Teach Computing

Computer Science Accelerator Programme Handbook

teachcomputing.org

National Centre for Computing Education

Computer Science Accelerator Handbook

Your guide to gaining GCSE Subject Knowledge Certification

Welcome 2

Algorithms 5

Computer Systems 7

Data and Information 12

Design and Development 16

Impact of Technology 20

Networks 23

Programming 27

Safety and Security 31

What support is available? 34

How can I practice for the test? 35

Answers to the sample test questions 38

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Welcome to the Computer Science Accelerator

Hello! You've taken the first step on the *National Centre for Computing Education Certificate in GCSE computer science subject knowledge (Computer Science Accelerator)*. We aim to support you through your learning journey, to make developing your computer science (CS) subject knowledge as easy as possible for you.

The Computer Science Accelerator CPD programme helps all teachers, including those from non-specialist backgrounds, to gain the knowledge and skills needed to teach GCSE Computer Science. It provides a variety of NCCE courses and resources to suit your learning needs including:

- Online CPD: courses that you can complete at your own pace
- Remote CPD: courses delivered "face-to-face" over a series of short online sessions
- a team of champions on hand to support you throughout the programmes
- certification, so your knowledge and skills are recognised professionally

Once you have completed your CPD, there is a 30 minute, multiple choice test consisting of 25 questions taken from a question bank covering the whole of the GCSE computing curriculum. If you pass the test you will be notified immediately; if not, you will be given a second opportunity to sit the test. After that, there is no limit to the number of times you can attempt the test, but there will be a 48 hour reflection period after each attempt. All questions within the Handbook and test that contain code use OCR Pseudocode. You can find the Guide here

Support

You can access support through:

- CS Champions, who can provide guidance throughout the CS Accelerator programme. If you have not already been contacted by a CS Champion, please email CSChampionSupport@stem.org.uk with your contact details, mentioning that you are taking part in the CS Accelerator.
- Computing Hubs, who provide local support for teachers across England.
- Communities of practice run by Computing at School, which are local networks of computing teachers that share expertise, resources and best practice to encourage strong and effective teaching.
- This handbook provides a few questions for each topic, in the style of the CS Accelerator final assessment, for you to use to help assess your own learning. It also links to the CPD courses and other resources from the NCCE that you can use to develop your understanding of each topic area.

You can check your progress through the *National Centre for Computing Education Certificate in GCSE computer science subject knowledge*.

You may also be eligible for a CS Accelerator bursary.

Getting Started

If you are new to computing we recommend starting with our "New to computing" pathway. This is designed for teachers who are new to computing and computer science. This learning pathway will give you a comprehensive introduction to the whole GCSE curriculum.

For those of you who are more familiar with the computing curriculum, you can either:

- use our Teaching Advanced GCSE Computer Science pathway
- use the GCSE specifications to Computer Science Accelerator course map to identify courses in areas that you feel you need to develop (September 2020)
- pick courses by using the later sections in this handbook, in which the GCSE syllabus is separated into 8 different topic areas:
    - Algorithms
    - Computer Systems
    - Data and Information
    - Design and Development
    - Impact of Technology
    - Networks
    - Programming
    - Safety and Security

You can find all of the courses and book onto them through the Teach Computing courses page.

Finally, we anticipate updating this handbook as new courses and CPD becomes available. If you have any feedback to help us improve the document, please send it to: info@teachcomputing.org with 'CS Accelerator Handbook feedback' in the subject line.

CSA Self-Study

To ensure you're confident in your knowledge of the full breadth of subject knowledge, we recommend self-study is woven into your CSA journey, using this handbook to support your learning journey.

Once you have completed a face-to-face or online course, it's recommended you review the content within this handbook, explore the sample assessment questions, conduct further reading using resources provided and explore the wider CPD offer.

Tips for learning online with FutureLearn

Using FutureLearn

For many people learning online, and in particular using the FutureLearn platform to do so, is a new experience that can seem quite daunting. In order to help, the Raspberry Pi Foundation has put together a guide to learning using FutureLearn which includes advice about how to use the videos, course materials and comment sections included in the courses.

Free upgrades for teachers in England

Make sure that you access the courses through Teach Computing, rather than directly through FutureLearn. If you do this, you should see an "invitation" to take the course from the National Centre for Computing Education. By accepting this you'll get an upgrade to the course, extending your access to it beyond the usual FutureLearn limits. You'll also be awarded a certificate by FutureLearn when you complete the course. Make sure to click to confirm that you've completed each step as you work your way through the course!

Registering your progress with Teach Computing

Once you've completed the course, this will show on your Teach Computing dashboard, and count towards your certificate.This process may take several days, but if your completion hasn't registered in a week, please contact the NCCE by emailing info@teachcomputing.org.

Algorithms

Description

You will learn that an algorithm is a set of instructions that need to be followed in a particular order to solve a problem. At GCSE level you will need to be able to comprehend, design, create and evaluate algorithms.

The areas covered in the GCSE curriculum are:

- Creating algorithms to solve problems, decomposing problems into smaller, easier to solve parts, and abstracting away complexity
- Representing algorithms using pseudocode and flowcharts
- Tracing and Debugging algorithms to see what they do and fix faults
- Evaluating algorithms and comparing different algorithms
- Key Algorithms - Searching, Sorting
- Data Structures

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. When designing an algorithm identify the **FALSE** statement

A: The sequence of steps is important

B: An algorithm can be run on a computer

C: An algorithm can have parallel processes

D: An algorithm can be represented in a number of ways

2. What number will be output if the user enters 4 in the following program?

```
value = int(input(“enter a number:”))

count = value

for i = 0 to count
     value = value + value

print(“The answer is “ + str(value))
```

A: 60

B: 80

C: 64

D: 32

3. When searching unsorted data which of the following options is the most efficient?

A: Linear Search

B: Bubble Sort followed by Binary Search

C: Merge Sort followed by Binary Search

D: Binary Search

Further support

Below you will find links to relevant courses and resources, all of which can help improve your understanding of algorithms.

CPD from the NCCE

Representing algorithms using flowcharts and pseudocode (remote CPD) builds initial confidence in using the key building blocks of sequence, selection and iteration, and learn to apply algorithmic thinking.

Higher attainment in GCSE computer science - meeting the challenge of exams (remote CPD) explores how to apply algorithmic thinking within an exam context. You will learn how to decompose problems and create algorithms using pseudocode.

Programming 101: An Introduction to Python for Educators (online CPD) will take you through elementary concepts such as sequence, selection, repetition as well as introducing functions. Finally, you'll apply these skills in a program to solve a simple problem.

Programming 102: Think Like a Computer Scientist (online CPD) is appropriate for more confident Python programmers. You will delve more deeply into algorithms including several common search and sort algorithms. During the course you'll learn how to:

- break down problems into more manageable parts using functions which take parameters and output return values
- interpret algorithms expressed in plain English, in pseudocode and as flowcharts, and represent algorithms in these forms.

Resources from the NCCE

Isaac Computer Science: Although this collection of overviews for each sorting and searching algorithm are pitched beyond GCSE, they go into sufficient depth to really explain the mechanics of each one.

- Insertion sort
- Bubble sort
- Binary search
- Linear search

These resources from our Programming 102: Think like a Computer Scientist online course. are freely available to non-participants:

- What is an algorithm?
- Keeping Count - an example of an algorithm , and the implementation of that algorithm
- Introductions to sorting and searching
- Bubble sort:
    - An introduction to Bubble Sorts
    - Examples of bubble sorts from the web
- Merge sort:
    - An introduction to merge sorts
    - Exploring Merge Sorts
- Linear search:
    - Linear search explained
- Binary search:
    - Binary Search
- Algorithm efficiency:
    - Comparing efficiency
    - Comparing linear and binary search

TeachComputing CPD materials **-** Extract from the searching and sorting algorithms course:

- Using playing cards to compare insertion, bubble and merge sorts.

Other suggestions

BBC Bitesize KS3 introduces the topic of Algorithms and Computational Thinking.

BBC Bitesize KS4 provides greater depth on the topics of Algorithm Production, Common Algorithms and Computational Thinking, aligned to the main GCSE specifications.

These videos from Harvard University's introduction to Computer Science course cover sorting and searching algorithms.

- Lecture on arrays and sorting algorithms (with David Malan)
- Bubble sort (with Doug Lloyd)
- Insertion sort
- Binary search
- Linear search

This Algorithms, Flowcharts & Pseudocode CAS resource from the Computing at School assessment working group provides an overview of GCSE-related subject knowledge requirements.

Crash Course Computer Science video 13: Algorithms provides a good introduction to the topic.

The computer science field guide is an accessible free resource including a chapter on algorithms

Computer Systems

Description

You will learn what a computer is and how the constituent parts function together as a whole. You will need to understand that a computer system is a combination of hardware (the physical parts of a computer) and software (the programs that run on a computer) working together. The areas covered in the GCSE curriculum are:

- Systems
- Logic
- Hardware
- Software
- Architecture
- Communication & Coordination

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. Which of the following is **NOT** a function of the Operating System?

A: Transfers programs in and out of memory

B: Organise filesystem

C: Provide a user interface

D: Compress a video for use on the internet

2. Identify the factors that affect CPU performance.

A: Clock Speed, Number of Cores, RAM Size

B: Cache Size, Clock Speed, ROM Size

C: Cache Size, Clock Speed, Number of Cores

D: Clock Speed, Number of Cores, ROM Size

3. In Von Neumann architecture what is the purpose of the Memory Data Register?

A: Stores data that is being transferred to or from memory.

B: Stores the location in memory that data is to be transferred to or from.

C: Stores the current instruction.

D: Stores the numbers being used in calculations

Further support

Below you will find links to relevant courses, and resources, all of which can help improve your understanding of computer systems.

CPD from the NCCE

Introduction to computer systems, networking and security in GCSE computer science (remote CPD) introduces the different components of computer hardware, including devices not instantly recognisable as computers.

Computer Processors and Instruction sets (remote CPD) introduces the core of a modern computer - the processor. Learn how the instructions that humans write in computer programs are translated into machine code that the computer can process. Compare the differences between high-level and low-level programming languages, and how these can be used in the classroom. Learn, too, about different processor architectures.

Understanding Computer Systems (online CPD) covers what happens inside the machine and how computers turn inputs into outputs. You will learn what the computer operating system does and why you need it. You will also compare software and hardware, understand the importance of the central processing unit (CPU), and address factors that affect computer performance.

How Computers Work: Demystifying Computation (online CPD) provides an understanding of how computers work at a fundamental level. You'll explore system architecture, along with how computers use binary and logic. Once you've examined the von Neumann model of computer architecture and the Fetch-Execute cycle, you'll learn to build a range of simple circuits for maths, and then simulate various logic gates.

Resources from the NCCE

Isaac Computer Science: Systems is a basic recap of topics covered at GCSE. The detail here is not sufficient to cover all the topics in the test at the end of the programme - but will give you a good starting point to work from.

These resources from our Understanding Computer Systems online course are freely available to non-participants:

- The Startup Sequence describes the CPU, RAM, ROM and the hard drive and what they do as part of the operating system.
- Starting up the Operating System describes how hardware can affect how long it takes a computer to boot up
- Types of Software describes the difference between system and application software
- Pressing a key - what happens when a key is pressed, including the signals sent and how the OS and application deal with this signal
- A History of Input & Output Devices
- Accessibility and computing - a case study demonstrating how Kevin Lloyd, a software engineer at Lloyds Banking Group, uses accessible computing hardware and software in his everyday life.
- Sensors - input devices that don't need human input
- What is an operating system?
- The OS and the CPU - different algorithms that the OS can use to allocate processor time
- Speed & Perception - why more powerful components may not always correspond to a perception that a computer is "faster"

Teach Computing CPD Materials - Extracts from different elements of the Computer Systems face to face courses.

- Hardware And Software
- Input And Output Devices
- How The CPU Works and The FDE Cycle
- Risc And Cisc Processors
- Performance Of CPU
- Simple Assembly Programs
- Main Memory Including VM
- What is data, Secondary Storage including 'cloud' storage
- Embedded Systems

Other Suggestions

BBC Bitesize introduces 3 main topics at GCSE level: Systems Architecture, Memory and Storage.

Data and Information

Description

You will learn how computers process data and how the resulting information can be used to form judgements and make predictions. You will need to understand how data is stored, organised and used to represent real world artefacts and scenarios. The areas covered in the GCSE curriculum are:

- How numbers, text, images and sound are represented in computer systems
- Units of information from bits to petabytes
- Number Systems including binary, decimal and hexadecimal
- How computation is performed
- Lossy and lossless compression methods
- How encryption is used to secure data and information
- Databases

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. What is the denary result of converting 11011101 from Binary?

A: 221

B: 225

C: 223

D: 219

2. Identify the **FALSE** statement about bitmap images.

A: The image is split into pixels

B: Pixels store metadata about the whole image

C: A pixel can only have a single colour

D: Each colour is given a unique binary code

3. What is the file size in Kilobits of a sound sampled at 44kHz for 1 minute at 8 bits per sample?

A: 2640 Kb

B: 21120 Kb

C: 26400 Kb

D: 2112 Kb

Further support

Below you will find links to relevant courses and resources, all of which can help improve your understanding of data and information.

CPD from the NCCE

An introduction to algorithms, programming and data in GCSE computer science: Remote Delivery (Remote CPD) begins with the basics exploring how computers handle data in the form of binary and how this is used to represent characters, images etc.

Representing Data with Images and Sound: Bringing Data to Life (Online CPD) explores how computers do interesting things with data. You'll discover how to represent and manipulate text, images and sound, as well as compression and other algorithms.

Introduction to Encryption and Cryptography (Online CPD) introduces encryption and its use in the past by using the Caesar and Vigenère ciphers. You will also look at the present and future of encryption and investigate both symmetric and asymmetric encryption schemes.

Introduction to databases and SQL (Online CPD) introduces databases and why we use them, exploring how to use SQL to search and manipulate the data. Along the way, you'll learn about primary keys and table relationships, as well as how to create joins to search multiple tables..

Resources from the NCCE

From Isaac Computer Science:

- Data capacity
- Storage devices
- Factors affecting performance
- Data types
- Operators
- Database records

These resources from our Representing Data with Images and Sound: Bringing Data to Life online course are freely available to non-participants:

- Reviewing Binary gives a description of denary and binary number systems and how to convert from one to another.
- Character encoding now summaries ASCII and unicode character encoding and the differences.
- RGB: red, green, and blue describes how colours are represented using the 3 values of red, green and blue. It also includes a practical classroom activity.
- Hexadecimal shows how the hexadecimal number system is used and how to convert between hex, binary and denary.
- Images as data demonstrates the difference between binary and vector images and how they are stored.
- Everyday compression provides a summary of compression, why it is useful, and how it works.
- Lossless compression gives a description of lossless compression and a practical programming activity to demonstrate how it works.
- Lossy compression gives a description of lossy compression, presents a comparison to lossless, and includes a practical programming activity.
- What is encryption? from our Introduction to Encryption and Cryptography online course defines the purpose of encryption, why it is useful and how it is done.

These resources from our Introduction to databases and SQL online course are freely available to non-participants:

- Why use a database? describes why databases are useful and when they are used.
- The make-up of a database defines key database terminology such as tables, records and fields.
- Databases and spreadsheets explores the differences between databases and spreadsheets.

Teach Computing resource repository**:**

- Year 8 Representations: from clay to silicon code
- Year 9 Representations: going audio visual

Teach Computing CPD materials extracted from the data and information face to face courses:

- Converting binary to decimal
- Converting decimal to binary
- Converting hexadecimal values
- Data units
- How encryption works

Other suggestions

BBC Bitesize introduces the topic of data representation, the website includes topic overviews, videos and quizzes for the following areas: units; binary and denary; binary addition; binary shifts; hexadecimal; check digits; characters (ASCII and Unicode); images; sound; compression.

Design and Development

Description

You will learn what is involved in planning, creating and evaluating computing artifacts. You will need to understand how pseudocode, flowcharts, and structure diagrams are used to design software and how modern design is used to develop software. Areas covered in the GCSE curriculum are:

- Design
- Implementation
- Testing
- Refining
- Evaluating
- Collaborating

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. A student is asked to design a system. The system must generate a multiplication question using two random numbers and ask the user to guess their answer. How many inputs will the finished program need?

A: 3

B: 2

C: 1

D: 0

2. An input is supposed to accept numbers between 1 and 10 inclusive. Which of these would be an appropriate set of test data?

A. -1, 0, 1, 5, 10, 20000

B. 1,2,3,4,5,6,7,8,9,10

C. 5, 500, 5000

D. 1, 10

3. When refining code, which of these programming constructs is likely to help most in reducing the number of lines of code, to make it simpler to read and comprehend?

A: Selection

B: Repetition

C: Arrays

D: 2d Arrays

Further support

Below you will find links to relevant courses and resources, all of which can help improve your understanding of design and development.

CPD from the NCCE

Programming 102: Think Like a Computer Scientist covers various aspects of computational thinking techniques used to analyse problems and create abstract models.

Design and Prototype Embedded Computer Systems covers the iterative design process. You will discover how the purpose of a system affects how it is designed, from choosing its components to the look of the final product.

Python programming: advanced subject knowledge, implementation and testing (remote CPD) covers the software development cycle. You will explore the implementation and testing stages of the cycle including how to implement advanced programming techniques in Python.

Python programming: analysis, design and evaluation (remote CPD) covers the remaining areas of the software development cycle. You will learn how to analyse user requirements, design a solution using algorithms and how to evaluate the success of a program.

Resources from the NCCE

From Isaac Computer Science, Design covers some commonly used techniques for breaking down a problem and designing a solution for AS and A level.

These resources from our Teaching Physical Computing with Raspberry Pi and Python online course are freely available to non-participants:

- Creating a physical computing project contains a series of questions based around the computing cycle that can be used to help plan a project
- The design process describes an iterative design process consisting of the analyse, design, build, test life cycle.

These resources from our Design and Prototype Embedded Computer Systems are freely available to non-participants::

- Embedded and general-purpose computer systems discusses the difference between these types of system, including some design points.
- What is a smartwatch? demonstrates how devices can be designed for different users
- What is real-time computing? and Designing a real-time computing system demonstrate the design of an algorithm.
- The product design life cycle is described in this step - showing how the analyse, design, build, test life cycle applies to physical objects.
- 3D printing and manufacturing introduces 3D printing and design

Other suggestions

BBC Bitesize KS3 introduces algorithm design, examining approaches to solving problems.

BBC Bitesize KS4 goes deeper, with content matched to the main GCSE specifications:

- Investigating the requirements of users before and during the design and production stages
- Decomposition and Algorithms how to take a problem, decompose it and design an algorithm to solve it.
- Designing the Iterative design process methodology based on a cycle of prototyping, testing, analysing, and refining a product
- Producing robust programs Defensive design and robust programming focuses on safely handling unexpected errors.

This Harvard CS50 course video is an introduction to computational thinking key features;

- Problem solving
- Decomposition
- Writing Algorithms
- Pseudocode

Computer Science Wiki- Design is a detailed resource which focuses on the design stage, and stages of the System Life cycle.

Computer Science Wiki- Debugging contains information on debugging; the routine process of locating and removing computer program bugs, errors or abnormalities, using debugging tools and approaches.

Problem solving, algorithms and refinement from the Objects First website: Learn a basic process for developing a solution to a problem.

Impact of Technology

Description

You will learn how computers have brought about many environmental, ethical and legal issues and concerns that increasingly affect all of our daily lives. You will need to understand how individuals, systems and society as a whole interact with computer systems. Areas covered in the GCSE curriculum are:

- Legal implications
- Social issues
- Moral issues

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. Hacking was made illegal by Which UK Law?

A: Computer Misuse Act

B: GDPR

C: RIPA

D: Copyrights & Patents Act

2. Which of the following is a possible **environmental** impact of music streaming services?

A: More people expect to get music for free, so piracy increases

B: More electricity must be produced, potentially from polluting sources, to power the server farms

C: Less money will go to the music artists compared to download or CD sales

D: The algorithms that the streaming services use will tend to concentrate people’s listening habits on a few popular artists

3. Which feature of a creative commons licence would prevent someone else from taking credit for your work?

A: Non-Commercial

B: Non-Derivative

C: Attribution

D: Share Alike

Further support

Below you will find links to relevant courses and resources, all of which can help improve your understanding of the impact of technology.

CPD from the NCCE

Impact of Technology: How To Lead Classroom Discussions from the CS Accelerator programme explores the ethical, legal, cultural, and environmental concerns surrounding computer science

Higher attainment in GCSE computer science - meeting the challenge of exams (remote CPD) covers extended writing within exams. You will learn how to use topics such as legal, moral and social issues within an exam context.

Resources from the NCCE

These resources from our Impact of Technology: How To Lead Classroom Discussions online course are freely available to non-participants::

- Areas of interest. Discusses the areas of impact in detail.
- Copyright and Patents: Impact on Developers. Includes an interview with the Raspberry Pi creator and co-founder **Eben Upton** about how copyright and patents affect him as a creator and inventor.
- The Data Legislation Debate: security vs privacy. Discusses if the law provides security at the expense of privacy?
- Artificial Intelligence. Explores the reality of Artificial Intelligence, its applications and how to avoid any misconceptions

Other suggestions

Becoming a Digital Citizen: an Introduction to the Digital Society course from the University of York: Understand the ethical impact of using technology (privacy, inclusion, professionalism) on society.

BBC Bitesize KS4 includes simple tests at the end of each topic.

- The Digital Divide is the gap between those who have access to the latest technology and those who do not.
- examines the issues surrounding technology, including the difference between something being legal but morally wrong. It identifies what computer scientists need to think about when developing solutions
- Discusses the ethical, legal and environmental impacts of digital technology mapped to the AQA specification
- The internet and freedom of speech
- Design and technology content that is largely applicable to computing, covering Environmental, social and economic challenges

Craig ‘n’ Dave videos are presented by practising teachers of GCSE computer science includes a collection of videos covering key topics in this area.

The ACM Code of Ethics and Professional Conduct is lengthy but contains clear guidance from a professional body for computer scientists. Here is an interesting article - with references - on environmental impacts of technology from BI4ALL.

Networks

Description

You will learn that a network is two or more computers connected together, and that networks can be connected using different topologies and architectures. You will need to understand how networks can be used to retrieve and share information and what the associated risks are. Areas covered in the GCSE curriculum are:

- Classification of networks - topology, type, model
- Communication and Coordination
- Protocols
- Security
- Validation and Authentication,
- Encryption and Filtering
- Hardware

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. Which of these protocols operates at the Data Link layer?

A. IP
B. SMTP
C. HTTP
D. Ethernet

2. A small business wants to network their computers so that they can share peripheral devices between employees. Which topology would give them the most robust network?

A: Bus
B: Mesh
C: Star
D: Ring

3. Which Layer of the TCP/IP model establishes a virtual connection between the two computers?

A: Transport

B: Link (Ethernet)

C: Network

D: Application

Further support

Below you will find links to relevant courses and resources, all of which can help improve your understanding of networks.

CPD from the NCCE

Fundamentals of Computer Networks (Remote CPD) explains the hardware and network topologies used for data transfer between computers. The topics covered include:

- The Types of Networks
- Network Hardware
- Network Topologies
- Transmission Media (including WiFi) and the importance of WiFi encryption and the factors that influence performance.

The Internet and Cyber-Security (Remote CPD) explains how the internet works, the protocols that are needed to transfer data and the importance of staying safe when using the internet. The topics covered include:

- Addressing systems (IP and MAC) and how and why they are used
- What DNS is, and how/why it is used
- What the TCP/IP stack is
- What protocols are, different examples of them and what each is used for
- The main internet security threats including those that manipulate humans and those that manipulate machines

An Introduction to Computer Networking for Teachers (Online CPD) covers the different types of computer networks and how data can be transmitted securely. You will cover real world usage of networking technology to enhance your understanding. You will also become more familiar with how the internet works, including routing, DNS, and the World Wide Web.

Networking with Python: Socket Programming for Communication (Online CPD) explores the principles that industry professionals use when programming for networks, and how sockets are used to abstract the complexities of the internet.

Introduction to Cybersecurity for Teachers (Online CPD) introduces the core ideas of cybersecurity, including the different attacks that individuals and devices are vulnerable to and how to prevent them. You will explore malware, malicious bots, SQL injections, and physical threats to data. You will also build your knowledge of the different tools that protect data and websites. These include strong passwords, biometrics, two-factor authentication, and firewalls.

Resources from the NCCE

Issac Computer Science: Networking topic provides a basic recap of topics covered at GCSE. The detail here is not sufficient to cover all the topics in the test at the end of the programme, but it will give you a good starting point to work from.

Teach Computing CPD Materials extracted from the Network face to face courses:

- Network Types
- Network Hardware
- Network Topologies
- Virtual Networks
- Packet Switching
- Network Models
- Protocols 1 Protocols 2
- Network Addresses (IP)
- DNS (Domain Name System)
- Network Addresses (MAC)
- Transmission media (Copper, Optical, WiFi)
- Network Threats

These resources from our An Introduction to Computer Networking for Teachers online course are freely available to non-participants:

- Networks in Your Daily Life. Explores the various Networks you use every day, see how many different types of connection you use on a daily basis.
- The TCP/IP model and the Data Link / Network Access Layer. Includes some great animations to explain the TCP/IP model and the Data Link/Network Access Layer.
- Internet Protocol (IP) Addresses. Explores the addresses used on the internet, they work just like your postal address - following a logical order.

- Explaining the Layered Model. This step covers all the protocols your computer needs to transport data across the internet.
- Finding destination addresses with DNS and ARP. Explores what happens when you surf the web

Other suggestions

BBC Bitesize introduces 3 main topics at GCSE level: Network Hardware, the Internet and Security. Each section is a mini site featuring topic overviews, videos and quizzes.

Programming

Description

You will learn that programs are created using common building blocks, known as programming constructs. These programming constructs form the basis for all programs and are also used in algorithms. You will need to understand how to create software to allow computers to solve problems. The GCSE curriculum covers the following areas:

- Creating programming projects using suitable constructs
- Tracing & debugging code
- Modelling and simulation
- Evaluation and comparison of robustness, readability and security
- Input and output data from a program
- Arithmetic logic

Self Assessment

Below are examples of the questions in the final test. Answers can be found on page 38.

1. What will be the result of the following code?

```
print ( 5 MOD 6 )
```

A: 0.833’

B: 1

C: 1.2

D: 5

2. The following pseudocode processes the number of items in a list. What is output?

```
n = zero m = zero
for item in list
      n = n + 1 if item =
      = “tea”
         m = m + 1
print(m/n)
```

A. Output 1 if the first item in a longer list is “tea”

B. Output the number of items in the list

C. Output the number of times “tea” appears in the list

D Output the proportion of the items in the list that are "tea"

3. If you run the following program, what would happen?

```
        Def Dog (age)
              If age <= 2
dog = age*11 else
dog = 22 + ((age-2)*4) return dog

        print (Dog(“6”))
```

A: It would return 38.0.

B: It would produce a TypeError.

C: It would return “6”.

D: It would return 66.

Further support

Below you will find links to relevant online courses, face to face courses and resources, all of which can help improve your understanding of algorithms.

CPD from the NCCE

Python essential constructs - Sequence, selection and iteration (Remote CPD) covers how to write code to input, process and output data, and how to manipulate data stored in variables. Using the building blocks of sequence, selection and iteration you'll begin to understand how programs are constructed to perform a multitude of simple and more complex tasks.

Python programming - working with data (Remote CPD) covers data types, and how data structures are manipulated in Python programs. You'll create and edit files that can store data for later use, as you begin to develop simple software applications.

Python programming: advanced subject knowledge, implementation and testing (remote CPD) covers the software development cycle. You will explore the implementation and testing stages of the cycle including how to implement advanced programming techniques in Python

Python programming: analysis, design and evaluation (remote CPD) covers the remaining areas of the software development cycle. You will learn how to analyse user requirements, design a solution using algorithms and how to evaluate the success of a program.

Programming 101: An Introduction to Python for Educators (Online CPD) explores programming in Python. You'll discover basic programming concepts, learning how to understand the basics of Python syntax and interpret error messages.

Programming 102: Think like a Computer Scientist (Online CPD) covers how to break down problems into smaller parts, and then design and apply algorithms to data. You'll also explore list structures and their various uses.

Programming 103: Saving and Structuring Data (Online CPD) covers how to save text and binary files, and how to structure data so that programs can interpret it correctly. You will explore various common types of structured files, including CSV and JSON, and also find out how to connect to a SQL database to use it in your Python programs.

Resources from the NCCE

Isaac Computer Science:

- Data types
- Logical operators
- Subprograms
- Variables and constants
- Iteration
- Reading and writing to text files
- Arithmetic Operators

These resources from our Programming 101: An Introduction to Python for Educators online course are freely available to non-participants:

- What is programming? describes what programming is, why its important and the 3 basic constructs sequence, selection and repetition.
- Write your first Python program is a step by step guide to writing a Hello World program in Python using either the Mu IDE or trinket.
- Syntax describes that it is a set of rules of how code must be laid out, includes some typical examples and tips for resolving syntax errors.
- True or false a practical activity exploring how Python evaluates conditions as either True or false.
- Abstraction a description of abstraction and why it is useful in programming and computing.

Teach Computing CPD materials extracted from different elements of the programming face to face courses:

- Python essentials support sheet
- Data types
- Variables
- Logical operators
- Count controlled iteration
- Condition controlled iteration
- Selection

Other suggestions

The BBC Bitesize website introduces programming techniques through topic overviews, videos and quizzes.

The W3Schools website provides online tutorials of how to program using several languages including Python.

- User input
- Selection
- WHILE Loops
- FOR Loops
- Variables

Safety and Security

Description

As important data is stored on computers, measures such as passwords and anti-virus software are needed to keep those devices secure. You will need to understand what the risks are when using technology and how to protect individuals and systems. Areas covered by the GCSE curriculum are:

- Characteristics of threats to networks, digital systems and data
- Identifying vulnerabilities and protecting against threats

Self assessment Below are examples of the questions in the final test. Answers can be found on page 38.

1. Which of the following is **NOT** a Social Engineering technique?

A: Pharming

B: Phishing

C: Adware

D: Shouldering

2. For which of the following is preventing a hacker from gaining access to a network one of its primary aims?

A: Anti Malware

B: Router

C: Encryption

D: Firewall

3. Which of the following is **NOT** a Threat to your computer system.

A: Malware

B: Unpatched Software

C: Firmware Updates

D: Misconfigured Access Rights

Further support

CPD from the NCCE

Introduction to computer systems, networking and security in GCSE computer science (Remote CPD) Learn the fundamentals of computer security in this course for those with little prior experience in the subject.

Introduction to Cybersecurity for Teachers (Online CPD) The course provides an overview of common attacks on individual computer users and ways to prevent them. You'll learn about cybersecurity terminology, threats and defences.

Introduction to Encryption and Cryptography (Online CPD)
This course demonstrates different types of encryption, including both symmetric encryption such as the Caesar Cipher, and asymmetric encryption such as public-key cryptography.

The Internet and Cyber Security.(Remote CPD) Learn about the network of networks that comprises the internet, and the threats that are managed on internet-connected machines. You'll learn about the technical and human factors affecting security.

Resources from the NCCE

These resources from our Introduction to Cybersecurity for Teachers online course are feely available to non-participants:

- Automated social engineering discusses attacks that deceive victims into sharing valuable personal data, and ways to spot them.
- Phone security discusses common ways of protecting data on a mobile device
- Malware contains definitions for different types of malicious software
- Physical security discusses the importance of protecting the device that data is stored upon.

These resources from our Introduction to databases and SQL online course are freely available to non-participants.:

- SQL injections is a description of SQL injection and how databases can be exploited via this attack.

Isaac Computer Science:

- GCSE networking contains sections on 'threats posed to networks' and 'network vulnerabilities'.
- The encryption section is aimed at a-level, so goes beyond GCSE requirements.
- This section on a-level computer security covers aspects of GCSE to greater depth.

TeachComputing CPD materials:

- Network threats - definitions of a variety of cybersecurity threads listed.
- Case studies of security breaches from the Information Commissioner's Office.
- Explanations of key terms relating to threats and their prevention.
- Further detail on security measures such as penetration testing and encryption.

Other suggestions

BBC Bitesize KS3 introduces the topic of Safety & Responsibility. These overviews of online safety, bias & reliability and the law & ethics are ideal introductions to the topic as it is presented at KS3.

BBC Bitesize KS4 provides greater depth into the topic of System Security, covering core knowledge including forms of attack, threats to networks, and identifying & preventing vulnerabilities.

Crash Course Computer Science. Aspects of cybersecurity are covered in two accessible videos - on cybersecurity, and hacking- featuring animation and commentary

This code.org overview of cyber security covers some common threats and preventions that are explored at GCSE CS. The section on encryption gives further detail of security measures for safe transference of data.

Video from Kaspersky Labs explaining malware in its various forms, and a similar video from SANS. This video, also from SANS, explains the function of a firewall.

Video on penetration testing from Hitachi Systems which goes into more detail than is required for GCSE.

What support is available?

NCCE Computing Hubs

Computing Hubs provide local, responsive and tailored support to teachers across England. They are led by schools and colleges across England with an exceptional track record in teaching computing and computer science. They deliver face-to-face courses and provide local support for teachers in primary and secondary schools in their area. Find your local hub.

CS Champion Support

As part of the CS Accelerator Programme we are able to provide additional support and mentoring through our CS Champions, who can provide guidance throughout the programme, and advise on next steps following its completion.

Please email CSChampionSupport@stem.org.uk describing the support you require and how best to contact you.

Subject Matter Experts

We offer fully-funded consultancy and guidance to schools and colleges who meet our eligibility criteria This is provided by a network of computing education specialists, called Subject Matter Experts. Our experts work with leaders and teachers to identify an action plan for improving or delivering computing and computer science in their school or college.

An additional £1,400 bursary is also available for schools or colleges who are not currently offering GCSE computer science or are considering dropping the subject, when they create an action plan with our SMEs. Find out more.

Contact your local Subject Matter Expert

Communities of Practice

Communities of Practice - run by Computing at School (CAS) - are local networks of computing teachers that share expertise, resources and best practice to encourage strong and effective teaching.

How can I practice for the test?

Using the Diagnostic Tool when you register for the CSA programme will give you a good indication of the kind of questions you will get in the final test. Your results will be emailed to you showing your results from each area of the curriculum. This will help guide you towards the most appropriate CPD. You can use the Diagnostic Tool at any time to help you decide if you are ready to take the test"

Preparing for the assessment

There are plenty of resources available for you to use for revision before you take the final assessment.

Unlimited access to online courses

If you accessed the online courses through the Teach Computing website, you should have upgraded access to the courses on FutureLearn, which includes unlimited access. This means that you can go back to the course and use the text and video content in your revision. Although course facilitators will no longer be responding to comments, all of the course comments will still be visible, so you can see other learners' contributions to the course.

Online subject knowledge assessments

The National Centre for Computing Education has created free online subject knowledge assessments on Eedi. Although these are designed for you to use to evaluate your students' knowledge, you can also take these assessments in order to practice the style of questions which are included in the CS Accelerator final test.

Your own notes

Don't discount your own notes as a vital revision resource! Hopefully these notes will focus on the areas that you had to spend more time on during the course, as well as being formatted in the most useful way for you.

Other resources

This handbook contains links to free resources provided by external providers. While we hope that our courses are sufficient on their own, we know that people learn differently and so seeing a concept explained in another way can help embed the learning.

Following the assessment

As soon as you've completed the assessment, you'll be informed as to whether you've passed or not.

Following a successful pass

Congratulations! You've completed the CS Accelerator programme, however, your journey with the National Centre for Computing Education shouldn't stop there.

You can still access all of our online courses with a free upgrade by accessing them through Teach Computing. As well as all of the CS Accelerator online courses, there are other courses from the NCCE, such as courses covering pedagogy for teaching in secondary schools, or how to create an inclusive classroom to support students with SEND.

If you are a teacher at a state-funded school or college in England, then you can also continue to take CS Accelerator face-to-face or remote courses for free.

You can take advantage of the Teach Computing Curriculum, which contains everything you need to teach computing at key stages 1 to 4, including lesson plans (for 500 hours worth of lessons!), slides, worksheets, homework and assessment. All of this content is completely free to use and has been created by expert teachers, based on the latest pedagogical research and. It also provides an innovative progression framework where computing content (concepts, knowledge, skills, and objectives) has been organised into interconnected networks we call learning graphs.

Another good way to develop your knowledge within your school is to share what you have learnt with other teachers. You may even want to encourage them to take the CS Accelerator themselves!

You can also get involved with your local Computing at School community, and attend meetings with like-minded Computing teachers.

If you need to try again

Don't worry if you fail the assessment - you will be able to take it again and still achieve certification. The most important thing is not to see this as a failure, but just another stage in your journey to certification. If you were close to achieving the required standard for certification, you may want to take the test again immediately. You should be able to take the assessment a second time immediately, although you will have to leave a 48 hour gap between subsequent attempts.

If you missed the target mark by a larger margin, take some time to plan how you can improve your knowledge before your next attempt. You should have received some feedback containing your scores for the questions from each topic area. As well as reviewing your notes from the courses that you've taken that covered that area, you could also sign up for further courses to deepen your understanding - check the CS Accelerator Handbook for course suggestions by topic area.

Your CS Champion will also be able to provide additional support. If you have not already been contacted by a CS Champion, please email CSChampionSupport@stem.org.uk with your contact details, mentioning that you are taking part in the CS Accelerator.

Good luck - with perseverance you should soon be able to achieve the required standard and obtain the *National Centre for Computing Education Certificate in GCSE computer science subject knowledge*.

Self Assessment Answers

Algorithms 1. B 2. C 3. A

Computer Systems 1. D 2. C 3. A

Data and Information 1. A 2. B 3. B

Design & Development 1. C 2. A 3. B

Impact of Technology 1. A 2. B 3. C

Computer Networks 1. D 2. B 3. A

Programming 1. D 2. D 3. B

Safety & Security 1. C 2. D 3. C