DATA STORAGE - REPRESENTATION OF CHARACTER

- Text, numbers and symbols
  - ASCII is a character set which is a list of characters that can be recognized by a computer system
  - 7 – bit code (2^7= 128 characters)
  - But 128 characters are not enough for all languages and symbol
  - Unicode was invented with 16 bits or 2 bytes which can represent 65,536 characters

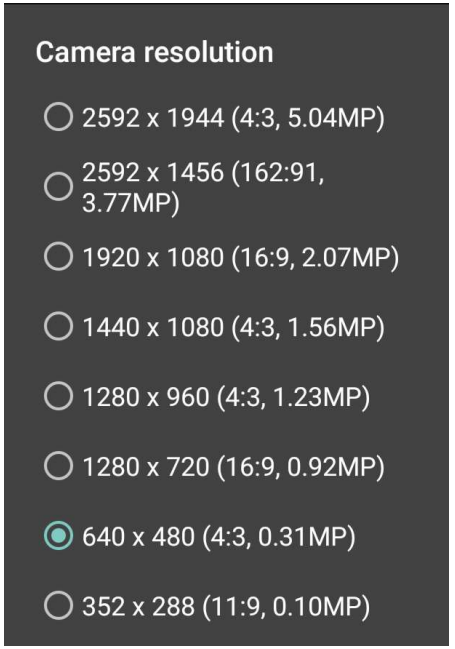
Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
32	20	<SPACE>	64	40	@	96	60	`
33	21	!	65	41	A	97	61	a
34	22	"	66	42	B	98	62	b
35	23	#	67	43	C	99	63	c
36	24	$	68	44	D	100	64	d
37	25	%	69	45	E	101	65	e
38	26	&	70	46	F	102	66	f
39	27	'	71	47	G	103	67	g
40	28	(	72	48	H	104	68	h
41	29	)	73	49	I	105	69	i
42	2A	*	74	4A	J	106	6A	j
43	2B	+	75	4B	K	107	6B	k
44	2C	,	76	4C	L	108	6C	l
45	2D	-	77	4D	M	109	6D	m
46	2E	.	78	4E	N	110	6E	n
47	2F	/	79	4F	O	111	6F	o
48	30	0	80	50	P	112	70	p

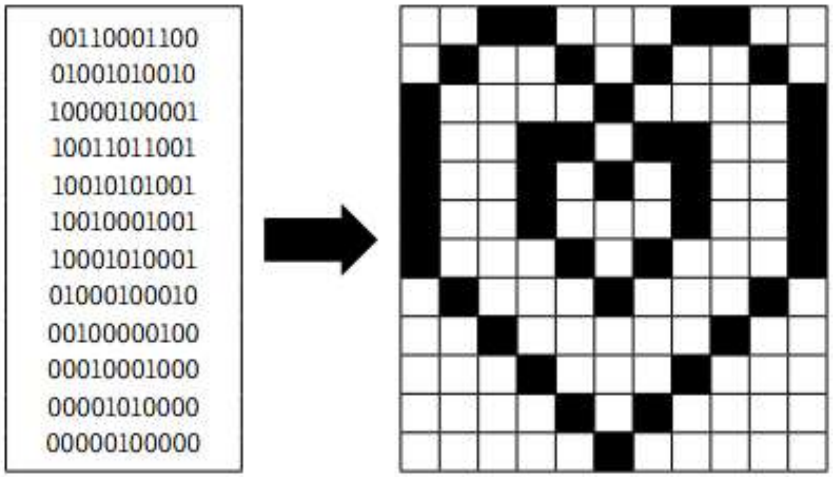
DATA STORAGE - REPRESENTATION OF CHARACTER

- A text file is stored on a hard disc. The file holds information from one side of a sheet of paper. The sheet of paper is represented as a grid, 80 columns wide and 100 rows long. Each cell in the grid contains a single 2-byte Unicode character.
- The file also contains 40 characters of metadata. The hard disc allocates space in blocks of 512 bytes.
- Construct an expression to show the number of blocks required to store the file. You do not need to do the calculation

DATA STORAGE - REPRESENTATION OF IMAGE

- Pictures
  - Bitmap image is an image that consists of pixels
  - Image resolution: normally has two number e.g. 1920 x 1080, 640 x 640
  - The first number refers to the number of pixels in width
  - The second number refers to the number of pixels in height
  - The sum of multiplication is the number of pixels of an image
  - Data inside a pixel is bit-depth or color depth
  - Higher bit-depth, better quality because more colors are available





DATA STORAGE - REPRESENTATION OF IMAGE

- Colour depth or bit depth
  - Number of bits representing a colour of the pixel
    - 1 bit : monochrome, black and white
    - 4 bits : 16 colours in a pixel
    - 8 bits : 256 colours
    - 16 bits : 65,536 colours
    - 24 bits : 16,772,216 colours
  - Standard of colour depth is 24 bits which consists of three colours red, green and blue so each colour has 8 bits
    - Hexadecimal is used for colour code
    - #FF0000 for red
    - #00FF00 for green
    - #0000FF for blue

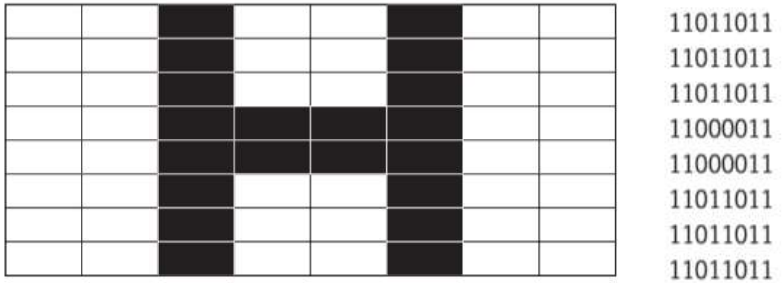
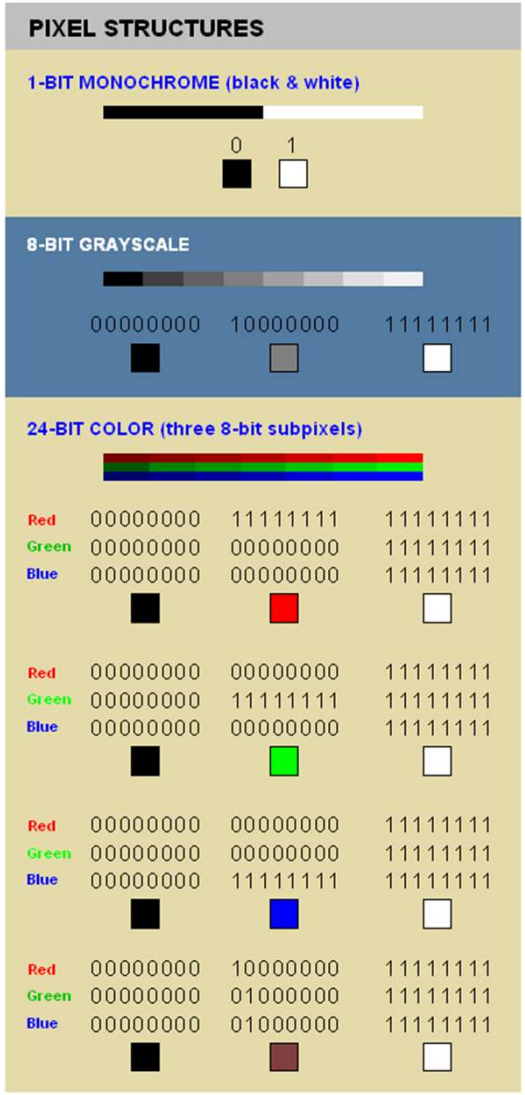


Figure 3.4 1-bit encoding forming the letter 'H'



DATA STORAGE - REPRESENTATION OF IMAGE

- Sarah is a wedding photographer. She wants to store 100 photographs on a USB flash memory drive for a customer. Each photograph is 1080 pixels wide and 768 pixels high. The photographs are 24-bit colour photographs.

Calculate the total file size, in kilobytes (kB), of all the photographs.

DATA STORAGE - REPRESENTATION OF IMAGE

- An image is 1920 pixels high and 1080 pixels wide. The image is stored with a 16-bit colour depth. The metadata for the image is 975 bytes. Construct an expression to show how the file size, in megabytes, is calculated. You do **not** need to do the calculation.

DATA STORAGE -REPRESENTATION OF SOUND

- Sounds in environment are in analogue
- Sounds are caused by vibrations
- Loud sound has higher amplitude
- High pitch has greater frequency

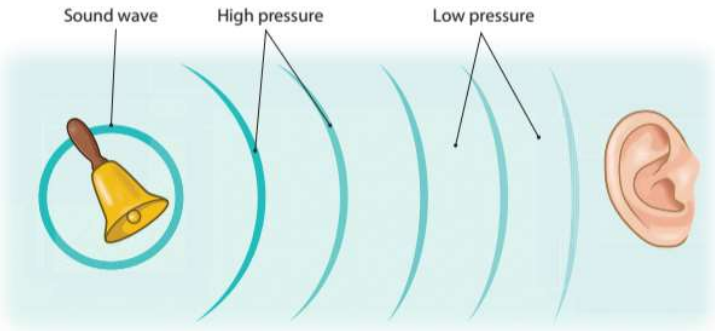


Figure 3.5 Sound waves travelling through the air from a vibrating bell

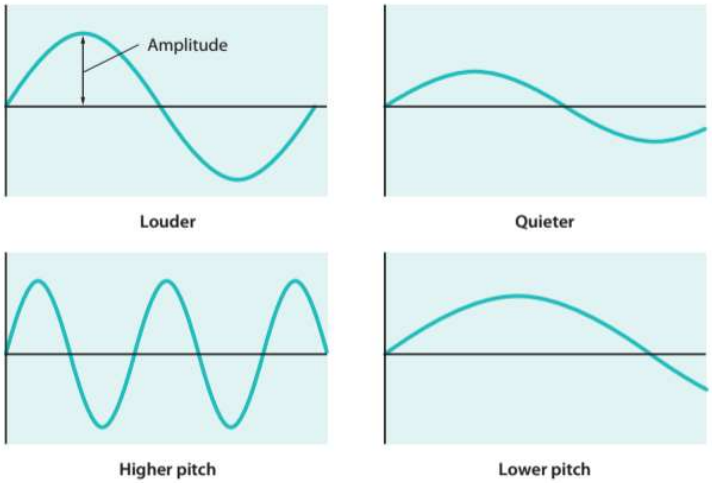
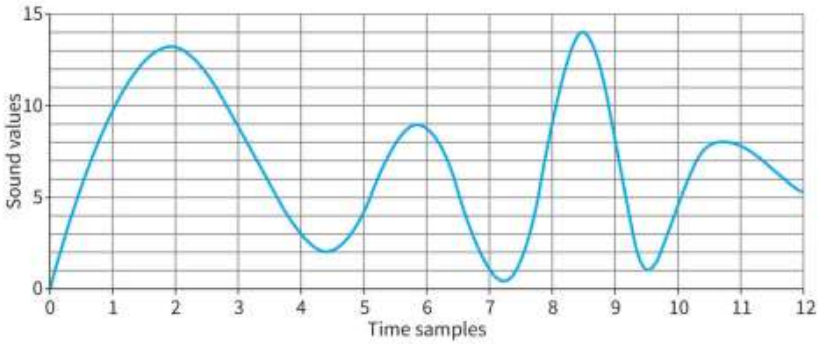


Figure 3.6 The bigger the wave, the louder the sound; the greater the frequency of the waves, the higher the pitch

DATA STORAGE - REPRESENTATION OF SOUND

- Digital recording
  - Sound in environment is in analog form but computers use digital data so the analogue data must be converted into digital data

- Converting analogue sound to digital data by sampling
  - Sampling: an amplitude(red line) of a wave is captured at regular intervals and convert to digital data
  - Each sample is represented by set of binaries called bit depth
  - Bit depth is a number of binary bits for representing a sound sample. Higher number of bits mean better sound quality



Time sample	1	2	3	4	5	6	7	8	9	10	11	12
Sound value	9	13	9	3.5	4	9	1.5	9	8	5	8	5.5

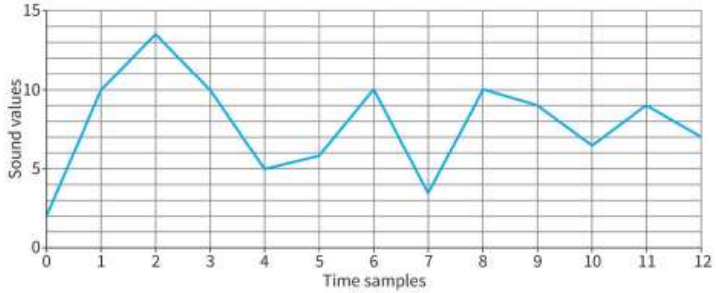
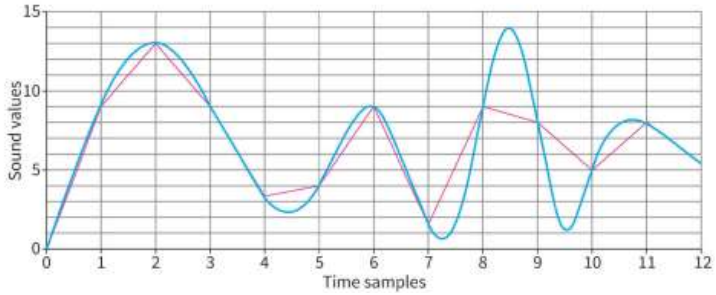
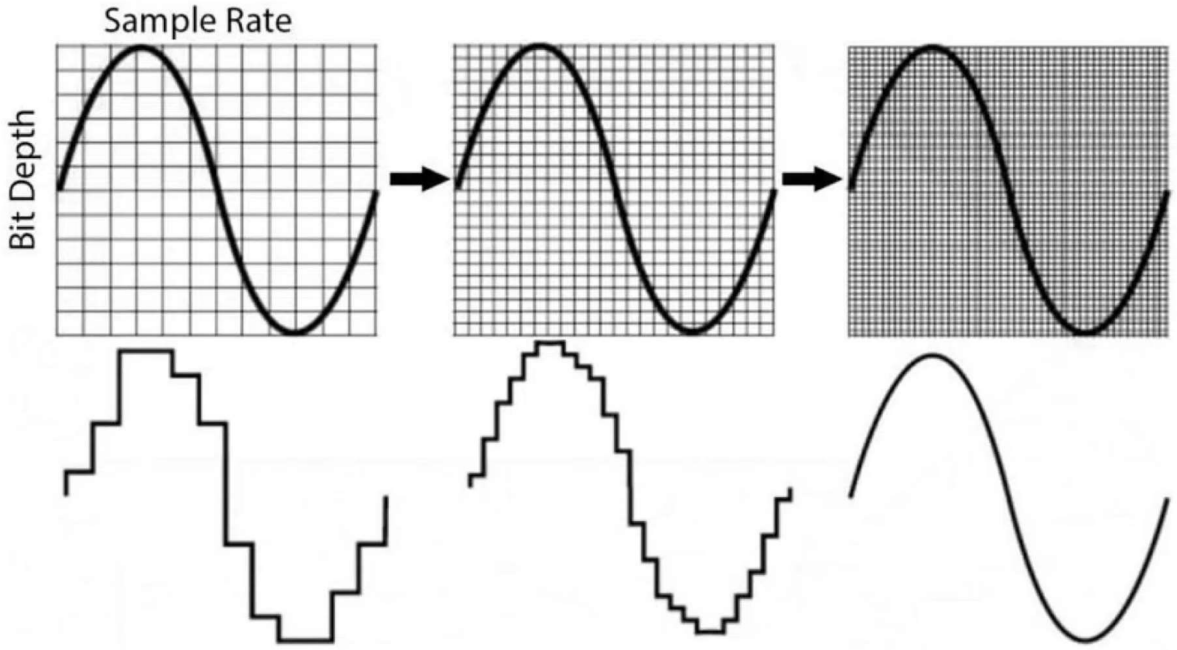


Figure 1.15 Sound wave created by playing back a recorded sound



DATA STORAGE - REPRESENTATION OF SOUND

- Sample rate: number of samples taken in a second (Hz)
- Bit rate: number of bits used per second



DATA STORAGE - REPRESENTATION OF SOUND

- Quality of the sound VS. File size
- Higher sample rate, better sound quality but bigger file size
- Higher bit depth, better sound quality but bigger file size

DATA STORAGE - REPRESENTATION OF SOUND

- Audio file size
  - An audio file size can be calculated by the multiplication of sample rate, bit depth, duration and number of channels
  - File size = sample rate x bit depth x duration x channels
  - Increasing sample rate, bit-depth will also increase file size which take up more space and upload/download time

Worked example

number of samples per second = 44,100

bit depth = 16 bits

duration = 2.5 minutes

number of channels = 2

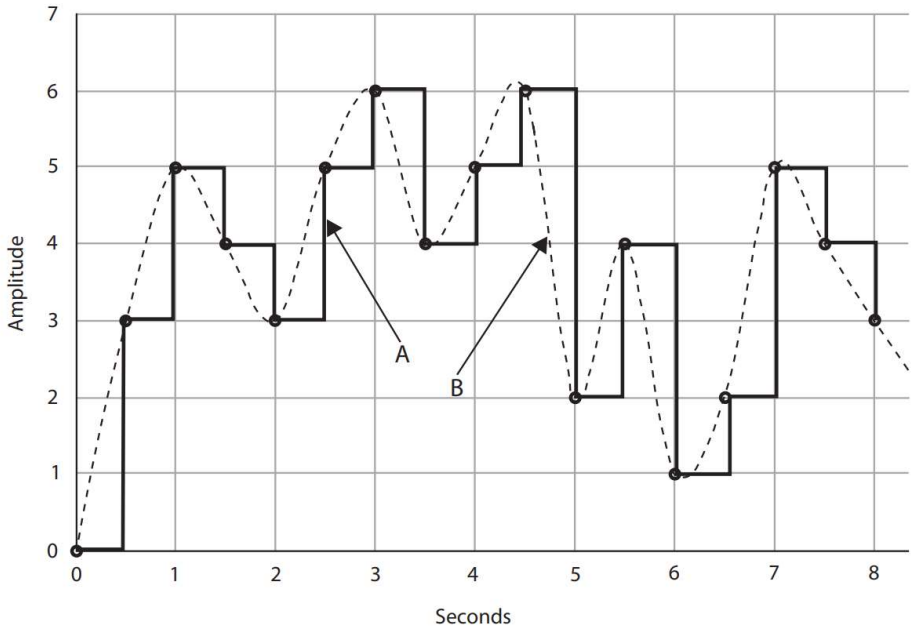
The size of the file is found from the following formula:

file size in bits = sample rate * bit depth * duration (in seconds) * number of channels

Therefore the file size of the above recording is

44,100 * 16 * 2.5 * 60 * 2 = 211,680,000 bits or 26,460,000 bytes or over 26 megabytes.

- What does A represent?
- What does B represent?
- Give the sampling frequency, including the correct units.
- how many bit-depth is required for this example
- Give the value in binary of the audio sample at the 7th second



DATA STORAGE - REPRESENTATION OF SOUND

- Alice wants to store a mp4. The sampling frequency is 47 kHz. The bit-depth is 64 The analogue signal lasts for 240 seconds.
- Construct an expression to show how the file size, in bytes, is calculated. You do not need to do the calculation.