Computer Science GCSE Overview

In the fast-evolving world of technology and computing, understanding the fundamentals is paramount. To prepare for your upcoming exam, you will explore the intricacies of system architecture, memory and storage, systems software, networks, system security, ethical and legal considerations, algorithms, programming, data representation, and computer logic.

Tasks

1. Answer the questions that your teacher has posted to Google Classroom. You may want to use the key terms below to help you.
2. Create Flashcards using the information below. (Each flashcard should have a question or definition on one side and an answer on the other)
3. Complete the Seneca Learning Task set by your teacher.

The overview below encompasses the essential knowledge needed to navigate the complexities of computer science. Below is a brief overview of each topic.

The link: https://www.youtube.com/@craigndave/playlists?view=50&sort=dd&shelf_id=2 will take you to the Craig N Dave you tube page where you can expand your knowledge of each topic.

1 System Architecture

- An embedded system is a type of processor designed to perform limited functions, normally one or two. They are often built into electronic machinery or devices.
- The purpose of the CPU is to process instructions given to a computer system. It carries out the instructions and any data that requires storage as a result is stored in the main memory.
- The CPU has a number of components that are involved in carrying out an instruction; these are the ALU, PC, CU, ACC, MAR and MDR, and the cache.
- The fetch–execute cycle is the name given to one whole cycle of processing and instruction.
- The clock speed of a CPU is measured in hertz. One hertz is the equivalent of one cycle per second. The greater the number of hertz available, the greater the performance of the CPU.
- A single-core processor can process one cycle at a time. A dual-core processor can process two cycles simultaneously. The more cores a CPU has, the more cycles it can process simultaneously and the greater the performance of the CPU.
- The cache is a small part of the CPU where commonly used instructions and data are stored. The more commonly used instructions and data that can be stored, the quicker the CPU can access these and the greater the performance.

2 Memory and Storage

- RAM is the place in a computer where all the programs and data that are currently in use are stored. It is volatile memory.
- ROM contains the programs that allow your computer to 'boot up'. It is non-volatile memory.
- Flash memory is a type of non-volatile memory that is used to store data long-term.

- Secondary storage is any storage, either internal or external to a computer, that is not under the direct control of the CPU. There are three types: optical, magnetic and solid-state.
- There are several factors a user will need to consider when choosing a suitable storage device; these include capacity, speed, portability, durability, reliability and cost.

3 Systems Software

- There are two main types of software that are used on computer systems: systems software and applications software.
- Systems software controls the operations of hardware in a computer system. Systems software also provides a platform to run applications software.
- Applications software is the everyday programs we use to create documents and carry out communication with each other using technology.
- An operating system is software that is loaded by the computer after the initial boot-up. It controls the operations of the hardware in a computer system and manages all other software. We interact with the operating system through a user interface.
- The operating system performs a number of functions including memory management, multitasking, peripheral management, user management and file management.
- Utility software is a type of systems software. It helps manage, maintain and control the computer's resources. There are a number of different types, including encryption software, defragmentation software, data compression and methods of backups.

4 Networks

- A network is a collection of devices that are connected together.
- We mainly use networks to communicate and share resources.
- A network can be a LAN or a WAN. A LAN is a network that covers a small geographic area; a WAN is a network that covers a large geographic area.
- A network can be structured as a client–server or a peer-to-peer format. A client–server network has a central computer that controls the operations of the network. A peer-to-peer network does not have a central computer; all the computers are equal.
- A network topology is the way in which the network is wired and structured. The two most common network topologies are star and mesh.
- To build a network we need a range of hardware including transmission media, routers, switches, NIC and, if it is a wireless network, WAPs.
- There are four main factors that can affect the performance of a network: bandwidth, latency, error rate and transmission media.
- A virtual network is one that is created using software.
- Wi-Fi is the wireless technology that we use to connect devices to the Internet. Wi-Fi uses radio waves to provide the connection.
- A DNS is a server that holds a directory of domain names and their corresponding IP addresses.
- Hosting is when a company stores the websites for companies of a web server to make them available for access using the Internet.
- For data to be transmitted over a network, it needs to be divided into packets. The act of sending the packets of data over a network is called packet switching.

- A protocol is a set of rules that govern how a network operates. Different protocols are used for different applications; they are also made up of a number of different layers.

5 System Security

- A network can create risks as well as bring about benefits.
- A network can come under attack in a number of different ways; this includes active, passive, distribution, insider and close-in attacks.
- Malware is harmful software that is unknowingly downloaded onto a user's computer system. It is designed to disrupt or damage the computer.
- Phishing is when an unauthorised person tries to collect personal and sensitive data by disguising themselves as a reputable individual or organisation.
- Social engineering preys on the issue that people are often the weak point in the security of a network. It preys on the problem that people can often be influenced into aiding access to network, often without them even knowing or realising it is happening.
- There are number of treats that a network can be subjected to; these include brute-force attacks, denial-of-service (DoS), data interception and theft, SQL injection and poor network policy.
- There are a number of measures that can be taken to protect a network; these include penetration testing, network forensics, network policies, anti-malware software, firewalls, user access levels, passwords and encryption.

6 Ethical, Legal, Cultural and Environmental Concerns

- Ethics represents society's opinions about what is right and what is wrong. When we talk about ethics in Computer Science, we are considering what society's opinions are about the use of computers and the development of hardware and software.
- Open-source software is a type of software for which the source code is made freely available.
- Proprietary software is software for which only the compiled code is released.
- There are a number of legislative acts that govern the use of computers; these include the Data Protection Act 1998, Computer Misuse Act 1990, Copyright Designs and Patents Act 1988, Creative Commons Licensing and Freedom of Information Act 2000.
- A stakeholder is an individual or an organisation that has an interest in, or is affected by, the development of a product or the actions of a company.
- The use of computers can affect many areas of our lives, including our culture, our privacy and our environment.

7 Algorithms

- Computational thinking is learning to break down problems in a logical way in order to build a solution. There are three main methods for computational thinking: abstraction, decomposition and algorithmic thinking.
- An algorithm is a sequence of steps or instructions that are carried out to solve a problem or perform a task. We can use two methods to plan an algorithm: flow charts and pseudocode.
- A searching algorithm is one that is designed to look through a data set and find a particular item of data. There are two types of searching algorithm that you need to know: these are linear search and binary search.

- A linear search is a simple sequential search of a data set. A binary searching algorithm works by repeatedly dividing a list in half till it finds the item of data.
- A sorting algorithm is one that is designed to sort a set of data into order. The three methods we need to know are a bubble sort, a merge sort and an insertion sort.
- A bubble sort starts at the beginning of a list and compares each item to find the greater, and swaps them if this is the case. A merge sort works by dividing a list in half repeatedly, till it has a set of lists that have one item in them. It then merges together each list till it has ordered the whole list again. An insertion sort is used to sort a data set into order by looking at each item in turn and placing it in the correct order in the data set.

8 Programming

- There are three main programming constructs: sequence, selection and iteration.
- When we write a program we need to apply data types to the data that it handles. There are five main data types: integer, real, Boolean, character and string.
- We store data in various ways in a program, including variables, constants and arrays.
- Arrays can be static or dynamic, and they can also be one-dimensional or two-dimensional.
- We may need to store data externally to a program; we do this using an external file. We need to be able to open and close the file to use it, and to also read and write data to and from the file.
- We may need to manipulate the strings of data that we store in a program, extracting sections from them and joining strings together.
- We can store sections of instructions that we may want to use in a program in a sub-program. There are two main types of sub-program: a function and a procedure.
- There are two main types of error that can occur when writing programs: syntax errors and logical errors.
- We can store data in a database, and we can use SQL to create queries that we can use to quickly and easily search through the data in a database.
- We need to ensure that when we write our code, we make it maintainable. We can do this in a variety of ways, including adding comments to our code and making sure that we correctly indent our code where necessary.
- We need to make sure that we thoroughly test the programs that we create, during the creation of the program with iterative testing, and at the end of the program with terminal testing.
- We can write programs in a high-level language or low-level language. We mainly choose high-level languages as they are closer to human language. Low-level languages are closer to what a computer understands.
- We need a translator to translate our programming language into machine code for a computer. There are three main types of translator: a compiler, an interpreter and an assembler.
- We often use an IDE to write our computer programs. IDEs have a number of features that we can make use of; these include editors, error diagnostics and translators.

9 Data Representation

- We process analogue data but computers process digital (binary) data. Therefore all data needs to be converted to binary to be processed by a computer.
- There are different number systems that we need to know to convert data from denary to binary and to hexadecimal. Denary is a base-10 system, binary is a base-2 system and hexadecimal is a base-16 system.

- A binary shift can be performed on a binary number. The shift can either be left or right. A binary shift will affect the denary value of the number.
- There are four rules we need to remember when adding binary numbers.
- If the addition of our binary number is greater than 255 this will create an overflow error.
- A check digit is an error detection method that can be used to check the data entry of numbers is correct. It is a calculation that is carried out on the data and a check digit is added to the data from the calculation. If the result of the calculation when the data has been entered is the same as the check digit, the data entered is correct.
- The text-based characters that we use every day need to be represented as binary to be processed by a computer. The computer knows what the character selected is by the use of a character set.
- Images are made up of pixels. The amount of data needed for each pixel depends on whether it is a colour image or black and white. If the colour depth and resolution of an image are increased, this increases the size of the image file.
- Sound is sampled at set time intervals when it is processed by a computer. This is called the sample frequency. If the sample frequency is increased, this will increase the size of the sound file. A sound file will also be increased if the sample size and the bit rate of the sound file are increased.
- Files can be compressed. A compression algorithm can be used to do this.
- There are two main types of compression algorithm: lossy and lossless. Lossy permanently removes redundant data from a file; lossless looks for repeating patterns to use to reduce the file size and does not remove any data.

10 Computer Logic

- A logic gate is a basic foundation block of a digital circuit; it controls the flow of electronic signals in the digital circuit.
- The logic of an AND gate is: For the output to be 1, both inputs need to be 1. If either input is 0, the output will be 0.
- The logic of an OR gate is: For the output to be 1, either input needs to be 1. If both inputs are 0, the output will be 0.
- The logic of a NOT gate is: For the output to be 1, the input must be 0.
- Logic gates can be combined together to create a logic circuit diagram.
- Logic gates and logic diagrams can be represented as a truth table. This shows all the possible outcomes of the gate or the circuit.