# Digital Solutions 2019 v1.2

General Senior Syllabus

This syllabus is for implementation with Year 11 students in 2019.

Queensland Government | Queensland Curriculum & Assessment Authority

For all Queensland schools

170147

# Contents

# 1 Course overview

## 1.1 Introduction

### 1.1.1 Rationale

Technologies have been an integral part of society for as long as humans have had the desire to create solutions to improve their own and others' quality of life. Technologies have an impact on people and societies by transforming, restoring and sustaining the world in which we live.

Australia needs enterprising and innovative individuals with the ability to make discerning decisions concerning the development, use and impact of technologies. When developing technologies, these individuals need to be able to work independently and collaboratively to solve open-ended problems. Subjects in the Technologies learning area prepare students to be effective problem-solvers as they learn about and work with contemporary and emerging technologies.

In Digital Solutions, students learn about algorithms, computer languages and user interfaces through generating digital solutions to problems. They engage with data, information and applications to create digital solutions that filter and present data in timely and efficient ways while understanding the need to encrypt and protect data. They understand computing's personal, local and global impact, and the issues associated with the ethical integration of technology into our daily lives.

Students engage in problem-based learning that enables them to explore and develop ideas, generate digital solutions, and evaluate impacts, components and solutions. They understand that solutions enhance their world and benefit society. To generate digital solutions, students analyse problems and apply computational, design and systems thinking processes. Students understand that progress in the development of digital solutions is driven by people and their needs.

Learning in Digital Solutions provides students with opportunities to create, construct and repurpose solutions that are relevant in a world where data and digital realms are transforming entertainment, education, business, manufacturing and many other industries. Australia's workforce and economy requires people who are able to collaborate, use creativity to be innovative and entrepreneurial, and transform traditional approaches in exciting new ways.

By using the problem-based learning framework, students develop confidence in dealing with complexity, as well as tolerance for ambiguity and persistence in working with difficult problems that may have many solutions. Students are able to communicate and work with others in order to achieve a common goal or solution. Students write computer programs to create digital solutions that: use data; require interactions with users and within systems; and affect people, the economy and environments. Solutions are developed using combinations of readily available hardware and software development environments, code libraries or specific instructions provided through programming. Some examples of digital solutions include instructions for a robotic system, an instructional game, a productivity application, products featuring interactive data, animations and websites.

Digital Solutions prepares students for a range of careers in a variety of digital contexts. It develops thinking skills that are relevant for digital and non-digital real-world challenges. It prepares them to be successful in a wide range of careers and provides them with skills to engage in and improve the society in which we work and play. Digital Solutions develops the 21st century skills of critical and creative thinking, communication, collaboration and teamwork,

personal and social skills, and information and communication technologies (ICT) skills that are critical to students' success in further education and life.

## Assumed knowledge, prior learning or experience

Students will have prior knowledge of the Australian Curriculum: Technologies, which is core in Years 7 and 8.

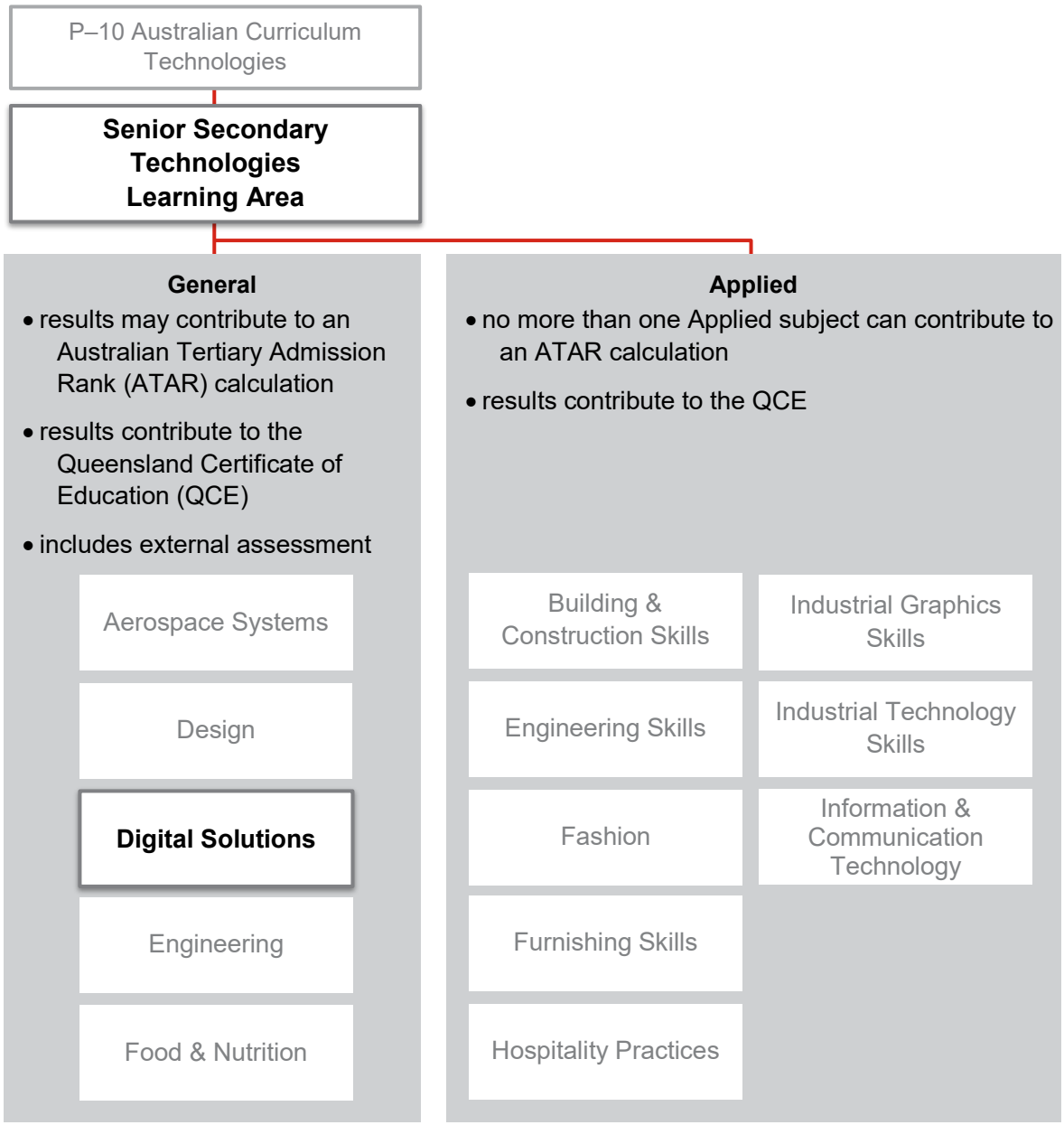
## Pathways

Digital Solutions is a General subject suited to students who are interested in pathways beyond school that lead to tertiary studies, vocational education or work. A course of study in Digital Solutions can establish a basis for further education and employment in the fields of science, technologies, engineering and mathematics.

## 1.1.2 Learning area structure

All learning areas build on the P–10 Australian Curriculum.

**Figure 1: Learning area structure**



### 1.1.3 Course structure

Digital Solutions is a course of study consisting of four units. Subject matter, learning experiences and assessment increase in complexity from Units 1 and 2 to Units 3 and 4 as students develop greater independence as learners.

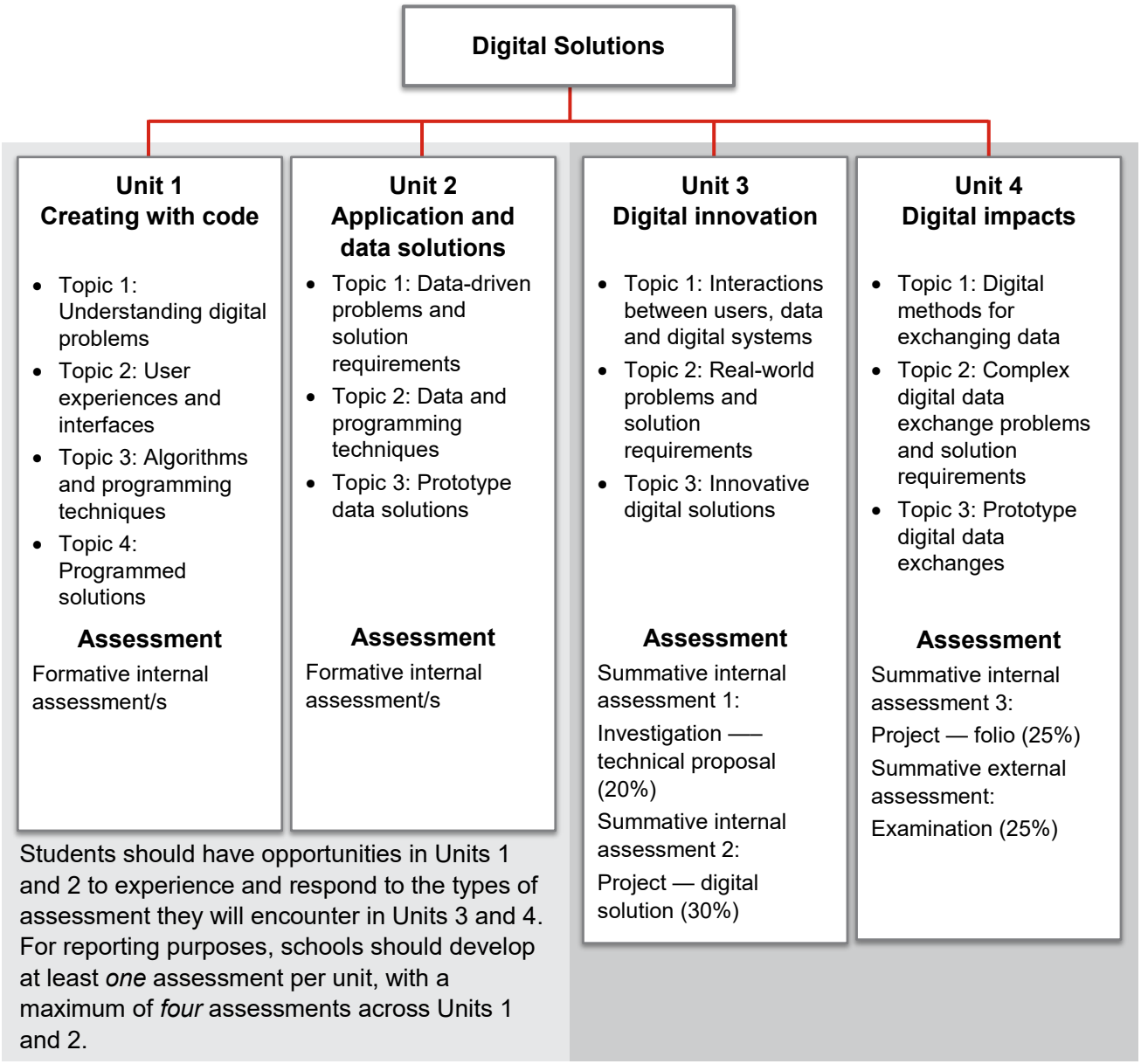
Units 1 and 2 provide foundational learning, which allows students to experience all syllabus objectives and begin engaging with the course subject matter. Students should complete Units 1 and 2 before beginning Unit 3. It is recommended that Unit 3 be completed before Unit 4.

Units 3 and 4 consolidate student learning. Only the results from Units 3 and 4 will contribute to ATAR calculations.

Figure 2 outlines the structure of this course of study.

Each unit has been developed with a notional time of 55 hours of teaching and learning, including assessment.

**Figure 2: Course structure**



# 1.2 Teaching and learning

## 1.2.1 Syllabus objectives

The syllabus objectives outline what students have the opportunity to learn. Assessment provides evidence of how well students have achieved the objectives.

Syllabus objectives inform unit objectives, which are contextualised for the subject matter and requirements of the unit. Unit objectives, in turn, inform the assessment objectives, which are further contextualised for the requirements of the assessment instruments. The number of each objective remains constant at all levels, i.e. Syllabus objective 1 relates to Unit objective 1 and to Assessment objective 1 in each assessment instrument.

Syllabus objectives are described in terms of actions that operate on the subject matter. Students are required to use a range of cognitive processes in order to demonstrate and meet the syllabus objectives. These cognitive processes are described in the explanatory paragraph following each objective in terms of four levels: retrieval, comprehension, analytical processes (analysis), and knowledge utilisation, with each process building on the previous processes (see Marzano & Kendall 2007, 2008). That is, comprehension requires retrieval, and knowledge utilisation requires retrieval, comprehension and analytical processes (analysis).

By the conclusion of the course of study, students will:

| Syllabus objective | Unit 1 | Unit 2 | Unit 3 | Unit 4 |
|---|---|---|---|---|
| 1. recognise and describe elements, components, principles and processes | • | • | • | • |
| 2. symbolise and explain information, ideas and interrelationships | • | • | • | • |
| 3. analyse problems and information | • | • | • | • |
| 4. determine solution requirements and criteria | • | • | • | • |
| 5. synthesise information and ideas to determine possible digital solutions | • | • | • | • |
| 6. generate components of the digital solution | • | • | • | • |
| 7. evaluate impacts, components and solutions against criteria to make refinements and justified recommendations | • | • | • | • |
| 8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts | • | • | • | • |

**1. recognise and describe elements, components, principles and processes**

When students recognise, they identify or recall facts and particular features of elements, components, principles and processes used in digital technologies. When students describe, they give an account of elements, components, principles and processes in technology contexts.

**2. symbolise and explain information, ideas and interrelationships**

When students symbolise, they represent information, idea development and system interrelationships in pseudocode, algorithms, code, models, sketches, diagrams, tables and/or schemas. When students explain, they make information, ideas and interrelationships clear by describing them in more detail or revealing relevant facts.

3. **analyse problems and information**

   When students analyse, they breakdown and examine problems and information to ascertain patterns, similarities and differences in order to identify elements, components and features, and their relationship to the structure of problems. They determine the logic and reasonableness of information by using systems thinking and decomposition, pattern recognition, and abstraction computational thinking.

4. **determine solution requirements and criteria**

   When students determine solution requirements and prescribed and self-determined criteria, they establish, conclude or ascertain the interface, algorithm, programming and identified solution needs and constraints.

5. **synthesise information and ideas to determine possible digital solutions**

   When students synthesise, they combine and integrate information and ideas, and resolve uncertainties using design, systems and computational thinking to create new understanding and identify possible digital solutions.

6. **generate components of the digital solution**

   When students generate, they use information, software, programming tools and skills to create components of an identified digital solution.

7. **evaluate impacts, components and solutions against criteria to make refinements and justified recommendations**

   When students evaluate, they appraise impacts, components and solutions by weighing up or assessing strengths, implications and limitations against prescribed and self-determined criteria. When students make refinements, they make partial or minor changes to improve the user experience and technical operation based on criteria. They use testing to evaluate and refine components and solutions based on criteria. When students make justified recommendations, they use supporting evidence to suggest enhancements.

8. **make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts**

   When students make decisions about mode-appropriate features, language and conventions, they use written, visual and spoken features to express meaning for particular purposes in a range of contexts. Written communication includes language conventions, specific vocabulary and language features such as annotations, paragraphs and sentences. Visual communication includes photographs, sketches, drawings, diagrams and motion graphics. Visual features include the elements and principles of visual communication. Spoken communication includes verbal and nonverbal features and may be for live or virtual audiences. Students use referencing conventions to practise ethical scholarship.

### 1.2.2 Underpinning factors

There are three skill sets that underpin senior syllabuses and are essential for defining the distinctive nature of subjects:

- literacy — the set of knowledge and skills about language and texts essential for understanding and conveying Digital Solutions content
- numeracy — the knowledge, skills, behaviours and dispositions that students need to use mathematics in a wide range of situations, to recognise and understand the role of mathematics in the world, and to develop the dispositions and capacities to use mathematical knowledge and skills purposefully

- 21st century skills — the attributes and skills students need to prepare them for higher education, work and engagement in a complex and rapidly changing world.

These skill sets, which overlap and interact, are derived from current education, industry and community expectations and encompass the knowledge, skills, capabilities, behaviours and dispositions that will help students live and work successfully in the 21st century.

Together these three skill sets shape the development of senior subject syllabuses. Although coverage of each skill set may vary from syllabus to syllabus, students should be provided with opportunities to learn through and about these skills over the course of study. Each skill set contains identifiable knowledge and skills that can be directly assessed.

## Literacy in Digital Solutions

Students develop digital literacy knowledge and skills as they:

- communicate information, ideas and detailed proposals to a variety of audiences
- read and interpret detailed written instructions for specific technologies, including diagrams and procedural writings such as software user manuals, design briefs, data patterns and pseudocode
- develop annotated drawings, software instructions and code
- write outlines, briefs, proposals, evaluations and reports.

Digital Solutions requires students to develop literacy skills that facilitate the effective communication of graphical and technical information, ideas and solutions to open-ended problems. Effective communication in Digital Solutions requires students to learn how to organise and manipulate information in logical sequences to convey meaning to particular audiences for specific purposes. Students develop and enhance this capacity through their learning experiences and by documenting the problem-solving process in Digital Solutions. They improve their ability to use knowledge of language conventions, textual features and mode-appropriate communication skills as they progress through the course of study.

These aspects of literacy knowledge and skills are embedded in the syllabus objectives, unit objectives and subject matter, and instrument-specific marking guides (ISMGs) for Digital Solutions.

## Numeracy in Digital Solutions

Numeracy encompasses the knowledge and skills that students need to:

- use digital technologies in a wide range of situations
- recognise and understand the role of digital technologies in the world
- develop the dispositions and capacities to use these skills and knowledge purposefully.

Students use mathematical knowledge and skills to:

- calculate and estimate
- interpret and draw conclusions from statistics
- logically develop algorithms and data throughout the process of generating ideas
- develop, test and refine components.

In using software, materials, tools and equipment, students work with the concepts of number, variable, geometry, scale, proportion and measurement.

Students create accurate technical representations, work with digital models and use computational thinking in decision-making processes when planning, developing and generating best-fit solutions.

These aspects of numeracy knowledge and skills are embedded in the syllabus objectives, unit objectives and subject matter, and ISMGs for Digital Solutions.

## 21st century skills

The 21st century skills identified in this syllabus reflect a common agreement, both in Australia and internationally, on the skills and attributes students need to prepare them for higher education, work and engagement in a complex and rapidly changing world.

| 21st century skills | Associated skills | 21st century skills | Associated skills |
|---|---|---|---|
| critical thinking | • analytical thinking<br>• problem-solving<br>• decision-making<br>• reasoning<br>• reflecting and evaluating<br>• intellectual flexibility | creative thinking | • innovation<br>• initiative and enterprise<br>• curiosity and imagination<br>• creativity<br>• generating and applying new ideas<br>• identifying alternatives<br>• seeing or making new links |
| communication | • effective oral and written communication<br>• using language, symbols and texts<br>• communicating ideas effectively with diverse audiences | collaboration and teamwork | • relating to others (interacting with others)<br>• recognising and using diverse perspectives<br>• participating and contributing<br>• community connections |
| personal and social skills | • adaptability/flexibility<br>• management (self, career, time, planning and organising)<br>• character (resilience, mindfulness, open- and fair-mindedness, self-awareness)<br>• leadership<br>• citizenship<br>• cultural awareness<br>• ethical (and moral) understanding | information & communication technologies (ICT) skills | • operations and concepts<br>• accessing and analysing information<br>• being productive users of technology<br>• digital citizenship (being safe, positive and responsible online) |

Digital Solutions helps develop the following 21st century skills:

- critical thinking
  - problem-solving using the problem-solving process in Digital Solutions
  - analytical thinking in formulating algorithm and program structures
  - decision-making by making informed choices and justified recommendations

  - intellectual flexibility by being open to alternative ideas and new learning
  - evaluating with purpose against criteria
- creative thinking
  - generating and applying new information and ideas to create and identify strategies to develop innovative solutions
  - using innovation to identify new ways of doing things and opportunities to reimagine solutions
  - demonstrating initiative and enterprise to be self-directed in learning and problem solving
  - demonstrating curiosity and imagination to motivate learning in digital technologies contexts
  - synthesising information and ideas to create new understanding
  - evaluating and refining ideas and solutions to identify alternative possibilities and make new links to knowledge
- communication
  - using and manipulating effective oral, written and visual communication
  - using specialised language, terminology, symbols, diagrams and texts to communicate digital technologies information and ideas effectively with diverse audiences in a range of contexts
- collaboration and teamwork
  - relating and interacting with others to solve problems in digital technologies contexts
  - recognising and using diverse perspectives to determine the influences and personal, social and economic impacts of digital technologies contexts
  - participating and contributing to create personal, team and community connections
- personal and social skills
  - developing personal, social, ethical, economic and legal understandings in digital technologies contexts
  - demonstrating adaptability and flexibility to create digital solutions in a range of digital technologies contexts
  - developing the ability to self-manage time and planning during Digital Solutions problem-solving
  - developing and enhancing the personal characteristics of resilience, mindfulness, open- and fair-mindedness, and self-awareness during Digital Solutions problem-solving
- information & communication technologies (ICT) skills
  - accessing, collating, evaluating, analysing and presenting information from primary and secondary sources
  - being productive users of information and communication technologies to manipulate digital information to ascertain trends, patterns or relationships and effectively communicate development of solutions to a specified audience.

These elements of 21st century skills are embedded in the syllabus objectives, unit objectives and subject matter, and ISMGs for Digital Solutions.

### 1.2.3 Aboriginal perspectives and Torres Strait Islander perspectives

The QCAA is committed to reconciliation in Australia. As part of its commitment, the QCAA affirms that:

- Aboriginal peoples and Torres Strait Islander peoples are the first Australians, and have the oldest living cultures in human history
- Aboriginal peoples and Torres Strait Islander peoples have strong cultural traditions and speak diverse languages and dialects, other than Standard Australian English
- teaching and learning in Queensland schools should provide opportunities for students to deepen their knowledge of Australia by engaging with the perspectives of Aboriginal peoples and Torres Strait Islander peoples
- positive outcomes for Aboriginal students and Torres Strait Islander students are supported by successfully embedding Aboriginal perspectives and Torres Strait Islander perspectives across planning, teaching and assessing student achievement.

Guidelines about Aboriginal perspectives and Torres Strait Islander perspectives and resources for teaching are available at www.qcaa.qld.edu.au/k-12-policies/aboriginal-torres-strait-islander-perspectives.

Where appropriate, Aboriginal perspectives and Torres Strait Islander perspectives have been embedded in the subject matter.

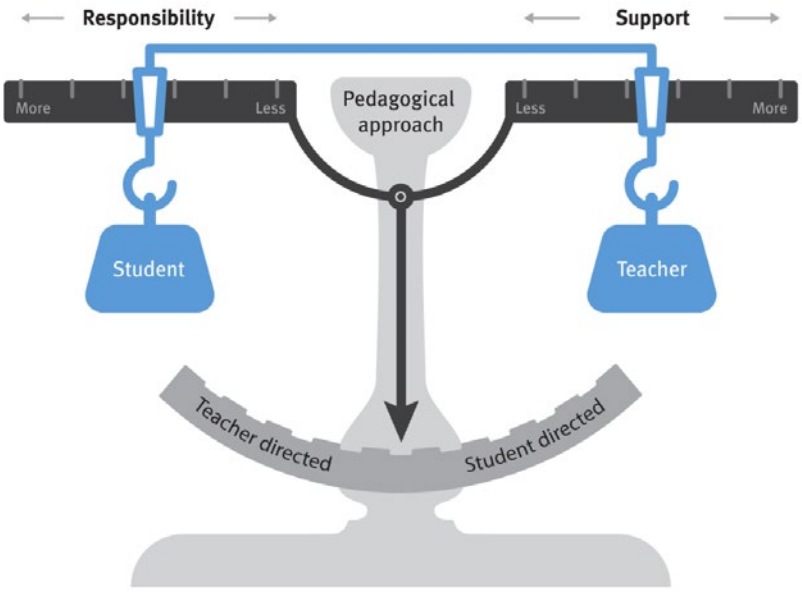
In Digital Solutions, opportunities exist across all four units for student exploration of Aboriginal perspectives and Torres Strait Islander perspectives during the problem-solving process. Students gain an appreciation for and an understanding of Aboriginal peoples' and Torres Strait Islander peoples' communities, cultures, needs and wants as they explore, develop, generate and evaluate sustainable solutions that lead to learning. In Digital Solutions, there are opportunities to explore Aboriginal and Torres Strait Islander data, design, perspectives, culture and history in the content of web pages, games and other applications. Digital Solutions should be developed respectfully in recognition of the inherent connectedness of Aboriginal peoples' and Torres Strait Islander peoples' culture, history, society and place, including plants and animals, and lead to improvements in the quality of people's lives in an increasingly complex and dynamic technological world.

### 1.2.4 Pedagogical and conceptual frameworks

#### Problem-based learning framework

In the Technologies learning area, the problem-based learning framework (as represented in Figure 3) provides the overarching pedagogical basis for the implementation of subject-specific problem-solving processes. Problem-based learning places students in real-world situations where they use skills associated with critical thinking, creative thinking, communication, collaboration and teamwork, personal and social skills, and information & communication technologies (ICT) skills in order to develop solutions that acknowledge personal, social, ethical, economic, legal and sustainability impacts.

**Figure 3: Problem-based learning framework in the Technologies learning area**




In Digital Solutions:

- problem-based learning is an active process of knowledge construction that uses open-ended problems as a stimulus for student learning
- problems that support problem-based learning should
  - challenge and motivate students to engage their interest
  - provide opportunities for students to examine the problem from multiple perspectives or disciplines
  - provide multiple possible solutions and solution paths
  - require students to comprehend and use a breadth and depth of knowledge during problem-solving
  - recognise students' prior knowledge
  - recognise students' stage of cognitive development
  - provide opportunities to allow all students to explore innovative open-ended solutions
  - relate to the real world
- the learning environment is organised to represent the complex nature of the problems students are required to solve, e.g. the learning area values collaboration using teamwork and brainstorming, as these are strategies used during real-world problem-solving
- the teacher is responsible for scaffolding student learning and cognition during problem-solving as a coach, guide or facilitator to maintain the independence and self-directedness of student learning
- self-directed learning does not mean students are self-taught; instead, teachers balance their participation so that students maintain responsibility for learning, e.g. students make decisions about the knowledge and skills they require to effectively solve a problem, supported by the teacher's questioning and cueing strategies
- the perception of student self-direction in the learning process is fundamental to problem-based learning.

## Digital Solutions problems

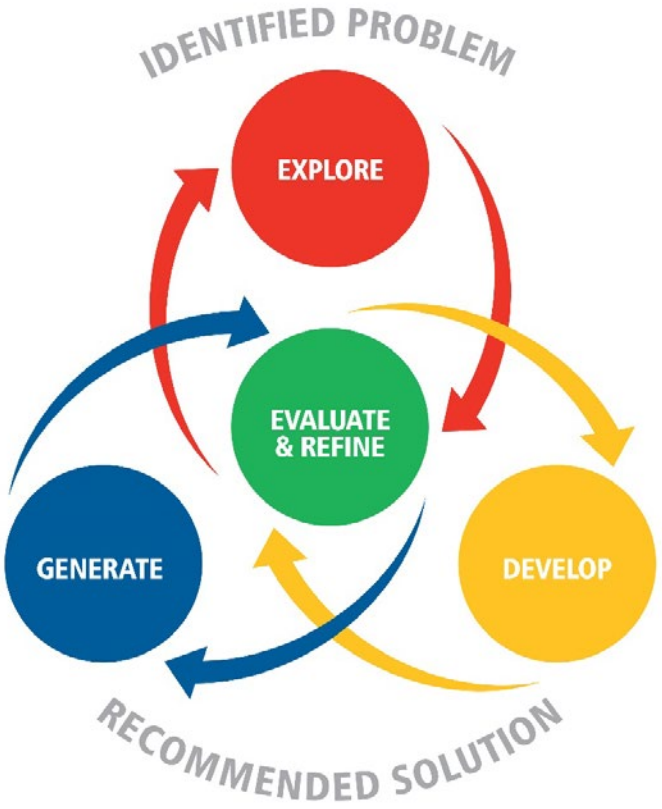
Central to problem-based learning is the provision or identification of suitably challenging, subject-specific, context-relevant, real-world problems. Student engagement with these problems facilitates student learning of Digital Solutions subject matter. Problems suitable for Digital Solutions:

- are identified as any human need, want or opportunity that requires a new or re-imagined digital solution
- are identified by teachers, clients and/or students in situations related to unit-specific and subject-relevant digital technologies elements, components, principles and processes
- promote purposeful analytical activities undertaken in response to an identified real-world related problem that requires a digital solution
- are resolved using the problem-solving process in Digital Solutions.

## The problem-solving process in Digital Solutions

The problem-solving process in Digital Solutions is analytical and technical in nature. The process is iterative, proceeds through a number of phases, requiring students to explore problems, develop ideas, generate components and digital solutions, and evaluate personal, social and economic impacts, components and digital solutions.

**Figure 4: Problem-solving process in Digital Solutions**



### Explore

The explore phase involves students investigating a need, want or opportunity to analyse and understand a digital problem and its relationship to existing solutions.

To explore the problem, students:

- describe problems from a user perspective
- recognise constraints
- use decomposition to dissect problems and existing solutions to similar problems
- use abstraction and pattern recognition to identify essential features of elements, components, relationships and structures of problems
- analyse problems, solutions and information to make decisions about the reasonableness of information and the structure, availability and accuracy of existing problems and solutions
- use systems thinking to identify and understand the relationships between users, solutions and the components of solutions in similar problems
- identify and understand possible solution requirements, such as information, skills and tools, by considering elements, components and features, and their relationship to the structure of the problem
- use design, systems and computational (decomposition, pattern recognition and abstraction) thinking processes to determine evaluation criteria that are used to appraise and make decisions throughout, and at the end of, the problem-solving process in Digital Solutions. Evaluation criteria are prescribed by the teacher or client (prescribed criteria) or determined by the student (self-determined criteria) and must include criteria to evaluate the personal, social and economic impacts, and quality, appropriateness and effectiveness of the developed component or solution
- use design thinking to evaluate ideas that best meet the evaluation criteria.

### Develop

The develop phase involves students creating new understanding and identifying possible solutions using design, systems, and abstraction and algorithmic computational thinking processes. Students evaluate personal, social and economic impacts, components and digital solutions against criteria throughout the develop phase to make decisions and refine the user experience and technical operation of components of the solution.

To develop ideas, students:

- use design thinking to visualise ideas and synthesise information and ideas in response to a digital problem by using drawing and creative skills to represent and communicate ideas
- acquire required information, tools and skills to implement a solution plan
- use computational thinking to apply abstraction procedures to problem components
- use computational thinking to express algorithms
- use systems and design thinking to develop ideas about components and solutions to test conceptual models
- use systems and design thinking to generate creative ideas, identify a solution and evaluate ideas that best meet the criteria for success.

### Generate

The generate phase involves students using information, software, programming tools and skills, and systems and design thinking processes to create components of an identified digital solution. Students evaluate personal, social and economic impacts, components and digital solutions against criteria throughout the generate phase to make decisions and refine the user experience and technical operation of components of the solution.

To generate solutions, students:

- use design and systems thinking processes to synthesise acquired information, ideas and skills to
  - generate individual components of a preferred solution
  - generate and refine a preferred solution in response to new or existing information
- use design thinking to evaluate and respond to the results of alpha testing
- use systems and design thinking to construct a solution and communicate knowledge and understanding of the solution.

### Evaluate and refine

When students evaluate, they use systems, design and computational thinking to appraise personal, social and economic impacts, components and digital solutions by weighing up or assessing strengths, implications and limitations against prescribed and self-determined criteria. When students refine ideas and a digital solution, they make partial or minor changes based on selected criteria to improve the user experience and technical operation. Evaluation occurs throughout each phase of the problem-solving process in Digital Solutions in order to refine the components and a solution in response to the prescribed and self-determined criteria.

To evaluate and refine, students:

- use pattern recognition to compare behaviours, e.g. usage and system, and outcomes of alternative solutions
- appraise test data and errors
- use design thinking to evaluate components and the digital solution against prescribed and self-determined criteria
- make changes in response to continual testing and appraisal of components and digital solutions
- make justified recommendations about inputs and the digital solution with supporting evidence.

Importantly, these four iterative phases are immersed within the 21st century skills of critical thinking, creative thinking, communication (which may occur in written, spoken, visual or multimodal forms), collaboration and teamwork, personal and social skills, and ICT skills.

### 1.2.5 Subject matter

Subject matter is the body of information, mental procedures and psychomotor procedures (see Marzano & Kendall 2007, 2008) that are necessary for students' learning and engagement with Digital Solutions. It is particular to each unit in the course of study and provides the basis for student learning experiences.

Subject matter has a direct relationship to the unit objectives, but is of a finer granularity and is more specific. These statements of learning are constructed in a similar way to objectives. Each statement:

- describes an action (or combination of actions) — what the student is expected to do
- describes the element — expressed as information, mental procedures or psychomotor procedures
- is contextualised to the topic or circumstance particular to the unit.

#### Programming language

A programming language is a formal computer language or constructed language to communicate instructions to a machine or computer. Programming languages can be used to create programs to control the behaviour of a machine or to express algorithms.

In Digital Solutions, schools will select programming languages to implement the four units of study. The selected programming languages must be well resourced, challenge students and encourage early success to develop student confidence. A list of recommended programming languages is included in each unit to assist in course implementation.

#### Algorithmic design method

Pseudocode will be used as the formal method of representing algorithms in this syllabus. Pseudocode is a descriptive method used to represent an algorithm and is a mixture of everyday language and programming conventions.

Pseudocode implements the basic control structures of assignment, sequence, selection, condition, iteration and modularisation through the use of keywords associated with the constructs, and textual indentation. Used to show how a computing algorithm should and could work, it is often an intermediate step in programming between the planning stage and writing executable code. Pseudocode can also be useful for:

- demonstrating thinking that later can become comments in the final program
- describing how an algorithm should work
- explaining a computing process to less technical people
- generating code in collaboration with others.

Pseudocode does not have a standard format and varies from programmer to programmer. However, a number of conventions are generally used.

**Conventions for writing pseudocode**

**KEYWORDS** are written in bold capitals and are often words taken directly from programming languages. For example, **IF**, **THEN** and **ELSE** are all words that can be validly used in most languages. **OUTPUT** and **COMPUTE** are from the language COBOL and **WRITE** is from the language Pascal.
Keywords do not have to be valid programming language words as long as they clearly convey the intent of the line of pseudocode.

Statements that form part of a **REPETITION LOOP** are indented by the same amount to indicate that they form a logical grouping.

In a similar way, **IF**, **THEN** and **ELSE** statements are indented to clearly distinguish the alternative processing paths.

The end of **REPETITION LOOPS** and **IF**, **THEN** and **ELSE** statements are explicitly indicated by the use of **ENDWHILE** and **ENDIF** at the appropriate points.

Pseudocode should clearly indicate what is happening at each step, including formulas of calculations.
For example:
**CALCULATE** net is not as clear as **CALCULATE** net = gross − tax.

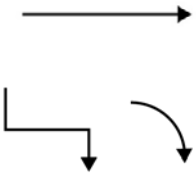
Programmers prefer to use a more abbreviated version in which memory cells used to store the input are given program-like names.
For example:
**INPUT** num1
**INPUT** num2
is preferable to
**INPUT** first number
**INPUT** second number

## Process-oriented analysis methods

Data flow diagrams (DFD), which include data source, data flow, data storage and process, are used to represent system interrelationships, data, system or process-oriented workflow.

DFDs are graphical representations of data flow through an information system. They do not represent programming logic or processing steps. Data flow symbols are used to represent data source, flow, storage and processes (Figure 4).

**Figure 5: Data flow diagram symbols, their names and functions**

| Symbol | Name and function | Symbol | Name and function |
|---|---|---|---|
|  | **Data source** or **External entity** — a source or destination of data flow that is outside the area of study |  | **Data flow** — a connector shows relationships between the representative shapes |
|  | **Data store** — repository of data; 'D' indicates a permanent computer file; 'M' indicates a manual file; 'T' indicates a transient store, deleted after processing |  | **Process** — transforms incoming data flow into outgoing data flow |

# 1.3 Assessment — general information

Assessments are formative for Units 1 and 2, and summative for Units 3 and 4.

| Assessment | Unit 1 | Unit 2 | Unit 3 | Unit 4 |
|---|---|---|---|---|
| Formative assessments | • | • | | |
| Summative internal assessment 1 | | | • | |
| Summative internal assessment 2 | | | • | |
| Summative internal assessment 3 | | | | • |
| Summative external assessment | | | | • |

## 1.3.1 Formative assessments — Units 1 and 2

Formative assessments provide feedback to both students and teachers about each student's progress in the course of study.

Schools develop internal assessments for each senior subject based on the learning described in Units 1 and 2 of the subject syllabus. Each unit objective must be assessed at least once.

For reporting purposes, schools should devise at least *two* but no more than *four* assessments for Units 1 and 2 of this subject. At least *one* assessment must be completed for *each* unit.

The sequencing, scope and scale of assessments for Units 1 and 2 are matters for each school to decide and should reflect the local context.

Teachers are encouraged to use the A–E descriptors in the reporting standards (Section 1.4) to provide formative feedback to students and to report on progress.

## 1.3.2 Summative assessments — Units 3 and 4

Students will complete a total of *four* summative assessments — three internal and one external — that count towards their final mark in each subject.

Schools develop *three* internal assessments for each senior subject, based on the learning described in Units 3 and 4 of the syllabus.

The three summative internal assessments will be endorsed and the results confirmed by the QCAA. These results will be combined with a single external assessment developed and marked by the QCAA. The external assessment results for Digital Solutions will contribute 25% towards a student's result.

### Summative internal assessment — instrument-specific marking guides

This syllabus provides ISMGs for the three summative internal assessments in Units 3 and 4.

The ISMGs describe the characteristics evident in student responses and align with the identified assessment objectives. Assessment objectives are drawn from the unit objectives and are contextualised for the requirements of the assessment instrument.

#### Criteria

Each ISMG groups assessment objectives into criteria. An assessment objective may appear in multiple criteria, or in a single criterion of an assessment.

### Making judgments

Assessment evidence of student performance in each criterion is matched to a performance level descriptor, which describes the typical characteristics of student work.

Where a student response has qualities from more than one performance level, a best-fit approach is used. Where a performance level has a two-mark range, it must be decided if the best fit is the higher or lower mark of the range.

### Authentication

Schools and teachers must have strategies in place for ensuring that work submitted for internal summative assessment is the student's own. Authentication strategies outlined in QCAA guidelines, which include guidance for drafting, scaffolding and teacher feedback, must be adhered to.

## Summative external assessment

The summative external assessment adds valuable evidence of achievement to a student's profile. External assessment is:

- common to all schools
- administered under the same conditions at the same time and on the same day
- developed and marked by the QCAA according to a commonly applied marking scheme.

The external assessment contributes 25% to the student's result in Digital Solutions. It is not privileged over the school-based assessment.

# 1.4 Reporting standards

Reporting standards are summary statements that succinctly describe typical performance at each of the five levels (A–E). They reflect the cognitive taxonomy and objectives of the course of study.

The primary purpose of reporting standards is for twice-yearly reporting on student progress. These descriptors can also be used to help teachers provide formative feedback to students and to align ISMGs.

### Reporting standards

| A |
|---|
| The student, in a range of digital technologies contexts, demonstrates: accurate and discriminating recognition and discerning description of elements, components, principles and processes; adept symbolisation and discerning explanation of relevant information, ideas and interrelationships.<br>The student demonstrates insightful analysis of problems and relevant information, astute determination of solution requirements and essential criteria against which to evaluate.<br>The student demonstrates: coherent and logical synthesis of relevant information and ideas to determine possible digital solutions; purposeful generation of components and digital solutions; critical evaluation of impacts, components and digital solutions against essential criteria with discerning refinement and justification of recommendations; discerning decision-making about, and fluent use of, mode-appropriate features, language and conventions for particular purposes and contexts. |
| **B** |
| The student, in a range of digital technologies contexts, demonstrates: accurate recognition and effective description of elements, components, principles and processes; methodical symbolisation and effective explanation of relevant information, ideas and interrelationships.<br>The student demonstrates considered analysis of problems and relevant information, logical determination of solution requirements and effective criteria against which to evaluate.<br>The student demonstrates: logical synthesis of relevant information and ideas to determine possible digital solutions; effective generation of components and digital solutions; reasoned evaluation of impacts, components and digital solutions against criteria with effective refinement and justification of recommendations; effective decision-making about, and proficient use of, mode-appropriate features, language and conventions for particular purposes and contexts. |
| **C** |
| The student, in a range of digital technologies contexts, demonstrates: appropriate recognition and description of elements, components, principles and processes; competent symbolisation and appropriate explanation of information, ideas and interrelationships.<br>The student demonstrates appropriate analysis of problems and information, reasonable determination of solution requirements and some criteria against which to evaluate.<br>The student demonstrates: simple synthesis of information and ideas to determine possible digital solutions; adequate generation of components and digital solutions; feasible evaluation of impacts, components and digital solutions against criteria with adequate refinement and justification of recommendations; appropriate decision-making about, and appropriate use of, mode-appropriate features, language and conventions for particular purposes and contexts. |

| D |
| --- |
| The student, in a range of digital technologies contexts, demonstrates: variable recognition and superficial description of aspects of elements, components, principles or processes; variable symbolisation and superficial explanation of information, ideas or interrelationships.<br>The student demonstrates superficial analysis of problems or information, vague determination of solution requirements and some criteria against which to evaluate.<br>The student demonstrates: rudimentary synthesis of information or ideas to determine possible digital solutions; partial generation of elements of digital solutions; superficial evaluation of impacts, components or digital solutions against criteria; variable decision-making about, and inconsistent use of, mode-appropriate features, language and conventions for particular purposes and contexts. |
| **E** |
| The student, in a range of digital technologies contexts, demonstrates: recognition of aspects of elements, components, principles or processes; disjointed symbolisation or explanation of aspects of information, ideas or interrelationships.<br>The student demonstrates the making of statements about problems, information or solution requirements.<br>The student demonstrates: unclear combination of information or ideas about digital solutions; identification of a change to an idea or a solution; generation of elements of solution components; unclear or fragmented use of mode-appropriate features, language and conventions. |

# 2 Unit 1: Creating with code

## 2.1 Unit description

In Unit 1, students will explore the creative and technical aspects of developing interactive digital solutions. They investigate algorithms, programming features and useability principles to generate small interactive solutions using programming tools and gain a practical understanding of programming features. This allows them the opportunity to explore existing and developing trends involving digital technologies.

### Unit requirements

In this unit, students are required to engage with and learn subject matter through the use of the various phases of the problem-solving process in Digital Solutions: explore, develop, generate and evaluate.

Teachers provide students with appropriately structured real-world problems that enable them to apply ideas, principles and processes of digital technologies. Students learn about and through the problem-solving process in Digital Solutions as they work individually or collaboratively to solve identified real-world digital problems that require new or re-imagined solutions.

#### Technology contexts

Schools must select a technology context to examine problems in this unit. Students must address both the subject matter and the programming features using a procedural text-based language in the selected technology context.

| Technology context | Example languages/frameworks |
|---|---|
| web applications:<br>• contain dynamic interactive content, e.g. a HTML5 site or applications with an informational or marketing focus. | • HTML and CSS with JavaScript and/or PHP (and related frameworks)<br>• .NET frameworks<br>• Python with web frameworks |
| mobile applications | • Cordova<br>• HTML/CSS/JavaScript<br>• Java<br>• Objective C<br>• Swift<br>• Xamarin and C# |
| interactive media, including:<br>• animations and simulations<br>• digital games, which must include<br>– level options (easy, medium, hard)<br>– scoring or lives<br>– user interface<br>• learning objects<br>• productivity applications. | • ActionScript<br>• Blender<br>• HTML5/CSS3 (with a procedural language)<br>• JavaScript (with Canvas)<br>• Processing<br>• Python<br>• Unity 3D (C#)<br>• Visual Basic .NET |

| Technology context | Example languages/frameworks |
|---|---|
| intelligent systems, including:<br>• 'Internet of Things'<br>• control systems<br>• robotics<br>• wearable technologies. | • C<br>• C++<br>• Python<br>• Robot C<br>• leJOS (Java framework)<br>• Gnikrap (JavaScript for EV3)<br>• Espruino (JavaScript Web IDE for micro controllers)<br>• Node.js |

## 2.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

1. recognise and describe programming elements and useability principles
2. symbolise and explain information, ideas and interrelationships related to programming problems
3. analyse problems and information related to a selected technology context
4. determine user experience and programming requirements, and self-determined and prescribed criteria of a programming problem
5. synthesise information and ideas to determine possible prototype digital solutions
6. generate user interface and programmed components of the prototype digital solution
7. evaluate impacts, components and solutions against criteria to make refinements and justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts.

## 2.3 Topic 1: Understanding digital problems

| Subject matter |
|---|
| In this topic, students will:<br>• understand<br>– the constituents of a digital problem<br>– methods of breaking down problems into parts using computational thinking and thinking tools, e.g. mind maps<br>• understand and describe personal, social and economic impacts<br>• analyse problems to identify<br>– the human need, want or opportunity that requires a new or re-imagined digital solution<br>– essential elements, components and features of problems in Digital Solutions<br>– where and how digital technologies are used to solve problems to meet personal, societal and organisational needs, e.g. through search engines, robotics, mobile phone applications, automobile control systems, wearable devices, and the use of smart objects in the Internet of Things<br>• explore existing solutions to similar problems, e.g. existing games or websites |

| Subject matter |
|---|
| • analyse a given problem to identify<br>  – the boundary or scope of the problem<br>  – constraints and limitations of the environment<br>  – the requirements of the solution<br>  – the user perspective and user-experience requirements<br>  – technical issues of the problem that influence the user-interface requirements<br>  – missing, required or unnecessary facts or information<br>  – prescribed and self-determined criteria to evaluate the personal, social and economic impacts of the solution<br>• appraise information and ideas<br>• communicate using<br>  – digital technologies–specific language<br>  – language conventions, textual features, such as annotations, paragraphs and sentences, and referencing conventions to convey information to particular audiences about digital solutions<br>  – sketches or diagrams to present information and ideas about the problem and programmed digital solutions<br>  – the modes of visual, written and spoken communication to present data and information about digital solutions. |

## 2.4 Topic 2: User experiences and interfaces

| Subject matter |
|---|
| In this topic, students will:<br>• recognise and describe<br>  – the meaning and importance of user experience<br>  – useability principles including accessibility, effectiveness, safety, utility and learnability<br>• explore existing user interfaces to<br>  – identify pitfalls and useful solutions<br>  – determine how user characteristics influence the user-interface requirements and user experience for problems and solutions in relation to the useability principles<br>• symbolise ideas for a user interface using sketches, diagrams, schematic diagrams or mock-ups<br>• generate user interfaces by investigating and applying useability principles<br>• evaluate and make recommendations about user interfaces based on useability principles |

## 2.5 Topic 3: Algorithms and programming techniques

| Subject matter |
|---|
| In this topic, students will:<br>• recognise and describe programming syntax and rules<br>• understand that simple algorithms consist of input, process and output at various stages<br>• understand and use the basic algorithm constructs including<br>  – assignment: used to store the value of an expression into a variable<br>  – sequence: a number of instructions processed one after the other<br>  – selection: the next instruction to be executed depends on a ‘condition’<br>  – condition: a logical expression that evaluates to true or false<br>  – iteration: a number of instructions are repeated |

**Subject matter**

  - modularisation: used for reducing the complexity of a system by deconstructing into more or less independent units or modules
- represent algorithms using pseudocode by
  - identifying and describing the steps and their behaviour in the algorithm
  - identifying and explaining the algorithmic steps required for a programmed solution
- symbolise algorithms and interrelationships with sketches and diagrams
- understand the five basic features of programming
  - variables
  - control structures
  - data structures
  - syntax
  - libraries and classes
- recognise, describe and use good programming practices, including dependability, efficiency, testing, debugging, error correction, coding conventions including commenting, consistent naming conventions, code simplicity and portability
- identify and describe
  - the purpose of code syntax and rules
  - the scope and use of local and global variables
  - code object/event triggers and their effect on user interfaces
- explore
  - programming development tools to understand how to use them effectively
  - the use of a procedural text-based language for
    - writing and modifying code and using existing code blocks or statements
    - interpreting programming language rules and syntax
    - analysing and critiquing the end result of code statements using input or output evidence, i.e. runtime evidence
  - functions and procedures with efficient and maintainable code that
    - includes reuseable coded components
    - responds to keyboard and mouse events
    - uses variables, selection structures, counted loops, while loops and single, multi-branch and nested conditional logic/statements
    - uses operators, including arithmetic (+, –, *, /, integer, modulus, exponent), comparison (<, >, <=, >=, equal, not equal) and logical (AND, OR, NOT)
  - the purpose of code statements by writing code and using existing code blocks or statements
  - object/event triggers and develop explanations about their effect/s on user interfaces
- communicate and clarify knowledge and understanding about the purpose of code statements using code comments.

## 2.6 Topic 4: Programmed solutions

**Subject matter**

In this topic, students will use a procedural text-based language to:

- apply the use of operators, including
  - arithmetic: +, –, *, /, integer, modulus, exponent
  - comparison: <, >, <=, >=, equal, not equal
  - logical: AND, OR, NOT
- output information to the screen in text-based or visual formats
- generate

| Subject matter |
| --- |
| – components of a solution by using existing code or writing new code statements<br>– modified code in response to new or existing information<br>– functions/procedures with efficient and maintainable code that includes reuseable code blocks or statements and responses to keyboard and mouse events<br>– selection structures, counted loops, while loops, and single, multi-branch and nested conditional logic statements<br>– local and global variables<br>– a prototype digital solution in response to a problem<br>• test inputs, outputs and processes<br>• evaluate and make recommendations about<br>– the use of programming language rules and syntax for a given problem<br>– algorithmic steps using debugging processes, e.g. desk checks<br>– the effectiveness of algorithms<br>– the end result of code statements using input or output evidence<br>– the user interface based on useability principles including accessibility, effectiveness, safety, utility and learnability<br>– the solution and its components by testing to identify errors using computational thinking processes, e.g. debugging techniques<br>– the personal, social and economic impacts of the solution<br>– the implemented solution against prescribed criteria, maintainability and useability principles. |

## 2.7 Assessment guidance

In constructing assessment instruments for Unit 1, schools should ensure that the objectives cover, or are selected from, the unit objectives. If one assessment instrument is developed for a unit, it must assess all the unit objectives. If more than one assessment instrument is developed, the unit objectives must be covered across those instruments.

The suggested techniques for Unit 1 are an Investigation and a Project.

# 3 Unit 2: Application and data solutions

## 3.1 Unit description

In Unit 2, students are required to engage with and learn subject matter through the use of the various phases of the problem-solving process in Digital Solutions. Students will optimise a given database and use programming skills acquired in Unit 1 to write procedural text-based code to generate a solution that interacts with an existing database via structured query language (SQL). Students will plan, develop and generate the interface and code to enable the user to insert, update, retrieve and delete data using an existing database via SQL. Prior to inserting the data, the system will validate the data being entered to ensure its integrity and reliability for use and storage. Retrieved data will be displayed to the user in an appropriate format, such as text or a symbolic visual form.

Students are required to understand the structure of a database, along with how primary and foreign keys and data types affect the performance of the database. Students will evaluate the security, privacy and ethical effects of storing data in databases from individual, organisational and government perspectives.

### Unit requirements

Teachers provide students with appropriately structured real-world problems that enable them to apply ideas, principles and processes of digital technologies. Students learn about and through the problem-solving process in Digital Solutions as they work individually or collaboratively to solve identified real-world digital problems that require new or re-imagined solutions.

#### Technology contexts for learning and languages

Schools must select a technology context to examine problems in this unit. Students must address both the subject matter and the programming features using a procedural text-based language in the selected technology context.

| Technology context | Database requirements | Example languages/frameworks |
|---|---|---|
| web applications | Students are to use an appropriate relational database management system for the problem they are undertaking.<br>Examples of suitable database management systems and client software are:<br>• MySQL/MariaDB + MySQL Workbench<br>• PostgreSQL + pgAdmin<br>• SQLite + DB Browser for SQLite<br>• SQLServer + SQL Server Management Studio<br>• or any other relational database management system using SQL. | • HTML and CSS with JavaScript and/or PHP and related frameworks<br>• .NET frameworks<br>• Python with web frameworks |
| mobile applications | | • Cordova<br>• HTML/CSS/JavaScript<br>• Java<br>• Objective C<br>• Swift<br>• Xamarin and C# |

| Technology context | Database requirements | Example languages/frameworks |
|---|---|---|
| interactive media, including:<br>• animations and simulations<br>• digital games<br>• learning objects<br>• productivity applications | | • C#<br>• Java<br>• JavaScript<br>• Python<br>• Visual Basic .NET |
| intelligent systems, including:<br>• 'Internet of Things'<br>• control systems<br>• robotics<br>• wearable technologies | | • C<br>• C++<br>• Python<br>• Robot C<br>• leJOS Java framework<br>• Gnikrap JavaScript for EV3<br>• Espruino JavaScript web IDE for micro controllers<br>• Node.js |

## 3.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

1. recognise and describe programming elements, data and useability principles, and data management processes
2. symbolise and explain information, ideas and data flow relationships within and between systems related to programming problems
3. analyse problems and information related to the selected technology context
4. determine solution requirements and prescribed and self-determined criteria of a programming problem
5. synthesise information and ideas to determine possible digital solutions
6. generate user interface and programmed components of the prototype digital solution
7. evaluate impacts, components and solutions against criteria to make refinements and justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts.

## 3.3 Topic 1: Data-driven problems and solution requirements

**Subject matter**

In this topic, students will:

- understand the nature of data-driven problems
- analyse problems associated with data insertion, including variations in data formats, data structures, validation rules and data requirements
- determine manageable aspects of a problem through decomposition, pattern recognition and analysis of
  - user requirements
  - programming options including
    - interactivity, e.g. user input and presentation of data
    - data models, and storage and output requirements
- recognise data types, constraints, and primary and foreign keys
- recognise and describe useability principles including accessibility, effectiveness, safety, utility and learnability
- symbolise
  - the links between external entities, data sources, data flow, processes and data storage in annotated context diagrams or data flow diagrams
  - algorithmic steps as pseudocode
- explore and communicate the personal, social and economic impacts of storing data in a database for individuals, organisations and governments
- explore and use the elements and principles of visual communication
  - elements are limited to space, line, colour, shape, texture, tone, form, proportion and scale
  - principles are limited to balance, contrast, proximity, harmony, alignment, repetition and hierarchy
- communicate using
  - digital technologies–specific language
  - language conventions, textual features such as annotations, paragraphs and sentences, and referencing conventions to convey information to particular audiences about digital solutions
  - sketches or diagrams to present information and ideas about the problem and programmed digital solutions
  - the modes of visual, written and spoken communication to present data and information about digital solutions.

## 3.4 Topic 2: Data and programming techniques

**Subject matter**

In this topic, students will:

- recognise the elements needed for a data-driven solution, including
  - boundary or scope
  - constraints and limitations of environments
  - programming requirements, e.g. SQL and algorithms
  - system requirements, e.g. platforms, connections, hardware and data stores
  - the data that is required from real-world data sources, e.g. files, peripheral devices, online sources and users
  - the personal, social and economic impacts of storing data in databases for individuals, organisations and governments
- understand

**Subject matter**

  - the difference between data, information and wisdom
  - that data-driven programming is typically applied to streams of structured data for filtering, transforming, aggregating (such as computing statistics), or calling other programs
  - SQL syntax and use SQL statements to solve a problem
  - that simple algorithms consist of input, process and output at various stages
  - that data is organised in tabular form and the skills and knowledge used to normalise and link tables together
  - the reasons and methods of database structure modification to third normal form (3NF)
- interpret the structure of a database represented by a relational schema (RS) to determine the relationship between data
- explain data principles including
  - acquisition
  - organisation, i.e. using appropriate naming conventions, data formats and structures
  - representation
  - integrity
  - anomalies
  - redundancy
  - security
- explain
  - the difference between data validation and data verification
  - referential integrity, normalisation and third normal form, relational database management system
  - the difference between primary key and foreign key
  - relations (tables) including rows; columns; primary, secondary and foreign keys; nulls; and views within a database management system
- symbolise
  - ideas for user interface and interconnecting systems using sketches, diagrams or mock-ups
  - data flow through a system using data flow diagrams
- analyse and structure data and data stores to reduce redundancy and ensure completeness, consistency and integrity for use and storage
- apply data management processes, e.g. encryption, consistency, searching, pattern recognition and de-identification
- understand and use the basic constructs of an algorithm including assignment, sequence, selection, condition, iteration and modularisation
- symbolise well-ordered and unambiguous algorithms using pseudocode for
  - procedural code that processes data for insertion into a database or manipulates or displays retrieved data
  - user interaction, data validation and data presentation
- communicate and clarify knowledge and understanding about the purpose of code statements using code comments.

## 3.5 Topic 3: Prototype data solutions

**Subject matter**

In this topic, students will:

- identify the prescribed and self-determined criteria to plan the user interface and programmed components of proposed solutions
- determine appropriate data types, constraints, and primary and foreign keys
- evaluate and modify a database structure to third normal form (3NF)
- generate
  - SQL SELECT statements, including WHERE, GROUP BY, HAVING, ORDER BY, COUNT, MIN, MAX, AVG, IN, inner-joins and sub-queries to retrieve appropriate data from existing databases
  - SQL CREATE, INSERT, UPDATE and DELETE statements to create database tables and views, and modify stored data
- generate a prototype digital solution to access, manipulate and display data in a website, mobile application or interactive media that
  - enables data to be inserted, updated, retrieved and deleted from single and multiple tables
  - validates the data to be entered for reliability to ensure that the data is valid for use and storage
  - includes user interfaces that will enable the insertion, updating and selection of data from/to a database
  - creates procedural code to control user interaction, data validation, execution of SQL queries, manipulation and display of query results through the user interface
- test the SQL, algorithm and procedural code components of the prototype digital solution for reliability, maintainability and efficiency
- test the user interfaces against useability principles
- evaluate
  - data quality using the prescribed criteria of accuracy and completeness
  - the prototype digital solution against prescribed and self-determined criteria.

## 3.6 Assessment guidance

In constructing assessment instruments for Unit 2, schools should ensure that the objectives cover, or are selected from, the unit objectives. If one assessment instrument is developed for a unit, it must assess all the unit objectives. If more than one assessment instrument is developed, the unit objectives must be covered across those instruments.

The suggested techniques for Unit 2 are an Examination and a Project — folio.

# 4 Unit 3: Digital innovation

## 4.1 Unit description

In Unit 3, students are required to engage with and learn subject matter through the use of the various phases of the problem-solving process in Digital Solutions. Students analyse the requirements of particular groups of people, and use knowledge and skills of problem-solving, computational, design and systems thinking. They will determine data requirements and use available resources to create prototyped digital solutions by programming and developing user interfaces to improve user experiences. Students will do this through one of the technology contexts: web or mobile applications, interactive media, or intelligent systems (which use microcontrollers, sensing or control boards).

### Unit requirements

In this unit, students are required to engage with and learn subject matter through the use of the various phases of the problem-solving process in Digital Solutions: explore, develop, generate and evaluate.

Teachers provide students with appropriately structured real-world problems that enable them to apply ideas, principles and processes of digital technologies. Students learn about and through the problem-solving process in Digital Solutions as they work individually or collaboratively to solve identified real-world digital problems that require new or re-imagined solutions.

#### Programming language

Schools may select more than one programming language to cover the required operations to be performed. The programming language/s selected must be a procedural text-based language.

For Unit 3, the programming language/s must allow the following operations to be performed:

- coding, selection, iteration, sequence and functions
- internal documentation, including comments, appropriate naming of variables and functions, and the use of white space and indents to identify blocks of related code
- setting of variables or data field type to Boolean, whole number, number with a decimal place, date and text
- creation and manipulation of variables with 2D data structures
- Read and Write to data files.

Data

The programming environment must allow:

- connection to data stores containing structured data
- retrieval of data from the data store
- manipulation of data in the data store by inserting data, updating data and deleting data
- execution and reading of the result of a SQL SELECT query, including WHERE, GROUP BY, HAVING, ORDER BY, sub-selection and inner-joins clauses.

User interface

The user interface development environment must permit the:

- receipt of input from a user
- communication of output to a user
- writing or transmission of data to a graphical user interface
- use of event listeners to detect and respond to user input events.

### Technology contexts for learning

Schools must select a technology context to examine problems in this unit. Students must address both the subject matter and the programming features in the selected technology context.

**Note:** Specifications, impacts and communication are similar across all contexts.

| Technology context | Explanation | Example languages/frameworks |
|---|---|---|
| web applications | Web applications contain dynamic interactive content and local or remote storage, e.g. HTML5 games and online shopping applications.<br>**Abstraction**<br>jQuery and similar frameworks, e.g. Bootstrap, may be used to improve user experience without increasing programming complexity.<br>**Data**<br>Data may be originally generated by the application or from an external source. Components must include code that<br>• reads and/or writes to local storage<br>• reads and/or writes to tables in a database.<br>**Algorithms and implementation**<br>Computer code or web applications will implement algorithms that store user data in a local data repository and select data for output to a web page or screen. The code to generate content should be separated from the code to manage presentation.<br>**Interactions**<br>User interfaces need to consider human–computer interface useability principles and error prevention when collecting and validating data. Data outputs need to consider alternative layouts for a variety of screen sizes. | • HTML and CSS with JavaScript and/or PHP and related frameworks<br>• .NET frameworks<br>• Python with web frameworks |

| Technology context | Explanation | Example languages/frameworks |
|---|---|---|
| mobile applications | Mobile applications contain dynamic interactive content and local or remote storage, e.g. games and online shopping applications.<br>**Abstraction**<br>Software libraries will be used to hide programming complexity.<br>**Data**<br>Data may be originally generated by the application or from an external source. Components must include code that<br>• reads and/or writes to local storage<br>• reads and/or writes to tables in a database.<br>**Algorithms and implementation**<br>Computer code or mobile applications will implement algorithms that store user data in a local data repository and select data for output to a screen.<br>**Interactions**<br>Uses code that interacts with mobile phone sensors and actuators e.g. tilt and vibrate. User interfaces need to consider human–computer interface useability principles, and error prevention when collecting and validating data. Data outputs need to consider alternate layouts for a variety of screen sizes. | • Cordova<br>• HTML/CSS/JavaScript<br>• Java<br>• Objective C<br>• Swift<br>• Xamarin and C# |
| interactive media, including:<br>• simulations<br>• digital games<br>• learning objects<br>• productivity applications | Interactive media generate visual or auditory outputs based on user input. Interactive media projects include computer-generated simulations, digital games, learning objects and productivity applications.<br>**Abstraction**<br>Software libraries will be used to hide programming complexity.<br>**Data**<br>Data may be originally generated by the application or from an external source. Components must include code that<br>• reads and/or writes to local storage<br>• reads and/or writes to tables in a database.<br>**Algorithms and implementation**<br>Computer code for interactive media will implement algorithms that create, manipulate and manage visual components, and generate output in response to user input.<br>**Interactions**<br>User interfaces for interactive media will be communicated with storyboards and annotated diagrams. Useability principles including user-experience components such as user instructions and user feedback are important parts of this technology context. Although screens, mouse and keyboard are common user-interface components, | • C#<br>• HTML5/CSS3/ JavaScript/PHP<br>• Python<br>• Visual Basic .NET<br>• web framework/s |

| Technology context | Explanation | Example languages/frameworks |
|---|---|---|
| | other user interfaces could be considered, such as gesture controls, proximity sensors, sound, video and touchpads. | |
| intelligent systems, including:<br>• 'Internet of Things'<br>• control systems<br>• robotics<br>• wearable technologies | Intelligent systems use hardware components with sensing and actuating technology, e.g. microcontrollers, sensing and control boards.<br>The Internet of Things can incorporate robotics and wearable technology.<br>**Abstraction**<br>Sample wi-fi libraries will be used to increase the data collection and transmission capabilities of the system without increasing programming complexity.<br>**Data**<br>Data may be originally generated by the application or from an external source. Components must include code that<br>• reads and/or writes to local storage<br>• reads and/or writes to tables in a database.<br>**Algorithms and implementation**<br>Computer code for the Internet of Things will implement algorithms that collect, store and process data collected from sensors.<br>**Interactions**<br>A graphical user interface such as a web page should be used to integrate the different components of the system. Useability principles must be applied to the web interface. | • C<br>• C++<br>• Python<br>• Robot C<br>• leJOS (Java framework)<br>• Gnikrap (JavaScript for EV3)<br>• Espruino (JavaScript web IDE for micro controllers)<br>• Node.js |

## 4.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

| Unit objective | IA1 | IA2 |
|---|---|---|
| 1. recognise and describe programming elements, digital system and user interface components, and useability principles | • | • |
| 2. symbolise and explain programming information, ideas and interrelationships between data structures and user experiences | • | • |
| 3. analyse problems and information related to the selected technology context | • | • |
| 4. determine solution requirements, and prescribed and self-determined criteria of a digital problem | • | • |
| 5. synthesise information and ideas to determine possible data elements, user interface and programmed components for digital solutions | • | • |
| 6. generate user interfaces and programmed components of the prototype digital solution | • | • |
| 7. evaluate impacts, components and a solution against criteria to make refinements and justified recommendations | • | • |
| 8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts. | • | • |

# 4.3 Topic 1: Interactions between users, data and digital systems

**Subject matter**

In this topic, students will:

- explore and analyse the meaning and importance of innovation and the personal, business and social opportunities presented by innovation
- recognise and describe components of a digital solution appropriate to the technology context selected.

| Technology context | Web applications | Mobile applications | Interactive media | Intelligent systems |
|---|---|---|---|---|
| components on which to focus | • server-side components including web server, DBServer and pre-processing components such as PHP<br>• client-side components including web browser and user device<br>• data components such as database structure<br>• internal data structures such as arrays, lists and dictionaries | • user-interface components such as user hardware and functionality to provide input and output<br>• program components such as objects, event handlers<br>• data resources such as external libraries and internal application data structures | • user-interface components such as user hardware and peripheral devices used for input and output<br>• program components such as objects, event handlers and multimedia assets<br>• external data stores such as file structures or object libraries<br>• internal data structures such as arrays, lists and dictionaries | • sensors<br>• actuators<br>• user-interface components<br>• analogue and digital input/output data streams<br>• administrative interface components<br>• network hardware and protocols<br>• internal data structures appropriate to the hardware storage code library selected |

- analyse a problem to identify and explain the
  - elements of a system
  - observable interactions
  - inputs and outputs
  - control mechanism
  - processes and interactions using logical diagrams and consistent symbols
- symbolise and explain
  - useability principles, including accessibility, effectiveness, safety, utility and learnability
  - a variety of interfaces
  - data flow through a system using data flow diagrams
- symbolise, explain and use advanced data processes, including table joins, referential integrity, redundancy reduction and anomaly updating
- explore
  - flexible development methods to support a variety of user profiles
  - methods of synthesising user interface, processing and data components to generate a prototype digital solution
- explore and use the elements and principles of visual communication
  - elements are limited to space, line, colour, shape, texture, tone, form, proportion and scale
  - principles are limited to balance, contrast, proximity, harmony, alignment, repetition and hierarchy
- determine possible personal, social and economic impacts
- appraise user interfaces against useability principles

## 4.4 Topic 2: Real-world problems and solution requirements

**Subject matter**

In this topic, students will:

- explore programming development tools to understand how to use them effectively
- analyse problems and information to determine
  - manageable aspects of the problem
  - a specific aspect of the problem to develop
  - boundary or scope of the problem
  - constraints and limitations of the environment
  - requirements of the solution
  - prescribed and self-determined criteria
  - and describe interactions in terms of inputs, processes and outputs
  - and explore data sources to understand relational and flat file data structures
- generate ideas using innovation and collaboration
- recognise and compare different file formats and data structures appropriate to the context
- determine file formats and data structures appropriate to the technology context
- analyse modularity and readability of program modules
- recognise and use
  - the basic constructs of an algorithm including assignment, sequence, selection, condition, iteration and modularisation
  - appropriate pseudocode conventions
- understand that simple algorithms consist of input, process and output
- symbolise well-ordered and unambiguous algorithms using pseudocode for
  - procedural code that processes data for insertion into a database or manipulates or displays retrieved data
  - user interaction, data validation and data presentation
- explain code steps using comment syntax appropriate to the programming language
- apply
  - computational thinking processes, e.g. creating, debugging, persevering and collaborating to identify possible algorithmic approaches
  - data algorithms for cleaning and merging data sources and iterating through data records
- generate generic pseudocode suitable for a variety of programming languages to communicate requirements for programmed components
- observe different styles of presenting a technical proposal for a digital solution
- communicate a technical proposal for a digital solution through a presentation
- communicate using
  - digital technologies–specific language
  - language conventions, textual features such as annotations, paragraphs and sentences, and referencing conventions to convey information to particular audiences about digital solutions
  - sketches or diagrams to present information and ideas about the problem and programmed digital solutions
  - the modes of visual, written and spoken communication to present data and information about digital solutions.

# 4.5 Topic 3: Innovative digital solutions

**Subject matter**

In this topic, students will:

- refine ideas for components of a prototype digital solution
- demonstrate a prototype of a digital solution
- generate a conceptual model of a possible solution by applying systems thinking that identifies
  - system boundaries
  - properties
  - inputs and outputs
  - user interface
  - system controls
- generate
  - low-fidelity user-interface prototypes appropriate to the digital context by using the elements and principles of visual communication such as sketches, mood boards, storyboards, sitemaps, wireframes and mock-ups
  - algorithms as simple programs by using programming development tools
  - pseudocode to solve defined problems
  - code that creates, reads, writes, opens and closes a file
- generate data structures using
  - SQL statements to INSERT, UPDATE and DELETE rows in a database
  - SQL CREATE, DROP and ALTER statements
  - SQL SELECT query, including WHERE, GROUP BY, HAVING, ORDER BY, sub-selection and inner-joins clauses
- generate program modules that
  - interact with users
  - interact with 2D data sources
  - validate data inputs
  - control the interactions in a digital solution
- communicate and clarify knowledge and understanding about the purpose of code statements using code comments
- synthesise user interface, processing and data components to generate a prototype digital solution
- appraise
  - the suitability of prescribed and self-determined criteria
  - the reliability, maintainability, sustainability, efficiency, effectiveness and useability of algorithms to draw conclusions and make recommendations
- appraise and refine user interfaces by
  - testing the useability principles, including accessibility, effectiveness, safety, utility and learnability
  - observing and recording user interactions from user experience critiques
- justify selection of relevant data from existing data sources
- evaluate
  - user interfaces from existing solutions using heuristic reviews for the useability principles
  - by testing program modules for reliability, maintainability and efficiency using computational thinking processes such as debugging to refine a prototype digital solution
- evaluate against prescribed and self-determined criteria the
  - user interface and programmed solutions
  - prototype digital solution.

# 4.6 Assessment

## 4.6.1 Summative internal assessment 1 (IA1): Investigation — technical proposal (20%)

### Description

This assessment requires students to research a specific problem through collection, analysis and synthesis of information. A technical proposal uses research or investigative practices to assess a range of cognitions in a particular context. Research or investigative practices include locating and using information beyond students' own knowledge and the data they have been given.

Students must adhere to research conventions, including citations, reference lists or bibliographies. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a proposal and identify a low-fidelity prototype digital solution.

### Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe data sources, programming elements, user interface components and useability principles
2. symbolise algorithms and user interfaces, and explain ideas and interrelationships between proposed data structures and user experiences of the identified problem
3. analyse the problem and information related to the selected technology context
4. determine programming and user experience requirements of the identified problem and prescribed and self-determined criteria
5. synthesise information and ideas to determine possible data elements, user interface and algorithm components for digital solutions
6. generate a technical proposal for user interfaces and algorithm components of the low-fidelity prototype digital solution
7. evaluate impacts, components and a low-fidelity prototype against prescribed and self-determined criteria to make refinements and justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions for written and spoken communication for a technical audience.

### Specifications

#### Description

In Digital Solutions students identify a problem in the selected Unit 3 technology context that uses an external data source. They iteratively explore, develop, generate and evaluate low-fidelity prototypes of user interfaces, algorithms and data in response to the identified problem. Students identify a single low-fidelity prototype digital solution and communicate the technical feasibility of the solution through a multimodal presentation.

The investigation will include referencing conventions using a recognised system of referencing.

The investigation will include the following assessable evidence:

- recognition and description of
  - data sources
  - appropriate programming development tools
  - useability principles and user-interface components
  - existing solutions to similar problems
- symbolisation using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots of
  - user interfaces
  - programming features communicated by algorithms
- explanation of
  - user experiences
  - useability principles and accessibility features
  - data structures
  - programming features
- analysis of the problem and information to identify
  - boundary or scope of the problem
  - constraints and limitations of the environment
  - data, programming and user-interface relationships
  - user experience
  - potential algorithmic implementations
  - possible personal, social and economic impacts
  - possible solutions
- determination of
  - requirements from the user perspective for the user experience
  - programming requirements
  - required data
  - prescribed and self-determined criteria
- synthesis of information and ideas to select the best approach for
  - user interface(s)
  - data structures of the proposed solution
  - coded components of the proposed solution
- generation of a low-fidelity (non-coded) prototype solution including user interface, data and algorithms
- evaluation against criteria, of
  - personal, social and economic impacts and considerations to identify risks

  - the user-interface prototype
  - the accuracy and efficiency of the algorithms
  - the low-fidelity non-coded prototype digital solution
- make refinements and justified recommendations for current and future improvements
- communication of
  - information and ideas to inform a technical audience
  - the technical feasibility of developing the prototype solution, including the technical aspects of the development process, e.g. algorithms, selection and justification of development tools, user-interface sketches, user-experience requirements.

The presentation of this investigation is multimodal. A multimodal presentation is the dynamic convergence of two or more communication modes within the same response and where all modes are attended to as part of meaning-making. Multimodal presentations can be delivered via different media or technologies. A variety of technologies are used to create or present the response. Replication of a written document into an electronic or digital format does not constitute a multimodal presentation.

There is no requirement for this presentation to be performed or conducted in front of the class or the teacher. For example, a multimodal presentation might be pre-recorded and presented to the teacher electronically. Each student may choose the mode/s and method of their presentation. These may need to be negotiated with the teacher.

Examples of a multimodal presentation include:

- a web page, in which elements such as visual effects, oral language, written language and still or moving images are combined
- a slideshow or animation documenting the application of the problem-solving process
- multimedia movies that may combine photographs, video, sound, text and a narrative voice
- a webinar, vodcast or podcast.

#### Conditions

- Length: multimodal presentation, 9–11 minutes
- Other:
  - the reference list is not included in the presentation time
  - schools implement authentication strategies that reflect QCAA guidelines (see Section 1.3.2).

## Summary of the instrument-specific marking guide

The following table summarises the mark allocation for the objectives assessed in the technical proposal.

| Criterion | Objectives | Marks |
|---|---|---|
| Retrieving and comprehending | 1, 2 | 5 |
| Analysing | 3, 4 | 6 |
| Synthesising and evaluating | 5, 6, 7 | 6 |
| Communicating | 8 | 3 |
| **Total** | | **20** |

## Instrument-specific marking guide

### Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe data sources, programming elements, user-interface components and useability principles
2. symbolise algorithms and user interfaces, and explain ideas and interrelationships between proposed data structures and user experiences of the identified problem

| The student work has the following characteristics: | Marks |
|---|---|
| • accurate and discriminating recognition and discerning description of data sources, programming elements, user-interface components and useability principles<br>• adept symbolisation of algorithms and user interfaces and discerning explanation of ideas and interrelationships between proposed data structures and user experiences of the identified problem. | 4–5 |
| • appropriate recognition and description of data sources, programming elements, user-interface components and useability principles<br>• competent symbolisation of algorithms or user interfaces and appropriate explanation of ideas and interrelationships between proposed data structures and user experiences of the identified problem. | 2–3 |
| • makes statements about elements and features of data, programming, user interface or useability principles<br>• variable symbolisation of algorithms and superficial explanation of aspects of ideas or interrelationships related to the identified problem. | 1 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Analysing

Assessment objectives

3. analyse the problem and information related to the selected technology context
4. determine programming and user-experience requirements of the identified problem and prescribed and self-determined criteria

| The student work has the following characteristics: | Marks |
|---|---|
| • insightful analysis of the problem and relevant contextual information to identify the relevant elements and features of user interface, data and programming components and their relationships to the structure of the identified problem<br>• astute determination of programming and user-experience requirements of the identified problem and essential prescribed and self-determined criteria. | 5–6 |
| • appropriate analysis of the problem and contextual information to identify some elements and features of user interface, data and programming components and their relationships to the structure of the identified problem<br>• reasonable determination of programming and user-experience requirements of the identified problem and some prescribed and self-determined criteria. | 3–4 |
| • superficial analysis of the problem or aspects of information to identify some elements or features of user interface or data or programming components or their relationships to the structure of the identified problem<br>• vague determination of some programming or user-experience requirements of the identified problem or prescribed criteria. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to determine possible data elements, user interface and algorithm components for digital solutions
6. generate a technical proposal for user interfaces and algorithm components of the low-fidelity non-coded prototype digital solution
7. evaluate impacts, components and a low-fidelity prototype against prescribed and self-determined criteria to make refinements and justified recommendations

| The student work has the following characteristics: | Marks |
|---|---|
| • coherent and logical synthesis of relevant information and ideas to determine data elements, user interface and algorithm components for digital solutions<br>• purposeful generation of a technical proposal for relevant user interfaces and algorithm components of the low-fidelity non-coded prototype digital solution<br>• critical evaluation of impacts, components and low-fidelity prototypes against effective prescribed and self-determined criteria to make refinements and astute recommendations justified by data. | 5–6 |
| • simple synthesis of information and ideas to determine possible data elements, user interface and algorithm components for digital solutions<br>• adequate generation of a technical proposal for some user interfaces and algorithm components of the low-fidelity non-coded prototype digital solution<br>• feasible evaluation of impacts, components and low-fidelity prototypes against some prescribed and self-determined criteria to make refinements and fundamental recommendations justified by data. | 3–4 |

| The student work has the following characteristics: | Marks |
|---|---|
| • rudimentary synthesis of information or ideas to determine possible data elements, user interface and algorithm components for digital solutions<br>• generation of elements of the low-fidelity non-coded prototype digital solution<br>• superficial evaluation of impacts, components or low-fidelity prototype against criteria. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Communicating

Assessment objective

8. make decisions about and use mode-appropriate features, language and conventions for written and spoken communication for a technical audience

| The student work has the following characteristics: | Marks |
|---|---|
| • discerning decision-making about, and fluent use of<br>– written, visual and/or spoken features to communicate about a solution<br>– language for a technical audience<br>– grammatically accurate language structures<br>– referencing and investigation conventions. | 2–3 |
| • variable decision-making about, and inconsistent use of<br>– written, visual and/or spoken features<br>– suitable language<br>– grammar and language structures<br>– referencing or investigation conventions. | 1 |
| • does not satisfy any of the descriptors above. | 0 |

## 4.6.2 Summative internal assessment 2 (IA2): Project — digital solution (30%)

### Description

This assessment focuses on the problem-solving process in Digital Solutions that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. The response is a coherent work that documents the iterative process undertaken to develop a solution to a technical proposal. It may include written paragraphs and annotations, diagrams, sketches, drawings, and components of a prototype digital solution.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

### Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe programming elements, user interface components and useability principles
2. symbolise and explain programming information and ideas, data structures and interrelationships between user experiences and data of the digital prototype
3. analyse the problem and information related to the technical proposal for a low-fidelity prototype digital solution
4. determine user interface, data, programmed and solution requirements of the digital solution and prescribed and self-determined criteria
5. synthesise information and ideas to determine data elements, user interface and programmed components for a digital solution
6. generate user interfaces and programmed components of the digital solution
7. evaluate impacts, components and the digital solution against prescribed and self-determined criteria to make refinements and justified recommendations
8. make decisions about and use mode-appropriate features, written language and conventions for a technical audience.

### Specifications

#### Description

In Digital Solutions, students document the application of the problem-solving process in response to a technical proposal document supplied by the teacher.

The project will include the following project and referencing conventions:

- headings that organise and communicate the student's thinking through the iterative phases of the problem-solving process in Digital Solutions
- a reference list and a recognised system of in-text referencing.

The project will include the following assessable evidence:

- recognition and description of
  - programmed and user-interface components
  - useability principles, including accessibility, effectiveness, safety, utility and learnability

- symbolisation using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots of
  - the user and developer problem
  - algorithms communicated in pseudocode that demonstrate knowledge and understanding of programming features
  - interrelationships between user experiences and data in the prototype digital solution
- explanation of
  - internal and external data components and data structures using appropriate symbols, code, data samples and screenshots from the prototype digital solution with annotations
  - the solution from a user-experience perspective communicated by way of a collection of annotated images of the user-interface components
  - how programming elements and user-interface components connect communicated in an annotated diagram
  - the functionality, useability and efficiency of the coded components communicated through code comments and annotations
- analysis of the information and the prototype digital solution to identify
  - data inputs
  - data and programmed components and their relationships to the structure of the prototype digital solution
  - the prototype's potential personal, social and economic impacts
- determination of
  - solution requirements
    - required essential elements and features of user interface
    - data requirements
  - prescribed and self-determined criteria
- synthesis of ideas and information about solutions for
  - user interfaces
  - data and programmed components of a prototype digital solution, e.g. annotated diagrams identifying and describing proposed components of the prototype digital solution
  - data repositories
  - programming to generate a prototype digital solution
- generation of
  - code for the prototype digital solution demonstrating
    - selection
    - iteration
    - user input
    - data output
  - a prototype digital solution by combining the user interface, data and coded components

- evaluation against criteria of
  - personal, social and economic impacts supported by a collection of data samples or representations
  - the accuracy and efficiency of the coded components supported by a collection of annotated code segments in tables, diagrams and written paragraphs identifying errors and actions to make refinements
  - the solution from a user-experience perspective supported by a collection of annotated images of the user-interface components
- make refinements and justified recommendations for current and future improvements.

The project is multimodal, using two or more communication modes within the same response, where all modes are used to provide evidence of the assessable objectives. The multimodal presentation for this instrument includes:

- a document containing written text, annotations, algorithms, code, screenshots, pictures and/or sketches
- a digital video that may combine images, video, sound, text and a narrative voice.

### Stimulus material

Teachers will prepare a technical proposal document as stimulus material for this assessment instrument.

The technical proposal will include the following:

- identification — a brief statement which identifies the real-world related need for developing the digital solution and relevant background information
- interactions — specifies information relating to interactions between humans and or the environment, and information systems, this may include proto-personas
- component specifications — specifications relating to data, user interface/experience and code.

### Conditions

- Length:
  - 8–10 A3 pages
  - 2–4 minute demonstration of the functionality of the user interface, data and coded components of the digital solution by video recording
  - 4–6 A4 pages of code with annotations
- Other:
  - the reference list is not included in the page count
  - schools implement authentication strategies that reflect QCAA guidelines (see Section 1.3.2).

## Summary of the instrument-specific marking guide

The following table summarises the mark allocation for the objectives assessed in the digital solution.

| Criterion | Objectives | Marks |
|---|---|---|
| Retrieving and comprehending | 1, 2 | 8 |
| Analysing | 3, 4 | 8 |
| Synthesising and evaluating | 5, 6, 7 | 10 |
| Communicating | 8 | 4 |
| **Total** | | **30** |

## Instrument-specific marking guide

### Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe programming elements, user-interface components and useability principles
2. symbolise and explain programming information and ideas, data structures and interrelationships between user experiences and data of the digital prototype

| The student work has the following characteristics: | Marks |
|---|---|
| • accurate and discriminating recognition and discerning description of relevant programming elements, user-interface components and useability principles<br>• adept symbolisation and discerning explanation of algorithms and relevant programming information and ideas, data structures and interrelationships between user experiences and data of the digital prototype. | 7–8 |
| • accurate recognition and effective description of relevant programming elements, user-interface components and useability principles<br>• methodical symbolisation and effective explanation of algorithms and relevant programming information and ideas, data structures and interrelationships between user experiences and data of the digital prototype. | 5–6 |
| • appropriate recognition and description of some programming elements, user-interface components and useability principles<br>• competent symbolisation and appropriate explanation of algorithms and some information and ideas, and interrelationships between user experiences and data of the digital prototype. | 3–4 |
| • variable recognition and superficial description of programming elements, user-interface components or useability principles<br>• variable symbolisation and superficial explanation of information, ideas or interrelationships. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Analysing

Assessment objectives

3. analyse the problem and information related to the technical proposal for a low-fidelity prototype digital solution
4. determine user interface, data, programmed and solution requirements of the digital solution and prescribed and self-determined criteria

| The student work has the following characteristics: | Marks |
|---|---|
| • insightful analysis of the problem and relevant contextual information to identify the essential elements and features of user interface, data and programmed components and their relationships to the structure of the low-fidelity prototype digital solution<br>• astute determination of the user interface, data, programmed and solution requirements of the digital solution and essential prescribed and self-determined criteria. | 7–8 |
| • considered analysis of the problem and relevant contextual information to identify the relevant elements and features of user interface, data and programmed components and their relationships to the structure of the low-fidelity prototype digital solution<br>• logical determination of the user interface, data, programmed and solution requirements of the digital solution and effective prescribed and self-determined criteria. | 5–6 |
| • appropriate analysis of the problem and contextual information to identify some elements and features of user interface, data and programmed components and their relationships to the structure of the low-fidelity prototype digital solution<br>• reasonable determination of the user interface, data, programmed and solution requirements of the digital solution and some prescribed and self-determined criteria. | 3–4 |
| • superficial analysis of the problem or partial information to identify aspects of elements or features of the low-fidelity prototype digital solution<br>• vague determination of some solution requirements of the digital solution and some criteria. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to determine data elements, user interface and programmed components for a digital solution
6. generate user interfaces and programmed components of the digital solution
7. evaluate impacts, components and the digital solution against prescribed and self-determined criteria to make refinements and justified recommendations

| The student work has the following characteristics: | Marks |
|---|---|
| • coherent and logical synthesis of relevant information and ideas to determine data elements, user interface and programmed components for a digital solution<br>• purposeful generation of efficient user interface and programmed components of the digital solution<br>• critical evaluation of impacts, user experience and coded components and the digital solution against essential prescribed and self-determined criteria to make discerning refinements and astute recommendations justified by data. | 9–10 |

| The student work has the following characteristics: | Marks |
|---|---|
| • logical synthesis of relevant information and ideas to determine data elements, user interface and programmed components for a digital solution<br>• effective generation of user interface and programmed components of the digital solution<br>• reasoned evaluation of impacts, user experience and coded components and the digital solution against effective prescribed and self-determined criteria to make effective refinements and considered recommendations justified by data. | 7–8 |
| • simple synthesis of information and ideas to determine data elements, user interface and programmed components for a digital solution<br>• adequate generation of user interface and programmed components of the digital solution<br>• feasible evaluation of impacts, user experience and coded components and the digital solution against some prescribed and self-determined criteria to make adequate refinements and fundamental recommendations justified by data. | 5–6 |
| • rudimentary synthesis of partial information or ideas to determine data elements, user interface or programmed components<br>• partial generation of user interface and programmed components of the digital solution<br>• superficial evaluation of impacts, user experience components or the solution against some criteria. | 3–4 |
| • unclear combination of information, ideas or solution components<br>• identification of a change to an idea or a solution. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Communicating

Assessment objective

8. make decisions about and use mode-appropriate features, written language and conventions for a technical audience

| The student work has the following characteristics: | Marks |
|---|---|
| • discerning decision-making about, and fluent use of<br>– written and visual features to communicate about a solution<br>– language for a technical audience<br>– grammatically accurate language structures<br>– referencing and project conventions. | 3–4 |
| • variable decision-making about, and inconsistent use of<br>– written and visual features<br>– suitable language<br>– grammar and language structures<br>– referencing or project conventions. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

# 5 Unit 4: Digital impacts

## 5.1 Unit description

In Unit 4, students learn how data is shared in both local and global contexts, particularly how digital solutions are increasingly required to exchange data securely and efficiently. Students will understand elements of cybersecurity by exploring the conditions, environment and methods for enabling data to flow between different digital systems. They will analyse data privacy and data integrity risks associated with transferring data between applications and evaluate the personal, social and economic impacts associated with the use and availability of both public and private data. Students will develop an application that simulates the exchange of data between two applications.

### Unit requirements

In Unit 4, the programming language must allow the following operations:

- text-based syntax
- modularisation
- interactivity
- input and output to data stores, e.g. files and databases
- availability to connect to other devices and services
- use of lists and records.

Students may use an object-oriented programming language.

SQL syntax version must be based on generic ANSI-style SQL, i.e. SQL-92.

## 5.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

| Unit objective | IA3 | EA |
|---|---|---|
| 1. recognise and describe programming elements, components of data exchange systems, privacy principles and data exchange processes | • | • |
| 2. symbolise and explain data structures and specifications, methods for exchanging data, algorithms and data-flow relationships within and between systems | • | • |
| 3. analyse problems and information related to digital systems | • | • |
| 4. determine solution requirements and prescribed and self-determined criteria | • | |
| 5. synthesise information and ideas to determine possible components of digital solutions | • | • |
| 6. generate components of the digital solution | • | |
| 7. evaluate impacts, components and solutions against prescribed and self-determined criteria to make refinements and justified recommendations | • | • |
| 8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts. | • | |

## 5.3 Topic 1: Digital methods for exchanging data

**Subject matter**

In this topic, students will:

- recognise and describe
  - encryption and authentication strategies appropriate for securing data transmissions and their differences
  - features of symmetric (Data Encryption Standard — DES, Triple DES, AES — Advanced Encryption Standard, Blowfish and Twofish) and assymetric (RSA) encryption algorithms
  - how data compression, encryption and hashing are used in the storage and transfer of data
  - how simple algorithms consist of input, process and output at various stages
  - how useability principles are used to inform solution development
  - how the elements and principles of visual communication inform user interface development
- explain
  - Australian Privacy Principles (2014) and ethics applicable to the use of personally identifiable or sensitive data from a digital systems perspective
  - network transmission principles, including latency, jitter, guarantee and timeliness of delivery, and protocols relevant to the transmission of data over the internet, e.g. HTTP, HTTPS, FTP, VPN, streaming and broadcasting data packets
  - methods for data exchange used to transfer data across networked systems including REST, JSON and XML
- symbolise, analyse and evaluate Caesar, Polyalphabetic (e.g. Vigenere and Gronsfield), and one-time pad encryption algorithms
- describe data using appropriate naming conventions, data formats and structures
- symbolise and explain
  - how application sub-systems, e.g. front end, back end, work together to constitute a solution

- secure data transmission techniques and processes, including the use of encryption, decryption, authentication, hashing and checksums
- the basic constructs of an algorithm, including assignment, sequence, selection, condition, iteration and modularisation

- symbolise
  - representations of a digital solution
  - data flow through a system using data flow diagrams.

## 5.4 Topic 2: Complex digital data exchange problems and solution requirements

**Subject matter**

In this topic, students will:

- analyse problems and information to determine
  - boundary of scope of given problems
  - constraints and limitations of environments
  - requirements of the solution components
  - necessary coded modularity and features
  - factors and risks that affect data security, including confidentiality, integrity and availability, and privacy
  - existing code within inbuilt libraries
  - prescribed and self-determined criteria to appraise the implementation, e.g. protection, security and interactions
- analyse, evaluate and make refinements to data to ensure completeness, consistency and integrity
- analyse and explain a system's data process by developing data flow diagrams that link external entities, data sources, processes and data storage
- determine manageable aspects of a problem through a decomposition and analysis of
  - constraints
  - risks
  - available tools and code libraries
  - data storage and output requirements
  - data interface
- determine data sources required to generate data components
- symbolise algorithmic steps as pseudocode
- explain the purpose of code and/or algorithm statements using code comments and annotations
- communicate using
  - digital technologies–specific language
  - language conventions; textual features such as annotations, paragraphs and sentences; and referencing conventions to convey information to particular audiences about digital solutions
  - sketches or diagrams to present information and ideas about the problem and programmed digital solutions
  - the modes of visual, written and spoken communication to present data and information about digital solutions.

# 5.5 Topic 3: Prototype digital data exchanges

**Subject matter**

In this topic, students will:

- Synthesise information and ideas to determine prototype components of data exchange solutions
- use a suitable programming environment to
  - implement algorithms using modularisation
  - receive data from an external source, and process and display the data in an appropriate format
  - incorporate existing code libraries (where applicable)
- develop simple Caesar, Polyaphabetic (e.g. Vignere and Gronsfeld), and one-time pad encryption algorithms
- generate
  - a well-ordered and unambiguous algorithm to solve defined problems using pseudocode
  - a prototype digital solution that uses appropriate data structures including JSON or XML, to exchange data
- manipulate data from an external source
- generate data structures using
  - SQL CREATE, DROP and ALTER statements
  - SQL INSERT and UPDATE
  - SQL SELECT query, including WHERE, GROUP BY, HAVING, ORDER BY, sub-selection and inner-joins clauses
- generate within programmed methods
  - sequence
  - selection, i.e. use of single and nested, simple or compound conditions
  - iterations, including nesting or simple or compound conditions
  - use of code-specific arithmetic comparison and logical operators, including real division, integer division, modulus
  - use of data types, error-checking functions and conversions
  - use of structures, including one-dimensional collections, e.g. arrays and lists
- evaluate by desk checking algorithms to predict the output for a given input, identify errors and validate algorithms
- evaluate
  - security impacts of data and its use, dissemination, storage, accuracy and ownership on personal, social and economic needs
  - the solution against prescribed and self-determined criteria
  - solutions by testing to refine their accuracy, reliability, maintainability, efficiency, effectiveness and useability
  - and make justified recommendations related to the security impacts of digital solutions, taking into consideration changes in interactivity and ways information and data are created, used and shared.

# 5.6 Assessment

## 5.6.1 Summative internal assessment 3 (IA3): Project — folio (25%)

### Description

This assessment focuses on the problem-solving process in Digital Solutions that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. The response is a coherent work that documents the iterative process undertaken to develop a solution to a problem. It may include written paragraphs and annotations, data, tables, algorithms, diagrams, sketches, illustrations, digital prototypes and models.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop the folio.

### Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe key elements of an application, components of data exchange systems, and data security processes
2. symbolise and explain data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data
3. analyse a data exchange problem and information related to data security
4. determine data exchange system requirements, a security strategy for data, and prescribed and self-determined criteria
5. synthesise information and ideas to determine selected data, algorithms and coded components of data exchange solutions
6. generate components of the data exchange solution
7. evaluate impacts, coded components and a data exchange solution against prescribed and self-determined criteria to make refinements and justified recommendations
8. make decisions about and use mode-appropriate features, written language and conventions for a technical audience.

### Specifications

#### Description

In the Project — folio, students document the application of the problem-solving process in Digital Solutions in response to an identified real-world digital problem. The response contains three parts that enable students to explore the exchange of data between two different digital systems and evaluate security impacts of transmitting data between devices and over the internet on personal, social and economic needs. The project will include the following project and referencing conventions:

- headings that organise and communicate the student's thinking through the iterative phases of the problem-solving process in Digital Solutions
- a reference list and a recognised system of in-text referencing.

The project will be in three parts:

- Part 1: Research and investigation — Students will research and investigate digital methods that could be used to exchange data between two digital systems.
- Part 2: Data exchange solution — Students will use an iterative process to create and test a data exchange solution that simulates the exchange of data between two digital systems.
- Part 3: Impacts — Students will analyse the data security and privacy risks associated with transferring data between two digital systems. They will evaluate the personal, social and economic impacts of data to be transferred, and recommend appropriate strategies to increase data security, e.g. confidentiality, integrity and availability.

The project will include the following assessable evidence:

Part 1: Research and investigation

- recognition and description of key elements of
  - a data exchange application
  - components of data exchange systems
  - data security processes
- symbolisation using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots, and explanation of
  - data interface, data structures and data specifications
  - digital methods of exchanging data
- analysis of the data exchange problem to identify
  - the data structures, including data input and output requirements
  - data exchange methods
- determination of data exchange system requirements
- evaluation against prescribed and self-determine criteria of the most suitable process for exporting and importing data between the two digital systems.

Part 2: Data exchange solution

- symbolisation using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots, and explanation of
  - data flow relationships within and between systems
  - programming features and ideas using annotated code segments
  - algorithms communicated in pseudocode
- determination of prescribed and self-determined criteria
- synthesis of data, algorithm and coded component ideas to generate components of a data exchange solution that simulates the exchange of data between two digital systems; the solution will receive data in one format and programmatically transform it into another format for sharing/displaying
- evaluation of the
  - accuracy of code after testing to identify errors and actions to make improvements
  - digital data exchange solution against prescribed and self-determined criteria

  - functionality, useability and efficiency of the components of the digital solution
- make refinements and justified recommendations for current and future improvements.

Part 3: Impacts

- recognition and description of key elements of
  - risks associated with storing and accessing data
  - digital security strategies, including authentication and encryption strategies
- analysis of a data security problem to identify risks to
  - the system
  - data security and privacy
- determination of security strategy for data
- evaluation against prescribed and self-determined criteria of the impact of data transmission on personal, social and economic needs
- recommend an appropriate strategy to increase data security.

The project is multimodal, using two or more communication modes within the same response, where all modes are used to provide evidence of the assessable objectives. The multimodal presentation for this instrument includes:

- a document containing written text, annotations, algorithms, code, screenshots, pictures and/or sketches
- a digital video that may combine images, video, sound, text and a narrative voice.

**Stimulus material**

Teachers may prepare a technical proposal document as stimulus material for this assessment instrument.

If prepared, the technical proposal should include the following:

- identification — a brief statement which identifies the real-world related need for developing the digital solution and relevant background information
- interactions — specifies information relating to interactions between humans and or the environment, and information systems, this may include proto-personas
- component specifications — specifications relating to data, user interface/experience and code.

**Conditions**

- Length:
  - 8–10 A3 pages
  - 2–4 A4 pages of code with annotations
  - 1–2 minute demonstration of the functionality of the data exchange solution by video recording
- Other:
  - the reference list and appendixes are not included in the page count
  - schools implement authentication strategies that reflect QCAA guidelines (see Section 1.3.2).

## Summary of the instrument-specific marking guide

The following table summarises the mark allocation for the objectives assessed in the Project — folio.

| Criterion | Objectives | Marks |
|---|---|---|
| Retrieving and comprehending | 1, 2 | 6 |
| Analysing | 3, 4 | 7 |
| Synthesising and evaluating | 5, 6, 7 | 8 |
| Communicating | 8 | 4 |
| **Total** | | **25** |

## Instrument-specific marking guide

### Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe key elements of an application, components of data exchange systems, and data security processes
2. symbolise and explain data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data

| The student work has the following characteristics: | Marks |
|---|---|
| • accurate and discriminating recognition and discerning description of key elements of an application, components of data exchange systems, and data security processes<br>• adept symbolisation and discerning explanation of data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data. | 5–6 |
| • appropriate recognition and description of key elements of an application, components of data exchange systems, and data security processes<br>• competent symbolisation and appropriate explanation of data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data. | 3–4 |
| • variable recognition and superficial description of elements of an application, components of data exchange systems, or data security processes<br>• variable symbolisation and superficial explanation of aspects of data interface, data flow relationships or digital methods of exchanging data. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Analysing

Assessment objectives

3. analyse a data exchange problem and information related to data security
4. determine data exchange system requirements, a security strategy for data, and prescribed and self-determined criteria

| The student work has the following characteristics: | Marks |
|---|---|
| • insightful analysis of the data exchange problem and relevant information related to data security to identify the data structures, data exchange methods, risks to data and code components<br>• astute determination of data exchange requirements, security strategy for data, code for the data conversion program and essential prescribed and self-determined criteria. | 6–7 |
| • considered analysis of the data exchange problem and relevant information related to data security to identify the data structures, data exchange methods, risks to data and code components<br>• logical determination of data exchange requirements, security strategy for data, code for the data conversion program and effective prescribed and self-determined criteria. | 4–5 |
| • appropriate analysis of the data exchange problem and information related to data security to identify the data structures, data exchange methods, risks to data and code components | 2–3 |

| The student work has the following characteristics: | Marks |
|---|---|
| • reasonable determination of data exchange requirements, security strategy for data or code for the data conversion program and some criteria. | |
| • makes statements about aspects of the data exchange problem, data structures, data exchange methods, risks to data or code components<br>• vague determination of some data exchange requirements, security strategy for data and some criteria. | 1 |
| • does not satisfy any of the descriptors above. | 0 |

### Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to determine selected data, algorithms and coded components of data exchange solutions
6. generate components of the data exchange solution
7. evaluate impacts, coded components and a data exchange solution against prescribed and self-determined criteria to make refinements and justified recommendations

| The student work has the following characteristics: | Marks |
|---|---|
| • coherent and logical synthesis of relevant information and ideas to determine selected data, algorithms and coded components of data exchange solutions<br>• purposeful generation of efficient components of the data exchange solution<br>• critical evaluation of impacts, coded components and a data exchange solution against essential prescribed and self-determined criteria to make discerning refinements of code and astute recommendations justified by data. | 7–8 |
| • logical synthesis of relevant information and ideas to determine data, algorithms and coded components of data exchange solutions<br>• effective generation of components of a data exchange solution<br>• reasoned evaluation of impacts, coded components and the digital data exchange solution against effective criteria to make effective refinements of code and considered recommendations justified by data. | 5–6 |
| • simple synthesis of information or ideas to determine data, algorithms and coded components of data exchange solutions<br>• adequate generation of components of the data exchange solution<br>• feasible evaluation of impacts, coded components and a digital data exchange solution against some criteria to make adequate refinements of code and fundamental recommendations justified by data. | 3–4 |
| • unclear combinations of information or ideas to determine data, algorithms or coded components of data exchange solutions<br>• superficial evaluation of impacts, or the digital data exchange solution, against criteria. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

**Criterion: Communicating**

Assessment objective

8. make decisions about and use mode-appropriate features, written language and conventions for a technical audience

| The student work has the following characteristics: | Marks |
|---|---|
| • discerning decision-making about, and fluent use of<br>– written and visual features to communicate about a solution<br>– language for a technical audience<br>– grammatically accurate language structures<br>– referencing and project conventions. | 3–4 |
| • variable decision-making about, and inconsistent use of<br>– written and visual features<br>– suitable language<br>– grammar and language structures<br>– referencing or project conventions. | 1–2 |
| • does not satisfy any of the descriptors above. | 0 |

## 5.6.2 Summative external assessment (EA): Examination (25%)

### General information

Summative external assessment is developed and marked by the QCAA. In Digital Solutions, it contributes 25% to a student's overall subject result.

The external assessment in Digital Solutions is common to all schools and administered under the same conditions, at the same time, on the same day.

### Description

The examination is a supervised test that assesses the application of a range of cognitions to multiple provided items.

Student responses must be completed individually, under supervised conditions, and in a set timeframe.

## Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe programming elements, components of exchange systems, privacy principles and data exchange processes
2. symbolise and explain programming ideas, data specifications, data exchange processes, and data flow within and between systems
3. analyse problems and information related to a digital problem
5. synthesise information and ideas to determine possible low-fidelity components of secure data exchange solutions
7. evaluate impacts, components and solutions against criteria to make refinements and justified recommendations

**Note:** Objectives 4, 6 and 8 are not assessed in this instrument.

## Specifications

### Description

Combination response

This assessment will include a combination of one extended response, a number of short response and/or multiple-choice questions.

Extended response

- is constructed using one item; the item is a response to an unseen problem based on stimulus material
- requires sustained analysis, synthesis and evaluation to fully solve a problem.

Short response

- consists of a number of items that ask students to respond to the following activities:
  - sketching, labelling or interpreting tables or diagrams
  - multiple-choice, sentence or short-paragraph responses
  - writing and calculating using algorithms
  - responding to unseen stimulus materials.
- where applicable, students are required to write in full sentences, constructing a response so that ideas are maintained, developed and justified.

### Conditions

- Time: 2 hours plus perusal (15 minutes)
- Length: 800–1000 words in total, including
  - 50–250 words for short-response answers
  - 400 words or more for the extended response

## Instrument-specific marking guide

No ISMG is provided for the external assessment.

# 6 Glossary

| Term | Explanation |
|---|---|
| **A** | |
| **abstraction** | a process of reducing complexity to formulate generalised fundamental ideas or concepts removed from specific details or situation, e.g. the idea that a cricket ball is a sphere in the same way that a soccer ball is, or the concept that data can be organised in records made up of fields irrespective of whether the data are numbers, text, images or something else;<br>abstraction involves hiding details of an idea, problem or solution that are not relevant to focus on a manageable number of aspects |
| **accomplished** | highly trained or skilled in a particular activity; perfected in knowledge or training; expert |
| **accuracy** | the condition or quality of being true, correct or exact; freedom from error or defect; precision or exactness; correctness;<br>in science, the extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty |
| **accurate** | precise and exact; to the point; consistent with or exactly conforming to a truth, standard, rule, model, convention or known fact; free from error or defect; meticulous; correct in all details |
| **adept** | very/highly skilled or proficient at something; expert |
| **adequate** | satisfactory or acceptable in quality or quantity; equal to the requirement or occasion |
| **algorithm** | step-by-step procedures required to solve a problem, e.g. to find the largest number in a list of positive numbers<br>• note the first number as the largest<br>• look through the remaining numbers in turn, and if a number is larger than the number found in the first step, note it as the largest<br>• repeat this process until complete; the last noted number is the largest in the list;<br>an algorithm may be described in many ways; pseudocode is often useful in visualising an algorithm |
| **analyse** | dissect to ascertain and examine constituent parts and/or their relationships; break down or examine in order to identify the essential elements, features, components or structure; determine the logic and reasonableness of information;<br>examine or consider something in order to explain and interpret it for the purpose of finding meaning or relationships and identifying patterns, similarities and differences |

| Term | Explanation |
|---|---|
| **animation** | a series of images that when combined suggest movement;<br>animations are of varying sophistication and may use two-dimensional or three-dimensional imaging; these may be images of: an object moving, moving around an object, moving through a space, parts moving, or moving from external to internal views, or vice versa |
| **animations and simulations** | animations and simulations are visually oriented solutions with an emphasis on animation and providing users with instant feedback through graphics and interaction. Simulations may model phenomena with a set of simple rules. Animations and simulations allow students to observe behaviours of basic computational processes |
| **annotated** | made or furnished critical or explanatory notes, or comments to a picture, drawing, sketch or diagram |
| **annotations** | explanatory notes or comments; usually added to a sketch or drawing |
| **app** | a software application with a very specific or narrow purpose designed to run on mobile devices (such as smartphones or tablets), through a web browser or on a personal computer;<br>the feature set of an application is limited when compared with a full-featured desktop application for a similar purpose, e.g. a photo-editing application has a smaller set of features than an industry-standard photographic suite |
| **applied learning** | the acquisition and application of knowledge, understanding and skills in real-world or lifelike contexts that may encompass workplace, industry and community situations; it emphasises learning through doing and includes both theory and the application of theory, connecting subject knowledge and understanding with the development of practical skills |
| **Applied subject** | a subject whose primary pathway is work and vocational education; it emphasises applied learning and community connections;<br>a subject for which a syllabus has been developed by the QCAA with the following characteristics: results from courses developed from Applied syllabuses contribute to the QCE; results may contribute to ATAR calculations |
| **apply** | use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation |
| **appraise** | evaluate the worth, significance or status of something; judge or consider a text or piece of work |
| **appreciate** | recognise or make a judgment about the value or worth of something; understand fully; grasp the full implications of |
| **appropriate** | acceptable; suitable or fitting for a particular purpose, circumstance, context etc. |
| **apt** | suitable to the purpose or occasion; fitting; appropriate |
| **area of study** | a division of, or a section within, a unit |
| **argue** | give reasons for or against something; challenge or debate an issue or idea; persuade, prove or try to prove by giving reasons |
| **aspect** | a particular part of a feature of something; a facet, phase or part of a whole |

| Term | Explanation |
|---|---|
| **assess** | measure, determine, evaluate, estimate or make a judgment about the value, quality, outcomes, results, size, significance, nature or extent of something |
| **assessment** | purposeful and systematic collection of information about students' achievements |
| **assessment instrument** | a tool or device used to gather information about student achievement |
| **assessment objectives** | drawn from the unit objectives and contextualised for the requirements of the assessment instrument<br>(see also 'syllabus objectives', 'unit objectives') |
| **assessment technique** | the method used to gather evidence about student achievement, (e.g. examination, project, investigation) |
| **assignment** | a basic construct of an algorithm used to store the value of an expression into a variable |
| **astute** | showing an ability to accurately assess situations or people; of keen discernment |
| **ATAR** | Australian Tertiary Admission Rank |
| **audience** | an individual or group for whom the response is designed and delivered |
| **Australian privacy principles** | The Australian Privacy Principles (APPs), which are contained in schedule 1 of the *Privacy Act 1988* (Privacy Act), outline how most Australian and Norfolk Island Government agencies, all private sector and not-for-profit organisations with an annual turnover of more than $3 million, all private health service providers and some small businesses (collectively called 'APP entities') must handle, use and manage personal information (Australian Government 2013). The principles are available in PDF at www.oaic.gov.au/resources/agencies-and-organisations/guides/app-quick-reference-tool.pdf |
| **authoritative** | able to be trusted as being accurate or true; reliable; commanding and self-confident; likely to be respected and obeyed |
| **B** | |
| **balanced** | keeping or showing a balance; not biased; fairly judged or presented; taking everything into account in a fair, well-judged way |
| **basic** | fundamental |
| **binary** | two states or permissible values to represent data, such as ON and OFF positions of a light switch or transistors in a computer silicon chip that can be in either the electrical state of ON or OFF;<br>binary data are typically represented as a series of single digits referred to as binary digits (or bits) due to each taking on the value of either 0 or 1 |
| **branching** | making a decision between two or more actions depending on sets of conditions and the data provided, e.g. in testing whether a light works |
| **C** | |
| **calculate** | determine or find (e.g. a number, answer) by using mathematical processes; obtain a numerical answer showing the relevant stages in the working; ascertain/determine from given facts, figures or information |

| Term | Explanation |
|---|---|
| **categorise** | place in or assign to a particular class or group; arrange or order by classes or categories; classify, sort out; sort; separate |
| **challenging** | difficult but interesting; testing one's abilities; demanding and thought-provoking; usually involving unfamiliar or less familiar elements |
| **characteristics** | a set of distinguishing aspects (including attributes and behaviours) of an object, material, living thing, system or event;<br>in Digital Solutions, e.g. the characteristics of a stored digital graphic may be the colour depth (maximum number of colours represented), the resolution (number of pixels per area, or height and width) and the compression used |
| **clarify** | make clear or intelligible; explain; make a statement or situation less confused and more comprehensible |
| **clarity** | clearness of thought or expression; the quality of being coherent and intelligible; free from obscurity of sense; without ambiguity; explicit; easy to perceive, understand or interpret |
| **class time** | includes the time made available for students to independently respond to extended assessment tasks and any associated and required teaching and learning time |
| **classify** | arrange, distribute or order in classes or categories according to shared qualities or characteristics |
| **clear** | free from confusion, uncertainty or doubt; easily seen, heard or understood |
| **clearly** | in a clear manner; plainly and openly; without ambiguity |
| **coding** | translating programming logic into code, i.e. the implementation of a solution using tools, techniques and best practices |
| **coherent** | having a natural or due agreement of parts; connected; consistent; logical; orderly; well-structured and makes sense; rational, with parts that are harmonious; having an internally consistent relation of parts |
| **cohesive** | characterised by being united, bound together or having integrated meaning; forming a united whole |
| **collaborate** | work with others to conduct a specific task |
| **comment** | express an opinion, observation or reaction in speech or writing; give a judgment based on a given statement or result of a calculation |
| **communicate** | convey knowledge and/or understandings to others; make known; transmit |
| **compare** | display recognition of similarities and differences and recognise the significance of these similarities and differences |
| **competent** | having suitable or sufficient skills, knowledge, experience etc. for some purpose; adequate but not exceptional; capable; suitable or sufficient for the purpose;<br>having the necessary ability, knowledge or skill to do something successfully; efficient and capable (of a person); acceptable and satisfactory, though not outstanding |

| Term | Explanation |
|---|---|
| **competently** | in an efficient and capable way; in an acceptable and satisfactory, though not outstanding, way |
| **complex** | composed or consisting of many different and interconnected parts or factors; compound; composite; characterised by an involved combination of parts; complicated; intricate; a complex whole or system; a complicated assembly of particulars |
| **components** | parts (made of two or more elements) that make up a whole object or system and perform specific functions, e.g. a digital solution usually includes three components: data, system/user interface and text-based source code that may be interpreted or compiled |
| **comprehend** | understand the meaning or nature of; grasp mentally |
| **comprehensive** | inclusive; of large content or scope; including or dealing with all or nearly all elements or aspects of something; wide-ranging; detailed and thorough, including all that is relevant |
| **compression** | a process of encoding information using fewer bits, i.e. 0 or 1, than an original representation, to reduce file size, typically using mathematical formulas to remove repeated data, combine related data or simplify data, e.g. a line segment can be represented by the position of the end points instead of every dot on it;<br>common examples include:<br>• .zip files, which can contain one or more files or folders that have been compressed<br>• .jpg files in digital photography are produced by processing complete (lossless) data from a camera's sensor through compressing (looking for redundant/unnecessary data) into a smaller file size<br>• .mp3 files for audio, which compress an original audio source to reduce the file size significantly but still sound like an exact copy of the original |
| **computational thinking** | a problem-solving method that involves various techniques and strategies that can be implemented by digital systems; techniques and strategies may include organising data logically, breaking down problems into parts, defining abstract concepts, and designing and using algorithms, patterns and models |
| **condition** | a logical expression that evaluates to true or false; a pre-condition is a statement or set of statements that describes a condition or conditions that should be true when a specific operation is called; a post-condition is a statement or set of statements that describes a condition or conditions that should be true when the operation has completed its task |
| **concise** | expressing much in few words; giving a lot of information clearly and in a few words; brief, comprehensive and to the point; succinct; clear; without repetition of information |
| **concisely** | in a way that is brief but comprehensive; expressing much in few words; clearly and succinctly |
| **conduct** | direct in action or course; manage; organise; carry out |
| **consider** | think deliberately or carefully about something, typically before making a decision; take something into account when making a judgment; view attentively or scrutinise; reflect on |
| **considerable** | fairly large or great; thought about deliberately and with a purpose |

| Term | Explanation |
|---|---|
| **considered** | formed after careful and deliberate thought |
| **consistent** | agreeing or accordant; compatible; not self-opposed or self-contradictory; constantly adhering to the same principles; acting in the same way over time, especially so as to be fair or accurate; unchanging in nature, standard or effect over time; not containing any logical contradictions (of an argument); constant in achievement or effect over a period of time |
| **constraints** | limitations or restrictions that must be considered and accommodated when defining a problem, e.g. teacher-specified limitations, available time, physical realities, legalities |
| **construct** | create or put together (e.g. an argument) by arranging ideas or items; display information in a diagrammatic or logical form; make; build |
| **content** | the things that are held or included in something, includes context, concepts, principles, processes, purpose and scenarios |
| **context** | the circumstances that form the setting for an event, statement or idea, and in terms of which it can be fully understood |
| **contrast** | display recognition of differences by deliberate juxtaposition of contrary elements; show how things are different or opposite; give an account of the differences between two or more items or situations, referring to both or all of them throughout |
| **control systems** | a device or set of devices to manage, command, direct or regulate the behaviour of other devices or systems; a mechanical, optical or electronic system that is used to maintain a desired output |
| **controlled** | shows the exercise of restraint or direction over; held in check; restrained, managed or kept within certain bounds |
| **convincing** | persuaded by argument or proof; leaving no margin of doubt; clear; capable of causing someone to believe that something is true or real; persuading or assuring by argument or evidence; appearing worthy of belief; credible or plausible |
| **course** | a defined amount of learning developed from a subject syllabus |
| **create** | bring something into being or existence; produce or evolve from one's own thought or imagination; reorganise or put elements together into a new pattern or structure; to form a coherent or functional whole |
| **creative** | resulting from originality of thought or expression; relating to or involving the use of the imagination or original ideas to create something; having good imagination or original ideas |
| **credible** | capable or worthy of being believed; believable; convincing |
| **criteria** | characteristics by which something is evaluated or appraised; the teacher or client (prescribed) or students (self-determined) develop criteria, e.g. specific needs, identified purpose, impacts quality or effectiveness of solution |
| **criterion** | the property or characteristic by which something is judged or appraised |

| Term | Explanation |
|---|---|
| **critical** | involving skilful judgment as to truth, merit etc.; involving the objective analysis and evaluation of an issue in order to form a judgment; expressing or involving an analysis of the merits and faults of a work of literature, music or art; incorporating a detailed and scholarly analysis and commentary (of a text); rationally appraising for logical consistency and merit |
| **critiques** | reviews (e.g. of a theory, practice, performance) that are detailed, analytical and critical |
| **cursory** | hasty, and therefore not thorough or detailed; performed with little attention to detail; going rapidly over something, without noticing details; superficial |
| **D** | |
| **data** | in Digital Solutions, discrete representation of information using number codes; data may include characters (e.g. alphabetic letters, numbers and symbols), images, sounds and/or instructions that, when represented by number codes, can be manipulated, stored and communicated by digital systems, e.g. characters may be represented using ASCII code or images may be represented by a bitmap of numbers representing each 'dot' or pixel |
| **data collection** | describes the numerical, categorical and textual facts measured, collected, e.g. from data loggers or harvested from local councils, Australian Bureau of Statistics or other websites, or calculated as the basis for creating information and its binary representation in digital systems |
| **data flow diagrams** | visual representations describing the flow of data through a system |
| **data validation** | in computer science, ensuring that data inserted into an application satisfies defined formats and other input criteria |
| **database** | a collection of data organised by records and fields that can be easily stored, accessed, managed and updated; each discrete piece of data to be stored is represented by a field (e.g. song title, song artist or bank account number, date of transaction) and values in the fields that are associated with an entity (e.g. a song, a bank transaction) are a record; interaction with a database usually takes place through a user interface designed specifically for the structure and use of the stored data |
| **decide** | reach a resolution as a result of consideration; make a choice from a number of alternatives |
| **declarative knowledge** | the facts and information known in a particular field or in total, as compared to procedural knowledge which is concerned with knowing how to carry out a task |
| **decomposition** | to separate a complex problem into parts to allow a problem to be more easily understood, e.g. to create an interactive story, one can decompose the problem to a list of characters and their characteristics (e.g. clothing), the actions of the characters, the backdrops and the sequence of scenes with reference to which characters, actions and backdrops are involved in each scene; decomposition may be represented in diagrams |

| Term | Explanation |
|---|---|
| **deconstructing** | a process of dismantling or pulling apart a product or system to systematically identify and analyse components and their relationships |
| **deduce** | reach a conclusion that is necessarily true, provided a given set of assumptions is true; arrive at, reach or draw a logical conclusion from reasoning and the information given |
| **defensible** | justifiable by argument; capable of being defended in argument |
| **define** | give the meaning of a word, phrase, concept or physical quantity; state meaning and identify or describe qualities |
| **demonstrate** | prove or make clear by argument, reasoning or evidence, illustrating with practical example; show by example; give a practical exhibition |
| **derive** | arrive at by reasoning; manipulate a mathematical relationship to give a new equation or relationship;<br>in mathematics, obtain the derivative of a function |
| **describe** | give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something |
| **design thinking** | use of strategies for understanding design problems, visualising and generating creative ideas, and analysing and evaluating those ideas that best meet the criteria for success; students use both convergent and divergent thinking skills; divergent thinking supports creativity and the generation of a range of ideas, and convergent thinking supports the selection and generation of a preferred solution |
| **desk checking** | a method used by a human to check the logic of a computer program's algorithm to reduce the likelihood of errors occurring; this may be done on paper, using a diagram or mentally trying a sample of typical inputs to see what the outputs would be; e.g. to desk check a branching statement {IF age >65 THEN 'retire' ELSE 'keep working'}, the values for age of 64, 65 and 66 could be tried to show that 64 and 65 would result in 'keep working' and 66 in 'retire' so that it could be decided if the statement worked as intended |
| **detailed** | executed with great attention to the fine points; meticulous; including many of the parts or facts |
| **determine** | establish, conclude or ascertain after consideration, observation, investigation or calculation; decide or come to a resolution |
| **develop** | elaborate, expand or enlarge in detail; add detail and fullness to;<br>cause to become more complex or intricate |
| **devise** | think out; plan; contrive; invent |
| **differentiate** | identify the difference/s in or between two or more things; distinguish, discriminate; recognise or ascertain what makes something distinct from similar things;<br>in mathematics, obtain the derivative of a function |
| **digital games** | interactive digital solutions that can be used for entertainment purposes. |
| **digital information** | the nature and forms of information stored digitally, and processes that transform digital data into information for various purposes and meanings, including structures, properties, features and conventions of particular forms of digital information and appropriate methods of storage, transmission and presentation of each form |

| Term | Explanation |
|---|---|
| **digital technologies** | any technology controlled using digital instructions, including computer hardware and software, digital media and media devices, digital toys and accessories, and contemporary and emerging communication technologies; these technologies are based on instructions given, using binary (0 or 1) code, that invariably mean one or more processors are present to respond to these instructions; computers, smartphones, digital cameras, printers and robots are all examples of digital technologies |
| **discerning** | discriminating; showing intellectual perception; showing good judgment; making thoughtful and astute choices; selected for value or relevance |
| **discriminate** | note, observe or recognise a difference; make or constitute a distinction in or between; differentiate; note or distinguish as different |
| **discriminating** | differentiating; distinctive; perceiving differences or distinctions with nicety; possessing discrimination; perceptive and judicious; making judgments about quality; having or showing refined taste or good judgment |
| **discuss** | examine by argument; sift the considerations for and against; debate; talk or write about a topic, including a range of arguments, factors or hypotheses; consider, taking into account different issues and ideas, points for and/or against, and supporting opinions or conclusions with evidence |
| **disjointed** | disconnected; incoherent; lacking a coherent order/sequence or connection |
| **distinguish** | recognise as distinct or different; note points of difference between; discriminate; discern; make clear a difference/s between two or more concepts or items |
| **diverse** | of various kinds or forms; different from each other |
| **document** | support (e.g. an assertion, claim, statement) with evidence (e.g. decisive information, written references, citations) |
| **draw conclusions** | make a judgment based on reasoning and evidence |
| **E** | |
| **effective** | successful in producing the intended, desired or expected result; meeting the assigned purpose |
| **efficient** | working in a well-organised and competent way; maximum productivity with minimal expenditure of effort; acting or producing effectively with a minimum of waste, expense or unnecessary effort |
| **elementary** | simple or uncompounded; relating to or dealing with elements, rudiments or first principles (of a subject);<br>of the most basic kind; straightforward and uncomplicated |
| **elements** | constituent parts of a more complex whole; a fundamental, essential or irreducible part of a composite entity; two or more elements make a component |
| **elements and principles of visual communication** | the elements form the basic components of visual communication; they are acted upon by principles that are ways of arranging or organising the elements; principles are something that can be repeatedly and dependably done with elements to produce some sort of visual effect |

| Term | Explanation |
|---|---|
| **encryption** | a process in cryptography of encoding (converting) data, using mathematical formulas, into a form that only an intended recipient can decode, often including a personal digital signature, e.g. when connecting to an online banking or shopping website, typically on login, a secure communication is set up based on encryption provided at the website, and this will be represented by a https://URL and a lock symbol on the user's internet browser |
| **erroneous** | based on or containing error; mistaken; incorrect |
| **essential** | absolutely necessary; indispensable; of critical importance for achieving something |
| **ethical** | relating to moral principles that govern a person's or group's behaviour |
| **evaluate** | make an appraisal by weighing up or assessing strengths, implications and limitations; make judgments about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria |
| **examination** | a supervised test that assesses the application of a range of cognitions to one or more provided items such as questions, scenarios and/or problems; student responses are completed individually, under supervised conditions, and in a set timeframe |
| **examine** | investigate, inspect or scrutinise; inquire or search into; consider or discuss an argument or concept in a way that uncovers the assumptions and interrelationships of the issue |
| **explain** | make an idea or situation plain or clear by describing it in more detail or revealing relevant facts; give an account; provide additional information |
| **explicit** | clearly and distinctly expressing all that is meant; unequivocal; clearly developed or formulated; leaving nothing merely implied or suggested |
| **explore** | look into both closely and broadly; scrutinise; inquire into or discuss something in detail |
| **express** | convey, show or communicate (e.g. a thought, opinion, feeling, emotion, idea or viewpoint);<br>in words, art, music or movement, convey or suggest a representation of; depict |
| **extended response** | an open-ended assessment technique that focuses on the interpretation, analysis, examination and/or evaluation of ideas and information in response to a particular situation or stimulus; while students may undertake some research when writing the extended response, it is not the focus of this technique; an extended response occurs over an extended and defined period of time |
| **extension subject** | a two-unit subject (Units 3 and 4), for which a syllabus has been developed by the QCAA, that is an extension of one or more General subject/s, studied concurrently with, or after completion of, Units 3 and 4 of that subject |
| **extensive** | of great extent; wide; broad; far-reaching; comprehensive; lengthy; detailed; large in amount or scale |
| **external assessment** | summative assessment that occurs towards the end of a course of study and is common to all schools; developed and marked by the QCAA according to a commonly applied marking scheme |

| Term | Explanation |
|---|---|
| **external examination** | a supervised test, developed and marked by the QCAA, that assesses the application of a range of cognitions to multiple provided items such as questions, scenarios and/or problems; student responses are completed individually, under supervised conditions, and in a set timeframe |
| **extrapolate** | infer or estimate by extending or projecting known information; conjecture; infer from what is known; extend the application of something (e.g. a method or conclusion) to an unknown situation by assuming that existing trends will continue or similar methods will be applicable |
| **F** | |
| **factual** | relating to or based on facts; concerned with what is actually the case; actually occurring; having verified existence |
| **familiar** | well-acquainted; thoroughly conversant with; well known from long or close association; often encountered or experienced; common;<br>(of materials, texts, skills or circumstances) having been the focus of learning experiences or previously encountered in prior learning activities |
| **feasible** | capable of being achieved, accomplished or put into effect; reasonable enough to be believed or accepted; probable; likely |
| **features** | prominent or conspicuous elements, components or characteristics of a structured whole |
| **fluent** | spoken or written with ease; able to speak or write smoothly, easily or readily; articulate; eloquent;<br>in artistic performance, characteristic of a highly developed and excellently controlled technique; polished; flowing smoothly, easily and effortlessly |
| **fluently** | in a graceful and seemingly effortless manner; in a way that progresses smoothly and readily |
| **formative assessment** | assessment whose major purpose is to improve teaching and student achievement |
| **fragmented** | disorganised; broken down; disjointed or isolated |
| **frequent** | happening or occurring often at short intervals; constant, habitual or regular |
| **fundamental** | forming a necessary base or core; of central importance; affecting or relating to the essential nature of something; part of a foundation or basis |
| **G** | |
| **General subject** | a subject for which a syllabus has been developed by the QCAA with the following characteristics: results from courses developed from General syllabuses contribute to the QCE; General subjects have an external assessment component; results may contribute to ATAR calculations |
| **generate** | produce; create; bring into existence |

| Term | Explanation |
|---|---|
| **H** | |
| **hypothesise** | formulate a supposition to account for known facts or observed occurrences; conjecture, theorise or speculate, especially on uncertain or tentative grounds |
| **I** | |
| **ideas** | thoughts, notions or suggestions as to a possible course of action |
| **identify** | distinguish; locate, recognise and name; establish or indicate who or what someone or something is; provide an answer from a number of possibilities; recognise and state a distinguishing factor or feature |
| **IF** | a conditional decision statement used to control the flow of a program (see branching); the structure of an IF statement evaluates an expression (e.g. hour < 12) and performs a specified code block only if the condition is true; e.g.:<br><br>if hour < 12:<br>print ('Good morning!')<br><br>Here, the program would only print the words 'Good morning!' if the hour of the day is less than 12 |
| **illogical** | lacking sense or sound reasoning; contrary to or disregardful of the rules of logic; unreasonable |
| **impacts** | describes analysing and predicting the extent to which personal, social and economic needs are met through existing and emerging digital technologies; appreciating the transformative potential of digital technologies in people's lives. It also involves consideration of the relationship between information systems and society and in particular the ethical and legal obligations of individuals and organisations regarding ownership, privacy of data and information |
| **implement** | put something into effect, e.g. a plan or proposal |
| **implementation** | the automation of an algorithm, typically by using appropriate software or writing a computer program |
| **implicit** | implied, rather than expressly stated; not plainly expressed; capable of being inferred from something else |
| **improbable** | not probable; unlikely to be true or to happen; not easy to believe |
| **inaccurate** | not accurate |
| **inappropriate** | not suitable or proper in the circumstances |
| **inconsistent** | lacking agreement, as one thing with another, or two or more things in relation to each other; at variance; not consistent; not in keeping; not in accordance; incompatible; incongruous |
| **independent** | thinking or acting for oneself, not influenced by others |
| **in-depth** | comprehensive and with thorough coverage; extensive or profound; well-balanced or fully developed |

| Term | Explanation |
|---|---|
| **infer** | derive or conclude something from evidence and reasoning, rather than from explicit statements; listen or read beyond what has been literally expressed; imply or hint at |
| **information** | knowledge, evidence |
| **informed** | knowledgeable; learned; having relevant knowledge; being conversant with the topic; based on an understanding of the facts of the situation (of a decision or judgment) |
| **innovation** | either something new or a change made to an existing product, process, idea or field |
| **innovative** | new and original; introducing new ideas; original and creative in thinking |
| **insightful** | showing understanding of a situation or process; understanding relationships in complex situations; informed by observation and deduction |
| **instrument-specific marking guide** | ISMG; a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment<br>(see 'assessment objectives') |
| **integral** | *adjective*<br>necessary for the completeness of the whole; essential or fundamental;<br>*noun*<br>in mathematics, the result of integration; an expression from which a given function, equation or system of equations is derived by differentiation |
| **intelligent systems** | include hardware components with sensing and actuating technology and solutions that focus on automated systems designed for a user experience;<br>these technologies allow students to explore how computational processes respond to given inputs (e.g. environmental information such as light or sound) to produce specified outputs; feedback occurs through tight loops, allowing for trial-and-error investigations |
| **intended** | designed; meant; done on purpose; intentional |
| **interactions** | reciprocal action or exchange or influence between humans or the environment and digital or information systems, especially relating to user interfaces, this encompasses communication and collaboration facilitated by digital systems |
| **interactive** | a form of digital prototype that allows the two-way flow of information between a computer and user |
| **interactive media** | generate visual or auditory outputs based on user input or enhance the productivity of the user; projects include computer-generated simulations, digital games, learning objects and productivity applications |
| **internal assessment** | assessments that are developed by schools;<br>summative internal assessments are endorsed by the QCAA before use in schools and results externally confirmed contribute towards a student's final result |

| Term | Explanation |
|---|---|
| **Internet of Things** | the Internet of Things vision is for a world full of networked physical objects; the Internet of Things is concerned with equipping objects with internet accessible identification and data sharing capabilities; ideally, these objects are augmented with sensing, processing and network capabilities, providing them with the ability to make sense of their local situation and interact within a given context |
| **interpret** | use knowledge and understanding to recognise trends and draw conclusions from given information; make clear or explicit; elucidate or understand in a particular way;<br>bring out the meaning of, e.g. a dramatic or musical work, by performance or execution; bring out the meaning of an artwork by artistic representation or performance; give one's own interpretation of;<br>identify or draw meaning from, or give meaning to, information presented in various forms, such as words, symbols, pictures or graphs |
| **investigate** | carry out an examination or formal inquiry in order to establish or obtain facts and reach new conclusions; search, inquire into, interpret and draw conclusions about data and information |
| **investigation** | an assessment technique that requires students to research a specific problem, question, issue, design challenge or hypothesis through the collection, analysis and synthesis of primary and/or secondary data; it uses research or investigative practices to assess a range of cognitions in a particular context; an investigation occurs over an extended and defined period of time |
| **irrelevant** | not relevant; not applicable or pertinent; not connected with or relevant to something |
| **ISMG** | instrument-specific marking guide; a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment<br>(see 'assessment objectives') |
| **isolated** | detached, separate or unconnected with other things; one-off; something set apart or characterised as different in some way |
| **iteration** | a repetition of a process or set of instructions in computer programming where each repeated cycle builds on a previous (see 'REPEAT statement'); typically this uses a FOR loop command with a counter such as the example below to add the numbers from 1 to 9;<br>for number = 1 to 9;<br>sum = sum + number |
| **iterative** | recursive; revisiting earlier parts of a process to further clarify meaning or refine ideas and solutions |
| **J** | |
| **judge** | form an opinion or conclusion about; apply both procedural and deliberative operations to make a determination |
| **justified** | sound reasons or evidence are provided to support an argument, statement or conclusion |
| **justify** | give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable |

| Term | Explanation |
|---|---|
| **K** | |
| **keys** | unique identifiers in a relational database used to ensure that a record in a table can be uniquely identified by one or a combination of fields within a table; three common types are:<br>• primary: a relational database has only one primary key; it is a unique identifier for each record used to help establish relationships with other tables, e.g. licence number, phone number, student ID<br>• secondary: a table may have more than one choice for the primary key; only one is chosen as the primary key; those not chosen are known as secondary keys, e.g. if student ID is chosen as the primary key, other choices including licence number and phone number are secondary keys<br>• foreign: a primary key from one table that appears as a field in another where the first table has a relationship to the second, e.g. if table A has a primary key X that linked to table B where X was a field in B, then X would be a foreign key in B. |
| **L** | |
| **learning area** | a grouping of subjects, with related characteristics, within a broad field of learning, e.g. the Arts, sciences, languages |
| **learning objects** | digital solutions that can be used to support learners; they can be created:<br>• for instructional problems<br>• to model procedures<br>• to be informational. |
| **logical** | rational and valid; internally consistent; reasonable; reasoning in accordance with the principles/rules of logic or formal argument; characterised by or capable of clear, sound reasoning; (of an action, decision etc.) expected or sensible under the circumstances |
| **logically** | according to the rules of logic or formal argument; in a way that shows clear, sound reasoning; in a way that is expected or sensible |
| **low-fidelity prototype** | used throughout the problem-solving process to quickly and simply move ideas and concepts from abstract to reality to clarify understanding and inform further exploration and development; a simple, non-functional three-dimensional, digital interactive or digital sequential representation using basic processes, materials or software that may be unrelated to how a final solution is produced, e.g. stop-motion animation of a mobile application rather than a coded solution or clay models of a handheld item to confirm the application of ergonomic data about a user's grip; algorithms to represent coding and sketches to represent user interface |
| **M** | |
| **make decisions** | select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position |
| **manipulate** | adapt or change to suit one's purpose |

| Term | Explanation |
|---|---|
| **mental procedures** | a domain of knowledge in Marzano's taxonomy, and acted upon by the cognitive, metacognitive and self-systems; sometimes referred to as 'procedural knowledge';<br>there are three distinct phases to the acquisition of mental procedures — the cognitive stage, the associative stage and the autonomous stage; the two categories of mental procedures are skills (single rules, algorithms and tactics) and processes (macroprocedures) |
| **methodical** | performed, disposed or acting in a systematic way; orderly; characterised by method or order; performed or carried out systematically |
| **methodology** | a system of methods used in a particular area of study or activity |
| **mind map** | a purposeful diagram used to visually organise information; allows the abstract relationships between ideas to be explored and refined; visual representations may include images, words and parts of words; usually a central idea or concept is placed in the middle and associated ideas arranged around it |
| **minimal** | least possible; small; the least amount; negligible |
| **mobile applications** | types of software applications that use hardware functionality and run on a mobile device, such as a smartphone or tablet computer; often provide users with similar services to those accessed on desktop computers |
| **models** | physical or digital representations of an idea or design concept that describe, simplify, clarify or provide an explanation of an idea or design concept |
| **modify** | change the form or qualities of; make partial or minor changes to something |
| **modularisation** | a concept used for reducing the complexity of a system; this system (e.g. IT application) is deconstructed into more or less independent units or modules; the modules should be able to exist independently from each other, but the system as a whole can only function as an integrated structure |
| **motion graphics** | sequential representations of images and sound; video; animation; digital multimedia presentation |
| **multimodal** | uses a combination of at least two modes (e.g. spoken, written), delivered at the same time, to communicate ideas and information to a live or virtual audience for a particular purpose; the selected modes are integrated so that each mode contributes significantly to the response |

| Term | Explanation |
|---|---|
| **N** | |
| **narrow** | limited in range or scope; lacking breadth of view; limited in amount; barely sufficient or adequate; restricted |
| **normal form** | a defined standard structure for relational databases; the forms are progressive, meaning that to qualify for third normal form a table must first satisfy the rules for second normal form, and second normal form must adhere to those for first normal form; the first three normal forms are:<br>• first normal form — the information is stored in a relational table, each column contains atomic values, and there are not repeating groups of columns<br>• second normal form — the table is in first normal form and all the columns depend on the table's primary key<br>• third normal form — the table is in second normal form and all of its columns are not transitively dependent on the primary key<br>(Wenzel, 2017) |
| **normalisation** | the process of ensuring that a database conforms to a set of normal forms. Its primary purpose is to remove redundancies that create threats to data integrity such as update anomalies. It also plays a role in making querying more efficient. (VCAA, 2014) |
| **nuanced** | showing a subtle difference or distinction in expression, meaning, response etc.; finely differentiated;<br>characterised by subtle shades of meaning or expression; a subtle distinction, variation or quality; sensibility to, awareness of or ability to express delicate shadings, as of meaning, feeling or value |
| **O** | |
| **objectives** | see 'syllabus objectives', 'unit objectives', 'assessment objectives' |
| **obvious** | clearly perceptible or evident; easily seen, recognised or understood |
| **open-ended problems** | loosely structured and complex, having no one correct solution or solution path, and requiring students to comprehend and apply a breadth and depth of knowledge during problem-solving |
| **optimal** | best; most favourable under a particular set of circumstances |
| **organise** | arrange; order; form as or into a whole consisting of interdependent or coordinated parts, especially for harmonious or united action |
| **organised** | systematically ordered and arranged; having a formal organisational structure to arrange, coordinate and carry out activities |
| **output** | a result of something (physical or virtual) such as power, energy, action, material or information produced by a person, machine or a system |
| **outstanding** | exceptionally good; clearly noticeable; prominent; conspicuous; striking |
| **P** | |
| **partial** | not total or general; existing only in part; attempted, but incomplete |
| **particular** | distinguished or different from others or from the ordinary; noteworthy |

| Term | Explanation |
|---|---|
| **pedagogy** | the discipline that deals with the theory and practice of education; it thus concerns the study of how best to teach |
| **perceptive** | having or showing insight and the ability to perceive or understand; discerning (see also 'discriminating') |
| **performance** | an assessment technique that requires students to demonstrate a range of cognitive, technical, creative and/or expressive skills and to apply theoretical and conceptual understandings through the psychomotor domain; it involves student application of identified skills when responding to a task that involves solving a problem, providing a solution or conveying meaning or intent; a performance is developed over an extended and defined period of time |
| **peripheral devices** | digital components that can be connected to a digital system but are not essential to the system, e.g. printer, scanner, digital camera |
| **persuasive** | capable of changing someone's ideas, opinions or beliefs; appearing worthy of approval or acceptance; (of an argument or statement) communicating reasonably or credibly<br>(see also 'convincing') |
| **perusal time** | time allocated in an assessment to reading items and tasks and associated assessment materials; no writing is allowed; students may not make notes and may not commence responding to the assessment in the response space/book |
| **planning time** | time allocated in an assessment to planning how to respond to items and tasks and associated assessment materials; students may make notes but may not commence responding to the assessment in the response space/book; notes made during planning are not collected, nor are they graded or used as evidence of achievement |
| **platforms** | computer operating systems |
| **polished** | flawless or excellent; performed with skilful ease |
| **precise** | definite or exact; definitely or strictly stated, defined or fixed; characterised by definite or exact expression or execution |
| **precision** | accuracy; exactness; exact observance of forms in conduct or actions |
| **predict** | give an expected result of an upcoming action or event; suggest what may happen based on available information |
| **principles** | specific types of generalisations that deal with relationships; a proposition that serves as the foundation for a system of belief or behaviour or for a chain of reasoning |
| **problems** | situations raised for consideration or solution |
| **problem-based learning** | an active, constructivist process that incorporates the use of open-ended problems as a stimulus for student learning |
| **problem-solving process** | consists of subject specific problem-solving processes (explore, develop, generate and evaluate) used to iteratively find solutions to difficult or complex problems or situations |

| Term | Explanation |
|---|---|
| **procedural text-based language** | a type of computer programming language that specifies a series of well-structured steps and procedures within its programming context to compose a program; it contains a systematic order of statements, functions and commands to complete a computational task or program; text-based refers to languages whose primary input and output are based on text rather than graphics or sound; this excludes GUI and non-procedural languages |
| **procedure** | an established or official way of doing something |
| **processes** | a series of actions or steps taken in order to achieve a particular result |
| **product** | an assessment technique that focuses on the output or result of a process requiring the application of a range of cognitive, physical, technical, creative and/or expressive skills, and theoretical and conceptual understandings; a product is developed over an extended and defined period of time; in Technologies, a designed solution; a tangible end result of a human, construction, mechanical, manufacturing or digital process; created by practical application of knowledge and skills |
| **productivity applications** | simple programs that run on a standard desktop computing platform to increase the productivity of the user |
| **proficient** | well advanced or expert in any art, science or subject; competent, skilled or adept in doing or using something |
| **programming** | the process of writing computer programs; creating the logic and making decisions to resolve problems (Oxford University Press 2017) |
| **programming tools** | software programs or scripts used to assist a programmer to create, debug, maintain, develop or model software; this includes coded and graphical user interface components |
| **project** | an assessment technique that focuses on a problem-solving process requiring the application of a range of cognitive, technical and creative skills and theoretical understandings; the response is a coherent work that documents the iterative process undertaken to develop a solution and includes written paragraphs and annotations, diagrams, sketches, drawings, photographs, video, spoken presentations, physical prototypes and/or models; a project is developed over an extended and defined period of time |
| **propose** | put forward (e.g. a point of view, idea, argument, suggestion) for consideration or action |
| **protocols** | a set of generally accepted standards or 'rules' that govern relationships and interactions between and within information systems |
| **prototype** | a trial solution to test an idea to inform further development; demonstrates the interaction of the components of a product, service or environment; its purpose is to identify if and how well a solution functions and can be tested by stakeholders |
| **prove** | use a sequence of steps to obtain the required result in a formal way |
| **pseudocode** | a type of descriptive algorithm that is a mixture of everyday language and programming languages (see Section 1.2.5) |

| Term | Explanation |
|---|---|
| **psychomotor procedures** | a domain of knowledge in Marzano's taxonomy, and acted upon by the cognitive, metacognitive and self-systems; these are physical procedures used to negotiate daily life and to engage in complex physical activities; the two categories of psychomotor procedures are skills (foundational procedures and simple combination procedures) and processes (complex combination procedures) |
| **purpose** | the reason for which something is done or created or for which something exists |
| **purposeful** | having an intended or desired result; having a useful purpose; determined; resolute; full of meaning; significant; intentional |
| **Q** | |
| **QCE** | Queensland Certificate of Education |
| **R** | |
| **realise** | create or make (e.g. a musical, artistic or dramatic work); actualise; make real or concrete; give reality or substance to |
| **reasonable** | endowed with reason; having sound judgment; fair and sensible; based on good sense; average; appropriate; moderate |
| **reasoned** | logical and sound; based on logic or good sense; logically thought out and presented with justification; guided by reason; well-grounded; considered |
| **recall** | remember; present remembered ideas, facts or experiences; bring something back into thought, attention or one's mind |
| **recognise** | identify or recall particular features of information from knowledge; identify that an item, characteristic or quality exists; perceive as existing or true; be aware of or acknowledge |
| **recommendation** | a suggestion or proposal as to the best course of action |
| **refine** | to make partial or minor changes to something in order to improve it; modify in relation to selected criteria |
| **refined** | developed or improved so as to be precise, exact or subtle |
| **reflect on** | think about deeply and carefully |
| **rehearsed** | practised; previously experienced; practised extensively |
| **related** | associated with or linked to |
| **relational schema** | the definition of a table, that is, the table's name, column headings and type of data in each column |
| **relevance** | being related to the matter at hand |
| **relevant** | bearing upon or connected with the matter at hand; to the purpose; applicable and pertinent; having a direct bearing on |
| **reliable** | constant and dependable or consistent and repeatable |
| **repetitive** | containing or characterised by repetition, especially when unnecessary or tiresome |

| Term | Explanation |
|---|---|
| **reporting** | providing information that succinctly describes student performance at different junctures throughout a course of study |
| **requirements** | necessary conditions identified from stakeholders' needs or wants; used to inform criteria against which to evaluate |
| **resolve** | consolidate and communicate intent through a synthesis of ideas and application of media to express meaning |
| **REST** | the underlying architectural principle of the web, where requesting systems (clients, browsers) and servers can interact in complex ways without the client knowing anything beforehand about the server and the resources it hosts using a uniform and predefined set of stateless operations; this is a way of providing interoperability between computer systems on the internet; an API that adheres to the principles of REST does not require the client to know anything about the structure of the API; the server provides whatever information the client needs to interact with the service |
| **robotics** | a branch of engineering that involves the conception, design, manufacture and operation of robots; this field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bioengineering |
| **routine** | often encountered; previously experienced; commonplace; customary and regular; well-practised;<br>performed as part of a regular procedure, rather than for a special reason |
| **rudimentary** | relating to rudiments or first principles; elementary; undeveloped; involving or limited to basic principles; relating to an immature, undeveloped or basic form |
| **rules** | a set of explicit or understood regulations or principles governing conduct or procedure; an accepted principle or instruction that states the way things are or should be done, and tells you what you are allowed or are not allowed to do |
| **S** | |
| **safe** | secure; not risky |
| **scenario** | a consistent written or verbal picture of a phenomenon or sequence |
| **schemas** | describe the cognition used during aspects of problem-solving that organise information; representations that record and clarify thinking, e.g. mind maps |
| **school-based assessment** | assessment developed, administered and marked by teachers as part of the school curriculum;<br>(see also 'internal assessment') |
| **secure** | sure; certain; able to be counted on; self-confident; poised; dependable; confident; assured; not liable to fail |
| **select** | choose in preference to another or others; pick out |

| Term | Explanation |
|---|---|
| **SELECT** | a statement in structured query language (SQL) that retrieves information from a database; the structure of a SELECT statement provides for optional clauses that allow for the filtering, grouping and sorting of data on retrieval; a simple SELECT statement may look like the following:<br><br>> SELECT * FROM People;<br><br>where the resulting set would be all of the records in the People table; following is an example of a more complicated SELECT statement:<br><br>> SELECT * FROM People WHERE gender='m';<br><br>this uses the optional WHERE clause to retrieve only the males (that is, that have a gender of 'm') from the database table |
| **selection** | a basic construct of an algorithm indicating the next instruction to be executed depends on a 'condition'; a condition is defined for these purposes as a logical expression that evaluates to true or false |
| **sensitive** | capable of perceiving with a sense or senses; aware of the attitudes, feelings or circumstances of others;<br>having acute mental or emotional sensibility; relating to or connected with the senses or sensation |
| **sequence** | place in a continuous or connected series; arrange in a particular order |
| **show** | provide the relevant reasoning to support a response |
| **significant** | important; of consequence; expressing a meaning; indicative; includes all that is important;<br>sufficiently great or important to be worthy of attention; noteworthy; having a particular meaning; indicative of something |
| **simple** | easy to understand, deal with and use; not complex or complicated; plain; not elaborate or artificial;<br>may concern a single or basic aspect; involving few elements, components or steps |
| **simplistic** | characterised by extreme simplification, especially if misleading; oversimplified |
| **simulation** | a representation of a process, event or system that imitates a real or idealised situation |
| **situation** | the general state of things; the combination of circumstances at a given time |
| **sketches** | drawings or paintings in simple form, giving essential features but not necessarily with detail or accuracy;<br>in Mathematics, represent by means of a diagram or graph; the sketch should give a general idea of the required shape or relationship and should include features;<br>in Technologies, a two-dimensional informal visualisation method completed freehand, often instantly capturing an idea for later use and therefore lacking in presentation quality; sketches are usually produced manually, using pencil, ink and paper, but may be software-assisted |

| Term | Explanation |
|---|---|
| **skilful** | having technical facility or practical ability; possessing, showing, involving or requiring skill; expert; dexterous;<br>demonstrating the knowledge, ability or training to perform a certain activity or task well; trained, practised or experienced |
| **skilled** | having or showing the knowledge, ability or training to perform a certain activity or task well; having skill; trained or experienced; showing, involving or requiring skill |
| **solution (digital)** | the end result of applying a problem-solving process to a problem that can be solved digitally; it usually includes three components: data, system/user interface and text-based source code that may be interpreted or compiled; in a digital solution the interface triggers the execution of code |
| **solve** | find an answer to, explanation for, or means of dealing with (e.g. a problem);<br>work out the answer or solution to (e.g. a mathematical problem); obtain the answer/s using algebraic, numerical and/or graphical methods |
| **sophisticated** | of intellectual complexity; reflecting a high degree of skill, intelligence etc.; employing advanced or refined methods or concepts; highly developed or complicated |
| **specific** | clearly defined or identified; precise and clear in making statements or issuing instructions; having a special application or reference; explicit or definite; peculiar or proper to something, as qualities, characteristics, effects etc. |
| **specification** | the process of defining and communicating a problem precisely and clearly; e.g. explaining the need to direct a robot to move in a particular way; an algorithm is a precise description of the steps and decisions needed to solve a problem |
| **sporadic** | happening now and again or at intervals; irregular or occasional; appearing in scattered or isolated instances |
| **straightforward** | without difficulty; uncomplicated; direct; easy to do or understand |
| **structure** | *verb*<br>give a pattern, organisation or arrangement to; construct or arrange according to a plan;<br>*noun*<br>in languages, arrangement of words into larger units, e.g. phrases, clauses, sentences, paragraphs and whole texts, in line with cultural, intercultural and textual conventions |
| **structure** | an ordered assembly of elements, components and features that form an organised pattern or system |
| **structured** | organised or arranged so as to produce a desired result |
| **structured data** | information with a high degree of organisation, thus allowing seamless inclusion in a relational database and is readily searchable by simple, straightforward search engine algorithms or other search operations |
| **structured query language (SQL)** | specialist programming language used to manage data and access data in relational database management systems |

| Term | Explanation |
|---|---|
| **subject** | a branch or area of knowledge or learning defined by a syllabus; school subjects are usually based in a discipline or field of study<br>(see also 'course') |
| **subject matter** | the subject-specific body of information, mental procedures and psychomotor procedures that are necessary for students' learning and engagement within that subject |
| **substantial** | of ample or considerable amount, quantity, size etc.; of real worth or value; firmly or solidly established; of real significance; reliable; important; worthwhile |
| **substantiated** | established by proof or competent evidence |
| **subtle** | fine or delicate in meaning or intent; making use of indirect methods; not straightforward or obvious |
| **successful** | achieving or having achieved success; accomplishing a desired aim or result |
| **succinct** | expressed in few words; concise; terse; characterised by conciseness or brevity; brief and clear |
| **sufficient** | enough or adequate for the purpose |
| **suitable** | appropriate; fitting; conforming or agreeing in nature, condition or action |
| **summarise** | give a brief statement of a general theme or major point/s; present ideas and information in fewer words and in sequence |
| **summative assessment** | assessment whose major purpose is to indicate student achievement; summative assessments contribute towards a student's subject result |
| **superficial** | concerned with or comprehending only what is on the surface or obvious; shallow; not profound, thorough, deep or complete;<br>existing or occurring at or on the surface; cursory; lacking depth of character or understanding; apparent and sometimes trivial |
| **supported** | corroborated; given greater credibility by providing evidence |
| **sustainable** | supporting the needs of the present without compromising the ability of future generations to support their needs |
| **sustained** | carried on continuously, without interruption, or without any diminishing of intensity or extent |
| **syllabus** | a document that prescribes the curriculum for a course of study |
| **syllabus objectives** | outline what the school is required to teach and what students have the opportunity to learn; described in terms of actions that operate on the subject matter; the overarching objectives for a course of study<br>(see also 'unit objectives', 'assessment objectives') |
| **symbolise** | represent or identify by a symbol or symbols |
| **syntax** | the structure of statements in a computer language |
| **synthesise** | combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding |

| Term | Explanation |
|---|---|
| **system** | a group of interacting objects, materials or processes that form an integrated whole; systems can be open or closed; a system has properties and/or functions that can be described differently from its component parts; systems can be identified as four types:<br>• natural systems, e.g. an ecosystem including plants and animals<br>• designed physical systems, e.g. buildings, road networks, aircraft, airports<br>• designed abstract systems, e.g. mathematic equations, computer algorithms<br>• human activity systems, e.g. a team task, flight crew, human–machine interface |
| **systematic** | done or acting according to a fixed plan or system; methodical; organised and logical;<br>having, showing or involving a system, method or plan; characterised by system or method; methodical; arranged in or comprising an ordered system |
| **systems thinking** | a holistic approach to the identification and solving of problems, where parts and components of a system, their interactions and interrelationships are analysed individually to see how they influence the functioning of the whole system; this approach enables students to understand systems and work with complexity, uncertainty and risk; systems thinking also involves understanding the interdependence between systems and how a change or output from one system can affect another, and how this affects larger systems such as the economy and society |
| **T** | |
| **technical feasibility** | the process of proving that the concept is technically possible; the aim of a technical feasibility study is to confirm that the prototype or solution will perform as intended and to verify that there are no barriers in generating these; it should communicate the technical aspects of the development process, e.g. algorithms, selection and justification of development tools, sketches and diagrams of the user interface, user experience and other requirements for development |
| **technical proposal** | a multimodal presentation to communicate the strengths, limitations, implications, and technical specifications and feasibility of a proposed digital solution; may be for a live or virtual audience<br>or<br>a document that lists and defines the technical specifications of a contract or project, includes three sections, identification — a brief statement which identifies the real-world related need for developing the digital solution and relevant background information, interactions — specifies information relating to interactions between humans and or the environment, and information systems, this may include proto-personas, and component specifications — specifications relating to data, user interface/experience and code |
| **technologies** | materials, data, systems, components, tools and equipment used to create solutions for identified needs and opportunities, and the knowledge, understanding and skills used by people involved in the selection and use of these |

| Term | Explanation |
|---|---|
| **technology** | the development of products, services and environments, using various types of knowledge, including computational, design, systems, social, ethical, economic, environmental, legal and sustainability knowledge to meet human needs and wants; 'the know-how and creative process that may use tools, systems and resources to solve problems and enhance control over the natural and man-made environment in an endeavour to improve the human condition' (UNESCO 1985 cited in Ferguson 2009, p. 7) |
| **test** | take measures to check the quality, performance or reliability of something |
| **theory** | a set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena; theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power |
| **thorough** | carried out through, or applied to, the whole of something; carried out completely and carefully; including all that is required;<br>complete with attention to every detail; not superficial or partial; performed or written with care and completeness; taking pains to do something carefully and completely |
| **thoughtful** | occupied with, or given to, thought; contemplative; meditative; reflective; characterised by or manifesting thought |
| **topic** | a division of, or sub-section within, a unit; all topics/sub-topics within a unit are interrelated |
| **U** | |
| **unclear** | not clear or distinct; not easy to understand; obscure |
| **understand** | perceive what is meant by something; grasp; be familiar with (e.g. an idea); construct meaning from messages, including oral, written and graphic communication |
| **uneven** | unequal; not properly corresponding or agreeing; irregular; varying; not uniform; not equally balanced |
| **unfamiliar** | not previously encountered; situations or materials that have not been the focus of prior learning experiences or activities |
| **unit** | a defined amount of subject matter delivered in a specific context or with a particular focus; it includes unit objectives particular to the unit, subject matter and assessment direction |
| **unit objectives** | drawn from the syllabus objectives and contextualised for the subject matter and requirements of a particular unit; they are assessed at least once in the unit<br>(see also 'syllabus objectives', 'assessment objectives') |
| **unrelated** | having no relationship; unconnected |
| **useability** | able or fit to be used; judged by the useability principles of efficiency effectiveness, safety, utility and learnability |

| Term | Explanation |
|---|---|
| **useability principles** | principles used to improve the user experience, including<br>• accessibility: ability to be used by many different people, even people with disabilities<br>• effectiveness: ability of users to use the system to do the work they need to do, includes reliability<br>• safety: ability for users to make errors and recover from the mistake<br>• utility: ability of the system to provide all the functionality that users need<br>• learnability: how easy a system is to learn |
| **use** | operate or put into effect; apply knowledge or rules to put theory into practice |
| **user experience** | those aspects that affect how an end user interacts with digital systems such as visual, interface and navigation design, user needs, and functional and content requirements; this is determined by improving the solution's useability based on the useability principles of accessibility, effectiveness, safety, utility and learnability (VCAA, 2014) |
| **user interface** | characteristics of the boundary between users and a computer system, or the manner in which users interact with computer hardware or software; in software, this usually comprises fields for text and number entry, mouse pointers, buttons and other graphical elements; in hardware, sensors, switches, dials and light-emitting diodes (LEDs) provide information about the interactions between a user and a machine, a machine and another machine or a machine and the environment |
| **V** | |
| **vague** | not definite in statement or meaning; not explicit or precise; not definitely fixed, determined or known; of uncertain, indefinite or unclear character or meaning; not clear in thought or understanding;<br>couched in general or indefinite terms; not definitely or precisely expressed; deficient in details or particulars;<br>thinking or communicating in an unfocused or imprecise way |
| **valid** | sound, just or well-founded; authoritative; having a sound basis in logic or fact (of an argument or point); reasonable or cogent; able to be supported; legitimate and defensible; applicable |
| **validity** | sound, reasonable, relevant, defensible, well grounded, able to be supported with logic or theory |
| **variable** | *adjective*<br>apt or liable to vary or change; changeable; inconsistent; (readily) susceptible or capable of variation; fluctuating; uncertain;<br>*noun*<br>in mathematics, a symbol, or the quantity it signifies, that may represent any one of a given set of numbers and other objects |
| **variety** | a number or range of things of different kinds, or the same general class, that are distinct in character or quality;<br>(of sources) a number of different modes or references |
| **virtual** | representation of an object in a digital form |

| Term | Explanation |
|---|---|
| **W** | |
| **wearable technologies** | electronic devices able to be worn on the body as a purposeful fashion accessory or part of material used in clothing. A major feature of these devices is their ability to connect to the internet, allowing data to be exchanged between the device and a network |
| **web applications** | client–server software applications in which the client–user interface runs in a web browser, e.g. webmail, online retail sales etc. |
| **wide** | of great range or scope; embracing a great number or variety of subjects, cases etc.; of full extent |
| **with expression** | in words, art, music or movement, conveying or indicating feeling, spirit, character etc.; a way of expressing or representing something; vivid, effective or persuasive communication |

# 7 References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# 8 Version history

| Version | Date of change | Update |
|---|---|---|
| 1.1 | January 2018 | Editorial edits |
| | | Amendments to Figure 4: Data flow diagram symbols, their names and functions |
| | | Subject matter<br>Unit 1: Topic 4 — removal of 'generate local and global variables to store data'<br>Unit 2: Topic 1 — addition of 'recognise and describe useability principles including accessibility, effectiveness, safety, utility and learnability'<br>Unit 4: Topic 1 — addition of 'how useability principles are used to inform solution development' and 'how the elements and principles of visual communication inform user interface development' |
| | | Unit 4: Unit requirements — addition of 'SQL syntax version must be based on generic ANSI-style SQL, i.e. SQL.-92' |
| | | Unit 4: Unit objective 3 modified |
| | | IA1: Investigation — technical proposal<br>• Specifications — Amendments to 'The investigation will include the following assessable evidence' (evaluation section)<br>• Criterion: Communicating — 3–4 marks now 2–3 marks, 1–2 marks now 1 mark |
| | | IA2: Project — digital solution<br>• Criterion: Synthesising and evaluating — 'determine' replaced 'develop' |
| | | IA3:<br>• Specifications — Amendments to 'The investigation will include the following assessable evidence' (Part 2: Data exchange solution)<br>• Condition amendment (Length) — 6–8 A3 pages now 8–10 A3 pages, 1–2 A4 pages now 2–4 A4 pages |
| | | Amendments to ISMGs to reflect assessment modifications |
| | | Glossary update |
| 1.2 | June 2018 | Editorial edits |
| | | Subject matter amendments |
| | | IA2: Project — digital solution<br>• Amendments to specifications |
| | | IA3: Project — folio<br>• Amendments to specifications |
| | | EA: Examination<br>• Assessment objectives reworded<br>• Removal of assessment objectives 4, 6 and 8 from the instrument. |
| | | Glossary update |

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Queensland Curriculum & Assessment Authority
PO Box 307 Spring Hill QLD 4004 Australia
154 Melbourne Street, South Brisbane

Phone: (07) 3864 0299
Email: office@qcaa.qld.edu.au
Website: www.qcaa.qld.edu.au