Knowledge Organiser GCSE Computer Science

Unit: Topic 1 – Computational Thinking
Year: 9

Purpose of Unit:

- **Develop** a set of computational thinking skills that enable you to design, implement and analyse algorithms for solving problems.
- **Understand** the standard flowchart symbols required for the exam.

Key Learning/Knowledge:

- What are the benefits of decomposing problems?
- What is abstraction when used to model real world problems?
- What are the benefits of using subprograms?
- Why is sequence, selection and iteration used when designing programs
- How standard searching algorithms (linear, binary) work.
- How standard sorting algorithms (bubble, merge) work.
- How a truth table is completed for **AND**, **OR** and **NOT** gates
- Why logic gates are needed within computer circuitry.

Key Skills:

- to solve problems using decomposition and abstraction
- to develop algorithms using flow charts and Python code
- to complete truth tables for logic gates

Key Vocabulary and meanings:

Decomposition - breaking a complex problem or system into parts that are easier to conceive, understand, program, and maintain.

Abstraction - filtering out – essentially, ignoring - the characteristics that we don't need in order to concentrate on those that we do.

Algorithm - a plan, a set of step-by-step instructions to solve a problem.

Flowchart - a diagram that shows an overview of a program. Flowcharts normally use standard symbols to represent the different types of instructions.

Sequence - statements are executed one after another.

Selection - The process of making a decision. The result of the decision determines which path the program will take next.

Iteration - Where a set of instructions or structures are repeated in a sequence a specified number of times or until a condition is met.

Searching Algorithms - an algorithm designed to solve a search problem. Common examples are linear and binary search.

Sorting Algorithms - An algorithm that puts elements of a list into an order. Common examples are bubble and merge sort.

Logic Gates - A fundamental component of a digital circuit. Each gate has one or more inputs and produces a single output that depends on the input(s).

Links to prior knowledge/learning:
Year 9 – Topic 1 Computational Thinking content
Year 9 – Programming content

Cross Curricular link/ World Issues
Construction of accurate sentences which are linked to the specific topic

Computational thinking skills (decomposition/abstraction) that can be used across the curriculum

Modelling real world scenarios

Knowledge Organiser GCSE Computer Science

Unit: Topic 6 – Programming
Year: 9

Purpose of Unit:

- **Develop** programming skills to enable you to design, read, write and debug programs. You must apply your skills to solve real problems and produced readable, robust programs.
- **Understand** the need to use programming construct (sequence, selection and iteration) when designing and creating programs.

Key Learning/Knowledge:

- What are the benefits of decomposing problems?
- What is abstraction when used to model real world problems?
- Why it is important to follow the syntax of the Python programming language.
- What are the benefits of using subprograms?
- What are the benefits of using whitespace and indentation when writing code?
- How if statements are used to 'select' different lines of code based on a condition being met.
- How loops (for/while) are used when repeating code.
- How lists can be used to store multiple values in one variable.
- How different data types are used to store different values (strings, integers, float).
- How inputs can be used to get data from the user.
- How outputs can be used to display information to the user.
- Why validation is needed when user enter data?
- How operators (arithmetic and relational) are used in calculations and comparisons.
- How subprograms can be used to increase the readability and functionality of code.

Key Skills:

- to solve problems using decomposition and abstraction
- to create code using the Python programming language

Key Vocabulary and meanings:

Decomposition - breaking a complex problem or system into parts that are easier to conceive, understand, program, and maintain.

Abstraction - filtering out – essentially, ignoring - the characteristics that we don't need in order to concentrate on those that we do.

Algorithm - a plan, a set of step-by-step instructions to solve a problem.

Variable - a value that can change, depending on conditions or on information passed to the program.

Data Structure - data is stored for efficient search and retrieval. Different data structures are suited for different problems (Lists and 2D Lists).

Data Types - classification of the type of data being stored or manipulated within a program. Examples include strings, integers and float.

Validation – an automatic computer check to ensure that the data entered is sensible and reasonable.

Arithmetic Operator - mathematical function (+ - / *) that takes two operands and performs a calculation on them.

Relational Operators - are used to compare the values within an expression, for example, <, >, ==,!=

For Loops – are count controlled loops and will iterate a set number of times.

While Loops – are condition controlled loops and will iterate until a condition is met.

Subprograms – a block of code define by the user that can be used whenever it is 'called'

Procedure – a type of subprogram that 'does stuff' for example, saving to a file.

Function – a type of subprogram that returns a value.

	Local Variable – a variable that is only available within the scope of the subprogram it is in. **Global Variable –** a variable that is available within the scope of the whole program and can be accessed from anywhere.
Links to prior knowledge/learning: Topic 1 Computational Thinking content Topic 6 Programming content	
Cross Curricular link/ World Issues Construction of accurate sentences which are linked to the specific topic Computational thinking skills (decomposition/abstraction) that can be used across the curriculum Problem solving using logical reasoning Modelling real world scenarios	

Knowledge Organiser GCSE Computer Science

Unit: Topic 2 – Data
Year: 9

Purpose of Unit:

- **Understand** how computers use binary to represent different types of data.
- **Understand** how different types of data are represented in a computer.

Key Learning/Knowledge:

- How do computers use binary to represent data (numbers, text, sound, and graphics) and program instructions?
- What are unsigned integers and two's complement signed integers?
- How do you convert between denary and 8-bit binary numbers (0 to 255, -128 to +127)
- How can two positive binary patterns be added together?
- What is hexadecimal notation and how is it used?
- How do computers encode characters using 7-bit ASCII?
- How are bitmap images represented in binary (pixels, resolution, and colour depth)?
- How is analogue sound represented in binary (amplitude, sample rate, bit depth, sample interval)?
- What are the limitations of binary representation of data when constrained by the number of available bits?
- How is data storage measured in binary multiples (bit, nibble, byte, kibibyte, mebibyte, gibibyte, tebibyte)?
- How do you construct expressions to calculate file sizes and data capacity requirements?
- Why is data compressed?
- What methods of compressing data are there? (lossless, lossy)

Key Skills:

- Conversion of different number bases:
  - Binary (2)
  - Denary (10)
  - Hexadecimal (16)
- Addition of two binary numbers

Key Vocabulary and meanings:

Pixel - Short for 'picture element' - smallest part of a graphic image

Resolution - Resolution refers to the number of pixels in an image. Resolution is sometimes identified by the width and height of the image as well as the total number of pixels in the image.

ASCII - Industry standard set of characters, limited to 7 bits - 128 unique characters can be represented

Character set - The list of characters recognised by a computer

Colour depth - The number of bits used to encode the colour of each pixel

Sampling - Measurements taken of a sound wave at regular intervals of time

Sample rate - The number of samples taken per second, often measured in Kilohertz (kHz)

Sample interval - The distance or time between data points or measurements.

Bitmap - An image composed of pixels with a fixed resolution

Binary - The binary number system is base 2, using only bits 0 and 1.

Two's Complement – A signed binary number which represents negative numbers.

Hexadecimal - A base-16 number system that uses sixteen distinct symbols 0-9 and A-F to represent numbers from 0 to 15.

1. **Byte** - A group of eight bits.
2. **Nibble** - 4 bits
3. **Kibibyte (KiB)** - 1024 bytes
4. **Mebibyte (MiB)** - 1024 kibibytes
5. **Gibibyte (GiB)** -1024 mebibytes

Links to prior knowledge/learning:

- Number bases

Cross Curricular link/ World Issues

- Construction of accurate sentences which are linked
- Maths – Number bases
- Understanding of how all data in the world is represented by binary 1/0 and how this data is stored for different formats.

Knowledge Organiser GCSE Computer Science

Unit: Topic 3 - Computers
Year: 9

Purpose of Unit:

- **Understand** the hardware and software components that make up a computer system
- **Understand** the different 'levels' of programming languages

Key Learning/Knowledge:

Hardware

- How does the von Neumann stored program concept work
- What are the roles of main memory (RAM), CPU (control unit, arithmetic logic unit, registers), clock, address bus, data bus, control bus in the fetch-decode-execute cycle
- How does secondary storage store data stored on devices (magnetic, optical, solid state)
- What is an embedded system and what are embedded systems are used for

Software

- What is the purpose and functionality of an operating system (file management, process management, peripheral management, user management)
- What is the purpose and functionality of utility software (file repair, backup, data compression, disk defragmentation, anti-malware)
- What is the importance of developing robust software and methods of identifying vulnerabilities (audit trails, code reviews)

Programming Languages

- What are the characteristics and purposes of low-level and high-level programming languages
- How an interpreter differs from a compiler in the way it translates high-level code into machine code

Key Skills:

- Understanding how the operating system (OS) provides different functions to the user
  - File management
  - Process management
  - Peripheral management
  - User management
- Fetch-decode execute cycle and the use of registers for each part of the cycle

Key Vocabulary and meanings:

CPU - Central Processing Unit

Von Neumann architecture - John von Neumann developed the stored program computer. in a von Neumann computer, both programs and the data they use are stored in memory

ALU (Arithmetic Logic Unit) - carries out mathematical and logical operations including AND, OR and NOT, and binary shifts. it compares values held in registers

CU (Control Unit) - coordinates all of the CPU's actions in the fetch-decode-execute cycle and decodes instructions. sends and receives control signal to fetch and write data

MDR (Memory Data Register) - holds data or a program instruction when it is fetched from memory or data that is waiting to be written to memory

Clock - regulates the speed and timing of all signals and computer functions

Registers - very small, very fast memory locations. Registers are built into the CPU chip to temporarily store memory addresses, instructions or data. they are used in the fetch-execute cycle for specific purposes

Buses (address, data and control) - wires used to transfer data, instructions, memory addresses (of data and instructions), and control signals from one component to another

RAM - the computer's temporary working memory. it is volatile which means it gets wiped as soon as the power is switched off

Operating System (OS) - a group of programs that is essential for managing the computer's resources.

Secondary storage - non-volatile, its contents is retained even when the power is witched off

Low-level language - A language close to machine code. Related closely to the design of the machine. A one-to-one language.

High-level language - A language designed to help a programmer express a computer program in a way that reflects the problem being solved

	rather than how the computer will produce the solution. One-to-many language.
Links to prior knowledge/learning: • Hardware components of a computer	
Cross Curricular link/ World Issues • Construction of accurate sentences which are linked • Understanding how most digital devices will be 'structured' the same in terms of hardware albeit in a different format/scale.	

Knowledge Organiser GCSE Computer Science

Unit: Topic 4 – Networks
Year: 9

Purpose of Unit:

- **Understand** the how computers are connected together to form networks
- **Understand** the various techniques to improve network security

Key Learning/Knowledge:

Networks

- How are computers connected in a network?
- What are the different types of networks (LAN, WAN)
- How is the internet structured (IP addressing, routers)
- What are the characteristics of wired and wireless connectivity
- What could impact on performance (speed, range, latency, bandwidth)
- How are network speeds are measured (bits per second (kilobit, megabit, gigabit))
- What is the role of network protocols (Ethernet, Wi-Fi, TCP/IP, HTTP, HTTPS, FTP) and email protocols (POP3, SMTP, IMAP)
- How does the 4-layer (application, transport, internet, link) TCP/IP model handles data transmission over a network
- What is the expression for transmission rate?
- What are the characteristics of network topologies (bus, star, mesh)

Network Security

- What is the importance of network security?

Key Skills:

- Constructing expression to work out file transmission speeds.

File size in bits / transfer speed in bps = time in secs

Key Vocabulary and meanings:

ISP - an Internet Service Provider (ISP) provides users with access to the internet

LAN - a Local Area Network (LAN) is a connection of computers and devices in a single-site or small area

WAN - a Wide Area Network (WAN) is a connection of computers and devices across cities, counties and even continents

Networks - two or more computing devices connected via a transmission medium to exchange data

WWW - the World Wide Web (WWW) is the collection of webpages accessible via the Internet

DNS - the Domain Name System (DNS) is the hierarchical naming system used to identify computers reachable through the internet or other Internet Protocol (IP) networks

Latency - the period of time it takes for information to travel between source and destination

Bandwidth - the volume of data that can travel along a medium (cable/radio wave) at one time

IP address - a number that uniquely identifies each computer or device connected to the internet

Network Speed - the data transmission speed is measured in bits per second (bps)
Bus Topology - a network in which there is one main backbone that all computers and devices connect to

Star Topology - a network in which there is a central device that all computers and devices connect to

Mesh Topology - a network in which every computer and device connects to every other computer and device, there is no central device

Links to prior knowledge/learning:

- Constructing mathematical expressions

Cross Curricular link/ World Issues

- Construction of accurate sentences which are linked

Knowledge Organiser GCSE Computer Science

Unit: Topic 5 – Issues and Impacts
Year: 9

Purpose of Unit:

- **Be aware** of the influence of digital technology around the world
- **Recognise** some of the issues and impacts on wider society associated with the use of digital technology.

Key Learning/Knowledge:

- How do digital devices impact the environment in terms of energy consumption, manufacture, replacement cycle and disposal?
- What are the ethical and legal issues associated with the collection and use of personal data (privacy, ownership, consent, misuse, data protection)
- What are the ethical and legal issues associated with the use of artificial intelligence, machine learning and robotics (accountability, safety, algorithmic bias, legal liability)
- What are the different methods of intellectual property protection for computer systems and software (copyright, patents, trademarks, licencing)
- What are the different threats to digital systems posed by malware (viruses, worms, Trojans, ransomware, key loggers)
- How do hackers exploit technical vulnerabilities (unpatched software, out-of-date anti-malware) and use social engineering to carry out cyberattacks
- What are the methods of protecting digital systems and data (anti-malware, encryption, acceptable use policies, backup and recovery procedures)

Key Skills:

- Understanding of the environmental impact of technology of society
- Understanding of the legal and ethical impact of technology on society

Key Vocabulary and meanings:

Computing technology - Hardware, software and infrastructure that underpin current and emerging computer systems
E-waste - Discarded electronic equipment, including computer technology, mobile devices, etc.
Carbon footprint - Carbon dioxide produced as a result of consuming energy
Ethics - a set of moral principles that govern a person's behaviour
Privacy - the right to be left alone and free from unwanted scrutiny and intrusion
Personal data - Information that is personal and unique to an individual
Identity theft - Stealing someone's personal details in order to commit fraud, or another crime
Surveillance technology - CCTV, drones, number plate recognition, bugging and tracking devices used to monitor and record people's activities, often without their knowledge
Whistle-blower - Someone who draws attention to the activities of an organisation or person believed to be acting illegally or unethically
Location-based services - services that enable people to access and share real-time location **information online**
GDPR (2018) - Law that controls how organisations can use personal data they have gathered
'Big data' - A term for the huge amounts of personal data that is gathered and analysed from online activities
Computer Misuse Act (1990) -Law that defines these crimes:
Digital inclusion - Ensuring everyone has access to computing technology and online services
Digital divide - Gap between those who have access to computer technology and it's benefits, and those who do not
Professionalism - the competence or skill expected of a professional
Intellectual Property (IP) - The legal term for work that has been created and has commercial value (music track, film, novel, etc.)
Patents - exclusive rights granted to an inventor to make, use and sell an invention for a fixed period of time
Copyright, Designs and Patents Act (1988) - Law that makes it illegal to copy or modify intellectual property without permission
Proprietary software - Software that is paid for, not open for modification
Open-source software - Software that is free, can be modified by users

Links to prior knowledge/learning:

- Topic 2 - Data
- Topic 3 – Computers
- Topic 4 – Networks

Cross Curricular link/ World Issues

- Construction of accurate sentences which are linked
- Understanding of how the use of digital technology impacts society