Unit 24: TECHNICAL FUNDAMENTALS FOR COMPUTING PROFESSIONALS

Delivery guidance

Approaching the unit

A modern IT professional is required to have a wider set of core skills. As digital systems get increasingly integrated into every aspect of an organisation, the need for specialists that can also integrate in to wider teams has also increased. The key skills for a computing professional will often be technical in nature, as befits their role, but they are now often required to understanding of wider issues that impact not only the organisation that they work for, but on society as a whole.

The focus of this unit should be to give learners both the core technical skills required to be an effective computing professional, but also enable them to understand the wider issues of the use of digital systems. The focus of Learning Aim A should be on developing an understanding of number, logic and the basics of computer programming. It may be beneficial for learners to have first studied Unit 4, but the unit content does not assume any previous knowledge and so defines some of the basics of coding learners will need to know if they are approaching coding for the first time. For Learning Aim A, learners will need access to a coding environment appropriate to the chosen language and also access to computer systems that will allow learners to explore system scripting. The content or Learning Aim B explores wider issues including Cybersecurity, Health and Safety as well as Moral and ethical issues. Learning Aim C explores computer hardware and infrastructure.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the Learning aims

Learning aim A you could start by exploring the ways in which number systems are used within computers and ow they form the building blocks of all computers. Learners should be able to use and interpret number systems that are used in computer systems to process numerical data and should also be able to perform operations and calculations of data in these forms. Learners should understand the purpose of systems used for representing text in digital form and the associated processes and implications.

You should give learners the opportunity to explore and apply standard programming structures and conventions in a range of contexts. You should start by looking at logical and mathematical concepts in small, isolated tasks before moving to larger more complex problems that combine different logical and mathematical constructs. It can be helpful to explore the constructs in a range of different contexts (e.g. validation techniques, standard algorithms) so that learners can see how the common basic structures can be combined to build more complex solutions. You may wish to initially explore the programming and scripting content through pseudocode, in some cases by removing the requirements to follow a language specific syntax, learners can more easily focus on the logic. Note that, pseudocode this is not a requirement of the unit, but can be a helpful teaching tool. The unit content dos does not dictate which coding and scripting languages to use, so you should select languages that best suit your learners and local requirements. To properly access the content learners will need access to an Interactive Development Environment (IDE) to help with the writing and running of their code. For the scripting they will need computer systems that provide suitable levels of access to run the shell (e.g. Bash, PowerShell, Command Prompt, many centres may find this difficult to implement on their network, due to security restrictions so centres may wish to provision stand-alone machines for this activity or make use of virtualised computer solutions that can be contained and secured.

Learning aim B focuses on the exploration of issues relating to the use of computer systems. You should use this learning aim to build on the knowledge from unit 1, for example Topic B3 can build on Topic F from Unit 1. While some considerations may be consistent, for example considerations relating to health, issues can emerge over time. Equip learners with up-to-date knowledge of digital systems and give them opportunities to explore emerging technologies and the associated implications for organisations. Emphasise with learners that keeping up with developments in systems and the associated implications is another key requirement for a computing professional. Following suitable tutor-led theoretical input, give learners opportunities to explore a range of contexts to which they can apply their knowledge and demonstrate their ability to choose appropriate processes and, where appropriate, digital systems to meet a range of needs. You should help them to use their knowledge to make decisions, plan, and evaluate digital systems in order to mitigate potential issues. The content here can tend to become quite theoretical and 'book led' in nature, so try to provide plenty of opportunities for learners apply their knowledge through practical tasks, for example learners could develop their understating of firewalls, anti-malware etc through a task where they are provided with a physical computer system on which they can set up and install security software.

Due to their lack of previous experience in some areas, learners can find some of the more wide-ranging issues difficult to appreciate, particularly those that relate to impacts in a place of work or a less familiar sector. Educational visits and guest speakers can be invaluable in these situations by providing contextualisation that cannot always be easily conveyed in regular classroom activities.

Learning aim C focuses on computer hardware and infrastructure. the development of a cloud-based solutions. Learners should have an understanding of how individual internal computer components and larger hardware devices can be used individually or in combination with other computer systems. Learners should have a sound understanding of how the features of different hardware devices affect their use in an IT system, as well as the implications of the relationship(s) between components, devices and relevant peripherals.

Learners should explore the ways in which data is transmitted within and between computer systems. Learners should explore the technologies that enable devices and systems to communicate and share data with each other and how the features and characteristics of these technologies affect the system and its effectiveness. Learners should be aware of different connection types and the processes used to transmit data using these connection methods. Learners should have a strong grasp of networking and the role and implications of these technologies in terms of meeting the needs of organisations and their stakeholders. Learners should be able to plan hardware solutions for a range of situations. You could start by looking at some small, isolated problems/tasks (e.g. building a desktop PC to meet a single user's needs) and slowly move more complex, multi-faceted problems such as planning a complete infrastructure upgrade for a specified organisation.

While parts of this content may be quite theoretical in nature, to ensure effective learning in this learning aim you should incorporate as many practical tasks as possible. Providing learners with the opportunities to, for example, build computers and configure basic networks will engage and enthuse learners. For more complex network solutions, network simulation tools such as Cisco Packet Tracer can help to incorporate more practical tasks.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Explore the mathematics, logic and processes of computer systems	**A1** Number systems **A2** Coding and scripting	A portfolio of evidence detailing the use of shell scripts and computer programs to meet a range of identified needs.
B Investigate issues relating to the use of digital systems	**B1** Cybersecurity **B2** Health and safety issues **B3** Moral and ethical issues	A report analysing potential issues, in relation to technology for an identified organisation, including: • a review of its current practices and systems and identification of: • potential security issues • social, moral and ethical considerations • suggestions for how identified issues can be addressed • an evaluation of the impact of implementing suggestions on the company and wider stakeholders.
C Design a computer infrastructure solution	**C1** Computer systems architecture **C2** Memory and storage **C3** Data communication **C4** Network design	A portfolio of evidence detailing the design of a computer infrastructure solution to meet the needs of an identified organisation, which may include:

		• design documents for an infrastructure solution • feedback on the documentation/designs collected from others • improved version of the documentation /design • written justification of design decisions • an evaluation of the designs.

Assessment guidance

This unit is internally assessed. There is a maximum number of three summative assignments for this unit. Tutors should refer to the assessment guidance in the specification for specific detail, particularly in relation to the requirements for Pass, Merit and Distinction grades.

The first assignment requires learners to produce a portfolio of evidence that demonstrates their ability to produce program code and shell scripts to meet a variety of requirements.

The learner must demonstrate use of shell scripting (e.g. Bash, PowerShell, Command Prompt) to automate routine administrative tasks, including as a minimum:

- performing file management operations e.g. move, copy, delete rename
- installing, removing and updating software
- a batch processing task
- two different system monitoring tasks (e.g. network packet analysis, CPU usage, IP LAN monitoring).

The learner must also produce a series of computer programs that show appropriate use of:

- mathematical, relational and Boolean operators
- data types, e.g. string, integer, float/real, Boolean
- constants and variables
- run time data structures, e.g. list, array, tuple, dictionary
- selection and iteration.

The second assignment requires to assess the impact the wider issues of using computer systems may impact on an identified company. This assignment would be best supported by a detailed case study that provides clear information as to the organisation, the business context and the likely stakeholders. Learners will need to consider issues relating to:

- cyber security
- health and safety issues
- moral and ethical issues
- legislation.

Learners could produce the evidence for this in different ways including a written formal report or a presentation to the group. If a presentation is used then

assessors could use video recording combined with an observation sheet to cite which assessment criteria the learner has met, with appropriate commentary supporting the reason for awarding a particular grade. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The third assignment requires the learner to plan a computer infrastructure solution for an identified organisation. It is recommended, although not a requirement, that the organisation used for this assignment is the same organisation as considered in Assignment 2. Learners will be expected to define a set of aims and requirements for the network and provide plans for the hardware and infrastructure that would meet the identified aims. Leaners will need to demonstrate that they have reviewed and refined the designs, providing justification for decisions made. Finally, learners will be required to evaluate the extent to which their design meets the identified organisation needs.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Introduction
Depending on which units the learners have studied before this, you may wish to briefly look at the concepts of computational thinking and how they can use this to help solve problems. This unit should give learners a solid understanding of the key knowledge, skills and behaviours required by computing professionals and how these relate to a wider context. Where possible incorporate practical activities to develop hands on skills that learners can apply to a range of contexts.
Learning aim A: Explore the mathematics, logic and processes of computer systems
• You could begin by providing an overview of the learning aim introducing the aim and how the concepts of computational thinking can be applied to practical problems. • Explain to learners that d that computational thinking is not really specific knowledge to be recalled but rather a set of skills and a way of working that can be applied to aspects of this and other units.

- For topic A1 Learners should explore how numbers, text and images are represented as data on a computer system. Learners should be able to work with units of data and perform mathematical operations on denary, binary and hexadecimal numbers. You should give learners opportunities to explore the use of number systems in a range of different contexts.
- For topic A2 Learners should explore programming constructs, and the logical and mathematical structures that can be used to develop code and scripts. It may be beneficial to introduce these topics using pseudocode as a way of exploring the concepts without the additional demand of learning the syntax of a particular language. However, as learners start to understand the concepts covered in the topic, you should start to show them how these concepts can be implemented within appropriate coding and scripting languages.
- Start with isolated aspects of a programming constructs and the chosen language and slowly build the complexity of the problems learners have to solve.
- When you are confident that learners understand the key concepts, give them several practical exercises to practise these concepts. For example, learners could be given a workbook to work through at their own pace as the topic progresses. This workbook should give them coding snippets to show how the concepts are applied to problems. This will also give you an opportunity to monitor learners' progress.
- As learners hone their programming skills and work through various tasks, it would be useful to bring learners together periodically to recap the skills that they have mastered. Also, when an exercise proves challenging for some learners, you could work through model answers on an interactive whiteboard, with the assistance of other learners in the class. This will also give you a chance to ask learners direct questions to check their understanding. You could ask stronger programmers in the class to formally buddy/work with weaker learners.

Learning aim B: Investigate issues relating to the use of digital systems

- Topic B1 should provide learners with opportunities to explore the potential internal and external threats, be they accidental and malicious, to data and information stored on and used by IT systems, and the impact this can have on an organisation and its stakeholders. The subject content could be introduced by tutor presentations and individual and group research tasks. The use of case studies and carefully selected news articles can help to keep the topic interesting and the keep the learners engaged.

- Ask learners to consider ways in which systems can be protected from potential threats. You should ask them to explore the ways in which individuals and organisations can reduce potential risk and mitigate damage to, and loss of, data. computational thinking techniques to design a solution to an identified problem.
- Learners should build on learning form unit 1 and You should help learners develop the ability to analyse the impact and implications of these risks beyond superficial levels. Through real-world examples, case studies and discussion, you should allow learners to explore how relevant factors are linked and how considering one thing may have an impact on another.
- For Topic B2 learners should explore the potential health and safety issues relating to the use of digital systems. Start by exploring the more common issues that learner may already have explored in other units. As they become aware of these you should explore a wider range of issues, and consider how issues and risks may be amplified in different situations and contexts. Also consider the impact health and safety risks could have on an organisation, including how they can mitigate issues and the implications of implementing safe working practices.
- For Topic B3 learners should explore the wider moral and ethical considerations associated with the use of digital systems. Learners should explore how the use of digital systems within the workplace affect the organisations and its stakeholders. Help your learners to gain a strong grasp of relevant legislation relating to the use of digital systems in the country of delivery and how this ay impact on moral and ethical uses of digital systems. For example, the concept of protected characteristics and discrimination (direct and indirect) may be included in a country's laws and so help ensure an organisation is working in an ethical manner. However, where issues are not covered in law, there may be a moral obligation to still ensure equality and equity are applied. These topics can often lead to engaging and stimulating discussions, having some prompts and key questions prepared for these types of lessons can help keep discussion on track and help you direct learners to specific areas of consideration.

Learning aim C: Design a computer infrastructure solution

- For topics C1 and C2 it may be appropriate to teach the content in a blended fashion rather than in a linear nature as represented in the specification.
- Learners should understand how the individual components can be connected to form computer systems and how the features and characteristics of each of the components affect the system as a whole.
- Learners should be able to analyse the use and features of different computer architecture models (e.g. mobile vs desktop processors) and how the components in a computer system may be similar (or vary) depending on the architecture. in a range of contexts and would benefit from exploring the use of different approaches in both theoretical and practical activities. You should expect learners to research developments in this field and give them opportunities to build physical and virtual (emulated) systems to meet different success criteria.
- Topics C3 and C4 would also benefit from a blended teaching approach. it may be helpful to introduce this topic by first considering different methods of connecting devices and systems together that are familiar to learners (e.g. Bluetooth and Wi-Fi. Start by looking at some of the features and limitations of different connection methods (e.g. ease of connection, relative speeds, security) before progressing to more technical networking concepts. Learners should be clear about the technical factors that affect data communication and networking and the impact these have on their functions, and the resulting implications for individuals and organisations.
- Learners should develop their understating of network infrastructure including topologies, components and how networking is utilised in different scenarios. This topic is closely linked with content in Unit 11 and learners who are following the extended diploma, may benefit from completing that unit first. However, completing Unit 11 first is not necessary and for centres not delivering that unit, you may be able to draw on materials that are available for that unit to support your delivery.
- This learning aim strongly leads itself to practical tasks. Following some tutor led theoretical input, learners should be given opportunities to interact with physical systems. Initially you could start with some simple practical 'workshops' showing learners step-by-step how to install different components and progress to learners being provided with a specific set of user requirements and designing and building a system that meets these needs.

- As learners grow in confidence you can provide less scaffolding and get learner to produce the larger and more independent solutions, such as designing full infrastructure solutions for an identified organisation. In these cases, it is not practical to build the full installation, but these tasks can be supported through use of network simulation tools such as Cisco Packet Tracer.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 1: Information Technology Systems – Strategy, Management and Infrastructure
- Unit 11: Cyber Security and Incident Management.

Resources

Textbooks

Thomatis M – *Network Design Cookbook: Architecting Cisco Networks* (lulu.com, 2015) ISBN 9781257750245 Computing Blindfolded: New Developments in Fully Homomorphic Encryption - Vinod Vaikuntanathan

Denise D and White R – *The Art of Network Architecture: Business-Driven Design* (Cisco Press, 2014) ISBN 9781587143755

Websites

https://linuxconfig.org/bash-scripting-tutorial-for-beginners

An introduction to the purpose and use of Bash shell

https://learn.microsoft.com/en-us/training/modules/script-with-powershell/

An introduction to PowerShell scripting - Microsoft training materials

https://www.w3schools.com/

Programming tutorials for wide range of languages

https://www.codecademy.com/

Online programming courses in a range of languages

https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-computer-networking.html

An introduction to computer networking

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling students to access them through the school/college intranet.