

# Institute of Coding: Accreditation Standard

## Theme 1 - University Learners - Work Package 1.1

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DRAFT PROPOSAL 4.1

This is an evolving document and should not be used to implement any programme or curricula.

# 1. Background

## 1.1 Context

The proposed standard must be:

- a. Fit for purpose for whole project especially themes 1, 2 and 3
- b. Fit for all IoC partners
- c. Fit for broad industry
- d. Takes into account existing standards

## 1.2. Requirements

An initial discussion in the online meeting on 9th April identified a number of requirements within the context above.

1. Some overarching targets are givens:
  - a. FHEQ (Framework for Higher Education Qualifications) outcomes statement
    - i. equivalents for Scotland/Wales/Northern Ireland?
  - b. QAA (Quality Assurance Agency) subject benchmark statement
  - c. (for degree apprenticeships) Institute for Apprentices (IfA) endorsement.
2. The standard needs to specify both technical and “soft” skills.
  - a. The focus should be on work readiness rather than employability
3. Must meet the needs of, and be endorsed by, industry
  - a. Should be able to recognise both industry-created and academic content.
  - b. Should allow interoperability between HEIs and industry
  - c. In particular, must support needs of SMEs

#### 4. Must be flexible

- a. Given that there will be several curricula, a core standard with extensions may be appropriate.
  - The core might include such as coding, group work, lifecycle, soft skills.
- b. (For theme 2) – needs to support degree apprenticeships as well as degrees (L6 & L7).
- c. (for theme 3) – would be good if it were possible to specify chunks smaller than a complete degree – perhaps using some sort of “layering” or “component” model.
- d. Should link to other accreditations
  - i. e.g., BCS, IET
  - ii. Will be different from Tech Partnership Degrees (TPD) standards for degree apprenticeships.

Industry involvement in the development and adoption of the standard is crucial. This will require ongoing involvement of individuals from a wide range of employers from across the sector, constituting a broadly-based industrial panel.

### 1.3. Constraints

Development will require industrial participation in discussions and workshops.

If the standard is to be used for Degree Apprenticeships (DAs), then it needs to address a distinct space from those standards already in operation, primarily those developed/under development by Tech Partnership and ONS.

No standard is of value if it is neither accepted by the sector nor implementable. The eventual operation of the standard is outwith the discussion in this paper.

The IoC is not (yet) authorised to accredit anything – at best, it might offer a “kite mark” endorsement. Only professional bodies, such as BCS are currently able to accredit against a standard.

## 1.4. Opportunities

In developing the new standard, we could choose to work with existing accreditation bodies (BCS, TPD, GCHQ), and/or with other bodies such as SFIA who manage a user-defined skills framework for the sector.

In order to distinguish the IoC standard from other standards, such as those managed by TPD, we might align it to professional qualifications, such as CITP, or CIISP.

Early informal discussions with both BCS and SFIA indicate that they are willing – indeed, keen! – to collaborate with IoC

## 1.5. Discussion

The separation of the standard from the curricula (workstreams 1.2, 1.3 and themes 2/3) mean that the standard itself needs to be very flexible and adaptable. This is best achieved by abstraction.

There is a marked contrast between standards such as the BCS accreditation criteria and the TPD DA standards: the former has relatively few generic requirements that can be contextualised for a particular degree, whereas the latter is essentially a long conjunctive list of requirements. Indeed, in the latter, there is no application of MoSCow (must/should/could/won't) – all requirements and sub-requirements are given equal weight.

One of the key requirements is that the standard must meet industry needs. Although foundational knowledge and principles are important, the key focus is to be on what [graduates] will be able to do. That is, it will focus on skills and outcomes, rather than on curriculum and inputs.

And, crucially, the definition of skills and outputs needs to be recognised and accepted by industry.

It may be appropriate for the standard to suggest “staged” outputs – particularly in the context of degree apprenticeships – to ensure that those following a standard are “billable” early in their studies.

## 2. Rationale for a new accreditation standard

### 2.1 Aim

The Institute of Coding aims to, "create a new way to develop the digital skills you'll need at work and beyond."

The purpose of IoC workstream 1.1 is to codesign with industry a new standard for "digital" graduates.

As the latest, post-Shadbolt, venture seeking to address the "digital skills gap", the focus is on digital skills for the workplace, rather than on knowledge and learning for their own sake.

### 2.2. Digital skills for the workplace

The primary requirements of employers include –

- graduates must be billable (competent)
- graduates must be adaptable (underpinning knowledge for cognate skill areas)
- graduates must be effective problem solvers (which is fundamentally what university education is about)

These are the fundamental drivers for the IoC, not some add-on concept of "employability". Competence, adaptability and problem solving are at the heart of the IoC standard – they are not simply to be retro-fitted to an academic curriculum based on an encyclopaedic Body of Knowledge (BoK).

BoKs are reference points, **from** which curricula are drawn, rather than templates **for** curricula. Foundational knowledge and principles remain important, but the key focus for the IoC standard is on what graduates will be able to do. That is, it focuses on skills and outcomes, rather than on curriculum and inputs; and hence

on **competence** (as described in a skills framework) rather than on knowledge (derived from a BoK).

## 2.3. Accreditation standards

An accreditation standard is a statement of what all (accredited) graduates should achieve. It describes a minimum level of achievement.

The IoC Accreditation Standard set out in this document ensures that graduates will meet the requirements of both the Framework for Higher Education Qualifications (FHEQ) outcomes statement and the Quality Assurance Agency (QAA) subject benchmark statement.

Furthermore, graduates from a programme meeting the IoC Accreditation Standard should also meet the educational requirements for BCS Accreditation for at least CITP. The focus on competence rather than knowledge means that graduates may also have gained some of the experience required for chartered status.

## 2.4. The development of competence

Competence lies at one end of a spectrum that starts with knowledge (knowing how to do something), progresses through capability (being able to something in a controlled environment) to competence. This maps more appropriately to Simpson's Hierarchy |<sup>1</sup> rather than to Bloom's Taxonomy |<sup>2</sup>, the latter being the more usual reference for the design of academic assessment. The two are compared with the competence spectrum, and with each other, in table 1.

Item	"Competence" spectrum	Simpson's Hierarchy	Bloom's Taxonomy
1			<b>Remember:</b> recall facts and basic concepts
	<b>Recognition:</b> understand what the problem is	<b>Perception:</b> responds to cues in real world	
2	<b>Knowledge:</b> knowing how to deal with it	<b>Set:</b> ready to apply a known sequence of steps	<b>Understand:</b> describe ideas or concepts
3	<b>Capability:</b> have done it at least once	<b>Guided Response:</b> imitation and practice	<b>Apply:</b> relate information to new situations
4	<b>Not incompetent:</b> doesn't repeat mistakes	<b>Mechanism:</b> learned responses with confidence and proficiency	
			<b>Analyse:</b> draw connections amongst ideas
5			<b>Evaluate:</b> justify a stand or decision
	<b>Competent:</b> reproducible, reliable, creative	<b>Explicit Overt Response:</b> quick, accurate and coordinated performance	

**Table 1:** Mapping between competence hierarchy, Simpson's hierarchy and Bloom's taxonomy

The descriptions for the competence spectrum seek to echo some of the concerns expressed by employers for why some computing graduates are not "competent", and what it might mean if they were. They draw also on Miller's

pyramid (1990) |<sup>3</sup>, proposed originally for the assessment of clinical competence, and from the descriptions of nursing competence described by Herman and Kenyon (1987) |<sup>4</sup>. These abstractions bear remarkable similarity to the levels of Simpson's hierarchy, rather than to those of Bloom.

Note that there is considerable similarity between the characterisations for Simpson's Hierarchy and Bloom's (revised) taxonomy across the first three levels, although the former is fundamentally "practical", and the latter "theoretical". Indeed, the first level of Bloom seems entirely abstract, which is why it is shown on a separate row of table 1. However, there may be a (weak) argument that perception and recognition are based, at least to some extent, on memory and on association of facts.

For the next two levels, despite attempts to assert that "analyse" in Bloom's taxonomy might actually mean to analyse the failure of a machine, for example – something which is eminently practical – the fourth and fifth level of Bloom are essentially knowledge-focussed, that is, theoretical, and do little to capture practical application; indeed, in many ways, they just enhance "capability" without delivering "competence". Simpson, for these two levels, is essentially practical – about doing things, and doing them successfully; this practical emphasis is reflected directly both in Miller and in Herman and Kenyon.

Given that employers apparently want graduates to be able to do things, rather than just reason about them, the practical emphasis expressed in Simpson's hierarchy seems more appropriate for the IoC standard – against which outcomes will be measured - than the purely cognitive perspective of Bloom.

This goal may pose challenges for traditional degree programmes, which may currently include few opportunities for students actually to practise their skills in the real world.

But a focus on competence – rather than just capability, however advanced – is entirely in keeping with the goals for the IoC.



## 2.5. Reference to skills framework

Since competence is described in skills frameworks rather than BoKs, it is appropriate to express the IoC standard, which focusses on competence, in terms of a relevant skills framework.

As noted in Bowers and Howson (2019) |<sup>5</sup>, for the computing profession, the most appropriate skills framework is the Skills Framework for the Information Age, SFIA |<sup>6</sup>, now in version 7.

### 2.5.1 The SFIA Framework

SFIA is industry focussed, maintained and updated regularly by its user community (primarily employers). It has become the de facto global IT skills Framework, used in nearly 200 countries by organisations and individuals to characterise and manage their skills.

The underlying SFIA model is a two-dimensional matrix consisting of skills on one axis and seven levels of responsibility on the other. SFIA (v7) describes 102 skills. Cells in the matrix correspond to individual professional skills at various levels of competence. A typical job – or occupation – usually comprises about three skills, usually at the same or similar levels.

### 2.5.2 Choice of levels

SFIA characterises the seven levels of responsibility in terms of Autonomy, Influence, Complexity, Knowledge and Business Skills. As discussed by Bowers and Howson |<sup>7</sup>, (good) new graduates should normally be able to work at SFIA Level 3 – the "Apply" level, corresponding to being a competent practitioner. The responsibility characteristics defined for SFIA level 3 meet virtually all of the generic skills stipulated by both FHEQ and the QAA SBS for Computing, and the majority required for CITP. Competence at SFIA Level 3 is therefore the target for the IoC standard for Bachelor's degrees.

In contrast, experience at SFIA Level 5 ("ensure") is the normal benchmark required to attain Chartered status, which one would expect normally to be achieved a few years after graduation. Although this level might be achieved on

some post-experience Master's programmes, competence at Level 4 ("enable") is more appropriate for the IoC Master's standard.

## 2.6 The IoC standards - principles

### 2.6.1 Competence requirements

The IoC standards are defined in terms of competences in SFIA skills. The description of a SFIA skill gives *exemplar* activities that would demonstrate competence in that skill at a particular level. The exemplars are generic, so that there is flexibility in how they should be interpreted in a particular environment.

Furthermore, even if a given individual is not performing all of the suggested activities, that does not mean they are not competent. SFIA is **not** a conjunctive checklist; the target for competence should be between 50 and 85% of the tasks specified for any skill.

### 2.6.2 Using BoKs

Bodies of Knowledge should be drawn upon to design curricula to develop (focussed) competence.

### 2.6.3 Number of competence skills

The only place that most undergraduate students (without the benefit of a placement / internship etc.) will be able to demonstrate competence is likely to be in their final year (capstone) project. In that context, it is probable that there will be scope for the majority of students to develop competence corresponding to only **one** SFIA skill at (SFIA) Level 3.

Similar arguments apply for taught Masters' students. Although projects at Masters level may be more substantial than those for undergraduates, so also are the responsibility characteristics for SFIA Level 4. Hence, in the absence of a substantial placement, Master's students should be required to develop competence in only **one** SFIA skill at Level 4.

## 2.7 Commentary

The principal advantages of adopting a standard based on SFIA include:

- Use of the SFIA framework provides an abstraction mechanism that can assure comparable standards across different curricula;
- The SFIA responsibility characteristics provide a core which corresponds to the generic skills in IfA requirements, FHEQ and QAA benchmark statements.
- Underpinning knowledge for additional SFIA skills addresses the FHEQ/QAA requirements for breadth of knowledge.
- LSEPI and sustainability as explicit additional requirements ensure coverage of BCS CITP accreditation requirements.
- Those developing different curricula can select skills appropriate to their focus and context;
- SFIA is not prescriptive about how competence is developed - it allows providers to choose how to deliver that competence, and for competence to be developed by different providers within a single qualification;
- SFIA is widely recognised across industry – both in the UK and internationally.
- SFIA focusses on what it means to be competent – that is, on particular expertise that is useful in employment, rather than on the curriculum studied to gain that expertise.
- Given that the focus is on exemplars to demonstrate competence, so that different individuals (students/apprenticeships) may have strengths in different aspects of a skill, this approach avoids the "conjunctive shopping list" approach of some other standards.
- BCS and IET are core partners in the SFIA Foundation.

## 2.8 Final comments

Although the IoC standards are based on the SFIA framework, they are not simply that framework.

The standards specify the number and level of skills required by an IoC graduate, together with the range of additional underpinning knowledge.

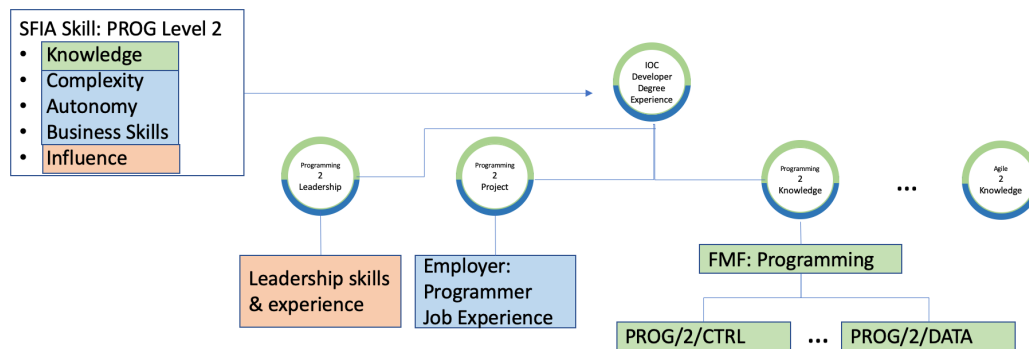
The standards are designed explicitly to meet the stated aims, and do so as follows:

- Competence in 1 skill => productive, able to operate in a live environment, billable etc.
- Underpinning knowledge for additional skills => adaptability, breadth of knowledge
- SFIA responsibility characteristics => employability
- Non-specificity of standard => flexibility

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  2. Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., Wittrock, M.C. (2001). A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives. New York: Pearson, Allyn & Bacon
  3. Miller GE. The assessment of clinical skills/competence/performance. Acad Med. 1990;65(9 suppl):s63–s67
  4. Herman GD, Kenyon RJ (1987) Competency-Based Vocational Education. A Case Study, Shaftsbury, FEU, Blackmore Press, cited in Fearon, M. (1998) Assessment and measurement of competence in practice, Nursing Standard 12(22), pp43-47.
  5. David S Bowers, Oli Howson (2019) "Analysis of accreditation approaches in the Computing sector", The Institute of Coding
  6. <https://www.sfia-online.org/en/reference-guide>
  7. ibid

## 4. Badges and Contributing Components

The following diagram illustrates a possible mapping between SFIA skills, Flexible Modular Framework components of a curriculum, and Open Badges:



# IoC Degree Standards

## Bachelor's degree with honours

Graduates should:

- have demonstrated the responsibility characteristics for SFIA Level 3;
- have demonstrated **competence** in one or more relevant SFIA skills at level 3 (the competence skill(s));
- have **underpinning knowledge** for a total of **four** SFIA skills at levels 3 or 4, including the competence skill(s), and with at least one at SFIA level 4;
- understand and apply the legal, social, ethical and professional principles that are relevant to their chosen skills;
- demonstrate an understanding of the need for sustainable computing in the context of their chosen skills.

## Master's degree

Graduates should:

- have demonstrated the responsibility characteristics for SFIA Level 4;
- have demonstrated **competence** in **at least one** relevant SFIA skills at level 4 (the competence skill(s));
- have **underpinning knowledge** for a total of **three** SFIA skills at levels 4 or 5, including the competence skills, and with at least one at SFIA level 5;
- understand and apply the legal, social, ethical and professional principles that are relevant to their chosen skills;
- demonstrate an understanding of the need for sustainable computing in the context of their chosen skills.

Note that these standards make no assumptions about the format of delivery of a degree – so, for example, the standards apply equally to university-based

degrees, degree apprenticeships and degrees incorporating an industrial placement.

Furthermore, the standards are threshold requirements: good or excellent students from IoC programmes may exceed the relevant standard, and this should be reflected in the classification of their degree.

## Explanatory Notes

The demonstration of competence in a SFIA skill requires that students have completed relevant tasks more than just once or twice in a controlled/safe environment. They should have had repeated experience of those tasks in varying contexts, sufficient to be competent to deploy the skill for a real customer or as an independent practitioner, without needing routine supervision.

In order to achieve competence in any SFIA skill, graduates must also have demonstrated the responsibility characteristics for the corresponding SFIA level. Demonstrating these characteristics will probably require evidence from completing a number of independent projects within the scope of the chosen SFIA skill together with evidence of generic leadership and business skills.

Since the underpinning knowledge required for at least one skill at SFIA Level 4/5 may be for the same SFIA skill as a "competence" skill, the requirement for underpinning knowledge is for sufficient skills to bring the total number of SFIA skills demonstrated – either by underpinning knowledge or through competence – to the number required for the specific standard – that is, a total of four skills for a Bachelor's degree and three for a Master's.

Some SFIA skills are not defined for the lower levels (2, 3, 4). If such skill would be appropriate for a particular programme, the IoC may approach SFIA to extend the skill definition to include the required level. In the meantime, the IoC Accreditation Panel may accept a draft description of the skill at the required level. The computing profession is subject to a range of legal and ethical requirements which may be specific to particular skill areas – such as accessibility law – or may be more generic – such as the provisions of GDPR. Graduates should be fully aware of the legal and ethical requirements that will affect them, as well as the social and professional responsibilities that arise in

their work. It is likely that sufficient detail of legal and ethical requirements will have been taught alongside technical material for graduates to have a sound understanding of how these requirements affect their activities.

In addition to these explicit requirements, it is likely that any graduate achieving the standard will have additional underpinning knowledge, and possibly competence, corresponding to several additional SFIA skills at Levels 1, 2 or (for Master's degrees) 3.

## Instantiation

The separation of the standard from the specific curricula (in parallel workstreams 1.2, 1.3 and themes 2/3) mean that the standard itself must be flexible and adaptable. The standard is phrased in terms of demonstration of competence corresponding to responsibility levels in the SFIA framework, but does not mandate any particular skills. Since the responsibility characteristics in SFIA are common across all skills, and the tasks specified at a particular level for different skills are broadly comparable in difficulty, this abstraction approach allows the specification of a standard that is independent of the particular subject focus – just as the FHEQ, QAA SBS and BCS accreditation requirements are independent of any particular focus. This generic standard can then be instantiated for a number of distinct subject areas, determined by the SFIA skills selected.

## Recognition of achievement

It is proposed that the achievement of "competence" and (underpinning) "knowledge" for particular SFIA skills at the required levels will be recognised by the award of IoC/SFIA badges. Smaller, micro-accreditation badges may also be offered for micro-modules within the flexible modular framework (theme 3), which could be combined to achieve a single IoC/SFIA "knowledge" badge.



# Process to design an IoC curriculum

## Introduction

This document outlines a process to develop a degree curriculum that will satisfy the IoC standard. The worked example is based on Bachelor's degree for a "web developer" profile, which is entirely arbitrary, but should be sufficiently widely understood to serve as a generic example.

## The IoC standard

The IoC standard for a Bachelor's degree with honours specifies that students should:

- have demonstrated the responsibility characteristics for SFIA Level 3;
- have demonstrated competence in one or more relevant SFIA skills at level 3 (the competence skill(s));
- have underpinning knowledge for a total of four SFIA skills at levels 3 or 4, including the competence skill(s), and with at least one at SFIA level 4;
- understand and apply the legal, social, ethical and professional issues that are relevant to the chosen skills;
- heed the drivers for sustainable computing in the context of the chosen skills.

The demonstration of competence requires that students have not done things just once or twice, in a controlled/safe environment, but have had experience sufficient to be competent to deploy the skills for a real customer, without needing routine supervision.

In order to achieve competence in any SFIA skill, graduates must have demonstrated the responsibility characteristics for SFIA Level 3. Demonstrating these characteristics requires evidence of experience from completing a number

of independent projects within the scope of the chosen SFIA skill together with evidence of generic leadership and business skills.

Since the underpinning knowledge required for at least one skill at SFIA Level 4 may be for the same SFIA skill as that for the "competence" skill, the requirement for underpinning knowledge in this case would be for three additional skills at SFIA Level 3. If the underpinning knowledge at SFIA Level 4 is for a SFIA skill different from the "competence" skill, then the requirement for underpinning knowledge is for one skill at SFIA Level 4 and two further skills at Level 3, in addition to that for the "competence" skill.

The computing profession is subject to a range of legal and ethical requirements which may be specific to particular skill areas – such as accessibility law – or may be more generic – such as the provisions of GDPR. Graduates should be fully aware of the legal and ethical requirements that will affect them, as well as the social and professional responsibilities that arise in their work. It is likely that sufficient detail of legal and ethical requirements will have been taught alongside technical material for graduates to have a sound understanding of how these requirements affect their activities. In addition to these explicit requirements, it is likely that any graduate achieving the standard will also have underpinning knowledge, and possibly competence, for several SFIA skills at Levels 1 or 2.

## Outline process

1. Identify SFIA skills that would be relevant for the required role
2. Review the selected skills against industry / academic requirements – address any gaps
3. Review the skills identified to determine which should be output (SFIA Level 3) requirements and which are needed as "underpinning" at SFIA/HE levels 1/2
4. Refine the list of output SFIA skills until there are 4 or 5 at SFIA level 3. This may involve either "demoting" skills if too many are deemed relevant or adding additional generic skills should there be too few.
5. For each of the selected SFIA skills, identify what knowledge is required to underpin the skill

6. Identify what prior knowledge would be required for each package of knowledge
7. Identify opportunities for experience development that could be incorporated into the curriculum (to allow students to build evidence of competence).
8. Package the learning into modules, to create a curriculum
9. Check learning dependencies between modules
10. Map contributions from each module to output SFIA skills.

## Process – worked example

In this section, we work through the development of the "web developer" degree programme summarised in the [Appendix: Web Developer Example](#).

### 1. Identify SFIA skills

Identify SFIA skills that would be relevant for the required role. The initial list of SFIA skills is constructed simply by considering each of the skill areas in turn.

- Information security
- information content publishing
- data management
- portfolio, programme and project support
- requirements definition and management
- software design
- programming/software development
- data modelling and design
- Testing
- information content authoring
- user experience design
- user experience evaluation

- systems integration and build
- service design - service level management
- service transition - configuration management, asset management, change management, release and deployment
- service operation - system software, security administration, application support, IT infrastructure, database administration, storage management, network support, problem management, incident management
- Quality management
- Quality assurance
- Measurement
- stakeholder management - supplier management, customer service support
- sales and marketing - marketing, sales support, product management

This list is clearly too long, and some of the skills identified are areas for which only superficial knowledge may be needed.

## 2. Review the selected skills

Review the selected skills against industry / academic requirements against industry / academic requirements.

Reviewing the skills identified, one further skill was added – Solution Architecture. This is defined only from level 4 in SFIA v7, but something in this area is important underpinning for any web developer.

## 3. Review the skills identified

Review the skills identified to determine which should be output (SFIA Level 3) requirements and which are needed as "underpinning" at SFIA/HE levels 1/2.

The third stage is to refine the list of possible skills under four headings:

- Level 3/4 target
- Level 2 underpinning

- Only awareness needed
- Not relevant

### **Level 3/4 target**

- Information security SCTY
- requirements definition and management REQM
- programming/software development PROG
- systems integration and build SINT
- release and deployment RELM

### **Level 2 underpinning**

- Solution Architecture ARCH (not currently defined at level 2)
- portfolio, programme and project support PROF
- data modelling and design DTAN
- information content authoring INCA
- user experience design HCEV

### **Awareness only**

- service design - {service level management}
- service transition - {configuration management, asset management, change management, release and deployment}
- service operation {system software, security administration, application support, IT infrastructure, database administration, storage management, network support, problem management, incident management}

### **Not relevant**

Note that some of the skills identified under this heading are "not relevant" simply because they are subsumed in other skills already selected.

For example, user experience evaluation is part of user experience design.

- information content publishing

- data management
- software design
- Testing
- Quality management
- Quality assurance
- Measurement
- user experience evaluation
- stakeholder management - supplier management, customer service support
- sales and marketing - marketing, sales support, product management

#### 4. Refine the list

Refine the list of output SFIA skills until there are 4 or 5 at SFIA level 3. This may involve either "demoting" skills if too many are deemed relevant or adding additional generic skills should there be too few.

In this iteration, there are 5 target skills for levels 3 or 4. Hence, the set of target skills should both be achievable and offer sufficient breadth.

#### 5. Identify underpinning knowledge

For each of the selected SFIA skills, identify what knowledge is required to underpin the skill. For underpinning knowledge, look at the skill description for Level 3. In some cases, the description of the activities are already fairly close to a description of the knowledge required, for example, Information content authoring Level 2 INCA2. For others, the underpinning knowledge may simply be, "know how to...".

For example, for [Data Modelling and Design DTAN L2](#):

Applies data analysis, design, and modelling techniques to establish, modify or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions).

The relevant underpinning knowledge might be:

Know how to apply data analysis, design, and modelling techniques to establish, modify or maintain a data structure and its associated components. This will include understanding how to construct entity descriptions, relationship descriptions and attribute definitions.

## 6. Identify prior knowledge

Identify what prior knowledge would be required for each package of knowledge. Some skills may need to be contextualised.

For example, Programming/Software Development PROG is generic, but this particular programme is for web developers.

So, **PROG L3**:

Designs, codes, verifies, tests, documents, amends and refactors moderately complex programs/scripts. Applies agreed standards and tools, to achieve a well-engineered result. Collaborates in reviews of work with others as appropriate.

Needs to be interpreted in the context of web development – both server-side and client-side scripts, in a range of languages, and probably using databases and other technologies. Thus, the underpinning knowledge is likely to be built on introductory programming, display elements, scripting languages, database definition and manipulation and an understanding of the architecture options for web apps. This is standard curriculum construction – high level outputs need to be grounded in lower level skills.

## 7. Identify experience opportunities

Identify opportunities for experience development that could be incorporated into the curriculum (to allow students to build evidence of competence). Building competence through experience – and accumulating evidence of that experience – is central to an IoC degree.

There are many ways in which opportunities for real experience may be built into a degree programme. The mechanisms chosen for this worked example are:

- Two "clinic" modules, in which students, under supervision, provide website construction/development for (paying) local customers
- Industry-sponsored and mentored group projects in years 2 and 3
- Summer internships between years 1 & 2 and/or years 2 and 3
- A final year project that should deliver at least one product for a "real" customer.

## 8. Package into modules

Package the learning into modules, to create a curriculum. The draft curriculum is shown [here](#)

With the exception of the higher than usual proportion of experience modules (necessary to deliver competence) and the fairly tight focus on web development, the curriculum actually looks fairly traditional. It may lack a little breadth compared with a traditional programme, and happens, in this example, to lack any explicit options. However, there will be considerable choice for students in how they focus their activities in the experience modules.

## 9. Check learning dependencies

This is, again, standard curriculum design. The dependencies between modules are shown in the "builds on" / "supports" links in the module descriptions.

## 10. Map to SFIA skills

Map contributions from each module to output SFIA skills.

The purpose of the model curriculum is to ensure that students meet the IoC standard. A good final check in the design of the curriculum is to ensure that the knowledge required for each of the target skills is covered, probably across several modules, and that there are ample opportunities for appropriate



experience to be gained. It is helpful here to consider the links from the skill descriptions to the modules that underpin them.

# Generic Skills

From SFIA Version 7

## Responsibility Characteristics - required for all graduates

### Level 3

#### Autonomy

Works under general direction. Uses discretion in identifying and responding to complex issues and assignments. Receives specific direction, accepts guidance and has work reviewed at agreed milestones. Determines when issues should be escalated to a higher level.

#### Influence

Interacts with and influences colleagues. Has working level contact with customers, suppliers and partners. May supervise others or make decisions which impact the work assigned to individuals or phases of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work.

#### Complexity

Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution.

#### Knowledge

Has a sound generic, domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and organisational information. Demonstrates effective application

of knowledge. Has an appreciation of the wider business context. Takes action to develop own knowledge.

## Business skills

Demonstrates effective communication skills.

Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation, standards and procedures.

Contributes fully to the work of teams. Appreciates how own role relates to other roles and to the business of the employer or client.

Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities.

Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work.

## SFIA skills that could be relevant for any curriculum

Portfolio, programme and project support PROF The provision of support and guidance on portfolio, programme and project management processes, procedures, tools and techniques. Support includes definition of portfolios, programmes, and projects; advice on the development, production and maintenance of business cases; time, resource, cost and exception plans, and the use of related software tools. Tracking and reporting of programme/project progress and performance are also covered, as is the capability to facilitate all aspects of portfolio/ programme/ project meetings, workshops and documentation.

### Level 4

Takes responsibility for the provision of support services to projects. Uses and recommends project control solutions for planning, scheduling and tracking projects. Sets up and provides detailed guidance on project management

software, procedures, processes, tools and techniques. Supports programme or project control boards, project assurance teams and quality review meetings. Provides basic guidance on individual project proposals. May be involved in aspects of supporting a programme by providing a cross programme view on risk, change, quality, finance or configuration management.

### **Level 3**

Uses recommended portfolio, programme and project control solutions for planning, scheduling and tracking. Sets up project files, compiles and distributes reports. Provides administrative services to project boards, project assurance teams and quality review meetings. Provides guidance on project management software, procedures, processes, tools and techniques.

## Project management PRMG

The management of projects, typically (but not exclusively) involving the development and implementation of business processes to meet identified business needs, acquiring and utilising the necessary resources and skills, within agreed parameters of cost, timescales, and quality. The adoption and adaptation of project management methodologies based on the context of the project and selecting appropriately from predictive (plan-driven) approaches or adaptive (iterative/agile) approaches.

### **Level 4**

Defines, documents and carries out small projects or sub-projects (typically less than six months, with limited budget, limited interdependency with other projects, and no significant strategic impact), alone or with a small team, actively participating in all phases. Identifies, assesses and manages risks to the success of the project. Applies appropriate project management methods and tools whether predictive (plan-driven) approaches or adaptive (iterative/agile) approaches. Agrees project approach with stakeholders, and prepares realistic plans (including quality, risk and communications plans) and tracks activities against the project schedule, managing stakeholder involvement as appropriate. Monitors costs, timescales and resources used, and takes action where these deviate from agreed tolerances. Ensures that own projects are formally closed

and, where appropriate, subsequently reviewed, and that lessons learned are recorded.

# Data Analytic Skills

SFIA skills that could be relevant for Data Analytics

## Analytics INAN

The application of mathematics, statistics, predictive modeling and machine-learning techniques to discover meaningful patterns and knowledge in recorded data. Analysis of data with high volumes, velocities and variety (numbers, symbols, text, sound and image). Development of forward-looking, predictive, real-time, model-based insights to create value and drive effective decision-making. The identification, validation and exploitation of internal and external data sets generated from a diverse range of processes.

### Level 3

Undertakes analytical activities and delivers analysis outputs, in accordance with customer needs and conforming to agreed standards..

## Data management DATM

The management of practices and processes to ensure the security, quality, integrity, safety and availability of all forms of data and data structures that make up the organisation's information. The management of data and information in all its forms and the analysis of information structure (including logical analysis of taxonomies, data and metadata). The development of innovative ways of managing the information assets of the organisation.

### Level 3

Applies ethical and robust techniques in the transformation of data from one format/medium to another, in line with organisational policies and procedures and being sensitive to risks around the use of information.

## Methods and tools METL

The definition, tailoring, implementation, assessment, measurement, automation and improvement of methods and tools to support planning, development, testing, operation, management and maintenance of systems. Ensuring methods and tools are adopted and used effectively throughout the organisation.

### Level 3

Provides support on the use of existing methods and tools. Configures methods and tools within a known context. Creates and updates the documentation of methods and tools.

## Database design DBDS

The specification, design and maintenance of mechanisms for storage of and access to data in support of business information needs. Design of the physical data layer, addressing enterprise data resource needs and local stored data structures. Definition of physical or virtual data warehouse structures required to support business intelligence and data analytics services.

### Level 3

Develops appropriate physical database or data warehouse design elements, within set policies, to meet business change or development project data requirements. Interprets installation standards to meet project needs and produces database or data warehouse component specifications.

## Database administration DBAD

The installation, configuration, upgrade, administration, monitoring and maintenance of databases. Providing support for operational databases in production use and for internal or interim purposes such as iterative developments and testing. Improving the performance of databases and the tools and processes for database administration (including automation).

### **Level 3**

Uses database management system software and tools to collect agreed performance statistics. Carries out agreed database maintenance and administration tasks.



# Cybersecurity Skills

## Information security SCTY

The selection, design, justification, implementation and operation of controls and management strategies to maintain the security, confidentiality, integrity, availability, accountability and relevant compliance of information systems with legislation, regulation and relevant standards.

### Level 3

Communicates information security risks and issues to business managers and others. Performs basic risk assessments for small information systems. Contributes to vulnerability assessments. Applies and maintains specific security controls as required by organisational policy and local risk assessments. Investigates suspected attacks. Responds to security breaches in line with security policy and records the incidents and action taken.

## Information governance IRMG

The overall governance of how all types of information, structured and unstructured, whether produced internally or externally, are used to support decision-making, business processes and digital services. Encompasses development and promotion of the strategy and policies covering the design of information structures and taxonomies, the setting of policies for the sourcing and maintenance of the data content, and the development of policies, procedures, working practices and training to promote compliance with legislation regulating all aspects of holding, use and disclosure of data.

### Level 4

Ensures implementation of information and records management policies and standard practice. Ensures effective controls are in place for internal delegation, audit and control relating to information and records management. Assesses and manages risks around the use of information. Provides reports on the

consolidated status of information controls to inform effective decision making. Recommends remediation actions as required. Ensures that information is presented effectively.

## Penetration testing PENT

The assessment of organisational vulnerabilities through the design and execution of penetration tests that demonstrate how an adversary can either subvert the organisation's security goals or achieve specific adversarial objectives. Penetration testing may be a stand-alone activity or an aspect of acceptance testing prior to an approval to operate. The identification of deeper insights into the business risks of various vulnerabilities.

### Level 4

Maintains current knowledge of malware attacks, and other cyber security threats. Creates test cases using in-depth technical analysis of risks and typical vulnerabilities. Produces test scripts, materials and test packs to test new and existing software or services. Specifies requirements for environment, data, resources and tools. Interprets, executes and documents complex test scripts using agreed methods and standards. Records and analyses actions and results. Reviews test results and modifies tests if necessary. Provides reports on progress, anomalies, risks and issues associated with the overall project. Reports on system quality and collects metrics on test cases. Provides specialist advice to support others.

## Digital forensics DGFS

The collection, processing, preserving, analysis, and presentation of forensic evidence based on the totality of findings including computer-related evidence in support of security vulnerability mitigation and/or criminal, fraud, counterintelligence, or law enforcement investigations.

### Level 4

Contributes to digital forensic investigations. Processes and analyses evidence in line with policy, standards and guidelines and supports production of forensics findings and reports.

## Business risk management BURM

The planning and implementation of organisation-wide processes and procedures for the management of risk to the success or integrity of the business, especially those arising from the use of information technology, reduction or non-availability of energy supply or inappropriate disposal of materials, hardware or data.

### Level 4

Investigates and reports on hazards and potential risk events within a specific function or business area.

## Data management DATM

The management of practices and processes to ensure the security, quality, integrity, safety and availability of all forms of data and data structures that make up the organisation's information. The management of data and information in all its forms and the analysis of information structure (including logical analysis of taxonomies, data and metadata). The development of innovative ways of managing the information assets of the organisation.

### Level 4

Takes responsibility for the accessibility, retrievability, security, quality, retention and ethical handling of specific subsets of data. Assesses the integrity of data from multiple sources. Provides advice on the transformation of data/information from one format or medium to another. Maintains and implements information handling procedures. Enables the availability, integrity and searchability of information through the application of formal data and metadata structures and protection measures. Manipulates specific data from information services, to satisfy defined information needs.

# Hypothetical instantiation - Web App Developer

This is a worked example of a hypothetical instantiation of an IOC degree for a Web App Developer, showing the mapping of SFIA skills and model curriculum.

## Curriculum

### Year 1

Semester 1	Semester 2	Summer
PROG101   <sup>1</sup>	WEBD102   <sup>4</sup>	
...	COMP102   <sup>5</sup>	
NWSC101   <sup>2</sup>	PROF102   <sup>6</sup>	
BSYS101   <sup>3</sup>	CLIN102   <sup>7</sup>	Internship   <sup>8</sup>

### Year 2

Semester 1	Semester 2	Summer
SPMG201   <sup>9</sup>	ARCH202   <sup>13</sup>	
UCDD201   <sup>10</sup>	NWSC202   <sup>14</sup>	
DMAD201   <sup>11</sup>	WEBP202   <sup>15</sup>	
PROJ201   <sup>12</sup>	CLIN202   <sup>16</sup>	Internship   <sup>8</sup>

## Year 3

Semester 1	Semester 2	Summer
CSVC301   <sup>17</sup>	MOBS302   <sup>21</sup>	
RQMS301   <sup>18</sup>	LEAN302   <sup>22</sup>	
SYSI301   <sup>19</sup>	PROJ302   <sup>23</sup>	
PROJ301   <sup>20</sup>	...	

- 
1. [Introductory Programming](#)
  2. [Network & Security Fundamentals](#)
  3. [Business Systems & Drivers](#)
  4. [Developing Web Content](#)
  5. [Computational Thinking](#)
  6. [Communications and Professional Practice](#)
  7. [Web Content Clinic](#)
  8. [Summer Internship](#)
  9. [Service & Project Management](#)
  10. [User Centred Design & Development](#)
  11. [Data Modelling & Design](#)
  12. [Yr 2 Group Project](#)
  13. [Systems Architecture](#)
  14. [Network & Web Security](#)
  15. [Web Programming](#)
  16. [Web Development Clinic](#)
  17. [Cloud Based Services](#)
  18. [Requirements Management](#)
  19. [Systems Integration & Testing](#)
  20. [Yr 3 Group Project](#)
  21. [Mobile & Cross-Platform Services](#)
  22. [Business Agility](#)

## 23. Final Project

# ARCH202 : Systems Architecture

**15 credits**

*to be turned into a module description*

client - server architectures

web services, http, smtp

APIs

messaging formats - html, json, xml

soap vs rest / restful

## Skills Contributions

- [ARCH](#)
- [PROG](#)
- [RELM](#)
- [REQM](#)
- [SCTY](#)
- [SINT](#)

# BSYS101: Business Systems & Drivers

**15 credits**

All organisations need to remain relevant to deliver value to their markets, customers or public and this means a process of keeping abreast of how to continually deliver products and services that are at least as good as they can get elsewhere, if not better.

Computer systems are essential components of a business's armoury, and help to deliver their products and services to the market. Understanding what a computer system needs to do means being aware of the commercial drivers for that system - being *commercially aware*.

Being commercially aware means understanding what your organisation exists to do, and the context it operates within. It means having a good understanding of your organisation, how it works, who its customers are, how it adds value to them and what influences your success and the overall performance of the organisation.

Every organisation is subject to internal and external factors that mean reacting to change and developing strategies to respond to them are a key activity for managers. This course will help you to address the ongoing process of adapting and responding to the external environment while adjusting to what happens inside your organisation. You will consider how in today's complex organisations it is not acceptable to "do your own thing" without understanding the consequences elsewhere. It is not simply a matter of understanding your role, but how you fit into the big picture. Commercial awareness is not simply about acquiring a body of knowledge but rather a continuous dynamic process of recognising what affects your business now, and how it could be affected in the future. This means understanding customers and stakeholders, the work of colleagues, partners and competitors and how your role relates to them.

This module will explore how common commercial computer systems, particularly web-based services, can contribute to the various commercial drivers experienced by a company.



## Skills Contributions

- [REQM](#)

## Source

*developed from Open University short course BG020: Commercial Awareness*

# CLIN102: Web Content Clinic

## 15 credits

The web content clinic is part of the web development clinic run by the school. As a first year member of the clinic, your role will be to populate and update websites that have been developed for clients.

You will not simply be typing ready-prepared material – you will be creating the content from information provided by the client, ensuring that it is in a form that is appropriate for the intended audience. As you work in the clinic, you will be gaining valuable experience, which you should log in your e-portfolio.

## Skills Contributions

- [HCEV](#)
- [INCA](#)
- [PROF](#)
- [REQM](#)
- [EXPERIENCE](#)
- [LEADERSHIP](#)

# CLIN202: Web Development Clinic

**15 credits**

For this module, you will contribute to the activities of the web clinic operated by the school. You will be working on real projects for real, paying customers – so you will be expected to work professionally, building well-founded solutions. As you work in the clinic, you will be gaining valuable experience, which you should log in your e–portfolio.

## Skills Contributions

- [SCTY](#)
- [SINT](#)
- [HCEV](#)
- [INCA](#)
- [PROF](#)
- [PROG](#)
- [RELM](#)
- [REQM](#)
- [EXPERIENCE](#)
- [LEADERSHIP](#)

# COMP102: Computational Thinking

**15 credits**

Firstly, you will be introduced to the concept of computational thinking. In particular, you will consider the question 'What is it to compute?'. A number of key concepts are defined – such as computational problem, algorithm and abstraction – and their application is illustrated. You will be given examples of computational problems and their solutions in a wide variety of fields, ranging from physics and biology to economics and sports. You will also start using the Python programming language.

Secondly, you will be introduced to tools and techniques for:

- creating abstractions that represent a problem
- devising algorithms that solve a problem efficiently.

A range of standard data structures and algorithms for sorting, searching and optimisation will be covered and illustrated with practical examples. You will also encounter notions such as Big-O notation, induction and recursion.

Finally, you will further develop your understanding of sets, functions, logic and proofs. In particular, some of the ideas – that you will have been introduced to informally – will now be presented using formal mathematical notation. This will be in the context of concrete applications, such as databases. At this point, you'll also learn about the limitations of computational problem solving (non-computability and computational complexity) and recent developments in computing, such as quantum computing.

## Skills Contributions

- [DTAN](#)
- [PROG](#)

# Origin

*based on Open University Module M269: Algorithms, Data Structures and Computability.*

# CSV301: Cloud Based Services

## 15 credits

This module introduces the cloud model and the types of resources (processing power, databases, general storage and networking) that can be provided by a typical cloud infrastructure. Different levels of cloud model are investigated, such as Infrastructure as a Service (**IaaS**), Platform as a Service (**PaaS**) and Software as a Service (**SaaS**), and contrasted with the web services model.

The module briefly reviews consumer cloud offerings, such as Dropbox and Google Drive for storing assets, before moving on to more sophisticated commercial offerings of cloud infrastructure, such as OpenStack and Amazon Web Services (AWS). Virtualisation and the use of hypervisors are outlined with a focus on the common facilities of the dominant mainstream platforms, including monitoring resource usage, load balancing and automatic scaling of resources to meet demand.

As well as technical aspects, the module considers the business case for cloud in different contexts (start-up, corporate, projects, collaborations) and different approaches to distributing cloud infrastructure (private, public and collaborative) as well as considering security and legal implications for each approach.

A range of cloud operations are demonstrated and included in a set of practical activities to provide hands-on experiences. These activities include:

- using a cloud dashboard to create resource constraint descriptions in which to run virtual machines and other components
- creating security rules to control access to cloud resources
- launching, accessing, monitoring and destroying cloud resources
- scripting and testing an auto-scaling scenario so that an application which comes under a high load is automatically replicated with the load shared between the existing and new resources
- use of a programmatic REST API to perform cloud operations.

## Skills Contributions

- ARCH
- PROG
- RELM
- SCTY
- SINT

# DMAD201: Data Modelling & Design

**15 credits**

In this module, you'll learn about relational databases, including modelling the data required and implementing a data solution to meet needs and requirements.

The module will cover:

- business data requirements – databases and information systems
- modelling data requirements – conceptual and logical representations of a system
- realising the data model – from logical to physical, and implementation in SQL
- data manipulation using SQL
- data management – data quality and correctness, models and reality
- data in context – business and legal issues, performance and clarity, non-SQL technologies.

## Skills Contributions

- [DTAN](#)
- [REQM](#)
- [SINT](#)



# INTN: Summer Internship

The summer internship is an opportunity for you to gain some real-world experience, and to put into practice some of the skills you have developed in your first two years of study.

It is particularly important that you complete this internship before your final year if you did not have an opportunity for an internship between years 1 and 2.

It doesn't matter which area of the curriculum you apply – or, indeed, if you are exposed to new material which you have not yet covered. The important thing is to make the most of the opportunities you are offered, and to accumulate evidence of your developing competence in whichever tasks you are set.

You should take care to record evidence of your achievements in your e-portfolio. Over the course of your studies, you need to develop evidence to demonstrate your competence in one of the core SFIA skills:

- Information Security SCTY
- Programming/software development PROG
- Requirements definition and management REQM
- Systems integration and build SINT
- Release and deployment RELM

As well as evidence of your practical experience, you will also need evidence of your leadership skills, as specified in the SFIA framework.

## Skills Contributions

- PROF
- PROG
- RELM
- REQM

- SCTY
- SINT
- EXPERIENCE
- LEADERSHIP

# LEAN302 : Business Agility

**15 credits**

This module is based on a series of case studies which will explore how enterprises:

- choose how to exploit cloud technologies (private, public and hybrid);
- select development approaches that are appropriate for their needs and environment (lean, agile, iterative, waterfall etc.)
- identify the most appropriate technologies and environments to support their needs
- find an appropriate balance between insourcing and outsourcing
- choose between different vendors, and ensure that contracts and agreements are fit for purpose

For your assessment, you will select a major software development undertaken by a particular company, research published information on how successful that development was, and review how well the company followed the principles discussed in the module.

## Skills Contributions

- [ARCH](#)
- [RELM](#)
- [REQM](#)
- [SINT](#)

# MOBS302 : Mobile & Cross-Platform Services

**15 credits**

This module explores the current state of the mobile market and the prospects for mobile technology as well as its combined use with cloud technology. The module commences by investigating a range of challenges facing developers of mobile apps, including dealing with the multiplicity of:

- users' devices (tablets, mobile phones etc.)
- framework technologies (Java, Microsoft, Android, iOS)
- communication technologies (Web services, HTTP, and TCP sockets).

The module examines a range of considerations in developing a mobile application including deployment and upgrading, user interface design, performance and memory management as well as connectivity, back-end storage and security. It also includes a case study element, exploration of toolkits for developing applications and the practical development of a mobile application which is subsequently extended to exploit cloud facilities.

## Skills Contributions

- [ARCH](#)
- [PROG](#)
- [SINT](#)
- [RELM](#)

# NWSC101 : Network & Security Fundamentals

**15 credits**

The module introduces key concepts in networking and cyber security, It incorporates two online courses provided by Cisco:

- networking essentials
- cybersecurity essentials

## Skills Contributions

- [ARCH](#)
- [SCTY](#)

# NWSC202 : Network & Web Security

**15 credits**

This module builds on the networking and security concepts introduced in NWSC101, and explores some of the security issues that are most relevant to web services and their associated protocols.

You will learn to identify common web vulnerabilities, such as injection (for sql, javascript and html) and appropriate countermeasures and resilient approaches that should be adopted to minimise these risks.

## Skills Contributions

- [ARCH](#)
- [RELM](#)
- [REQM](#)
- [SCTY](#)
- [SINT](#)

# PROF102: Communications & Professional Practices

**15 credits**

This module introduces you to the foundations that underpin being an effective professional.

Developing a website or any other computer software is rarely an activity that is carried out alone. So, you will explore what it means to be a member of a team, and the various roles that you might fill.

Effective communication, both verbal and written, is crucial within teams, and is also very important between developers and customers. You will look at how to choose the most appropriate communication medium and how best to express yourself through that medium.

Professionalism in IT is more than just having a useful collection of technical skills. This module will introduce you to the range of legal, social and ethical issues that contribute to being a Computing professional.

You will look at the legal framework in which IT systems are developed, and consider the social impact that such systems may have. IT can also raise many ethical questions which you, as a professional, will need to address. Finally, but by no means least, IT systems need to be sustainable, with manageable impacts on resources, and particularly on the climate.

To succeed in this degree, you will need to build a professional portfolio, containing evidence of your experience and developing competence. You will relate your experience to SFIA, the Skills Framework for the Information Age, which will be introduced in this module, together with appropriate tools for building your portfolio.

## Skills Contributions

- PROF
- REQM
- LEADERSHIP



# PROG101: Introductory Programming

**30 credits**

Coding is at the heart of almost every computer application.

In this module, you will develop your coding skills using the Python programming language - not because it is necessarily the most widely used language, or because it is the one you will continue to use through your career. You will be using Python because it allows you to develop skills with all of the coding constructs that underpin the vast majority of programming languages.

You'll be introduced to a range of problem solving strategies, which you'll practise as you solve a number of coding challenges.

The assessment of this module will be based on a programming project.

## Skills Contributions

- [PROG](#)

# PROJ201: Group Project

**15 credits**

For this module, you will join a team of students from years two and three to complete some real-world tasks.

Your role will be to build components for a project. The third-year students will be responsible for coordinating and managing the project – you will have that opportunity next year, so this is your chance to watch and learn, as well as gaining experience working in a team.

In particular, you will have the opportunity to gain experience using the industry-standard code repository, github, and to learn how it can be used to enable collaborative development, sharing and commenting on code as you develop it.

Each group for this module will be monitored by the module leader, and will also have access to a mentor from industry.

The experience you gain should be recorded in your professional portfolio: it will count towards the experience you require for a "competency" badge.

## Skills Contributions

- [PROF](#)
- [REQM](#)
- [EXPERIENCE](#)
- [LEADERSHIP](#)

# PROJ301: Group Project

**15 credits**

You will gain experience in multiple aspects of software project management, including requirements reviews, component integration and testing. Your focus will be on the execution of the overall project, rather than on development of individual components. However, you will also have the opportunity to contribute to the project specification, approach and priorities.

In this module, you will be leading and managing, jointly with one or two other third year students, a group of year 2 students to deliver an industry-sponsored project.

You will share the responsibility to manage the team's use of industry-standard code repository, GitHub, and to ensure that it supports collaborative development. Groups who can not demonstrate effective use of GitHub are likely to score poorly on this module.

You will also share responsibility for liaising with the module leader, and with your group's industrial mentor.

The experience you gain should be recorded in your professional portfolio: it will count towards the experience you require for a "competency" badge.

## Skills Contributions

- [PROF](#)
- [REQM](#)
- [EXPERIENCE](#)
- [LEADERSHIP](#)

# PROJ302: Final Project

## 30 credits

This module is the capstone professional project for your degree programme. You will need to develop and deliver one or more artefact(s) for a real customer external to the University. You should aim to build on the experience you gained during one of your summer internships.

You will need to follow the complete lifecycle for each artefact, using whichever approach you think appropriate (e.g., agile, iterative etc.). You must also follow all relevant professional and ethical guidelines.

As this is a real-life project, you should expect to encounter difficulties and challenges, which you should document appropriately, and discuss in your project report.

You should be careful not to take on too much; but you must ensure that the experience you gain – including any failures – demonstrates your competence at level 3 in at least one of the five key SFIA skills for the degree:

- Information Security SCTY
- Programming/software development PROG
- Requirements definition and management REQM
- Systems integration and build SINT
- Release and deployment RELM Be aware that your customer will contribute to your assessment on this module.

## Skills Contributions

- ARCH
- DTAN
- HCEV

- PROF
- PROG
- RELM
- REQM
- SCTY
- SINT
- EXPERIENCE
- LEADERSHIP

# RQMS301: Requirements Management

**15 credits**

Comparing traditional approaches with agile processes and practices, you will learn about well-known software development processes, their phases, activities and techniques. This will help you to develop a critical understanding of the diversity of contexts of organisations, problems, and development teams, which will allow you to use your own judgment in a real situation.

By studying this module you will:

- be able to understand the business domain for a problem requiring a software solution or a change to an existing solution
- acquire the tools and knowledge to analyse and design such a solution or change
- understand how any chosen software architecture will impact on the satisfaction of all users requirements and expectations
- be able to apply and reuse design expertise from a set of design patterns
- develop the skills for testing outputs of all activities throughout the development process.

You will be equipped to apply your knowledge to the design of a wide range of software systems; from small systems in a single organisation (which still need to interact with a range of other services online) to those working in large-scale distributed environments based on coalitions of systems.

TBD

## Skills Contributions

- [DTAN](#)
- [HCEV](#)

- PROG
- RELM
- REQ M
- SINT

# SPMG201: Service & Project Management

**15 credits**

This module is arranged in two parts: *Service Management* and *Project Management*.

## Service Management

In the first part of the module, you'll look at how service management helps to ensure that users and customers receive from IT systems services that they value. Referencing the widely used service management framework, ITIL®, you'll start by exploring what's needed to operate existing services effectively, then look at how to identify where, when and why there might be scope for improving services. You'll go on to consider some of the strategic drivers for providing services to customers, and how to understand their value. You'll look also at the wide range of things that need to be addressed when designing a service, and then rolling it out into use. The part concludes by looking at how all these aspects of service management interact in the context of the ITIL Service Lifecycle.

## Project Management

This second part of the module will introduce you to project management, with an emphasis on managing software projects. You'll cover project management techniques and topics – such as project planning and activity planning, and managing risk and allocating resources. You'll also focus on the techniques that are most relevant to software project management, including:

- choosing an appropriate software development approach
- estimating how much development effort will be required
- exploring the tools and techniques for monitoring the progress of projects.



## Skills Contributions

- PROF

# SYSI301: Systems Integration & Testing

15 credits

It doesn't matter how carefully you have developed and tested a component of a system, it is still essential that the system of which it is a part is tested as a whole. For example, does the system still do everything that it is supposed to do, even if your new component isn't supposed to affect the existing functions? And are you sure that the latest build - which now contains *your* new component - actually still has all the latest versions of all the other components?

System integration and testing must themselves be discipline, not just ad-hoc processes, if they are to be effective.

In this module, you will explore the processes for developing and managing test processes and procedures, and how test-driven development can be used to minimise disruptions due to faulty code.

And you will examine how the use of a formal version control repository can minimise the risk of losing updates during a build.

## Skills Contributions

- [ARCH](#)
- [DTAN](#)
- [PROG](#)
- [RELM](#)
- [SINT](#)

# UCDD201: User Centred Design & Development

**15 credits**

Why are some interactive products so popular? How do you create products that everybody wants? One of the fundamental things you will learn in this module is the importance of user-centred design.

You will learn the value of moving away from your desk and 'stepping out into the world' to involve potential users in your early design ideas for interactive products. It is all too easy to assume that others think, feel and behave in the same way as we, the designer or developer, do. It is essential to take into account the diversity among users and their different perspectives and getting their feedback will help you to avoid any errors and misunderstandings that you may not have thought of. Involving users in the process is vital to creating great products and makes good business sense: after all, who wants to buy a bad product?

This module has three parts, which explore the key issues in user-centred design.

## *Part 1 - Requirements*

Who are the users and what do they want? As part of the process of defining the requirements for an interactive product we need to know the user's characteristics but we also need to be aware of the user's context – both in terms of their physical environment and in terms of the activities they are engaged in. This block studies a range of requirement gathering approaches including talking to users, observational methods including the use of technology probes, and more. You will also learn to use tools and techniques such as developing personas and scenarios, which will help you share information with the stakeholders (the team, the users, the customer) and communicate effectively about the requirements for an interactive product.

## *Part 2 – Design*

Designing is about balancing the requirements. It involves thinking through the underlying idea for the interactive product and the more concrete, physical aspects. This block tackles all these things. You will learn to use reflective tools to help you work out and communicate the main idea for a design, including what users will be able to do with it, and how they will experience it. We discuss a range of interface types, from more traditional screen-based forms of interaction to mobile, wearable, haptic and other interface types and you will learn and use a range of prototyping methods and tools.

### *Part 3 – Evaluation*

Evaluating an interactive product is essential to ensure that it meets the requirements or to identify ways in which it can be improved so that it does meet the requirements. This block presents the knowledge and techniques necessary to evaluate, including ethical considerations when evaluating with users; techniques and tips for observing users, and asking experts and users; and how to decide when to carry out field studies and when to use lab studies. You will learn how to present your findings and to reflect on the need for iteration of parts of the design life cycle.

## Skills Contributions

- [HCEV](#)
- [INCA](#)
- [PROG](#)
- [REQM](#)
- [SINT](#)

## Origin

*based on the Open University Module TM356: Interaction Design*

# WEBD102: Developing Web Content

**15 credits**

Whether they are static or dynamic, web pages are a combination of two things: content and layout.

This module covers the basic technologies on which the Web is founded. Aspects covered include: historic development of the Web; 'architecture' and basic client server architecture; protocols such as HTTP; content markup (HTML, CSS, XML) and issues of accessibility and usability; standards and standardisation organisations (W3C, Internet working group); and security (firewalls, HTTPS, certificates).

You will also explore how best to transform text provided by a client into text for use on a web page. This may involve little more than editing to correct errors; or it may involve a significant change in style. So, you will learn how to transform boring, unstructure text into an interesting web page.

## Skills Contributions

- [HCEV](#)
- [INCA](#)
- [REQM](#)

## Origin

*based on block 1 of the Open University Module TT284: Web Technologies*

# WEBP202: Web Programming

15 credits

## Part 1 Web architectures

The first part of this module focuses on how the components of the client-server architecture can deliver dynamic content to web pages. This part covers web application architectures, including cloud technology; server (Apache, Tomcat) and client side components (web browsers, databases) and programming languages (JavaScript, PHP and SQL).

## Part 2 Mobile content

Part 2 examines the trend toward more portable content and content customisation and also explores mobile content and applications. It considers aspects such as Web 2, content manipulation and approaches to delivering content to mobile devices. You will also undertake the development of a simple mobile application.

## Part 3 Developing applications

The final part explores how applications are planned, designed and developed by IT professionals, examining application design, development environments and tools as well as application deployment and maintenance.

## Skills Contributions

- [DTAN](#)
- [HCEV](#)
- [INCA](#)

- [PROG](#)
- [RELM](#)
- [SCTY](#)

## Origin

*based on blocks 2-4 of the Open University Module TT284: Web Technologies*

# SFIA Skills

## Level 3/4 targets

- Information Security [SCTY](#)
- Programming/software development [PROG](#)
- Requirements definition and management [REQM](#)
- Systems integration and build [SINT](#)
- Release and deployment [RELM](#)

## Level 2 underpinning

- Portfolio, programme and project support [PROF](#)
- Data modelling and design [DTAN](#)
- Information content authoring [INCA](#)
- User experience design [HCEV](#)
- Solution architecture [ARCH](#)

## Responsibility Characteristics

- [Leadership skills & experience](#)
- Influence / business skills
- [Job experience](#)
- Complexity/Autonomy/Business skills



# Responsibility Characteristics: Leadership Skills

## Influence

Interacts with and influences colleagues. Has working level contact with customers, suppliers and partners. May supervise others or make decisions which impact the work assigned to individuals or phases of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work.

## Business Skills

- Demonstrates effective communication skills.
- Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation, standards and procedures.
- Contributes fully to the work of teams. Appreciates how own role relates to other roles and to the business of the employer or client.

# Responsibility Characteristics: Work Experience

## Autonomy

Works under general direction. Uses discretion in identifying and responding to complex issues and assignments. Receives specific direction, accepts guidance and has work reviewed at agreed milestones. Determines when issues should be escalated to a higher level.

## Complexity

Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution.

## Business Skills

- Demonstrates an analytical and systematic approach to issue resolution.
- Takes the initiative in identifying and negotiating appropriate personal development opportunities.
- Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work.

# Solution Architecture ARCH

## Level 4

Contributes to the development of solution architectures in specific business, infrastructure or functional areas. Identifies and evaluates alternative architectures and the trade-offs in cost, performance and scalability. Produces specifications of cloud-based or on-premises components, tiers and interfaces, for translation into detailed designs using selected services and products. Supports a change programme or project through the preparation of technical plans and application of design principles that comply with enterprise and solution architecture standards (including security).

## Level 3

Not defined by SFIA

## Level 2

Not defined by SFIA

# Data Modelling & Design DTAN

## Level 3

Applies data analysis, design, modelling, and quality assurance techniques, based upon a detailed understanding of business processes, to establish, modify or maintain data structures and associated components (entity descriptions, relationship descriptions, attribute definitions). Advises database designers and other application development team members on the details of data structures and associated components.

## Level 2

Applies data analysis, design, and modelling techniques to establish, modify or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions).

# User Experience Design HCEV

## Level 3

Applies tools and methods to design and develop users' digital and off-line tasks, interactions and interfaces to meet agreed usability and accessibility requirements for selected system, product or service components. Creates workable prototypes. Assists, as part of a team, on overall user experience design. Assists in the evaluation of design options and trade-offs. Consistently applies visual design and branding guidelines.

## Level 2

not defined by SFIA

# Information Content Authoring INCA

## Level 3

Liaises with clients and representatives of the intended audience(s) to clarify detailed requirements. Designs, creates, controls and evaluates moderately-complex subject matter ensuring the needs of the audience(s) are met in a manner appropriate to the medium(s) in use. Makes informed decisions about the best way to present information to the audience(s), taking into consideration how information may be presented, identified, and searched for. Produces information artefacts that are accurate, current, relevant and easily understood by the intended audience(s). Applies moderation and editing processes to content supplied by others.

## Level 2

Develops an understanding of content development and authoring activities, such as information gathering, creating draft content, identifying appropriate illustrations, and proper treatment of copyright and considering the publication medium(s). Works with colleagues and clients to understand audience needs and to assimilate source material. Creates draft materials that present information clearly, concisely and accurately in appropriate plain language, which meets the requirements of the audience(s) as clearly, simply and quickly as possible. Applies guidelines and standards to moderate content from others, escalating where appropriate.

# Portfolio, Programme and Project Support PROF

## Level 4

Uses recommended portfolio, programme and project control solutions for planning, scheduling and tracking. Sets up project files, compiles and distributes reports. Provides administrative services to project boards, project assurance teams and quality review meetings. Provides guidance on project management software, procedures, processes, tools and techniques.

## Level 3

Assists with the compilation of portfolio, programme and project management reports. Maintains programme and project files from supplied actual and forecast data.

# Programming/Software Development PROG

## Level 4

Designs, codes, verifies, tests, documents, amends and refactors complex programs/scripts and integration software services. Contributes to selection of the software development approach for projects, selecting appropriately from predictive (plan-driven) approaches or adaptive (iterative/agile) approaches. Applies agreed standards and tools, to achieve well-engineered outcomes. Participates in reviews of own work and leads reviews of colleagues' work.

## Level 3

Designs, codes, verifies, tests, documents, amends and refactors moderately complex programs/scripts. Applies agreed standards and tools, to achieve a well-engineered result. Collaborates in reviews of work with others as appropriate.



# Release & Deployment Management

## RELM

### Level 4

Assesses and analyses release components. Provides input to scheduling. Carries out the builds and tests in coordination with testers and component specialists maintaining and administering the tools and methods – manual or automatic - and ensuring, where possible, information exchange with configuration management. Ensures release processes and procedures are maintained.

### Level 3

Uses the tools and techniques for specific areas of release and deployment activities. Administers the recording of activities, logging of results and documents technical activity undertaken. May carry out early life support activities such as providing support advice to initial users.

# Requirements Definition & Management

## REQM

### Level 4

Contributes to selection of the requirements approach for projects, selecting appropriately from predictive (plan-driven) approaches or adaptive (iterative/agile) approaches. Defines and manages scoping, requirements definition and prioritisation activities for initiatives of medium size and complexity. Facilitates input from stakeholders, provides constructive challenge and enables effective prioritisation of requirements. Reviews requirements for errors and omissions. Establishes the requirements base-lines, obtains formal agreement to requirements, and ensures traceability to source. Investigates, manages, and applies authorised requests for changes to base-lined requirements, in line with change management policy.

### Level 3

Defines and manages scoping, requirements definition and prioritisation activities for small-scale changes and assists with more complex change initiatives. Follows agreed standards, applying appropriate techniques to elicit and document detailed requirements. Provides constructive challenge to stakeholders as required. Prioritises requirements and documents traceability to source. Reviews requirements for errors and omissions. Provides input to the requirements base-line. Investigates, manages and applies authorised requests for changes to base-lined requirements, in line with change management policy.

# Information Security SCTY

## Level 4

Explains the purpose of and provides advice and guidance on the application and operation of elementary physical, procedural and technical security controls. Performs security risk, vulnerability assessments, and business impact analysis for medium complexity information systems. Investigates suspected attacks and manages security incidents. Uses forensics where appropriate.

## Level 3

Communicates information security risks and issues to business managers and others. Performs basic risk assessments for small information systems. Contributes to vulnerability assessments. Applies and maintains specific security controls as required by organisational policy and local risk assessments. Investigates suspected attacks. Responds to security breaches in line with security policy and records the incidents and action taken.

# Systems Integration and Build SINT

## Level 4

Provides technical expertise to enable the configuration of software, other system components and equipment for systems testing. Collaborates with technical teams to develop and agree system integration plans and report on progress. Defines complex/new integration builds. Ensures that integration test environments are correctly configured. Designs, performs and reports results of tests of the integration build. Identifies and documents system integration components for recording in the configuration management system. Recommends and implements improvements to processes and tools.

## Level 3

Defines the software modules needed for an integration build and produces a build definition for each generation of the software. Accepts completed software modules, ensuring that they meet defined criteria. Produces software builds from software source code for loading onto target hardware. Configures the hardware and software environment as required by the system being integrated. Produces integration test specifications, conducts tests and records and reports on outcomes. Diagnoses faults and records and reports on the results of tests. Produces system integration reports.