Higher National Unit Specification

General information

Unit title: Artificial Intelligence (SCQF level 7)

Unit code: HT9T 34

Superclass: CB

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Unit purpose

The purpose of this unit is to introduce learners to the principles and practice of Artificial Intelligence (AI). It is a non-specialist unit, intended for a wide range of learners; it is particularly appropriate for learners with an interest in Science, Technology, Engineering or Mathematics (STEM).

The unit covers the historical development of AI, contemporary applications of AI systems, current trends in AI, and the implications of AI for individuals, organisations and society, including the impact of AI on employment. Both general AI and narrow AI systems are explored. While the unit makes reference to computer science, it does not address this aspect of the field in any depth.

The unit explores the types of problem that contemporary AI can address including natural language processing, knowledge acquisition, learning, reasoning, perception and movement, and the approaches to solving those problems, including traditional symbolic approaches, statistical methods and computational intelligence. The roots of AI in computer science, mathematics, psychology, linguistics, philosophy and neuroscience are explored.

The unit relates this to learners' vocational interests by examining how AI is currently used in specific employment sectors. For example, the emerging use of robots in the health sector or the impact of AI in the office could be explored. This unit also considers the practical applications of AI in the learner's vocational field of interest.

An important aspect of the unit is the societal and ethical implications of AI, such as its impact on employment and its potential for bias. Controversial applications, such as its use in law enforcement, are also considered.

Higher National Unit Specification: General information (cont)

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At the completion of this unit, learners will understand the historical development of AI, including its relationship with a number of distinct disciplines, how narrow and general AI is currently used, and how it could be used in specific vocational areas. They will also appreciate its likely impact on employment and the ethical dilemmas that it poses.

Outcomes

On successful completion of the unit the learner will be able to:

1 Describe the historical development of artificial intelligence, machine learning and deep learning.
2 Describe contemporary applications of artificial intelligence systems.
3 Solve a problem in a specific vocational field using artificial intelligence.
4 Explain the ethical implications of artificial intelligence for society.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the unit

This is an introductory unit in the field of artificial intelligence and, as such, there are no recommended entry requirements. There is no requirement that learners have previous knowledge or experience of computer science.

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill None

Core Skill component Critical Thinking at SCQF level 5

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

Context for delivery

If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

Higher National Unit Specification: Statement of standards

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Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe the historical development of artificial intelligence, machine learning and deep learning.

Knowledge and/or skills

- Evolution of natural intelligence
- Distinction between AI, machine learning and deep learning
- Milestones in the evolution of AI including neural networks and robotics
- Influence of computer science, mathematics, psychology, linguistics, philosophy and neuroscience in the evolution of AI
- Technological factors in the development of AI including algorithms
- Functional and technological limitations of contemporary AI
- Timescales for potential future developments

Outcome 2

Describe contemporary applications of artificial intelligence systems.

Knowledge and/or skills

- Types of problem that AI can solve
- AI tools and techniques
- Problem solving approaches
- Applications of narrow AI
- Applications of artificial general intelligence (AGI)
- Big data and its role in machine learning including pattern recognition
- Benefits of AI to individuals, organisations and society

Higher National Unit Specification: Statement of standards (cont)

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Outcome 3

Solve a problem in a specific vocational field using artificial intelligence.

Knowledge and/or skills

- Applications of AI in specific vocational fields
- Benefits of these vocational applications
- AI tools and techniques that can be used to solve problems in this vocational field
- User skills in AI technologies
- User skills in applying AI tools and techniques to specific vocational problems

Outcome 4

Explain the ethical implications of artificial intelligence for society.

Knowledge and/or skills

- Impact of AI on society including technological unemployment and inequality
- Potential for machine bias
- Threat to personal privacy
- Robot rights and machine ethics
- Unintended consequences of advanced AI/super-intelligence
- Defences against unintended consequences including regulation

Evidence requirements for this unit

Learners will need to provide evidence to demonstrate their knowledge and/or skills across all outcomes by showing that they can produce:

- knowledge evidence
- product evidence

The knowledge evidence will comprise the descriptions and explanations required in Outcomes 1, 2 and 4. Evidence is normally required for all of the associated knowledge; however, sampling is permissible in certain circumstances (see below). The level of treatment for each topic need not be deep. The focus of the evidence is breadth, not depth. However, it is important that no key piece of knowledge is omitted (such as a key milestone in the development of AI). This evidence may be produced over the life of the unit, under loosely controlled conditions (including access to reference materials). Authentication will be necessary (see below).

The knowledge evidence may be sampled when testing is used. Given that the focus is breadth rather than depth, sampling must be wide and shallow (such as the use of selected response or short answer questions) rather than narrow and deep (such as the use of an extended response question on one element of the knowledge domain). When testing is used, it must be under supervised conditions and controlled in terms of location, timing and access to reference materials.

The product evidence will provide evidence that the learner has applied AI in a specific vocational field as required in Outcome 3. The evidence will take the form of an AI-based solution to a real or simulated vocational problem, which must be described or recorded. At least one vocational problem must be solved using AI tools and techniques. At this level, it is anticipated that the type of problem will be non-complex, and the types of tools and techniques employed will be basic. The solution(s) can take any appropriate form but must be capable of being evidenced in the form of a product (such as a report or video). This evidence may be produced under loosely controlled conditions.

The SCQF level of this unit provides additional context on the nature of the required evidence and the associated standards. The following level descriptors are particularly relevant to the evidence:

- An overall appreciation of the body of knowledge
- Knowledge that is embedded in the main theories, concepts and principles
- An awareness of the dynamic nature of knowledge and understanding
- Use some of the basic and routine professional skills, techniques, practices and materials
- Use a range of approaches to address defined and/or routine problems
- Exercise some initiative and independence in carrying out defined activities at a professional level

These level descriptors should be used (explicitly or implicitly) when making judgements about the evidence.

When evidence is produced in uncontrolled or loosely controlled conditions it must be authenticated. The *Guide to Assessment* provides further advice on methods of authentication.

The *Guidelines on Approaches to Assessment* (see the support notes section of this specification) provides specific examples of instruments of assessment.

Higher National Unit support notes

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Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this unit

The general context for this unit is the rising public interest in this emerging aspect of computer science and its vocational relevance to an increasing number of occupations and professions. The unit is intended for non-specialists and may be offered as part of a wide range of programmes. No prior knowledge of computer science is required.

This unit is intended to be a broad and general introduction to the field of artificial intelligence. As such, the treatment of any topic should be light. For example, the milestones in the evolution of AI need only cover a limited number of significant historical events in the field. The application of AI (Outcome 3), in particular, should be straight-forward (such as simple language translation systems or the use of digital assistants).

Throughout this unit it is vital to present the applications and implications of AI in a balanced way, neither overstating the opportunities nor understating the threats posed by this technology (or vice-versa).

AI can be categorised in several different ways. The nomenclature used in this unit specification is to categorise it as ‘narrow’ (such as autonomous cars) and ‘general’ (such as a general purpose robot driving a car).

Please note that the following guidance, relating to specific outcomes, does not seek to explain each knowledge/skills statement, which is left to the professionalism of the teacher. It seeks to clarify the statement of standards where it is potentially ambiguous. It also focuses on non-apparent teaching and learning issues that may be over-looked, or not emphasised, during unit delivery. As such, it is not representative of the relative importance of each knowledge/skill.

Outcome 1

This outcome relates to the historical development of AI, machine learning and deep learning. It seeks to put contemporary AI into an historical context so that learners can appreciate how current systems came about.

Higher National Unit support notes (cont)

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The knowledge statements are largely self-explanatory. Given the scope of the outcome, the treatment of each topic should be light. For example, the treatment of the evolution of natural intelligence should consist of a simple explanation of the evolution of biological intelligence together with a basic explanation of our present understanding of how the mind works. This minimalist treatment should be applied to the milestones in the evolution of AI, which should focus, only, on a few major breakthroughs. It should be emphasised that the evolution of AI has not been smooth — that there have been 'AI Winters' when developments stagnated. The role of algorithms in AI should be covered including the vital relationship between the quality of AI and the quality of the underlying algorithms and, less obviously, the biases and inaccuracies that can be introduced through software. The functional limitations of contemporary AI are simple (what AI currently can, and cannot, do) but the technological factors behind these limitations are complex and this needs to be presented in an accessible way to a non-expert audience.

One of the key outcomes of this unit is to make learners aware of the widespread use of AI in everyday objects (such as smartphones and digital assistants). For example, learners may not be aware of the role of AI in identifying people within photographs (facial recognition) or its use in natural language processing (voice recognition).

There is considerable debate (at the time of writing) around the likely timescales for achieving Artificial General Intelligence (AGI) and other future milestones such as self-driving cars and fully autonomous robots. The current ambiguity regarding timescales should be emphasised.

Outcome 2

This outcome focuses on the contemporary applications of AI. The applications are categorised as 'applied' or 'general'. Care should be taken when discussing problem solving approaches since this can be very complex. It is sufficient for learners to know that AI problems can be solved using statistical techniques, computational techniques and symbolic approaches, with examples of the type of problem associated with each approach.

Learners may not be aware of the link between AI and big data, and how big data has been used to improve AI. Concrete examples of this (such as how huge data sets have improved pattern recognition) should be provided.

The increasing use of artificial intelligence (the use of hybrid systems that involve machines and humans in collaboration but appearing to be purely AI systems) should be explained — and the reasons for such systems.

Given that Outcome 4 focuses on the drawbacks of AI, this outcome provides an opportunity to explain its benefits. The recommended approach is to focus on benefits in Outcomes 1–3 and then present learners with ethical dilemmas and disadvantages in Outcome 4.

Higher National Unit support notes (cont)

Unit title: Artificial Intelligence (SCQF level 7)

Outcome 3

This outcome requires learners to use AI to solve vocationally relevant problems. It builds on the previous outcome, which looked at a range of vocationally relevant applications of AI.

Possible vocational fields include: office administration, manufacturing, computing, engineering, law, marketing, social care and health care. The aim of the outcome is to make learners aware of how AI is currently used within the chosen vocation. The prospect of AI being introduced into middle class jobs should be explored. There is also an opportunity to discuss future developments (although this is not a required topic).

In this outcome, learners must actually use AI to solve a vocationally relevant problem. It is anticipated that the problem will be straight-forward. For example, in an office context, the learner might use a language translation system to talk to a customer in a foreign language; or use the AI features built into word processing software to improve productivity; or explore how AI can improve customer relationship management or health diagnosis. Although the application of AI should be simple, learners should be aware of the types of problem that can (and cannot) be solved by AI.

Outcome 4

This outcome relates to the ethical implications of AI. It should be presented in a balanced way, neither overstating nor understating the threats from the technology. There is a wealth of literature on this topic. An important outcome is that the learner has an intelligent and mature view of the actual and potential threats posed by AI. It is recommended that the focus is the more immediate, mundane threats (for example, the potential for AI to cause large scale technological unemployment) than the more futuristic, exotic threats (for example, the emergence of super intelligence and the enslaving of humans).

Learners may be unaware of the threat posed by AI to personal privacy through, for example, the use of digital assistants in the home. There is an opportunity to discuss the measures that could be taken by government to reduce this threat (through regulation of AI).

Outcome 1 touched on the vital importance of algorithms in determining the quality of the AI. This outcome provides an opportunity to discuss the intended and unintended biases that can be introduced into AI through coding or (more likely) training data. Learners may not be aware of the fundamental relationship between the ‘quality’ of AI (in terms of its decision making and objectivity) and the quality of the underlying algorithms (in terms of their training data and presumptions).

A number of contentious applications of AI pose specific ethical dilemmas such as its use in predicting and identifying re-offenders (‘future crime’) and the use of robots for companionship and sex. These applications raise issues relating to machine ethics and robot rights.

Higher National Unit support notes (cont)

Unit title: Artificial Intelligence (SCQF level 7)

Guidance on approaches to delivery of this unit

It is recommended that the knowledge outcomes are taught in sequence (1, 2 and 4). The practical outcome (3) can be taught at any time during the life of the unit. It is recommended that, to enliven learning, it is taught immediately after the basic theory is covered, early in the unit.

A suggested distribution of time, across the outcomes, is:

Outcome 1 10 hours
Outcome 2 8 hours
Outcome 3 12 hours
Outcome 4 10 hours.

The topics within the unit can be explained through the use of video, film and audio. The field of AI is rich in all three. A learner-centred approach to teaching is recommended. Most of the topics can be independently researched by learners. However, when this approach is used, it is vital that the teacher provides context and sets objectives and regularly reviews progress. Group discussions/debates are also suggested.

Summative assessment may be carried out at any time. However, when testing is used (see evidence requirements) it is recommended that this is carried out towards the end of the unit (but with sufficient time for remediation and re-assessment). When continuous assessment is used (such as the use of a web log), this could commence early in the life of the unit and be carried out throughout the duration of the unit.

There are opportunities to carry out formative assessment at various stages in the unit. For example, formative assessment could be carried out on the completion of each outcome to ensure that learners have grasped the knowledge contained within it. This would provide assessors with an opportunity to diagnose misconceptions, and intervene to remedy them before progressing to the next outcome.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

A traditional approach to (summative) assessment could involve a multiple choice test (for knowledge evidence) and a practical assignment (for product evidence).

The multiple choice test could assess the knowledge contained within Outcomes 1, 2 and 4. It could consist of four options (one key) with a pass mark of 60%. Given that Outcome 4 relates to explanations (rather than descriptions), there may need to be scenario type questions to assess the learner's competency. The test could consist of a relatively high number of questions (30 or 40 for example), lasting an hour, which would span all of the outcomes and sample all of the knowledge statements (including at least one question for each statement).

The practical assignment would involve the learner is using AI to solve a vocationally relevant problem and record his/her solution in an appropriate format, which may be a simple narrative description of the problem and its solution. For example, the learner might describe how he/she could use a real time communication system (such as Skype™) to facilitate a conversation between two people in a non-native language.

A more contemporary approach to assessment would involve the use of a web log (blog) to record learning (and the associated activities) throughout the life of the unit. The blog would provide knowledge evidence (in the descriptions and explanations) and product evidence (using, for example, video recordings). The blog should be assessed using defined criteria to permit a correct judgement about the quality of the digital evidence. In this scenario, every knowledge and skill must be evidenced; sampling would not be appropriate.

Formative assessment could be used to assess learners' knowledge at various stages throughout the life of the unit. An ideal time to gauge their knowledge would be at the end of each outcome. This assessment could be delivered through an item bank of selected response questions, providing diagnostic feedback to learners (when appropriate).

If a blog is used for summative assessment, it would also facilitate formative assessment since learning (including misconceptions) would be apparent from the blog, and intervention could take place to correct misunderstandings on an on-going basis.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Opportunities for developing Core and other essential skills

This Unit has the Critical Thinking component of Problem Solving embedded in it. This means that when learners achieve the Unit, their Core Skills profile will also be updated to show they have achieved Critical Thinking at SCQF level 5.

There are further opportunities to develop the Core Skills in *Information and Communication Technology* and *Problem Solving* (at SCQF level 6) through their use of AI tools and techniques (Outcome 3).
The unit will also provide opportunities to develop broader skills, such as citizenship, which will be required when they consider the ethics of AI (Outcome 4).

History of changes to unit

Version	Description of change	Date
02	Core Skills Component Critical Thinking at SCQF level 5 embedded.	24/11/2017

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General information for learners

Unit title: Artificial Intelligence (SCQF level 7)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This unit is an introduction to the field of Artificial Intelligence (AI) for the beginner. It is suitable for learners who are undertaking a wide range of qualifications. No previous knowledge of computer science is required for you to benefit from taking this unit.

The unit covers the theory and practice of AI. You would benefit from undertaking this unit if you want to know more about the basics of AI and how it can be used in practice.

The unit covers the following topics:

- the historical development of AI including robotics
- how technology has helped (and hindered) the development of AI
- what AI can be used for
- the limitations of contemporary AI
- the benefits of AI
- how AI can be used in the sorts of job that you are interested in
- how you could use AI in your current or future job
- how to use AI tools and techniques
- the ethical dilemmas posed by AI
- the impact of AI on employment

The treatment of each topic is light. This is not a Computer Science unit. It will be delivered in an accessible and interesting way, which may include the use of audio and video to enliven learning.

Although most of the unit is theoretical you will get the opportunity to apply AI in a real or imagined job role. You will gain hands-on experience on a range of AI tools and techniques such as language translation systems, voice recognition systems and digital assistants.

Teaching methods will likely include self-learning, research and group discussion.

The unit can be assessed in a number of ways including, for example, a written test or writing a blog. Whatever approach is taken, most of your time will be spent learning — not being assessed.

At the end of the unit you will know where AI came from, what it is capable of doing (and not doing), how you can use it in your job, and how it is impacting on the world around you. You could progress to other units in the field of computer science such as *Big Data* or *Emerging Technologies and Experiences*.

This Unit has the Critical Thinking component of Problem Solving embedded in it. This means that when you achieve the Unit, your Core Skills profile will also be updated to show you have achieved Critical Thinking at SCQF level 5.