

# **Pearson BTEC Level 4 Diploma in Software Languages**

## **Specification**

BTEC Professional qualification

First teaching February 2020

## **Edexcel, BTEC and LCCI qualifications**

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# 1 Introducing BTEC Professional qualifications

## What are BTEC Professional qualifications?

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BTEC Professional qualifications are work-related qualifications available from Level 4 to Level 8 in a range of sectors. They give learners the knowledge, understanding and skills they need to prepare for employment in a specific occupational area.

BTEC Professional qualifications put learning into the context of the world of work, giving learners the opportunity to apply their research, skills and knowledge in relevant and realistic work contexts. This applied, practical approach means learners develop the knowledge, understanding and skills they need for career progression or further study. As such, these qualifications are well suited to support the delivery of the Apprenticeship Standards.

The qualifications may be offered as full-time or part-time courses in colleges, training centres and through employers.

## Sizes of BTEC Professional qualifications

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For all regulated qualifications, Pearson specifies a total estimated number of hours that learners will require to complete and show achievement for the qualification – this is the Total Qualification Time (TQT). The TQT value indicates the size of a qualification.

Within the TQT, Pearson identifies the number of Guided Learning Hours (GLH) that we estimate a centre delivering the qualification might provide. Guided learning means activities, such as lessons, tutorials, online instruction, supervised study and giving feedback on performance, that directly involve tutors and assessors in teaching, supervising and invigilating learners. Guided learning includes the time required for learners to complete external assessment under examination or supervised conditions.

In addition to guided learning, other required learning directed by tutors or assessors includes private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

As well as TQT and GLH, qualifications can also have a credit value – equal to one-tenth of the TQT, rounded to the nearest whole number.

TQT and credit values are assigned after consultation with employers and training providers delivering the qualifications.

BTEC Professional qualifications are generally available in the following sizes:

- Award – a qualification with a TQT value of 120 or less (equivalent to a range of 1–12 credits)
- Certificate – a qualification with a TQT value in the range of 121–369 (equivalent to a range of 13–36 credits)
- Diploma – a qualification with a TQT value of 370 or more (equivalent to 37 credits and above).

## 2 Qualification summary and key information

Qualification title	Pearson BTEC Level 4 Diploma in Software Languages
Qualification Number (QN)	603/5452/5
Regulation start date	28/01/2020
Operational start date	01/02/2020
Approved age ranges	16–18 19+ Please note that sector-specific requirements or regulations may prevent learners of a particular age from embarking on this qualification. Please see <i>Section 6 Access and recruitment</i> .
Total Qualification Time (TQT)	400 hours.
Guided Learning Hours (GLH)	120 hours.
Assessment	External assessment – multiple choice test.
Grading information	The qualification and unit is at Pass grade.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, it is recommended that learners have experience of working in the digital sector or that they have achieved a relevant qualification, such as a Level 3 information and communication technologies qualification.  Centres must follow the guidance given in our document <i>A guide to recruiting learners onto Pearson qualifications</i> (see <i>Section 6 Access and recruitment</i> ).
Funding	Qualifications eligible and funded for post-16-year-olds can be found on the funding Hub. The Education and Skills Funding Agency also publishes a funding catalogue that lists the qualifications available for 19+ funding.  The Apprenticeship funding rules can be found at <a href="http://www.gov.uk">www.gov.uk</a>

Centres will need to use the Qualification Number (QN) when they seek public funding for their learners. The qualification title, unit titles and QN will appear on each learner's final certificate. Centres should tell learners this when recruiting them and registering them with Pearson. There is more information about certification in our *UK Information Manual*, available on our website, [qualifications.pearson.com](http://qualifications.pearson.com)



## 3 Qualification purpose

### Qualification objectives

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The Pearson BTEC Level 4 Diploma in Software Languages develops the knowledge and understanding learners need to carry out the job role of software developer relating to software languages. The qualification also enables learners to achieve the knowledge modules required to complete the on-programme element of the Software Developer Apprenticeship.

The qualification gives learners the opportunity to:

- develop knowledge related to software development
- develop technical knowledge and understanding of software languages
- achieve a Level 4 qualification
- develop personal growth and engagement in learning.

### Apprenticeships

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The Pearson BTEC Level 4 Diploma in Software Languages meets one of the mandatory gateway requirements in the Software Developer Level 4 Apprenticeship Standard.

Learners must achieve this qualification, one of the equivalent professional Ofqual regulated qualifications, or one of the equivalent vendor qualifications before progressing to the end-point assessment. The equivalent vendor qualifications are:

- Cloud certified developer apache
- Hadoop
- C++ PHP Drupal
- Oracle SQL Developer
- Oracle Java Certified
- MCP.net
- MTA/MCP programming in HTML5 with JavaScript and CSS3
- C#.

The knowledge outcomes from the Software Developer Apprenticeship Standard covered by the BTEC Level 4 Diploma in Software Languages are:

- understands and applies software design approaches and patterns and can interpret and implement a given design, compliant with security and maintainability requirements
- understands and applies the maths required to be a software developer (e.g. algorithms, logic and data structures).

## Progression opportunities

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Learners who achieve the qualification and who have met all other specified requirements of the Software Developer Apprenticeship Standard, can progress to achieving the full Apprenticeship certification that confirms competency in the software developer job role.

With further training and development, learners can progress to a more senior or complex job role such as senior software developer. Learners will also be eligible to apply for registration onto the Register of IT Technicians, confirming Skills Framework for the Information Age (SFIA) Level 3 professional competence, on completing the apprenticeship.

Alternatively, learners who have achieved the qualification but not completed the full apprenticeship requirements could progress to job roles such as software engineer, UI designer, UX designer, programmer/coder, applications developer, web developer or games developer or to other qualifications such as the BTEC Level 5 Higher National Diploma in Computing.

## Industry support and recognition

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This qualification is based on the requirements set out in the Software Developer Apprenticeship Standard issued by the Tech Partnership.

The employers involved in creating the Standard are:

Accenture, British Airways (BA), The British Computer Society (BCS) – The Chartered Institute for IT, British Telecom (BT), Capgemini, Cisco, Fujitsu, Hewlett Packard (HP), The International Business Machines Corporation (IBM), John Lewis, Lloyds, Microsoft, National Crime Agency (NCA), Telefonica, The Royal Signals, Telefonica, The Test Factory, Virgin Media, Visa.

## 4 Qualification structure

### Pearson BTEC Level 4 Diploma in Software Languages

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The learner will need to meet the requirements outlined in the table below before Pearson can award the qualification.

Number of units that must be achieved	1
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Unit number	Mandatory unit	Level	Guided Learning Hours
1	Software Languages	4	120

## 5 Centre resource requirements

As part of the approval process, centres must make sure that the resource requirements below are in place before offering the qualification.

- Centres must have appropriate physical resources (for example IT, learning materials, teaching rooms) to support the delivery and assessment of the qualification.
- Staff involved in the assessment process must have relevant expertise and occupational experience.
- There must be systems in place that ensure continuing professional development (CPD) for staff delivering the qualification.
- Centres must have appropriate health and safety policies in place that relate to the use of equipment by learners.
- Centres must deliver the qualifications in accordance with current equality legislation. For further details on Pearson's commitment to the Equality Act 2010, please see *Section 6 Access and recruitment*. For full details of the Equality Act 2010, visit [www.legislation.gov.uk](http://www.legislation.gov.uk).

For information on the requirements for implementing assessment processes in centres, please refer to the *BTEC UK Quality Assurance Centre Handbook* available on our website.

## 6 Access and recruitment

Our policy on access to our qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from barriers that restrict access and progression
- there should be equal opportunities for all wishing to access the qualifications.

Centres must ensure that their learner recruitment process is conducted with integrity. This includes ensuring that applicants have appropriate information and advice about the qualification to ensure that it will meet their needs.

Centres should review applicants' prior qualifications and/or experience, considering whether this profile shows that they have the potential to achieve the qualification.

We refer centres to our *Equality, diversity and inclusion policy*, which can be found in the support section of our website.

### Prior knowledge, skills and understanding

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No prior knowledge, understanding, skills or qualifications are required for learners to register for this qualification. However, it is recommended that learners have either experience of working in the digital sector or have achieved a relevant qualification (such as a Level 3 information and communication technologies qualification).

### Access to qualifications for learners with disabilities or specific needs

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Equality and fairness are central to our work. Pearson's *Equality, diversity and inclusion policy* requires all learners to have equal opportunity to access our qualifications and assessments and that our qualifications are awarded in a way that is fair to every learner.

We are committed to making sure that:

- learners with a protected characteristic (as defined by the Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to learners who do not share that characteristic
- all learners achieve the recognition they deserve from undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

For learners with disabilities and specific needs, the assessment of their potential to achieve the qualification must identify, where appropriate, the support that will be made available to them during delivery and assessment of the qualification. Please see *Section 8 Assessment* for information on reasonable adjustments and special consideration.

## 7 Programme delivery

Centres are free to offer this qualification using any mode of delivery that meets learners' and employers' needs. It is recommended that centres make use of a wide range of training delivery methods, including direct instruction in classrooms, simulated demonstrations, research or applied projects, e-learning, directed self-study, field visits and role play. Whichever mode of delivery is used, centres must make sure that learners have access to the resources identified in the specification and to the subject specialists delivering the unit.

Centres must adhere to the Pearson policies that apply to the different models of delivery. Our document, *Collaborative and consortium arrangements for the delivery of vocational qualifications policy*, is available on our website.

Those planning the programme should aim to enhance the vocational nature of the qualification by:

- spending time with employers to better understand their organisational requirements and the methods of training that are most suitable, taking into consideration their available resources and working patterns
- collaborating with employers to ensure that learners have opportunities in the workplace to implement the knowledge and skills developed through the training programme
- developing up-to-date and relevant teaching materials that make use of scenarios relevant to the sector and relevant occupations
- giving learners the opportunity to apply their learning in realistic practical activities
- having regular meetings with employers to discuss learner progress, providing feedback and agreeing how any issues will be resolved
- developing projects or assessments, with input from employers.

Where legislation is taught, centres must ensure that it is current and up to date.

Where a unit is externally assessed, it is essential that learners have covered all of the unit content before they are tested.

For further information on the delivery and assessment of the Apprenticeships Standards please refer to document, *Apprenticeship funding: rules and guidance for employers* at [www.gov.uk/government/collections/sfa-funding-rules](http://www.gov.uk/government/collections/sfa-funding-rules)

## 8 Assessment

The table below gives a summary of the assessment method used in the qualification.

Assessment method
External assessment (onscreen test)

In administering external assessments, centres need to be aware of the specific procedures and policies that apply to, for example, registration, entries and results. More information can be found in our *UK Information Manual*, available on our website.

### Language of assessment

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External assessments for the unit in this qualification will be available in English only.

A learner taking the qualification may be assessed in British or Irish Sign Language where it is permitted for the purpose of reasonable adjustment.

Further information on the use of language in qualifications is available in our *Use of languages in qualifications policy* document, available on our website.

For further information on access arrangements, please refer to the *Granting reasonable adjustments* paragraph.



## External assessment

The table below gives information about the type and availability of external assessments that are available for this qualification. Centres should check this information carefully together with the relevant unit specifications and the sample assessment materials so that they can timetable learning and assessment periods appropriately.

Unit 1: Software Languages	
Type of assessment	Onscreen test using multiple-choice items.
Length of assessment	The external assessment will be 1 hour.
Number of questions	30
Assessment availability	On demand
First assessment availability	April 2020

Pearson sets and marks the external assessments.

The external assessment assesses the learning outcomes in the unit to meet the standard specified by the related assessment criteria. All the content in the unit is mandatory for the assessment and will be sampled across different versions of the assessment over time. Therefore, it is essential that learners have full knowledge of the unit content before being entered for the onscreen test.

Centres need to make sure that learners are:

- fully prepared to sit the external assessments
- entered for the tests at appropriate times, with due regard for resit opportunities as necessary.

Information about the structure and format of the assessment is available in the unit in *Section 10 Unit*.

Information about registering learners for the test and the systems requirements for delivering the onscreen tests is available on our website.

## Sample assessment materials

Each externally-assessed unit has a set of sample assessment materials (SAMs). The SAMs are there to provide an example of what the external assessment will look like in terms of the feel and level of demand of the assessment.

SAMs show the range of possible question types that may appear in the actual assessments and give a good indication of how the assessments will be structured.

While SAMs can be used for practice with learners, as with any assessment, the content covered, and specific details of the questions asked will change in each assessment.

A copy of each of these assessments can be downloaded from the qualification page on our website.

## Resits

Learners who take the onscreen test but do not perform as expected, are given the opportunity to resit the assessment. Opportunity for resits is purely at the centre's discretion. Centres will need to ensure that learners are fully prepared against any identified areas of weakness before resitting the assessment.

## Administrative arrangements for external assessment

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### Access arrangements requests

Access arrangements are agreed with Pearson before an assessment. They allow learners with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

Access arrangements should always be processed at the time of registration.

Learners will then know what type of arrangement is in place for them.

## Granting reasonable adjustments

For external assessment, a reasonable adjustment is one that Pearson agrees to make for an individual learner. A reasonable adjustment is defined for the individual learner and informed by the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, including:

- the needs of the learner with the disability
- the effectiveness of the adjustment
- the cost of the adjustment; and
- the likely impact of the adjustment on the learner with the disability and other learners.

Adjustment may be judged unreasonable and not approved if it involves unreasonable costs, timeframes or affects the integrity of the assessment.

## Special consideration requests

Special consideration is an adjustment made to a learner's mark or grade after an external assessment to reflect temporary injury, illness or other indisposition at the time of the assessment.

An adjustment is made only if the impact on the learner is such that it is reasonably likely to have had a material effect on that learner being able to demonstrate attainment in the assessment.

Centres are required to notify us promptly of any learners who they believe have been adversely affected and request that we give special consideration. Further information can be found in the special requirements section on our website.

## Conducting external assessments

Centres must make arrangement for the secure delivery of external assessments. All centres offering external assessments must comply with the Joint Council for Qualifications (JCQ) document *Instructions for conducting examinations*. The current version of this document is available on our website.

## Dealing with malpractice in assessment

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Malpractice means acts that undermine the integrity and validity of assessment, the certification of qualifications and/or may damage the authority of those responsible for delivering the assessment and certification.

Pearson does not tolerate actual or attempted actions of malpractice by learners, centre staff or centres in connection with Pearson qualifications. Pearson may impose penalties and/or sanctions on learners, centre staff or centres where malpractice or attempted malpractice has been proven.

Malpractice may occur or be suspected in relation to any unit or type of assessment within a qualification. For further details on malpractice and advice on preventing malpractice by learners, please see Pearson's *Centre Guidance: Dealing with Malpractice*, available on our website.

Centres are required to take steps to prevent malpractice and to investigate instances of suspected malpractice. Learners must be given information that explains what malpractice is for internal assessment and how suspected incidents will be dealt with by the centre. The *Centre Guidance: Dealing with Malpractice* document gives full information on the actions we expect you to take.

Pearson may conduct investigations if we believe a centre is failing to conduct internal assessment according to our policies. The above document gives further information and examples and details the penalties and sanctions that may be imposed.

In the interests of learners and centre staff, centres need to respond effectively and openly to all requests relating to an investigation into an incident of suspected malpractice.

### Learner malpractice

The head of centre is required to report incidents of suspected learner malpractice that occur during Pearson qualifications. We ask centres to complete JCQ Form M1 ([www.jcq.org.uk/malpractice](http://www.jcq.org.uk/malpractice)) and email it with any accompanying documents (signed statements from the learner, invigilator, copies of evidence, etc) to the Investigations Processing team at [candidatemalpractice@pearson.com](mailto:candidatemalpractice@pearson.com). The responsibility for determining appropriate sanctions or penalties to be imposed on learners lies with Pearson.

Learners must be informed at the earliest opportunity of the specific allegation and the centre's malpractice policy, including the right of appeal. Learners found guilty of malpractice may be disqualified from the qualification for which they have been entered with Pearson.

Failure to report malpractice constitutes staff or centre malpractice.

## Teacher/centre malpractice

The head of centre is required to inform Pearson's Investigations team of any incident of suspected malpractice (which includes maladministration) by centre staff, before any investigation is undertaken. The head of centre is requested to inform the Investigations team by submitting a JCQ M2 Form (downloadable from [www.jcq.org.uk/malpractice](http://www.jcq.org.uk/malpractice)) with supporting documentation to [pqsmalpractice@pearson.com](mailto:pqsmalpractice@pearson.com). Where Pearson receives allegations of malpractice from other sources (for example Pearson staff, anonymous informants), the Investigations team will conduct the investigation directly or may ask the head of centre to assist.

Pearson reserves the right in cases of suspected malpractice to withhold the issuing of results/certificates while an investigation is in progress. Depending on the outcome of the investigation, results and/or certificates may not be released, or they may be withheld.

We reserve the right to withhold certification when undertaking investigations, audits and quality assurance processes. You will be notified within a reasonable period of time if this occurs.

## Sanctions and appeals

Where malpractice is proven, we may impose sanctions or penalties, such as:

- mark reduction for affected external assessments
- disqualification from the qualification
- debarment from registration for Pearson qualifications for a period of time.

If we are concerned about your centre's quality procedures, we may impose sanctions such as:

- working with centres to create an improvement action plan
- requiring staff members to receive further training
- placing temporary blocks on the centre's certificates
- placing temporary blocks on registration of learners
- debarring staff members or the centre from delivering Pearson qualifications
- suspending or withdrawing centre approval status.

The centre will be notified if any of these apply.

Pearson has established procedures for centres that are considering appeals against penalties and sanctions arising from malpractice. Appeals against a decision made by Pearson will normally be accepted only from the head of centre (on behalf of learners and/or members or staff) and from individual members (in respect of a decision taken against them personally). Further information on appeals can be found in the *JCQ Appeals booklet* (<https://www.jcq.org.uk/exams-office/appeals>).

## 9 Centre recognition and approval

Centres that have not previously offered BTEC Specialist qualifications need to apply for, and be granted, centre recognition as part of the process for approval to offer individual qualifications.

Existing centres will be given 'automatic approval' for a new qualification if they are already approved for a qualification that is being replaced by a new qualification and the conditions for automatic approval are met.

Centres offering mandatory qualifications for the Apprenticeship Standards must be listed on the Education and Skills Funding Agency's Register of Training Organisations and have a contract to deliver these.

Guidance on seeking approval to deliver BTEC qualifications is given on our website.

### Approvals agreement

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All centres are required to enter into an approval agreement with Pearson, in which the head of centre or principal agrees to meet all the requirements of the qualification specification and to comply with the policies, procedures, codes of practice and regulations of Pearson and relevant regulatory bodies. If centres do not comply with the agreement, this could result in the suspension of certification or withdrawal of centre or qualification approval.

# 10 Unit

This section explains how the unit is structured. It is important that all tutors, assessors, internal verifiers and other staff responsible for the programme review this section.

The unit has the following sections.

## **Unit number**

The number of the unit in the sequence shown in the specification.

## **Unit title**

This is the formal title of the unit that will appear on the learner's certificate.

## **Level**

The unit and the qualification have a level assigned to them. The level assigned is informed by the level descriptors defined by Ofqual, the qualifications regulator.

## **Guided Learning Hours (GLH)**

This indicates the number of hours of activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, for example lectures, tutorials, online instruction and supervised study.

Pearson has consulted with users of the qualification and has assigned a number of hours to this activity for the unit.

## **Unit introduction**

This is designed with learners in mind. It indicates why the unit is important, what will be learned and how the learning might be applied in the workplace.

## **Learning outcomes**

The learning outcomes set out what a learner knows, understands or is able to do as the result of a process of learning.

## **Assessment criteria**

The assessment criteria specify the standard the learner is required to meet to achieve a learning outcome.

## Unit content

This section sets out the required teaching content of the unit and specifies the knowledge and understanding required for achievement of the unit. It enables centres to design and deliver a programme of learning that will enable learners to achieve each learning outcome and to meet the standard determined by the assessment criteria.

Where it is designed to support apprenticeships, the unit content is informed by the knowledge and understanding requirements of the relevant Apprenticeship Standard.

### Relationship between unit content and assessment criteria

The content in the unit is mandatory for the assessments and will be sampled across different versions of the assessment over time. Learners can be tested on any aspect of the content.

Learners should be asked to complete summative assessment only after the teaching content for the unit or learning outcomes has been covered.

### Legislation

Legislation cited in the unit is current at time of publication. The most recent legislation should be taught and assessed internally. External assessments will use the most recent legislation.

### Essential information for tutors and assessors

This section gives information to support delivery and the implementation of assessment. It contains the following subsections.

- *Essential resources* – lists any specialist resources needed to deliver the unit. The centre will be asked to make sure that these resources are in place when it seeks approval from Pearson to offer the qualification.
- *Assessment* – this section gives details of the format, structure and any specific conditions of the external assessment.



# Unit 1: Software Languages

**Level:** 4

**Guided Learning Hours:** 120

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## Unit introduction

This unit gives you the knowledge you need to enable you to interpret design documentation and specifications, for which software developers will have responsibility as part of an overall project. The unit will also give you an understanding of basic algorithmic processing and the elements of programming logic.

To develop a programmed software solution that meets business and user needs, it is necessary to understand the problem and be clear in terms of user requirements. Issues are often caused by poor understanding of user need, as well as poor planning.

Software developers do not arrive at a finished design immediately, instead developing design iteratively through a number of different versions. The primary role of the software developer is to design, create, test and implement high-quality code for a variety of platforms.

A software developer helps organisations in a range of industries to meet their business needs by developing effective, efficient, robust and often innovative applications.

You will understand the fundamental concepts of software languages used in the computing industry, including software design, the principles of different coding languages and the importance of having a secure development.

## Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria	
1	Understand software design concepts, considerations and documentation	1.1	Describe the fundamental concepts of software design
		1.2	Explain the importance of software design considerations
		1.3	Explain how to implement a software design document
2	Understand the need for design patterns in software design	2.1	Identify the documentation needed for design patterns in software design
		2.2	Explain the use of design patterns in software design
3	Understand the need for secure development	3.1	Explain each phase within the secure development lifecycle
		3.2	Describe common security threats to software
		3.3	Identify ways to reduce the security threats to software
		3.4	Identify the key techniques for defensive programming
4	Understand how to develop maintainable software and re-use code	4.1	Describe how to develop maintainable software
		4.2	Describe the types of code re-use
		4.3	Describe the advantages and disadvantages of code re-use

Learning outcomes		Assessment criteria	
5	Understand how to apply programming logic in different programming languages	5.1	Explain the use of fundamental principles and concepts within procedural languages
		5.2	Explain the use of fundamental principles and concepts within object-orientated languages
		5.3	Interpret common programming control structures that are used when developing code
		5.4	Explain the need for and use of common data structures when developing code
		5.5	Explain how different types of algorithms are used to solve problems
		5.6	Interpret how standard sorting algorithms are applied using pseudocode notation
		5.7	Interpret how standard searching algorithms are applied using pseudocode notation

## Unit content

### What needs to be learned

#### Learning outcome 1: Understand software design concepts, considerations and documentation

##### *Describe the fundamental concepts of software design*

- Abstraction:
  - extracts the essential information relevant to a particular purpose
  - process (hides relevant details; represents essential features of an item)
  - entity (model or view of an item)
  - common abstraction mechanisms
    - functional (involves the use of parameterized subprograms)
    - data (involves specifying data that describes a data object)
    - control
    - (states the desired effect, without stating the exact mechanism of control).
- Refinement:
  - used for decomposing a system from a high level of abstraction into a more detailed level (lower level) of abstraction
  - top down design approach
  - creates a sequence of compositions for the system being designed.
- Modularity:
  - divides the software into uniquely named and addressable components (modules)
  - each module can be developed independent of other modules
  - modules integrated together to meet the software requirements.
- Architecture:
  - provides an insight to all the interested stakeholders that enable them to communicate with each other
  - highlights early design decisions
  - creates intellectual models of how the system is organised into components.
- Refactoring:
  - simplifies the design of components without changing its function behaviour
  - process of changing the software system in a way that it does not change the external behaviour of the code.

## What needs to be learned

- Information hiding:
  - hides unnecessary details
  - useful when modifications are required during the testing and maintenance phase.

### ***Explain the importance of software design considerations***

- Compatibility:
  - able to operate with other products.
- Extensibility:
  - new features can be added without major changes to the software architecture.
- Modularity:
  - the software comprises well defined, independent components which leads to better maintainability.
- Fault-tolerance:
  - the software is resistant to and able to recover from component failure.
- Maintainability:
  - a measure of how easily bug fixes or functional modifications can be accomplished.
- Reliability:
  - the software can perform a required function under stated conditions for a specified period.
- Reusability
  - the ability to use some or all the aspects of the pre-existing software in other projects with little to no modification.
- Robustness:
  - the software can operate under stress or tolerate unpredictable or invalid input.
- Security:
  - the software can withstand and resist hostile acts and influences.
- Usability:
  - the software user interface must be usable for its target user/audience.

### ***Explain how to implement a software design document***

- Goals and vision:
  - software goals

## What needs to be learned

- software vision.
- Requirements:
  - user requirements (accessibility, who will use the software, what will they use the software for).
  - functional requirements (failure conditions, main purpose and how quickly it does it, input types and their limitations).
- User interface:
  - wireframes (transitions, error handling and constraints).
- Milestones and prioritisation:
  - completion deadlines
  - expected delivery
  - prioritize functionality.

## What needs to be learned

### Learning outcome 2: Understand the need for design patterns in software design

#### ***Identify the documentation needed for design patterns in software design***

- Pattern name and classification.
- Intent
  - identification of goals
  - identification of reasons.
- Motivation
  - problem where pattern can be used
  - context which pattern can be used.
- Applicability
  - situation where pattern can be used
  - context for pattern.
- Structure
  - class diagrams
  - interaction diagrams.
- Participants
  - listing of classes
  - listing of objects
- Consequences
  - results of using pattern
  - side effects of using pattern.
- Implementation.
- Sample code.

#### ***Explain the use of design patterns in software design***

- Creational patterns
  - abstract factory
  - builder
  - dependency injection
  - factory method
  - object pool
  - singleton.

## What needs to be learned

- Structural patterns
  - adapter
  - bridge
  - composite
  - decorator
  - façade
  - flyweight
  - front controller
  - marker
  - module.
- Behavioural patterns
  - blackboard
  - chain of responsibility
  - command
  - interpreter
  - iterator
  - mediator
  - memento
  - null object
  - servant
  - state
  - strategy.
- Concurrency patterns
  - active object
  - balking
  - binding properties
  - compute kernel
  - double-checked locking
  - event-based asynchronous
  - join
  - lock.



## What needs to be learned

### Learning outcome 3: Understand the need for secure development

#### ***Explain each phase within the secure development lifecycle***

- Requirements phase
  - user stories
  - define functional security requirements.
- Design phase
  - threat modelling.
- Development phase
  - secure coding standards
  - implementation tools
    - static application security testing (SAST)
    - dynamic application security testing (DAST).
- Testing phase
  - security functional test plans
  - vulnerability scanning
  - penetration testing.
- implementation phase
  - incident response team
  - security champions
  - bug bounties.

#### ***Describe common security threats to software***

- Security threats to software:
  - insider threats (malicious and accidental)
  - denial-of-service (DoS) attacks
  - SQL injection
  - buffer overflow
  - insecure application programming interfaces (APIs)
  - malware
  - spyware
  - worms

## What needs to be learned

- trojans
- viruses
- adware
- ransomware.

### ***Identify ways to reduce the security threats to software***

- Integrate an industry-standard security model.
- Educate personnel on security software.
- Perform architecture reviews and threat modelling.
- Carry out code reviews.
- Perform penetration tests.

### ***Identify the key techniques for defensive programming***

- Techniques:
  - sanitising inputs.
  - Protecting routine from bad data.
  - Using assertions to document preconditions and post-conditions.
  - Standardising exception handling in the code.
  - Performing null checks.

## What needs to be learned

### Learning outcome 4: Understand how to develop maintainable software and re-use code

#### ***Describe how to develop maintainable software***

- Design for maintainability from the outset.
- Iterative development and regular reviews help to improve quality.
- Readable code is easy to understand.
- Refactor code to improve its understandability.
- Relevant documentation helps developers understand the software.
- Automated build makes the code easy to compile.
- Automated tests make it easy to validate changes.
- Continuous integration makes the code easier to build and test.
- Version control helps keep code, tests and documentation up to date and synchronised.

#### ***Describe the types of code re-use***

- Opportunistic
  - finding existing code that can be used for a project.
- Planned
  - strategically designing components so that they'll be reusable in future projects.
- Internal
  - reusing an organisations own component.
- External
  - license a third-party component.
- Referenced
  - code contains a reference to reused code, they have distinct life cycles and can have distinct versions.
- Forked
  - code contains a local or private copy of the reused code, they share a single life cycle and a single version.

#### ***Describe the advantages and disadvantages of code re-use***

- Advantages
  - increased reliability

## What needs to be learned

- fewer development risks
- capitalise on expert skills
- adopt standards
- decrease development time.
- Disadvantages
  - a maintenance
  - long term reused code maintenance
  - tool support
  - not invented here syndrome
  - searching, evaluating, and adopting reused code.

## What needs to be learned

### Learning outcome 5: Understand how to apply programming logic in different programming languages

#### ***Explain the use of fundamental principles and concepts within procedural languages***

- Statements (lines of code in sequence).
- Blocks (one or more declarations or statements).
- Procedures (independent code module that fulfils some concrete task and is referenced within a larger body of source code).
- Modularity (splits program up into small parts or chunks, each one of these chunks contribute to the program and performs a task).
- Tools and techniques (functions, procedures, libraries, parameters, debugging).

#### ***Explain the use of fundamental principles and concepts within object-orientated languages***

- Classes (instance of an object, a user-defined data type, which holds its own data members and member functions).
- Objects (specific instance of a class; it contains real values instead of variables).
- Abstraction (handles complexity by hiding unnecessary details from the user).
- Encapsulation (bundles data and methods that work on that data within one unit).
- Inheritance (reusability, enables new objects to take on the properties of existing objects).
- Polymorphism (the ability of a variable, function or object to take on multiple forms).
- Tools and techniques (predefined functions, templates, integrated development environment (IDE)).

#### ***Interpret common programming control structures that are used when developing code***

- Sequence
  - line by line execution.
- Selection
  - if...then...else
  - ELSEIF (ELIF)
  - nested if
  - case/switch.

## What needs to be learned

- Iteration
  - repeat
  - for
  - while
  - do-while.

### ***Explain the need for and use of common data structures when developing code***

- Linked list
  - Need
    - don't know how many items will be included
    - need constant-time insertions/deletions
    - don't need random access to any elements.
  - Use
    - dynamic
    - allocates and reallocates memory.
- Array
  - Need
    - need indexed/random access to elements
    - know the number of elements ahead of time
    - need speed when iterating through all the elements in sequence.
  - Use
    - static
    - saves memory
    - cache friendly
    - easier to debug
    - multi-dimensional.
- Stack
  - Need
    - backtracking features
    - recursive algorithms
    - to get things out in the reverse order than you put them in.

## What needs to be learned

- Use
  - Dynamic
  - Last in First Out (LIFO).
- Queue
  - Need
    - first come first served application
    - breadth first search
    - to get things out in the order that you put them in.
  - Use
    - First in First Out (FIFO)
    - circular queue
    - linear queue.

### ***Explain how different types of algorithms are used to solve problems***

- Recursive
  - solves the base case directly
  - recurs with a simpler input each time.
- Backtracking
  - attempt to solve a sub-problem
  - desired outcome not reached, undo and start again.
- Dynamic
  - breaks down problem into several simpler sub-problems
  - solves each sub-problem only once
  - remembers past result and uses it to find new result.
- Divide and conquer
  - divides problem into smaller sub-problem of the same type
  - solves them recursively and then combines them to form the solution of the original problem.
- Greedy
  - takes optimal solution at the local level (without regards for any consequences) with the hope of finding optimal solution at the global level.

## What needs to be learned

- Brute force
  - tries all the possibilities until a satisfactory solution is found.

### ***Interpret how standard sorting algorithms are applied using pseudocode notation***

- Bubble.
- Quick.
- Insertion.
- Merge.
- Bucket.

### ***Interpret how standard searching algorithms are applied using pseudocode notation***

- Linear.
- Binary.
- Jump.
- Sublist.



## Essential information for tutors and assessors

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### Essential resources

There are no special resources needed for this unit.

### Assessment

This section must be read in conjunction with *Section 8 Assessment*.

This unit is externally assessed through an onscreen test, which is set and marked by Pearson. The test lasts for 1 hour and is worth 30 marks. The assessment is available on demand.

The test assesses all of the learning outcomes. The questions in the test are based on each assessment criterion and its associated unit content.

The test consists of multiple-choice items.

Items in the test will not necessarily be sequenced in the order of the criteria in the unit. Test items will not rely on or directly follow on from another test item. Test items may use colour images/diagrams/graphs for the context of the question or for the answer options.

A Pass grade is determined by learners achieving a defined cut score (pass mark).

# 11 Suggested teaching resources

This section lists resource materials that can be used to support the delivery of the unit across the qualification.

## Textbooks

Gamma E, Helm R, Johnson R – *Design Patterns: Elements of Reusable Object-Oriented Software* (Addison Wesley, 1994) ISBN 9780201633610

Bass L, Clements P, Kazman R – *Software Architecture in Practice (SEI Software Engineering)* (Addison Wesley, 2012) ISBN 9780321815736

Chemuturi M – *Software Design: A Comprehensive Guide to Software Development Projects* (Chapman and Hall, 2018) ISBN 9780815382768

Klimczak E – *Design for Software: A Playbook for Developers* (Wiley, 2013) ISBN 978-1119942900

Martin R – *The Clean Coder: A Code of Conduct for Professional Programmers* (Prentice Hall, 2011) ISBN 9780137081073

Richardson T, Thies C – *Secure Software Design* (Jones & Bartlett Learning, 2012) ISBN 978 1449626327

## 12 Further information and useful publications

To get in touch with us visit our 'Contact us' pages:

- Edexcel, BTEC and Pearson Work Based Learning contact details: [qualifications.pearson.com/en/support/contact-us.html](https://qualifications.pearson.com/en/support/contact-us.html).
- Books, software and online resources for UK schools and colleges: [www.pearsonschoolsandfecolleges.co.uk](http://www.pearsonschoolsandfecolleges.co.uk).

Key publications

- *Access arrangements and reasonable adjustments* (Joint Council for Qualifications (JCQ))
- *A guide to recruiting learners onto Pearson qualifications* (Pearson)
- *A guide to the special consideration process* (JCQ)
- *Guide to BTEC Quality Assurance* (Pearson)
- *Collaborative and consortium arrangements for the delivery of vocational qualifications policy* (Pearson)
- *Enquiries and appeals about Pearson vocational qualifications and end point assessment policy* (Pearson)
- *Equality, diversity and inclusion policy* (Pearson)
- *Guidance for reasonable adjustments and special consideration in vocational internally assessed units* (Pearson)
- *Suspected malpractice in examinations and assessments – Policies and procedures* (JCQ)
- *UK Information Manual* (Pearson)
- *Use of languages in qualifications policy* (Pearson).

All of these publications are available on our website.

Publications on the quality assurance of BTEC qualifications are also available on our website.

Our publications catalogue lists all the material available to support our qualifications. To access the catalogue and order publications, please visit our website.

### **Additional resources**

If you need further learning and teaching materials to support planning and delivery for your learners, there is a wide range of BTEC resources available.

Any publisher can seek endorsement for their resources and, if they are successful, we will list their BTEC resources on our website.

# 13 Professional development and training

Pearson supports UK and international customers with training related to BTEC qualifications. This support is available through a choice of training options offered on our website.

The support we offer focuses on a range of issues, such as:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing learner-centred learning and teaching approaches
- building in effective and efficient quality assurance systems.

The national programme of training we offer is on our website. You can request centre-based training through the website or you can contact one of our advisers in the Training from Pearson UK team via Customer Services to discuss your training needs.

## BTEC training and support for the lifetime of the qualifications

**Training and networks:** our training programme ranges from free introductory events through sector-specific opportunities to detailed training on all aspects of delivery, assignments and assessment. We also host some regional network events to allow you to share your experiences, ideas and best practice with other BTEC colleagues in your region.

**Regional support:** our team of Curriculum Development Managers and Curriculum Support Consultants, based around the country, are responsible for providing advice and support in centres. They can help you with planning and curriculum developments.

To get in touch with our dedicated support teams please visit our website.

## Your Pearson support team

Whether you want to talk to a sector specialist, browse online or submit your query for an individual response, there's someone in our Pearson support team to help you whenever – and however – you need:

- **Subject Advisors:** find out more about our subject advisor team – immediate, reliable support from a fellow subject expert
- **Ask the Expert:** submit your question online to our Ask the Expert online service and we will make sure your query is handled by a subject specialist.

Please visit our website at [qualifications.pearson.com/en/support/contact-us.html](https://qualifications.pearson.com/en/support/contact-us.html)

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