Learning Programme

Fundamentals of data representation– AS Level

Topic/Content	Objectives/Skills	Homework	Assessment	Stretch & Challenge (Thirst for Learning)
Number systems	• Be familiar with the concept of a natural number and the set $\mathbb{N}$ of natural numbers (including zero). • Be familiar with the concept of an integer and the set $\mathbb{Z}$ of integers. • Be familiar with the concept of a rational number and the set $\mathbb{Q}$ of rational numbers, and that this set includes the integers. • Be familiar with the concept of an irrational number. • Be familiar with the concept of a real number and the set $\mathbb{R}$ of real numbers, which includes the natural numbers, the rational numbers, and the irrational numbers. • Be familiar with the concept of ordinal numbers and their use to describe the numerical positions of objects. • Be familiar with the use of: o natural numbers for counting o real numbers for measurement.		Numerous classroom worksheets/questions Q and A's Conversions programming project Homework worksheets Past exam style questions End of unit exam	Complete research into floating point binary Add additional conversion / binary calculations to the conversion program the students has created Complete research into different encryption and compression techniques
Number bases	• Be familiar with the concept of a number base, in particular:	Conversions question worksheet		

	○ decimal (base 10) ○ binary (base 2) ○ hexadecimal (base 16). • Convert between decimal, binary and hexadecimal number bases. • Be familiar with, and able to use, hexadecimal as a shorthand for binary and to understand why it is used in this way.	Complete conversions program		
Units of information	• Know that: ○ the bit is the fundamental unit of information ○ a byte is a group of 8 bits • Know that the 2^n different values can be represented with *n* bits. • Know that quantities of bytes can be described using binary prefixes representing powers of 2 or using decimal prefixes representing powers of 10, eg one kibibyte is written as 1KiB = 2^{10} B and one kilobyte is written as 1kB = 10^3 B. • Know the names, symbols and corresponding powers of 2 for the binary prefixes: ○ kibi, Ki - 2^{10} ○ mebi, Mi - 2^{20} ○ gibi, Gi - 2^{30} ○ tebi, Ti - 2^{40} • Know the names, symbols and corresponding powers of 10 for the decimal prefixes: • kilo, k - 10^3			

	• mega, M – 10^6 • giga, G – 10^9 • tera, T - 10^{12}			

Binary number system	• Know the difference between unsigned binary and signed binary.
	• Know that in unsigned binary the minimum and maximum values for a given number of bits, *n*, are 0 and 2^n -1 respectively.
	• Be able to:
	  ○ add two unsigned binary integers
	  ○ multiply two unsigned binary integers.
	• Know that signed binary can be used to represent negative integers and that one possible coding scheme is two's complement.
	• Know how to:
	  ○ represent negative and positive integers in two's complement
	  ○ perform subtraction using two's complement
	  ○ calculate the range of a given number of bits, *n*.
	• Know how numbers with a fractional part can be represented in:
	  ○ fixed point form in binary in a given number of bits.
	• Be able to convert from:
	  ○ decimal to binary of a given number of bits
		Signed and unsigned binary worksheet
		
		Two's complement worksheet		

	○ binary to decimal of a given number of bits.			
Information coding systems	• Differentiate between the character code representation of a decimal digit and its pure binary representation. • Describe ASCII and Unicode coding systems for coding character data and explain why Unicode was introduced. • Describe and explain the use of: ○ parity bits ○ majority voting ○ check digits	Error checking worksheet		
Representing images, sound and other data	• Describe how bit patterns may represent other forms of data, including graphics and sound. • Understand the difference between analogue and digital: ○ data ○ signals • Describe the principles of operation of: ○ an analogue to digital converter (ADC) ○ a digital to analogue converter (DAC). • Know that ADCs are used with analogue sensors • Know that the most common use for a DAC is to convert a digital audio signal to an analogue signal.	Worksheet based on sound Worksheet based on images Complete programming project on encryption		

	• Explain how bitmaps are represented
	• Explain the following for bitmaps:
	  ○ Resolution
	  ○ colour depth
	  ○ size in pixels
	• Calculate storage requirements for bitmapped images and be aware that bitmap image files may also contain metadata
	• Be familiar with typical metadata
	• Explain how vector graphics represents images using lists of objects.
	• Give examples of typical properties of objects.
	• Use vector graphic primitives to create a simple vector graphic.
	• Compare the vector graphics approach with the bitmapped graphics approach and understand the advantages and disadvantages of each.
	• Be aware of appropriate uses of each approach.
	• Describe the digital representation of sound in terms of:
	  ○ sample resolution
	  ○ sampling rate and the Nyquist theorem
	• Calculate sound sample sizes in bytes.			

	• Describe the purpose of MIDI and the use of event messages in MIDI.
	• Describe the advantages of using MIDI files for representing music.
	• Know why images and sound files are often compressed and that other files, such as text files, can also be compressed.
	• Understand the difference between lossless and lossy compression and explain the advantages and disadvantages of each.
	• Explain the principles behind the following techniques for lossless compression:
	  ○ run length encoding (RLE)
	  ○ dictionary-based methods.
	• Understand what is meant by encryption and be able to define it.
	• Be familiar with Caesar cipher and be able to apply it to encrypt a plaintext message and decrypt a ciphertext.
	• Be able to explain why it is easily cracked
	• Be familiar with Vernam cipher or one-time pad and be able to apply it to encrypt a plaintext message and decrypt a ciphertext.
	• Explain why Vernam cipher is considered as a cypher with perfect security			

	• Compare Vernam cipher with ciphers that depend on computational security.			