

Multimedia

IMAGES

BITMAP



Each Box Is A PIXEL

By Combining Pixels

Bitmap Image is created

VECTOR



Drawing Objects, shapes

and instruction to make

them are stored which

makes vector graphics.

• **Vector graphics:** Images made up of drawing objects, the properties of each object determine its shape and appearance

· **Bitmap Images:** Images stored as an array of Individual Pixels.

BITMAP

Terms to memorize

· **Pixel:** Smallest Picture element which can be addressed.

· **Image Resolution:**

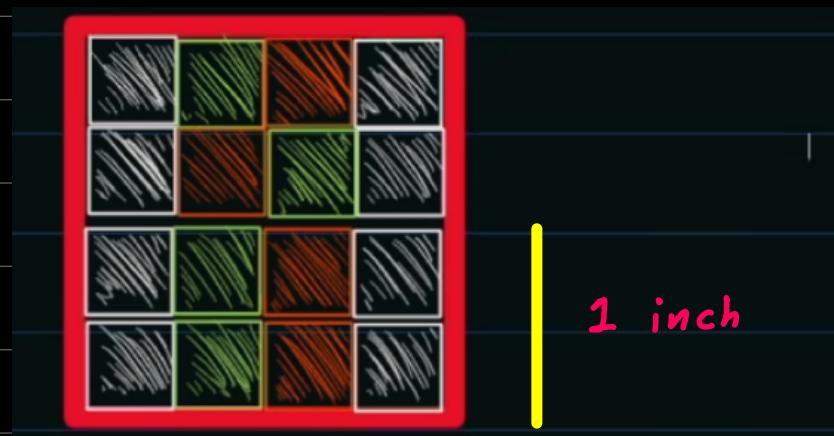
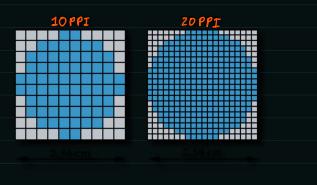


Image resolution = 2 PPI (2 pixels per inch)

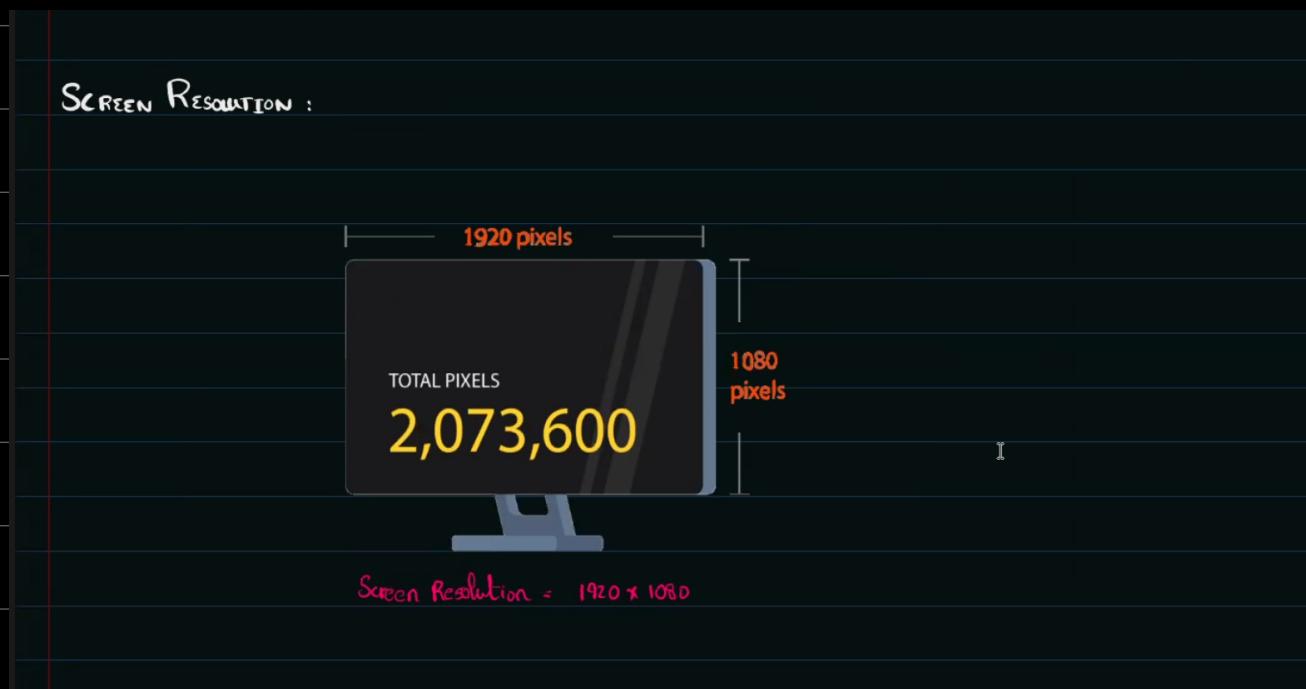
· Measured in pixels per inch, this value determines the amount of detail

an image has.



- Higher image resolution means there are more pixels per inch resulting in more pixel information and creating high quality images

Screen Resolution:



- Number of pixels which can be viewed horizontally and vertically on a screen.

• Colour Depth / Bit depth : No. of bits allocated to represent each pixel's colour.

• 2^n , n = bit/ colour depth

• 2^n = number of colour representations.



• Metadata: Data about data . e.g: filename, file format, colour depth

• File header: Contains information regarding the image such as image size, number of pixels, Type of compression, colour depth, file location.

• File header contains metadata

Q- How images are encoded into a digital format?

- The images are stored as bitmap images
- Each image is made up of pixels
- Each pixel is of a single colour
- Each colour has a unique binary number
- Sequence of each binary number is stored of each pixel

(go to end of notes)



Features of Graphic Editing Software

- 1) Re-size: Increase / decrease the size of an image
- 2) Crop: Remove certain part of the image
- 3) Blur: Reduce the focus
- 4) Red-eye reduction: Reduces red light reflected from human eye.

VECTOR GRAPHICS

Q- What are features of vector graphics?

- Vector graphics store set of instructions about how to draw the shape.
- Can be enlarged without the image being pixelated.
- Do not compress well
- Individual elements of vector graphics can be grouped
- Suitable for more geometric shapes.

Q- What are the benefits of using vector graphics?

- Can resize it without pixilation
- Images are re-drawn with each adjustment
- Smaller file size
- Storing commands, not individual pixels.
- Can be transferred quicker and downloaded quicker. (Smaller file size)

VECTOR GRAPHIC TERMS

Property: Data about shapes , e.g: length , width

Drawing List: The list of shapes involved

Drawing Objects: The object made with different shapes

File Size Calculation

Size : Width pixels \times height pixels \times colour depth

Unit = Bits

→ Unit

Exam Style Questions

4) A digital camera takes a bitmap image. The image is 2000 pixels wide by 1000 pixels high with a colour depth of 24-bits.

(a) Calculate an estimate of the file size for the image. Give your answer in megabytes. Show your working.

Working

Size = width \times height \times color depth

$2000 \times 1000 \times 24 = 48,000,000 \text{ bits}$

Convert to bytes by dividing with 8

$\frac{48,000,000}{8} = 6,000,000 \text{ bytes}$

$\frac{6,000,000}{1000 \times 1000} = 6 \text{ MB}$

Answer..... 6 MB [3]

Maximum number of colours	Minimum number of bits
68	1
256	2
127	3
2	7
249	8
	9

2 \times 2¹

4 \times 2²

8 \times 2³

2 \times 2⁴

128 \times 2⁷

256 \times 2⁸

512 \times 2⁹

[3]

Sound

Digital Data: Data stored as a binary value which can be either '0' or '1'

Analogue Data: Data obtained by measurement of physical property which can have any value from a continuous range of values

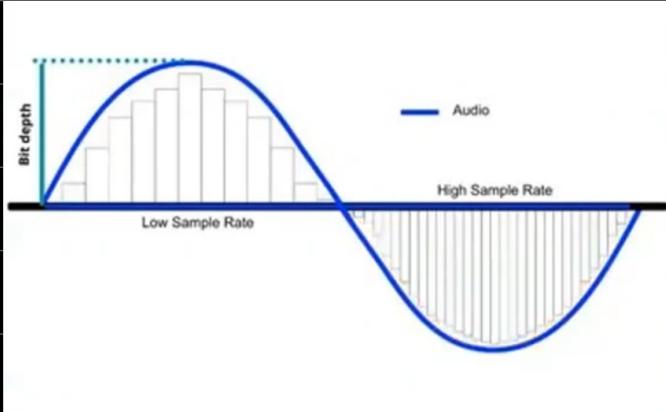
Sampling



CD Quality = 44100 Hz

Sampling: Taking measurements at regular time intervals

Sampling Rate: The number of samples taken per unit time, usually in seconds
(Hz)



High sample rate = Higher accuracy

Sampling Resolution: The number of bits used to store each sample.

Q- How sampling is used to record the sound clip / How sound is recorded digitally?

- The amplitude of the sound wave is determined
- at set time interval
- to get an approximation of the sound wave
- encoded as a sequence of binary numbers
- Increasing the sampling rate will improve the accuracy of the recording

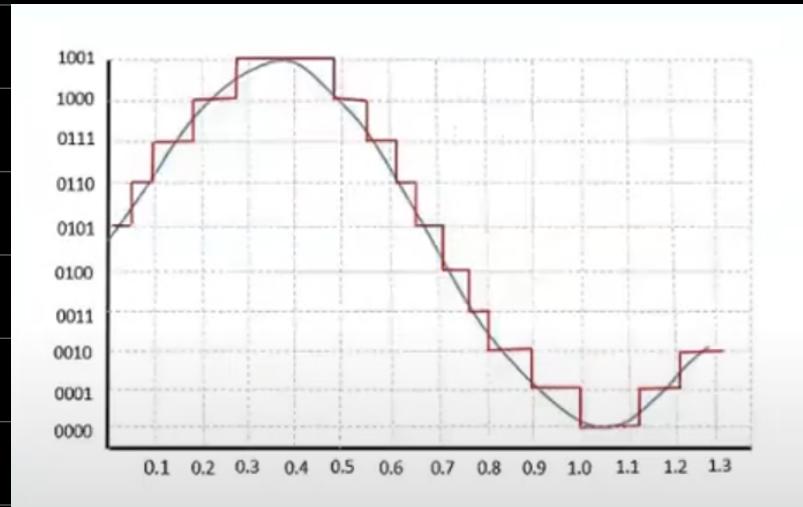
Quantization Error

• = Analogue

• = Digital

Analogue - Digital

= Quantization Error



Quantization error is the difference b/w the analogue signal and the closest digital value at each sampling instant.

Impacts of Changing Sampling Rate And Sampling Resolution

Sampling Rate

- Sampling Rate \propto Accuracy \propto File size
- The greater the sampling rate, greater the accuracy but file size increases. Smaller gaps b/w samples, so lesser quantization error.

Sampling Resolution

- Increasing sampling resolution means more bits per sample
- Greater range of values can be stored.
- Larger range of values means larger file size
- More accurate representation of sound.
- Reduces Quantization error

Benefits of higher Sampling Resolution

- Allow for large dynamic range → sounds b/w soft and hard sound
- More accurate representation

Drawbacks of higher Sampling Resolution

- Bigger file size , occupies more storage
- longer to transmit data / download
- Greater processing power needed.

Features of Sound Editing Software

- Edit start time, stop time
- Fade in and Fade out of a clip
- Delete part of a clip
- Frequency of sound can be altered
- Mix multiple sound tracks
- Use of filters
- Conversion b/w different audio file format

How to Calculate File Size

File Size (bits) = Sampling Rate \times Sampling Resolution \times time

(ii) Leonardo records his voice twice. Each recording is the same length and has the same sampling resolution. The first recording has a sampling rate of 44100Hz. The second recording has a sampling rate of 21000Hz.

Describe how the different sampling rates will affect the recording and the sound file.

The first recording will have a greater file size and more accurate sound quality whereas the second recording will have less accurate sound quality and smaller file size than the first recording.

[2]

Compression

Def: Reduction of file size

Q- Why do we need to compress a file?

- The data files have very large file size.
- It would take a long time to send the non-compressed file // compressed files will download faster
- A higher bandwidth would be needed to transmit the uncompressed file

bandwidth: Rate of data transfer

net bandwidth

application bandwidth

] different scenarios

Types of Compression

Lossless File Compression: In this technique, data is not lost, and the compressed file can be decompressed as the original

Lossy file compression: In this technique, data is lost and the decompressed file is not same as original

Application of Lossy and Lossless

Lossy: Accuracy of data is not important

- smaller file size needed => lossy reduces file size more than lossless

Lossless: Accuracy of data is important

Scenario Based Question

Q- Abdullah wants to compress a source code. Identify the most appropriate compression technique he should use.

Ans: • Lossless

- In this technique, data is not lost
- Any lost data will mean that program will not work.

Q- Photograph is to be emailed to a friend

* Ex. def

- Lossy
- All the data is not required
- The number of colours can be reduced without the user noticing
- E-mail requires a significantly smaller size
- This takes a shorter time to transmit

OR

• Lossless

• A high quality image is needed

- All of the data is needed and can not afford to lose any data

How Bitmap image is compressed

(a) A black and white bitmap image is shown.

Color	Code
Black	1A
White	3B

2B1	3B1	2B3	1B2	3B1	1B2	3B2
3B1	5B1	1B1	3B2	1B2	3B1	3B2
1B1	3B2	1B2	3B1	1B2	3B1	3B2
3B2	1B1	3B1	1B2	3B2	1B1	3B1

RLE (Run Length Encoding)

Explanation:

- looks for run of consecutive pixels of the same colour
- * Colour Code is
 - Stores the colour value and number of times it occurs written first
 - Lossless method of compression
- and then count
 - reference to the given image in question.
 - of repetition is written.

JPEG

- Lossy compression
- Removes part of the image which are not noticeable to human eye
- Technology

Crop: Removes Pixels \Rightarrow lossy compression

RLE: Stores colour code and count of repetition

JPEG: Removes part of images which are ignored by human eye

Fewer Colours: Uses fewer bits per pixel \Rightarrow lossy compression

Q- Describe lossy methods that can be used to compress the image.

- Reduce Bit depth: Reduces number of bits per pixel which means each pixel has fewer bits
- Reduce number of colours: Fewer colours means fewer bits needed to store each colour.
- Reduce image resolution: Fewer pixels per unit measurement means less binary to store

Q- How a vector image can be compressed?

- By using .svg (scalable vector graphic) which are defined in XML text files which allows them to be compressed

Q- How a sound can be compressed?

- MP3 uses technology known as audio compression
- sound file can be compressed by using the perceptual music shaping algorithm

Perceptual Music Shaping Algorithm

- Removes certain sounds: Frequencies that are outside human hearing range
- If two sounds are played at the same time, only (20-20000 Hz)
the louder sound can be heard by the ear, so softer sound is removed
- lossy compression

Q- Describe lossy methods that can be used to compress a sound?

- Reduce Sampling Resolution: Reduces number of bits per sample which means each sample has fewer bits
- Reduce Sampling Rate: Reduces number of samples per unit time which means less bits to store
- Perceptual Music Shaping: Removing parts of sound which are not noticeable to human ear.

(c) When storing music tracks in a computer, the MP3 format is often used. This reduces file size by about 90%.
Explain how the music quality is apparently retained.
<ul style="list-style-type: none">MP3 is a lossy compressed format
<ul style="list-style-type: none">uses psycho-acoustic modelling
<ul style="list-style-type: none">and perceptual music shaping
<ul style="list-style-type: none">removes sounds that the human ear can't hear
<ul style="list-style-type: none">only keeps sounds human ear can hear better than others
<ul style="list-style-type: none">discards softer sound if two sounds played together
[3]

RLE (text)

- aaaaaaaaaabbbbbbbccc
- ASCII → a=97 , b=98 , c=99
- 0897 0898 0699

Q- Describe differences between vector graphics and a bitmap image.

- Bitmap is made up of pixels
- Vector graphics store a set of instructions about how to draw the shape.
- When bitmap is enlarged the pixels get bigger and it pixelates
- When vector is enlarged , it is re-calculated and does not get pixelated
- Bitmap files are usually bigger than vector graphics files because of the needs to store data about each pixel.
- Vector graphics have a smaller file size because they just contain the instructions to create the shape.
- Bitmap images can be compressed with significant reduction in file size
- Vector graphics images do not compress well because of the little redundant data