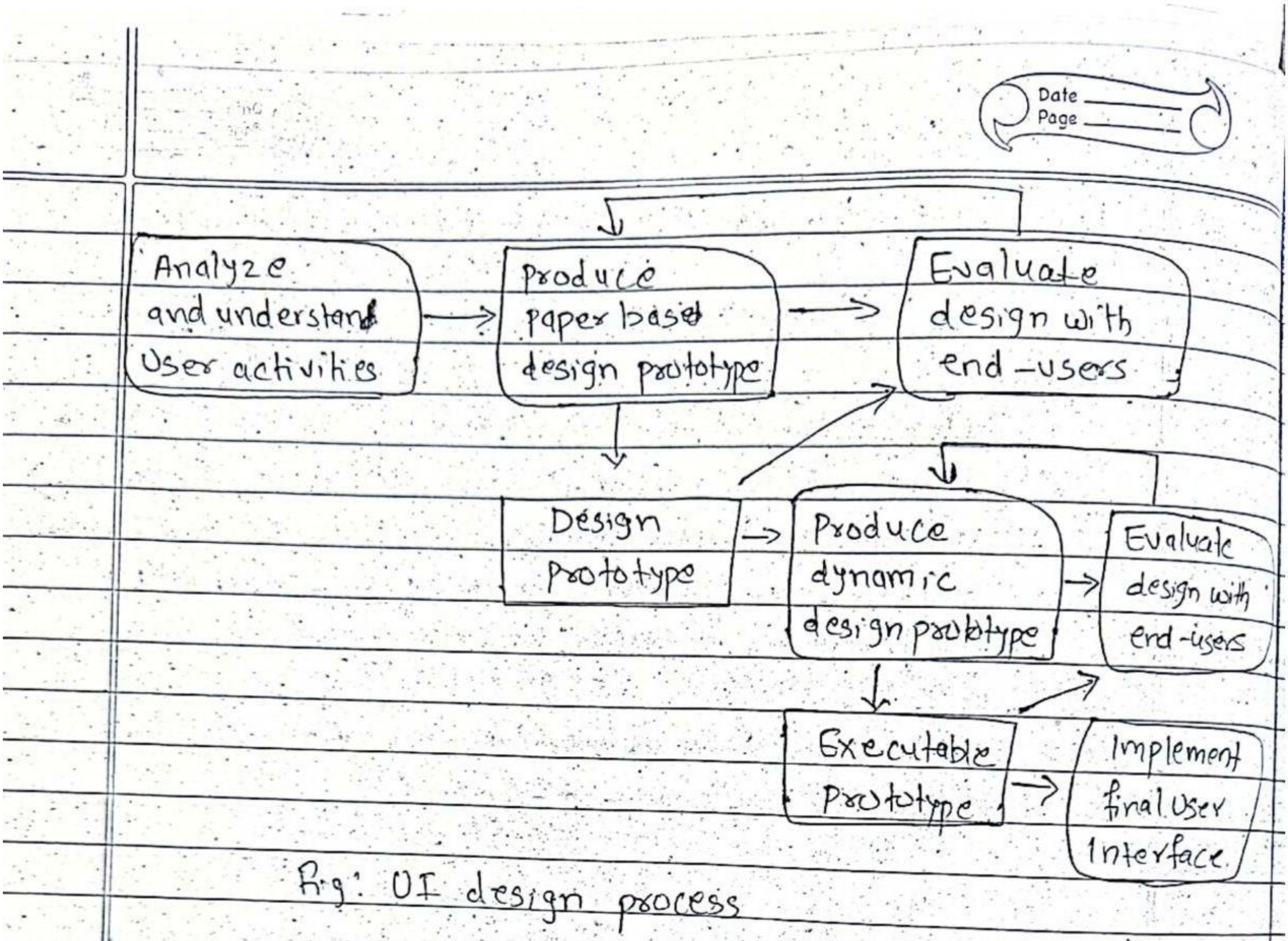


Fig: UI design process

(1) User Analysis:-

The main purpose of user analysis is to know what the user want to do with a system. It helps to know what user wants and helps designer to understand. Interviewing, ethnography are used for user analysis

(2) User Interface prototyping:-

The aim of prototyping is to allow users to gain direct experience with the interface. Without such direct experience, it is impossible to judge the usability of an interface.

(i) Paper prototyping:
- Walk through scenarios using sketches of the interface.
- Use a storyboard to present a series of interactions with the system.
- Paper prototyping is an effective way of get user reactions to a design proposal.

(ii) Prototyping techniques:
In prototyping techniques, script-dri prototyping can be used. For this develop a se of scripts and screens using a tool such as Macromedia Director. When the user interact with these, the screen changes to next display. Visual programming and Internet-based prototypi can be used as prototyping techniques.

User Interface Evaluation:
The goals of UI evaluation are to obtain feedback on how to improve the interface design an to assess if the interface meets its usability requir
- Some evaluation of a user interface design shou be carried out to assess its suitability. Full sca evaluation is very expensive and impractical fo most systems.
- Ideally, an interface should be evaluated again a usability specification.

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Q. Explain the general design guidelines for the multimedia user interface design and also mention the multimedia interface components.

Ans: The general design guidelines for multimedia user interface design are

① User familiarity:
The interface should use terms and concepts which are drawn from the experience of the people who will make most use of the system.

② Consistency:
The interface should be consistent in that, wherever possible, comparable operations should be activated in the same way.

③ Minimal Surprise:
User should never be surprised by the behavior of a system.

④ Recoverability:
The interface should include mechanisms to allow users to recover from error.

⑤ User guidance:
The interface should provide meaningful

feedback when errors occur and provide context-sensitive user help facilities.

(6) User diversity:

The interface should provide appropriate interaction facilities for different types of system user.

(7) Simplicity and easy to use.

Chapter 7:

Q. Explain the abstraction levels of programming in the multimedia system.

Ans:

Fig: Abstraction Level of programming

Abstraction Level in programming define different approaches with a varying degree of detail for representing accessing and manipulating data.

→ A multimedia application may access each level

→ A device is not part of operating system but is directly accessible to every component and application.

→ A library, the simplest abstraction level, includes the necessary functions for controlling the corresponding hardware with specific device access operation.

→ As with any device, multimedia device can be bound through a device driver respectively the operating system.
Hence, the processing of the continuous data becomes part of the system software

→ Multimedia device drivers is embedded in operating system simply considerably the implementation of device access and scheduling.

→ Higher Procedural Programming language most often used to implement commercial multimedia application

The code generated from the compiler can be processe through libraxies as well as through a system interface for continuous data.

→ Object Oriented environment provides the applicatior with a class hierarchy for the manipulation of multim dia - The generated or interpreted code can be proces: and controlled through libraries and system interface for continuous media.

Q. Explain the abstractions for programming such as librari system software, higher programming languages and object-oriented approach.

Ans: Libraries:

→ The processing of continuous media is based on set of functions which are embedded into libraries and libraries are provided together with the correspondi hardware.

→ The device driver or library controls all availab functions and also supports each device.

→ Some libraries considered as extensions of the graphical user interface whereas other libraries consist of control instruction passed as control blocks to corresponding driver.

(B) System Software:

→ Instead of implementing access to multimedia devices through individual libraries, the device access can become part of operating system.

Data as Time Capsules

→ Each Logical Data Unit (LDU) carries in its time capsule its data type, actual value and valid life span.

→ Useful concept for video, where each frame has a valid life span of 40 ms.

Data as Streams

→ A stream denotes the continuous flow of audio and video data between a source and a sink.

→ prior to the flow the stream is established equivalent to the setup of a connection in a networked environment.

) Higher Programming Languages

→ It can rely on library functions when continuous media programming is integrated.

→ As an alternative, it is possible to access abstractions such as constraints and event handlers in the operating system.

→ Integrated programming of applications with continuous media inside higher programming languages leads to simpler and clearer programming.

(D) Object-Oriented Approaches

→ Object Oriented approaches main function is to find its class in certain hierarchy.

→ Important properties of object-oriented system are:

1. Inheritance
2. Polymorphism.

Applications

Q: How can you apply multimedia system in tele-service?

Ans: Tele-services are services provided by communication system which are based on and make use of audio and video data.

(A) Based on conversational service:

→ A conversational service supports conversation between remotely located end users.
→ In this service, bi-directional delivery is done in synchronous mode.
E.g.: Video conferencing.

(B) Based on Messaging Service:

→ A messaging service provides an exchange of message between a sender and receiver where the end users are human beings and exchange of message in both directions is done asynchronously.
Example: Mailing System

(C) Based on Retrieval Service:
→ A retrieval service provides an exchange of message between a sender and receiver, where sender are called client and receiver as server.

→ The client requests information from the server, where the information is stored, the server retrieves the information and sends it back.
Example: Google cloud.

(D) Based on Tele-action service

→ Tele-action means to act a distance. Such actions include reading or writing some informatio to a remote location or possibly both.
Example: Banking System.

(E) Based on Distribution Service:

→ Distribution services are services for the distribu on of information to different remote sites.
→ They are one-way communication from broadcastin source to the remote destinations.
Example: TV broadcasting

Q. Application of multimedia in education.

→ Books and Newspapers can be interactive multimedia documents which may be electronically distributed to the home / user's declared address which saves time and money for both parties

(A) Based on Graphics:

Graphics are two-dimensional figures or illustration. Using graphics in education will increase student-understanding. It will enhance their memory skills because pictures are easy to remember.

(B): Based on Audio

→ Audio comfort students by conducting live online discussion via audio tools & platform.

→ Learning by audio also can help disable people such as blind people.

(C) Based on Video:

→ Video can provide visual simulation for students so that they can have a better understanding in learning.

→ Video in surgical training is helpful to students for better understanding which they didnot able by reading.

(D) Based on Animation:

→ Animation improve student's creativity while bringing fun in learning.

Example:

Student may not understand flow of blood over the heart by just lecture of teacher: But student can have clear concept when they learn with animated clips.

Q Application of multimedia in entertainment

1. Entertainment and Fine Arts:

- Multimedia is heavily used in the entertainment industry, especially to develop special effects in movies and animations.

2. Gaming:

- Multimedia games are a popular past-time and are software programs available either as CD-ROMs or online

→ Some video games also use multimedia feats. Multimedia applications that allows user to actively participate instead of just sitting by as passive recipients of information are called as Interactive Multimedia

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3. Cinema
   - Morphing
   - Superimposition
   - Animation
   - Digital Recasting.

4. Interactive Movies
5. Virtual Reality
6. Cyber-Sports
7. Music
8. Videos
9. Reading books.
10. Digital Recording.
11. Meeting people at virtual environment

- Based on virtual Reality (Gaming)
- Based on Interactive Audio (Google play music)

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4) What do you mean by authoring tools? Mention different types of authoring tools and explain it.

-> Multimedia authoring tools provide the framework for organizing and editing the elements of a multimed project.

Authoring tool provides an integrated environment for combining the content and functions of a project. It enables the developer to create, edit and import data.

In multimedia authoring system, multimedia elements and events are often regarded as objects. Each object is assigned properties and modifiers.

Types of authoring tools

1. Card and page based tools
2. Icon-based, event-driven tools
3. Time-based tools

(1) Card and page based tools

- Card-and page-based authoring systems provide a simp and easily understood metaphor for organizing multimedia elements.
- Cards are developed that have different elements assoc ated with them and are put in stacks. It contains media objects such as buttons, text fields, and graphic objects.
- It provides a facility for linking objects to

pages or cards. You can link the cards by allowing the user to click on buttons or other elements and jump to a different card in the stack

E.g: Hypercard, ToolBox

- Easy to understand metaphor
- 1 screen = 1 card = 1 page
- Easy to used

(B) Icon Based, Event-Driven Tools

- Icon-based, event-driven tools provide a visual programming approach to organize and present multimedia.
- Multimedia elements and interaction cues are organized as objects in a flowchart.
- Flowchart can be built by dragging appropriate icons from a library, and then adding the content.
- With icon-based programs, you use symbols in a flow chart.
- Each icon represents a particular event
- An advantage of icon-based programs is that you can easily see how a title is structured, that is the flow of a program and especially the branching.

E.g: Multimedia Authoware

- clear structure
- Easy editing and updating
- difficult to learn
- expensive

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(9) Time-Based Tools.

- Time-based tools are best suited for messages with a beginning and an end.
- Some time-based tools facilitate navigation and interact control.
- Time Based Authoring Programs use a movie metaphor Like a movie on videotape, you start the multimedia titl and it plays untill some action causes it to pause or st Eg Macromedia's Director and Flash are time-based development environments.
  - Good for creation animation
  - Branching, user control, interactivity
  - Expensive
  - Steep learning curve for advances features
  - Easy to put animation and interactive movies.
  - Interactive menus
  - Increase in file size

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Dithering:

Dithering is the process by which we create illusions of the colour that are not present actually. It is done by random arrangements of pixels.

Dithering is a technique to increase the number of colours to be perceived in an image. It is based on human eye's capability for spatial integration, that is, if you look at a number closely placed small objects from a distance, they will look like merged together.

Dithering techniques groups a number of pixels together, say 4, to form a cluster. When viewed from sufficient distance, the individual pixel will not be distinguishable. The cluster will look like a single block of a colour different from individual pixel.

Sound Editing tools:

Sound editing tools let the programmer hear sound as well as visualize it. One can cut/copy and paste sound and edit it with great accuracy. Integrating sound into multimedia project is very easy by using sound editing tools like Cool edit.

Cool edit can be used to record ones own

music, voice, or any other audio. It makes us a professional as fax as handling of sound is concerned. One can edit, mix the sound with any other audio and add effects to it. One can record sound from a CD, Keyboard, or any other sound played through the sound card. The other feature of this softwasre is that it can read and write MP3, which is the hot sound format in the present times. Once the recording is complete, the sound file can be converted into any desired format. In other words, there is a similarity in these editing tools - what photoshop can do to images; cool edit can do for sound.

Sound Forge is another professional quality sound editing tool that is used in multimedia work.

MIDI

MIDI (Musical Instrument Digital Interface) is an industry-standard protocol that enables electronic musical instruments and other equipment to communicate control and synchronize with each other and to exchange system data.

Devices such as computers, synthesizers, keyboard controllers, sound cards, samplers and drum machines.

MIDI doesnot transmit an audio-signal or media. The sounds are generated by the synthesizer, which receives the MIDI data.

MIDI - In port: Allows data to be received by a MIDI - compliant device
MIDI - out port: is used for transmitting data.
MIDI - Thru port: is used for linking a number of MIDI devices with a single transmitter.

A MIDI network is a combination of hardware and software that provides interconnectivity between a group of MIDI devices, such as synthesizers, controllers, and sequencers.

A synthesizer is an electronic musical instrument that uses one or more sound generators to create waveforms which are then processed and combined in order to generate musical sounds.
MIDI synthesizers provide musical tones and percusion based on the input of MIDI software messages.

A music sequencer is an application or a device designed to record and playback musical notation.
A MIDI sequencer records MIDI software message sequences & provides some sort of editing capabilities.

A sampler is an electronic musical instrument which plays back recordings (or "samples") that are loaded or recorded onto it to perform or compose music.

Softwares used in animation

(1) Adobe photoshop
(2) Anime studio
(3) Adobe Flash
(4) Auto desk 3DS Max
(5) Cinemas 4D, E
(6) Adobe After effects

Q. Explain the components used to build multimedia system.

→ Multimedia system is a system capable of processing multimedia data and applications. It is characterised by the processing, storage, generat manipulation, and rendition of multimedia information.

Components used to build multimedia system:

(1) Capture device:
Video camera, video recorder, audio microphone Keyboard, mice, graphics tablets.

(2) Storage device:
Hard disk, CD-ROMs, DVD-ROM

(3) Communication System
→ Local Network, Intranets, Internet

(4) Computer System
→ MPEG / VIDEO / DSP Hardware

(5) Display Device
→ CD-quality speakers, SVGA, Colour printers

Presentation media refers to tools and devices for the input and output of information

Storage media refer to a data carrier which enables storage of information.

Transmission medium characterizes different information carriers that enable continuous data transmission.

Information exchange medium includes all information carriers for transmission i.e all storage and transmission media.

Scanned with CamScanner

analog

Higher programming language.

(1) Media as Type:
→ define data type for video and audio
→ read.
→ merging.

(2) Media as file.
Another way of programming continuous media data is consideration of continuous media stream as file instead of data type.

file1 = open(microphone)
mix(file3, file1, file2)
merging 2 audio file & output through speaker.
use file to input & output.

(3) Media as process
— For time dependency.
→ process such as set-volume, set-loudness.

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object oriented language are able to meet the requirement
It is used to design and implement multimedia applica

Class : interface

camera

operation : zoom and set_back_light.

↓

zoom operation need to transform
absolute values ; into necessary relative parameters.

Object :

All object derived from same class include same
operation.

contains set of operation called methods -

A VCR object (Video Cassette Recorder) VCR

play : operation

play operation maps to VCR device driver

Inheritance :

class : Camera → parent

→ zoom, autofocus
Methods.

professional camera.

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Polymorphism:

Same name of method in several class with different implementation.

e.g.:

play function used with audio & video data.