

Pearson **Higher Nationals in** Computing

Specification

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> Level **BTEC** Higher National Certificate

BTEC

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Programme Structure

Year 1 (120 Credits)

Unit Number	Unit Title	Credits	Level	Core/ Optional
1	Programming	15	4	Core
2	Networking	15	4	Core
3	Professional Practice	15	4	Core
4	Database Design & Development	15	4	Core
5	Security	15	4	Core
6	Managing a Successful Computing Project (Pearson-set)	15	4	Core
10	Website Design & Development	15	4	Optional
11	Maths for Computing	15	4	Optional

Year 2 (120 Credits)

Unit Number	Unit Title	Credits	Level	Core/ Optional
13	Computing Research Project (Pearson-set)	30	5	Core
14	Business Intelligence	15	5	Core
23	Cryptography	15	5	Optional
29	Application Program Interfaces	15	5	Optional
40	User Experience and Interface Design	15	5	Optional
45	Emerging Technologies	15	5	Optional
47	Games Development	15	5	Optional

Unit 1:	Programming
Unit code	D/615/1618
Unit type	Core
Unit level	4
Credit value	15

Introduction

Programming involves describing processes and procedures which are derived from algorithms. The ability to program is what sets apart a developer and an end user. Typically the role of the developer is to instruct a device (such as a computer) to carry out instructions; the instructions are known as source code and is written in a language that is converted into something the device can understand. The device executes the instructions it is given.

Algorithms help to describe the solution to a problem or task; by identifying the data and the process needed to represent the problem or task *and* the set of steps needed to produce the desired result.

Programming languages typically provide the representation of both the data and the process; they provide control constructs and data types (which can be numbers, words, and objects, and be constant or variable).

The control constructs are used to represent the steps of an algorithm in a convenient yet unambiguous fashion. Algorithms require constructs that can perform sequential processing, selection for decision-making, and iteration for repetitive control. Any programming language that provides these basic features can be used for algorithm representation.

This unit introduces students to the core concepts of programming with an introduction to algorithms and the characteristics of programming paradigms.

Among the topics included in this unit are: introduction to algorithms, procedural, object-orientated & event-driven programming, security considerations, the integrated development environment and the debugging process.

On successful completion of this unit students will be able to design and implement algorithms in a chosen language within a suitable Integrated Development Environment (IDE). This IDE will be used to develop and help track any issues with the code.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Define basic algorithms to carry out an operation and outline the process of programming an application.
- LO2. Explain the characteristics of procedural, object-orientated and event-driven programming, conduct an analysis of a suitable Integrated Development Environment (IDE).
- LO3. Implement basic algorithms in code using an IDE.
- LO4. Determine the debugging process and explain the importance of a coding standard.

Essential Content

LO1 Define basic algorithms to carry out an operation and outline the process of programming an application

Algorithm definition:

Writing algorithms to carry out an operation, e.g. Bubble sort.

The relationship between algorithms and code.

The generation process of code; the roles of the pre-processor, compiler and linker, interpreter.

LO2 Explain the characteristics of procedural, object-orientated and eventdriven programming. Conduct an analysis of a suitable Integrated Development Environment (IDE)

Characteristics of code:

Definitions of: data types (the role of constants/variables), methods (including input/output), control structures, iteration, scope, parameter passing, classes, inheritance and events.

Key components of an IDE with a brief explanation each component.

LO3 Implement basic algorithms in code using an IDE

Implementation:

Developing simple applications which implements basic algorithms covered in LO1, using the features of a suitable language and IDE. Consider possible security concerns and how these could be solved.

LO4 Determine the debugging process and explain the importance of a coding standard

Review and reflection:

Documentation of the debugging process in the IDE, with reference to watch lists, breakpoints and tracing.

How the debugging process can be used to help developers fix vulnerabilities, defects and bugs in their code.

What a coding standard is and its benefits when writing code.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Define basic algorithm operation and outline the p application		
P1 Provide a definition of what an algorithm is and outline the process in building an application.	M1 Determine the steps taken from writing code to execution.	D1 Examine the implementation of an algorithm in a suitable language. Evaluate the relationship between the written algorithm and the code variant.
LO2 Explain the characteri orientated and event-drive an analysis of a suitable In Environment (IDE)		
P2 Give explanations of what procedural, object- orientated and event- driven paradigms are; their characteristics and the relationship between them.	M2 Analyse the common features that a developer has access to in an IDE.	D2 Critically evaluate the source code of an application which implements the programming paradigms, in terms of the code structure and characteristics.
LO3 Implement basic algor IDE		
P3 Write a program that implements an algorithm using an IDE.	M3 Use the IDE to manage the development process of the program.	D3 Evaluate the use of an IDE for development of applications contrasted with not using an IDE.
LO4 Determine the debugg the importance of a coding		
 P4 Explain the debugging process and explain the debugging facilities available in the IDE. P5 Outline the coding standard you have used in your code. 	M4 Evaluate how the debugging process can be used to help develop more secure, robust applications.	D4 Critically evaluate why a coding standard is necessary in a team as well as for the individual.

Recommended Resources

This unit does not specify which programme language should be used to deliver this content – this decision can be made by the tutor.

Examples of languages that are used in industry are C#, Python, Ruby, Java, but any language which will allow the student to achieve the Learning Outcomes is acceptable.

Textbooks

AHO, A. V. et al. (1987) Data Structures and Algorithms. 1st Ed. Addison-Wesley.

HUNT, A. et al. (2000) *The Pragmatic Programmer: From Journeyman to Master.* 1st Ed. Addison-Wesley.

MCCONNELL, S. (2004) Code Complete: A Practical Handbook of Software Construction. 2nd Ed. Microsoft Press.

Links

This unit links to the following related units:

Unit 19: Data Structures & Algorithms

Unit 20: Advanced Programming

Unit 28: Prototyping

Unit 2:	Networking
Unit code	H/615/1619
Unit type	Core
Unit level	4
Credit value	15

Introduction

Computer networks are the driving force behind the evolution of computer systems and allow users to access data, hardware and services regardless of their location. Being knowledgeable about the underlying principles of networking is of vital importance to all IT professionals. Networking is an environment that is increasingly complex and under continuous development.

Complex computer networking has connected the world by groups of small networks through internet links to support global communications. It supports access to digital information anytime, anywhere using many applications like email, audio and video transmission, including the World Wide Web, and this has opened the floodgates to the availability of information.

The aim of this unit is to provide students with wider background knowledge of computer networking essentials, how they operate, protocols, standards, security considerations and the prototypes associated with a range of networking technologies.

Students will explore a range of hardware, with related software, and will configure and install these to gain knowledge of networking systems. A range of networking technologies will be explored to deliver a fundamental knowledge of Local Area Networking (LAN), Wide Area Networking (WAN) and their evolution to form largescale networks and the protocol methodologies related to IP data networks will be explored.

On successful completion of this unit students will gain knowledge and skills to successfully install, operate and troubleshoot a small network; and the operation of IP data networks, router, switching technologies, IP routing technologies, IP services and basic troubleshooting. Supporting a range of units in the Higher National suite, this unit underpins the principles of networks for all and enables students to work towards their studies in vendor units, if applicable.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Examine networking principles and their protocols.
- LO2. Explain networking devices and operations.
- LO3. Design efficient networked systems.
- LO4. Implement and diagnose networked systems.

Essential Content

LO1 Examine networking principles and their protocols

Role of networks:

Purpose, benefits, resource implications, communications, working practice, commercial opportunity, information sharing, collaboration.

System types:

Peer-based, client-server, cloud, cluster, centralised, virtualised.

Networking standards:

Conceptual models e.g. OSI model, TCP/IP model; standards: e.g. IEEE 802.x.

Topology:

Logical e.g. Ethernet, Token Ring; physical e.g. star, ring, bus, mesh, tree, ring.

Protocols:

Purpose of protocols; routed protocols e.g. IPv4, IPv6, IPv6 addressing, Global unicast, Multicast, Link local, Unique local, EUI 64, Auto configuration, FTP, HTTP, SMTP, POP3, SSL; management of protocols for addressing.

LO2 Explain networking devices and operations

Networking devices:

Servers; hub, routers; switches; multilayer switch, firewall, HIDS, repeaters; bridges; wireless devices; access point (wireless/wired), content filter, Load balancer, Modem, Packet shaper, VPN concentrator.

Networking software:

Client software, server software, client operating system, server operating system, Firewall.

Server type:

Web, file, database, combination, virtualisation, terminal services server.

Server selection:

Cost, purpose, operating system requirement.

Workstation:

Hardware e.g. network card, cabling; permissions; system bus; local-system architecture e.g. memory, processor, I/O devices.

LO3 Design efficient networked systems

Bandwidth:

Expected average load; anticipated peak load; local internet availability; cost constraints, throughput.

Users:

Quality expectations, concept of system growth.

Networking services and applications:

DHCP; static vs dynamic IP addressing, reservations, scopes, leases, options (DNS servers, Suffixes), IP helper, DHCP relay, DNS records, Dynamic DNS.

Communications:

Suited to devices, suited to users, supportive of lifestyle desires, supportive of commercial requirements, security requirements, quality of service needs.

Scalable:

Able to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend changes, protocol utilisation, addressing.

Selection of components:

Supporting infrastructure needs; supporting connectivity requirements.

LO4 Implement and diagnose networked systems

Devices:

Installation of communication devices, allocation of addresses, local client configuration, server configuration, server installation, security considerations.

Verification of configuration and connectivity:

Installation of internet work communication medium, ping, extended ping, traceroute, telnet, SSH.

System monitoring:

Utilisation, bandwidth needs, monitoring user productivity and security of the system.

Maintenance schedule:

Backups, upgrades, security, auditing.

Diagnose and resolve layer 1 problems:

Framing, CRC, Runts, Giants, Dropped packets, late collisions, Input/Output errors.

Policy review:

Bandwidth, resource availability.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine networking pr		
 P1 Discuss the benefits and constraints of different network types and standards. P2 Explain the impact of network topology, communication and bandwidth requirements. 	M1 Compare common networking principles and how protocols enable the effectiveness of networked systems.	LO1 & 2 D1 Considering a given scenario, identify the topology protocol selected for the efficient utilisation of a networking system.
LO2 Explain networking dev	ices and operations	
 P3 Discuss the operating principles of networking devices and server types. P4 Discuss the inter-dependence of workstation hardware with relevant networking software. 	M2 Explore a range of server types and justify the selection of a server, considering a given scenario regarding cost and performance optimisation.	
LO3 Design efficient networ		
 P5 Design a networked system to meet a given specification. P6 Test and evaluate the design to meet the requirements and analyse user feedback. 	M3 Install and configure network services and applications on your choice.	D2 Design a maintenance schedule to support the networked system.
LO4 Implement and diagnos		
 P7 Implement a networked system based on a prepared design. P8 Document and analyse test results against expected results. 	M4 Recommend potential enhancements for the networked systems.	D3 Use critical reflection to evaluate own work and justify valid conclusions.

Recommended Resources

Textbooks

BURGESS, M. (2003) *Principles of Network and System Administration*. 2nd Ed. John Wiley and Sons Ltd.

HALLBERG, B. (2005) *Networking: A Beginner's Guide*. 4th Ed. Osborne/McGraw-Hill US.

LIMONCELLI, T. and HOGAN, C. (2001) *The Practice of System and Network Administration*. Addison-Wesley.

LOWE, D. (2005) *Networking All-in-One Desk Reference for Dummies*. 2nd Ed. Hungry Minds Inc.

OLIFER, N. and OLIFER, V. (2005) *Computer Networks: Principles, Technologies and Protocols for Network Design*. John Wiley and Sons Ltd.

STALLINGS, W. (2003) Data and Computer Communications. 7th Ed.(Prentice Hall)

SUBRAMANIAN, M. (2000) *Network Management: An Introduction to Principles and Practice.* Addison-Wesley.

TANENBAUM, A. (2002) Computer Networks. Prentice Hall PTR.

Journals

The Institute of Engineering and Technology

Links

This unit links to the following related units:

Unit 8: Computer Systems Architecture

Unit 15: Transport Network Design

Unit 17: Network Security

Unit 35: Network Management

Unit 36: Client/Server Computing Systems

Unit 3:Professional PracticeUnit codeY/615/1620Unit typeCoreUnit level4

15

Introduction

Credit value

The need to be effective as a communicator, critical thinker, analyser, team worker and interpreter is essential. Within the workplace these skills are needed on a daily basis to show proficiency in designated tasks as part of a job role. The development of academic competence, and also the continuation of life-long learning and Continuing Professional Development (CPD), is required to ensure that individuals have a valued set of interpersonal skills that can be applied to any situation or environment.

This unit provides a foundation for good practice in a variety of contexts. The ability to communicate effectively using different tools and mediums will ensure that practical, research, design, reporting and presentation tasks are undertaken professionally and in accordance with various communication conventions. In everyday life the ability to apply critical reasoning and solve problems are necessary skills to enable task resolution and facilitate effective decision-making. Working with others in a group environment academically or within the workplace is an integral part of everyday life. Therefore, understanding the dynamics of teams in terms of culture, roles and responsibilities will ensure that there is a better understanding and awareness of the importance and value of teamwork. Continuing professional development, self-improvement and working towards various goals is an area that is encouraged in the workplace through the appraisals framework. In addition, professional development extends into higher levels of learning and the need to demonstrate effective research skills and academic reporting skills is also required.

Among the topics included in this unit are: the development of communication skills and communication literacy; the use of qualitative and quantitative data to demonstrate analysis, reasoning and critical thinking; and tasks that require the integration of others within a team-based scenario and planning and problemsolving.

On successful completion of this unit students will be able to demonstrate leadership skills through the dynamics of team working, and through reflective practice be able to evaluate the contributions made as an individual and also of others. As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1 Demonstrate a range of interpersonal and transferable communication skills to a target audience.
- LO2 Apply critical reasoning and thinking to a range of problem-solving scenarios.
- LO3 Discuss the importance and dynamics of working within a team and the impact of team working in different environments.
- LO4 Examine the need for Continuing Professional Development (CPD) and its role within the workplace and for higher level learning.

Essential Content

LO1 Demonstrate a range of interpersonal and transferable communication skills to a target audience

Effective communication:

Verbal and non-verbal e.g. awareness and use of body language, openness and responsiveness, formal and informal dialogue and feedback to a range of different stakeholders; academic report writing; use of IT to enhance communication; use of source information to undertake research.

Interpersonal skills:

Soft skills e.g. personal effectiveness, working with others, use of initiative, negotiating skills, assertiveness skills and social skills.

Time management skills:

Prioritising workloads; setting objectives; using time effectively; making and keeping appointments; planning and scheduling tasks and activities.

LO2 Apply critical reasoning and thinking to a range of problem-solving scenarios

Specification of the problem:

Definition of the problem; analysis and clarification.

Identification of possible outcomes:

Identification and assessment of various alternative outcomes.

Tools and methods:

Use of problem-solving methods and tools.

Plan and implement:

Sources of information; solution methodologies; selection and implementation of the best corrective action e.g. timescale, stages, resources, critical path analysis.

Evaluation:

Evaluation of whether the problem was solved or not; measurement of solution against specification and desired outcomes; sustainability.

LO3 Discuss the importance and dynamics of working within a team and the impact of team working in different environments

Working with others:

Nature and dynamics of team and group work; informal and formal settings; purpose of teams and groups e.g. long-term corporate objectives/strategy; problem-solving and short-term development projects; flexibility/adaptability; team player.

Teams and team building:

Selecting team members e.g. specialist roles, skill and style/approach mixes; identification of team/work group roles; stages in team development e.g. team building, identity, loyalty, commitment to shared beliefs, team health evaluation; action planning; monitoring and feedback; coaching skills; ethics; effective leadership skills e.g. setting direction, setting standards, motivating, innovative, responsive, effective communicator, reliability, consistency.

LO4 Examine the need for Continuing Professional Development (CPD) and its role within the workplace and for higher level learning

Responsibilities:

Own responsibilities e.g. personal responsibility, direct and indirect relationships and adaptability, decision-making processes and skills, ability to learn and develop within the work role; other e.g. employment legislation, ethics, employment rights and responsibilities.

Performance objectives:

Setting and monitoring performance objectives, measurement tools for success and achievement.

Continuing Professional Development: lifelong learning, training and development, personal development, professional development.

Evidence criteria:

Production data, personnel data, judgemental data; rating methods e.g. ranking, paired comparison, checklist, management by objectives; skills audit (personal profile using appropriate self-assessment tools); evaluating selfmanagement; personal and interpersonal skills.

Motivation and performance:

Application and appraisal of motivational theories and techniques, rewards and incentives; manager's role; self-motivational factors.

Development plan:

Current performance; future needs; opportunities and threats to career progression; aims and objectives; achievement dates; review dates; learning programme/activities; action plans; personal development plans.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Demonstrate a range of transferable communication		
 P1 Demonstrate, using different communication styles and formats, that you can effectively design and deliver a training event for a given target audience. P2 Demonstrate that you have used effective time management skills in planning an event. 	M1 Design a professional schedule to support the planning of an event, to include contingencies and justifications of time allocated.	D1 Evaluate the effectiveness and application of interpersonal skills during the design and delivery of a training event.
LO2 Apply critical reasoning problem-solving scenarios	and thinking to a range of	
 P3 Demonstrate the use of different problem-solving techniques in the design and delivery of an event. P4 Demonstrate that critical reasoning has been applied to a given solution. 	 M2 Research the use of different problem-solving techniques used in the design and delivery of an event. M3 Justify the use and application of a range of solution methodologies. 	D2 Critique the process of applying critical reasoning to a given task/activity or event.
LO3 Discuss the importance within a team and the impace environments		
 P5 Discuss the importance of team dynamics in the success and/or failure of group work. P6 Work within a team to achieve a defined goal. 	M4 Analyse team dynamics, in terms of the roles group members play in a team and the effectiveness in terms of achieving shared goals.	D3 Provide a critical evaluation of your own role and contribution to a group scenario.
LO4 Examine the need for C Development (CPD) and its r for higher level learning		

Pass	Merit	Distinction
 P7 Discuss the importance of CPD and its contribution to own learning. P8 Produce a development plan that outlines responsibilities, performance objectives and required skills, knowledge and learning for own future goals. 	M5 Compare and contrast different motivational theories and the impact they can have on performance within the workplace.	D4 Evaluate a range of evidence criteria that is used as a measure for effective CPD.

Recommended Resources

Textbooks

Cottrell, S. (2001) *Critical Thinking Skills: Developing Effective Analysis and Argument*. 2nd Ed. Palgrave Macmillan.

Forde, C. (2006) *Professional Development, Reflection and Enquiry*. Sage Publications.

Megginson, D. and Whitaker, V. (2007) *Continuing Professional Development*. 2nd Ed. Chartered Institute of Personnel and Development.

Winstanley, D. (2005) *Personal Effectiveness: A guide to action.* Chartered Institute of Personnel and Development.

Journals

Journal of Group Dynamics Professional Development in Education

Websites

www.thinkwatson.com	Critical Thinking Resources "Critical Thinking Correlation Studies" (Research)
ipda.org.uk	International Professional Development Association (General Reference)

Links

This unit links to the following related units: Unit 6: Managing a Successful Computing Project

Unit 13: Computing Research Project

Unit 4:	Database Design & Development
Unit code	H/615/1622
Unit type	Core
Unit level	4
Credit value	15

Introduction

Organisations depend on their databases to provide information essential for their day-to-day operations and to help them take advantage of today's rapidly growing and maturing e-commerce opportunities. An understanding of database tools and technologies is an essential skill for designing and developing systems to support them.

Database systems continue to demand more complex data structures and interfaces, as applications get increasingly sophisticated. Most organisations collect and store large volumes of data, either on their own systems or in the cloud, and this data is used not just for the operational running of their business but also mined for other more intelligent and complex applications. Databases stand as the back-end of most systems used by organisations for their operations.

Database design and development is a fundamental and highly beneficial skill for computing students to master, regardless of their specialism.

The aim of this unit is to give students opportunities to develop an understanding of the concepts and issues relating to database design and development, as well as to provide the practical skills to translate that understanding into the design and creation of complex databases.

Topics included in this unit are: examination of different design tools and techniques; examination of different development software options; considering the development features of a fully functional robust solution covering data integrity, data validation, data consistency, data security and advanced database querying facilities across multiple tables; appropriate user interfaces for databases and for other externally linked systems; creating complex reports/dashboards, testing the system against the user and system requirements; and elements of complete system documentation.

On successful completion of this unit students will be able to use appropriate tools to design and develop a relational database system for a substantial problem. They will be able to test the system to ensure it meets user and system requirements and fully document the system by providing technical and user documentation. For practical purposes, this unit covers relational databases and related tools and techniques. A brief overview of object-oriented databases will also be covered.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Use an appropriate design tool to design a relational database system for a substantial problem.
- LO2. Develop a fully functional relational database system, based on an existing system design.
- LO3. Test the system against user and system requirements.
- LO4. Produce technical and user documentation.

Essential Content

LO1 Use an appropriate design tool to design a relational database system for a substantial problem

The role of database systems e.g. as back-end systems, in e-commerce, for data mining applications etc.

Determining user and system requirements.

Design tools and techniques for a relational database system.

Logical design for relational databases e.g. tables, data elements, data types, indexes, primary/foreign keys, entity relationship modelling, referential integrity, data normalisation to third normal form.

Designs for data integrity, data validations, data security and data controls.

User interface design.

Output designs for user requirements.

Overview of object-oriented databases and their design tools.

LO2 Develop a fully functional relational database system, based on an existing system design

Consideration of database and platform options for system development.

Examination of different software development options for developing the relational database system.

Implementation of the physical data model based on the logical model.

Data stores, internal storage and external storage (e.g. the cloud).

Implementation of security elements in databases.

Relational databases with controls like data validation using; input masks, drop down lists, option buttons.

User interface for requirements, functionality, reliability, consistency and performance.

Consideration of interface links with other systems e.g. internet-based applications.

Data manipulation using appropriate query tools, including complex queries to query across multiple tables, and using functions and formulae.

Database maintenance and data manipulation: inserts, updates, amendments, deletions, data backup and recovery.

System reports using report writing tools and report generators, dashboards.

LO3 Test the system against user and system requirements

Identify elements of the system that need to be tested.

Consider data that should be used to fully test the system.

Match tests against user and system requirements.

Test procedures to be used: test plans, test models e.g. white box, black box; testing documentation.

Functional and system testing and testing the robustness of the system, including help menus, pop-ups, hot-spots, data validation checks.

LO4 **Produce technical and user documentation**

Technical and user documentation and their contents.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Use an appropriate der relational database system		
P1 Design a relational database system using appropriate design tools and techniques, containing at least four interrelated tables, with clear statements of user and system requirements.	M1 Produce a comprehensive design for a fully functional system which includes interface and output designs, data validations and data normalisation.	D1 Assess the effectiveness of the design in relation to user and system requirements.
LO2 Develop a fully functio system, based on an existin	nal relational database g system design	
 P2 Develop the database system with evidence of user interface, output and data validations, and querying across multiple tables. P3 Implement a query language into the relational database system. 	 M2 Implement a fully functional database system which includes system security and database maintenance. M3 Assess whether meaningful data has been extracted through the use of query tools to produce appropriate management information. 	LO2 & 3 D2 Evaluate the effectiveness of the database solution in relation to user and system requirements, and suggest improvements.
LO3 Test the system agains requirements		
P4 Test the system against user and system requirements.	M4 Assess the effectiveness of the testing, including an explanation of the choice of test data used.	
LO4 Produce technical and		
P5 Produce technical and user documentation.	M5 Produce technical and user documentation for a fully functional system, including diagrams showing movement of data through the system, and flowcharts describing how the system works.	D3 Assess any future improvements that may be required to ensure the continued effectiveness of the database system.

Recommended Resources

Textbooks

Churcher, C. (2012) Beginning Database Design: From Novice to Professional. 2nd Ed. Apress.

Connolly, T. and Begg, C. (2014) Database Systems: A Practical Approach to Design, Implementation and Management. 6th Ed. Global Edition. Pearson.

Kroemke, D. and Auer, D. (2012) Database Concepts: International Edition. 6th Ed. Pearson.

Paulraj, P (2008). Database Design and Development: An Essential Guide for IT Professional. Wiley.

Stephens, R. (2008) Beginning Database Design Solutions. Wrox.

Journals

International Journal of Database Management Systems

Journal of Database Management

The Computer Journal

Journal of Systems Analysis and Software Engineering

Journal of Emerging Trends in Computing and Information Sciences

Websites

www.lynda.com	Database Training (Tutorials)
mva.microsoft.com	Microsoft Virtual Academy "Database Development" (Training)
mva.microsoft.com/ebooks	Microsoft Virtual Academy "Microsoft Press" (E-Books)

Links

This unit links to the following related units: Unit 7: Strategic Information Systems Unit 38: Database Management Systems

Unit 5:	Security
Unit code	K/615/1623
Unit type	Core
Unit level	4
Credit value	15

Introduction

Security is one of the most important challenges modern organisations face. Security is about protecting organisational assets, including personnel, data, equipment and networks from attack through the use of prevention techniques in the form of vulnerability testing/security policies and detection techniques, exposing breaches in security and implementing effective responses.

The aim of this unit is to provide students with knowledge of security, associated risks and how security breaches impact on business continuity. Students will examine security measures involving access authorisation, regulation of use, implementing contingency plans and devising security policies and procedures.

This unit introduces students to the detection of threats and vulnerabilities in physical and IT security, and how to manage risks relating to organisational security.

Among the topics included in this unit are Network Security design and operational topics, including address translation, DMZ, VPN, firewalls, AV and intrusion detection systems. Remote access will be covered, as will the need for frequent vulnerability testing as part of organisational and security audit compliance.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1 Assess risks to IT security.
- LO2 Describe IT security solutions.
- LO3 Review mechanisms to control organisational IT security.
- LO4 Manage organisational security.

Essential Content

LO1 Assess risks to IT security

IT security risks:

Risks: unauthorised use of a system; unauthorised removal or copying of data or code from a system; damage to or destruction of physical system assets and environment; damage to or destruction of data or code inside or outside the system; naturally occurring risks.

Organisational security: business continuance; backup/restoration of data; audits; testing procedures e.g. data, network, systems, operational impact of security breaches, WANs, intranets, wireless access systems.

LO2 Describe IT security solutions

IT security solution evaluation:

Network Security infrastructure: evaluation of NAT, DMZ, FWs.

Network performance: RAID, Main/Standby, Dual LAN, web server balancing.

Data security: explain asset management, image differential/incremental backups, SAN servers.

Data centre: replica data centres, virtualisation, secure transport protocol, secure MPLS routing and remote access methods/procedures for third-party access.

Security vulnerability: logs, traces, honeypots, data mining algorithms, vulnerability testing.

LO3 Review mechanisms to control organisational IT security

Mechanisms to control organisational IT security:

Risk assessment and integrated enterprise risk management: network change management, audit control, business continuance/disaster recovery plans, potential loss of data/business, intellectual property, hardware and software; probability of occurrence e.g. disaster, theft; staff responsibilities; Data Protection Act; Computer Misuse Act; ISO 3001 standards.

Company regulations: site or system access criteria for personnel; physical security types e.g. biometrics, swipe cards, theft prevention.

LO4 Manage organisational security

Manage organisational security:

Organisational security: policies e.g. system access, access to internet email, access to internet browser, development/use of software, physical access and protection, 3rd party access, business continuity, responsibility matrix.

Controlling security risk assessments and compliance with security procedures and standards e.g. ISO/IEC 17799:2005 Information Technology (Security Techniques – code of practice for information security management); informing colleagues of their security responsibilities and confirming their understanding at suitable intervals; using enterprise risk management for identifying, evaluating, implementing and follow up of security risks according to ISO 3001 standards.

Security: tools e.g. user log-on profiles to limit user access to resources; online software to train and update staff; auditing tools to monitor resource access; security audits; penetration testing; ethical hacking; gathering and recording information on security; initiating suitable actions for remediation.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Assess risks to IT secur		
 P1 Identify types of security risks to organisations. P2 Describe organisational 	M1 Propose a method to assess and treat IT security risks.	LO1 & 2 D1 Investigate how a 'trusted network' may be part of an IT security
security procedures.		solution.
LO2 Describe IT security solu		
P3 Identify the potential impact to IT security of incorrect configuration of firewall policies and third-party VPNs.	M2 Discuss three benefits to implement network monitoring systems with supporting reasons.	
P4 Show, using an example for each, how implementing a DMZ, static IP and NAT in a network can improve Network Security.		
LO3 Review mechanisms to control organisational IT security		
 P5 Discuss risk assessment procedures. P6 Explain data protection processes and regulations as applicable to an organisation. 	 M3 Summarise the ISO 31000 risk management methodology and its application in IT security. M4 Discuss possible impacts to organisational security resulting from an IT security audit. 	D2 Consider how IT security can be aligned with organisational policy, detailing the security impact of any misalignment.
LO4 Manage organisational security		
 P7 Design and implement a security policy for an organisation. P8 List the main components of an organisational disaster recovery plan, justifying 	M5 Discuss the roles of stakeholders in the organisation to implement security audit recommendations.	D3 Evaluate the suitability of the tools used in an organisational policy.
the reasons for inclusion.		

Recommended Resources

Textbooks

Alexander, D. et al. (2008) Information Security Management Principles. BSC.

Steinberg, R. (2011) *Governance, Risk Management, and Compliance: It Can't Happen to Us – Avoiding Corporate Disaster While Driving Success*. Wiley.

Tipton, H. (2010) *Information Security Management Handbook*. 4th Ed. Auerbach Pubs.

Websites

www.bcs.org	British Computer Society (General Reference)
www.bsa.org.uk	Business Software Alliance (General Reference)
www.fast.org.uk	Federation Against Software Theft (General Reference)
www.ico.gov.uk	Information Commissioners Office (General Reference)

Links

This unit links to the following related units:

- Unit 17: Network Security
- Unit 23: Cryptography
- Unit 24: Forensics
- Unit 25: Information Security Management

Unit 6:	Managing a Successful Computing Project	
Unit code	T/615/1625	
Unit type	Core unit	
Unit level	4	
Credit value	15	

Introduction

This unit is assessed by a Pearson-set assignment. The project brief will be set by the centre, based on a theme provided by Pearson (this will change annually). The theme and chosen project within the theme will enable students to explore and examine a relevant and current topical aspect of computing in the context of a business environment.

In order to ensure that client expectations are met in terms of requirements, deadlines and the estimated cost, the work to deliver new computer systems or services to business organisations, or to revamp the existing ones, is always organised in projects. Therefore, skilful, knowledgeable and experienced project managers have always been in demand. It is projected that 15.7 million new project management roles will be created around the world by 2020.

The aim of this unit is to offer students an opportunity to demonstrate the skills required for managing and implementing a project. They will undertake independent research and investigation for carrying out and executing a computing project which meets appropriate aims and objectives.

On successful completion of this unit students will have the confidence to engage in decision-making, problem-solving and research activities using project management skills. They will have the fundamental knowledge and skills to enable them to investigate and examine relevant computing concepts within a work-related context, determine appropriate outcomes, decisions or solutions and present evidence to various stakeholders in an acceptable and understandable format.

Learning Outcomes

By the end of this unit students will be able to:

- LO1 Establish project aims, objectives and timeframes based on the chosen theme.
- LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project.
- LO3 Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis.
- LO4 Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance.

Essential Content

LO1 Establish project aims, objectives and timeframes based on the chosen theme

Project management:

What is project management and what does it involve?

The key stages of project management.

The advantages of using project management and why it is important.

Initiation of the project and project planning phase:

Scoping a project – defining objectives, scope, purpose and deliverables to be produced.

Steps and documentation required in the initiation phase.

Developing the project plan, including planning for timescales and time management, cost, quality, change, risk and issues.

The work breakdown structure.

Use of Bar and Gantt Charts for effective planning.

LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project

Project execution phase:

Selecting appropriate methods of information gathering, data collection and material resourcing.

The distinct phases which support a coherent and logical argument.

Use of secondary research to inform a primary empirical study.

Qualitative and quantitative research methods.

Field work:

Selecting a sample of the consumer market, businesses or individuals (those who meet certain characteristics relevant to the research theme) is used to gather data (qualitative or quantitative).

Sampling approaches and techniques, including probability and non-probability sampling.

Ethics, reliability and validity:

All research should be conducted ethically – how is this achieved and reported?

Research should also be reliable (similar results achieved from a similar sample) and valid (the research should measure what it aimed to measure).

Analysing information and data:

Using data collection tools such as interviews and questionnaires.

Using analytical techniques such as trend analysis, coding or typologies.

LO3 Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis

Communicating outcomes:

Consider the method (e.g. written, verbal) and the medium (e.g. report, online, presentation).

Both method and medium will be influenced by the project research and its intended audience.

Convincing arguments:

All findings/outcomes should be convincing and presented logically where the assumption is that the audience has little or no knowledge of the project process.

Developing evaluative conclusions.

Critical and objective analysis and evaluation:

Secondary and primary data should be critiqued and considered with an objective mindset.

Objectivity results in more robust evaluations where an analysis justifies a judgement.

LO4 Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance

Reflection for learning and practice:

The difference between reflecting on performance and evaluating a project – the former considers the research process, information gathering and data collection, the latter the quality of the research argument and use of evidence.

The cycle of reflection:

To include reflection in action and reflection on action.

How to use reflection to inform future behaviour, particularly directed towards sustainable performance.

Reflective writing:

Avoiding generalisation and focusing on personal development and the research journey in a critical and objective way.

Generalisation:

Many studies result in generalised findings. Research which has its basis in a specific field such as Human Resource Management (HRM) and in a specific context should avoid generalised conclusions.

Outcomes should be specific and actionable.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Establish project aims, objectives and timeframes based on the chosen theme		
 P1 Devise project aims and objectives for a chosen scenario. P2 Produce a project management plan that covers aspects of cost, scope, time, quality, communication, risk and resources. P3 Produce a work breakdown structure and a Gantt Chart to provide timeframes and stages for completion. 	M1 Produce a comprehensive project management plan, milestone schedule and project schedule for monitoring and completing the aims and objectives of the project.	LO1 & 2 D1 Critically evaluate the project management process and appropriate research methodologies applied.
LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project		
P4 Carry out small-scale research by applying qualitative and quantitative research methods appropriate for meeting project aims and objectives.	M2 Evaluate the accuracy and reliability of different research methods applied.	
LO3 Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis		
 P5 Analyse research and data using appropriate tools and techniques. P6 Communicate appropriate recommendations as a result of research and data analysis to draw valid and meaningful conclusions. 	M3 Evaluate the selection of appropriate tools and techniques for accuracy and authenticity to support and justify recommendations.	LO3 & 4 D2 Critically evaluate and reflect on the project outcomes, the decision- making process and changes or developments of the initial project management plan to support justification of recommendations and learning during the project.
Pass	Merit	Distinction
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LO4 Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance		
P7 Reflect on the value of undertaking the research to meet stated objectives and own learning and performance.	M4 Evaluate the value of the project management process and use of quality research to meet stated objectives and support own learning and performance.	

Additional Evidence Requirements

In addition to the above assessment criteria, students will also be required to complete a project logbook to record ideas, changes and developments as they progress and complete the project.

Recommended Resources

Textbooks

Costley, C., Elliot, G. and Gibbs, P. (2010) *Doing Work Based Research: Approaches to Enquiry for Insider-researchers*. London: SAGE.

Dawson, C. (2016) *Projects in Computing and Information Systems: A Student's Guide*. UK: Pearson Education.

Flick, U. (2011) *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project*. London: SAGE.

Gray, D. (2009) Doing Research in the Real World. 2nd Ed. London: SAGE.

Guay, M., Schreiber, D. and Briones, S. (2016) *The Ultimate Guide to Project Management: Learn everything you need to successfully manage projects and get them done*. Free Kindle Edition. US: Zapier Inc.

Lock, D. (2013) Project Management 8th Edition. UK: Routledge.

Pinto, J.K. (2015) *Project Management: Achieving Competitive Advantage* 4th Ed. Pearson.

Journals

International Journal of Quantitative and Qualitative Research Qualitative Research Journal

Websites

www.gov.uk/government/publications

Department of Business Innovations and Skills "Guidelines for managing projects – How to organise, plan and control projects." (Report)

Links

This unit links to the following related units:

Unit 3: Professional Practice

Unit 13: Computing Research Project

Unit 14: Business Intelligence

Unit 34: Systems Analysis & Design

Unit 10:	Website Design & Development	
Unit code	R/615/1633	
Unit level	4	
Credit value	15	

Introduction

Wireless, public hotspots, mobile broadband and unlimited network connections means that accessing and using the internet to request, use and post information has never been so easy, or so important. As public, organisational and business demand increases, so does user expectation. Designers need to successfully use technology to deliver a high quality and consistent User Experiences (UX) through friendly and functional User Interfaces (UI). However, as the software and hardware evolves, so does the challenge of design.

This unit introduces students to the underpinning services required to host, manage and access a secure website before introducing and exploring the methods used by designers and developers to blend back-end technologies (server-side) with frontend technologies (client-side). To help ensure new designers are able to design and deliver a site that offers an outstanding User Experience (UX) supported by an innovative User Interface (UI) this unit also discusses the reasons, requirements, relationships, capabilities and features of the systems they will be using and gives them an opportunity to explore various tools, techniques and technologies with 'good design' principles to plan, design and review a multipage website.

Among the topics included in this unit are: domain structure, domain name systems, web protocols, database servers, development frameworks, website publishing, content management, search engine optimisation, web browsers, HTML standards, CSS and CSS pre-processing (LESS, SASS), presentation models, responsive design, integrated development environments, user requirements, interface design, user experience, branding, navigation, optimisation and validation.

On successful completion of this unit students will be able to explain server technologies and management services associated with the hosting and management of secure websites, categorise website technologies, tools and software used to develop websites, utilise website technologies, tools and techniques with good design principles to create a multipage website and create and use a Test Plan to review the performance and design of a multipage website.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1 Explain server technologies and management services associated with hosting and managing websites.
- LO2 Categorise website technologies, tools and software used to develop websites.
- LO3 Utilise website technologies, tools and techniques with good design principles to create a multipage website.
- LO4 Create and use a Test Plan to review the performance and design of a multipage website.

LO1 Explain server technologies and management services associated with hosting and managing websites

Hosting and website management:

Investigate relationships between domain names, DNS services and communication protocols used to access a website.

Overview of publishing and managing secure websites, including search engine indexing and ranking.

Different server technologies:

Differences between web server hardware, software and host operating systems.

Advantages of an integrated database system with regards to expanding website capability.

Common web development technologies and frameworks.

LO2 Categorise website technologies, tools and software used to develop websites

Website technologies:

Using front-end technologies, presentation layers and client-side programming to build a User Interface (UI) and effect User Experience (UX).

How back-end technologies, application layers and server-side programming can be used to enable personalisation and deliver dynamic content.

Tools, techniques and software used to develop websites:

Improving User Experience (UX) through Rich Internet Application (RIA) design using JavaScript and CSS frameworks and packages.

Overview of online content management systems including possible advantages and limitations with regards to design.

Using web design and development software to design and build a secure website.

LO3 Utilise website technologies, tools and techniques with good design principles to create a multipage website

Establish the client and user requirements:

Differentiate client and user requirements from behaviours.

Consider how audience and purpose could influence the look and feel of a website.

Review accessibility standards and guidelines and their possible impact on design and aesthetics.

Research and create good content combined with good design principles to create a multipage website:

Introduce and use recognised design principles, incorporating accessibility guidelines to implement an appropriately branded, multipage site.

Discuss why and how the quality of content can affect the performance of a website.

LO4 Create and use a Test Plan to review the performance and design of a multipage website

Consider factors that influence website performance:

Review how intuitive interfaces and actions, user-friendly designs, appropriate graphics, effective navigation and good quality content can help establish user trust and deliver an improved User Experience (UX).

Consider the effects of good and bad search engine optimisation (SEO) and indexing on the performance of a website.

W3C Validation (HTML and CSS) and how it influences website design and performance.

Establish a Test Plan and use it to assess the performance of a website:

Assess the impact of poorly optimised website graphics.

Research and conduct Quality Assurance (QA) and usability testing on a multipage website.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Explain server technolosservices associated with hoswebsites	ogies and management sting and managing	
 P1 Identify the purpose and types of DNS, including explanations on how domain names are organised and managed. P2 Explain the purpose and relationships between communication protocols, server hardware, operating systems and web server software with regards to designing, publishing and accessing a website. 	 M1 Evaluate the impact of common web development technologies and frameworks with regards to website design, functionality and management. M2 Review the influence of search engines on website performance and provide evidence-based support for improving a site's index value and rank through search engine optimisation. 	LO1 & LO2 D1 Justify the tools and techniques chosen to realise a custom built website.
LO2 Categorise website tec software used to develop we	hnologies, tools and ebsites	
 P3 Discuss the capabilities and relationships between front-end and back-end website technologies and explain how these relate to presentation and application layers. P4 Discuss the differences between online website creation tools and custom built sites with regards to design flexibility, performance, functionality, User Experience (UX) and User Interface (UI). 	M3 Evaluate a range of tools and techniques available to design and develop a custom built website.	

Pass	Merit	Distinction
LO3 Utilise website technolowith good design principles website	ogies, tools and techniques to create a multipage	
P5 Create a design document for a branded, multipage website supported with medium fidelity wireframes and a full set of client and user requirements.	M4 Compare and contrast the multipage website created to the design document.	D2 Critically evaluate the design and development process against your design document and analyse any technical challenges.
P6 Use your design document with appropriate principles, standards and guidelines to produce a branded, multipage website supported with realistic content.		
LO4 Create and use a Test performance and design of	Plan to review the a multipage website	
P7 Create a suitable Test Plan identifying key performance areas and use it to review the functionality and performance of your website.	M5 Evaluate the Quality Assurance (QA) process and review how it was implemented during your design and development stages.	D3 Critically evaluate the results of your Test Plan and include a review of the overall success of your multipage website; use this evaluation to explain any areas of success and provide justified recommendations for areas that require improvement.

Recommended Resources

Textbooks

Frain, B. (2012) *Responsive Web Design with HTML5 and CSS. UK*: Packt Publishing.

Krug, S. (2013) *Don't Make Me Think: A Common Sense Approach to Web Usability*. USA: New Riders.

Lidwell, W., Holden, K. and Butler, J. (2010) Universal Principles of Design, Revised and Updated: 115 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions and Teach Through Design. USA: Rockport Publishers.

Links

This unit links to the following related units:

Unit 40: User Experience & Interface Design

Unit 11:	Maths for Computing	
Unit code	D/615/1635	
Unit level	4	
Credit value	15	

Introduction

In 1837 English mathematicians Charles Babbage and Ada Lovelace collaboratively described a machine that could perform arithmetical operations and store data within memory units. This design of their 'Analytical Engine' is the first representation of modern, general-purpose computer technology. Although modern computers have advanced far beyond Babbage and Lovelace's initial proposal, they are still fundamentally relying on mathematics for their design and operation.

This unit introduces students to the mathematical principles and theory that underpin the computing curriculum. Through a series of case studies, scenarios and task-based assessments students will explore number theory within a variety of scenarios; use applicable probability theory; apply geometrical and vector methodology; and finally evaluate problems concerning differential and integral calculus.

Among the topics included in this unit are: prime number theory, sequences and series, probability theory, geometry, differential calculus and integral calculus.

On successful completion of this unit students will be able to gain confidence with the relevant mathematics needed within other computing units. As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1 Use applied number theory in practical computing scenarios.
- LO2 Analyse events using probability theory and probability distributions.
- L03 Determine solutions of graphical examples using geometry and vector methods.
- LO4 Evaluate problems concerning differential and integral calculus.

LO1 Use applied number theory in practical computing scenarios

Number theory:

Converting between number bases (Denary, Binary, Octal, Duodecimal and Hexadecimal).

Prime numbers, Pythagorean triples and Mersenne primes.

Greatest common divisors and least common multiples.

Modular arithmetic operations.

Sequences and series: Expressing a sequence recursively. Arithmetic and geometric progression theory and application. Summation of series and the sum to infinity.

LO2 Analyse events using probability theory and probability distributions

Probability theory:

Calculating conditional probability from independent trials. Random variables and the expectation of events. Applying probability calculations to hashing and load balancing.

Probability distributions:

Discrete probability distribution of the binomial distribution. Continuous probability distribution of the normal (Gaussian) distribution.

LO3 Determine solutions of graphical examples using geometry and vector methods

Geometry:

Cartesian co-ordinate systems in two dimensions. Representing lines and simple shapes using co-ordinates. The co-ordinate system used in programming output device.

Vectors:

Introducing vector concepts.

Cartesian and polar representations of a vector.

Scaling shapes described by vector co-ordinates.

LO4 Evaluate problems concerning differential and integral calculus

Differential calculus:

Introduction to methods for differentiating mathematical functions. The use of stationary points to determine maxima and minima. Using differentiation to assess rate of change in a quantity.

Integral calculus:

Introducing definite and indefinite integration for known functions.

Using integration to determine the area under a curve.

Formulating models of exponential growth and decay using integration methods.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Use applied number theory in practical computing scenarios		
 P1 Calculate the greatest common divisor and least common multiple of a given pair of numbers. P2 Use relevant theory to sum arithmetic and geometric progressions. 	M1 Identify multiplicative inverses in modular arithmetic.	D1 Produce a detailed written explanation of the importance of prime numbers within the field of computing.
LO2 Analyse events using pr probability distributions	obability theory and	
 P3 Deduce the conditional probability of different events occurring within independent trials. P4 Identify the expectation of an event occurring from a discrete, random variable. 	M2 Calculate probabilities within both binomially distributed and normally distributed random variables.	D2 Evaluate probability theory to an example involving hashing and load balancing.
LO3 Determine solutions of graphical examples using geometry and vector methods		
 P5 Identify simple shapes using co-ordinate geometry. P6 Determine shape parameters using appropriate vector methods. 	M3 Evaluate the co- ordinate system used in programming a simple output device.	D3 Construct the scaling of simple shapes that are described by vector coordinates.
LO4 Evaluate problems concerning differential and integral calculus		
 P7 Determine the rate of change within an algebraic function. P8 Use integral calculus to solve practical problems involving area. 	M4 Analyse maxima and minima of increasing and decreasing functions using higher order derivatives.	D4 Justify, by further differentiation, that a value is a minimum.

Recommended Resources

Textbooks

Stroud, K. A. (2009) Foundation Mathematics. Basingstoke: Palgrave Macmillan.

Journals

Journal of Computational Mathematics. Global Science Press.

Links

This unit links to the following related units: Unit 18: Discrete Maths Unit 22: Applied Analytical Models

Unit 13:	Computing Research Project
Unit code	T/615/1639
Unit type	Core
Unit level	5
Credit value	30

Introduction

This unit is assessed by a Pearson-set assignment. Students will choose their own project based on a theme provided by Pearson (this will change annually). The project must be related to their specialist pathway of study (unless the student is studying the general computing pathway). This will enable students to explore and examine a relevant and current topical aspect of computing in the context of a business environment and their chosen specialist pathway.

The aim of this unit is to offer students the opportunity to engage in sustained research in a specific field of study. The unit enables students to demonstrate the capacity and ability to identify a research theme, to develop research aims, objectives and outcomes, and to present the outcomes of such research in both written and verbal formats. The unit also encourages students to reflect on their engagement in the research process during which recommendations for future, personal development are key learning points.

On successful completion of this unit students will have the confidence to engage in problem-solving and research activities which are part of the function of a manager. Students will have the fundamental knowledge and skills to enable them to investigate workplace issues and problems, determine appropriate solutions and present evidence to various stakeholders in an acceptable and understandable format.

As a result they will develop skills such as communication literacy, critical thinking, analysis, synthesis, reasoning and interpretation which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1 Examine appropriate research methodologies and approaches as part of the research process.
- LO2 Conduct and analyse research relevant to a computing research project.
- LO3 Communicate the outcomes of a research project to identified stakeholders.
- LO4 Reflect on the application of research methodologies and concepts.

LO1 Examine appropriate research methodologies and approaches as part of the research process

Developing a research proposition:

The importance of developing methodical and valid propositions as the foundation for a research project.

Rationale: the purpose and significance for research question or hypothesis.

The value of the philosophical position of the researcher and the chosen methods.

Use of Saunders's research onion as a guide to establishing a methodological approach.

Literature review:

Conceptualisation of the research problem or hypothesis.

The importance of positioning a research project in context of existing knowledge.

Significance and means of providing benchmarks by which data can be judged.

Qualitative, quantitative and mixed method research:

Key theoretical frameworks for research.

Advantages and limitations of qualitative and quantitative research approaches and methods.

LO2 Conduct and analyse research relevant for a business research project

Research as a process:

Research has distinct phases which support a coherent and logical argument. This includes using secondary research to inform a primary, empirical, study.

Selecting a sample:

The importance of gathering data and information (qualitative or quantitative) to support research analysis.

Selecting sample types and sizes that are relevant to the research.

Considering sampling approaches and techniques, including probability and non-probability sampling.

Ethics, reliability and validity:

Research should be conducted ethically. How is this achieved and reported?

Research should also be reliable (similar results would be achieved from a similar sample) and valid (the research measures what it aimed to measure).

Analysing data:

Using data collection tools such as interviews and questionnaires.

Using analytical techniques such as trend analysis, coding or typologies.

LO3 Communicate the outcomes of a research project to identified stakeholders

Stakeholders:

Who are they? Why would they be interested in the research outcomes? What communication method do they expect?

Communicating research outcomes:

Consideration of different methods of communicating outcomes (e.g. written word, spoken word) and the medium (e.g. report, online, presentation). The method and medium will be influenced by the research and its intended audience.

Convincing arguments:

No matter what the method/medium, all research should be convincing and presented logically where the assumption is that the audience has little or no knowledge of the research process.

The importance of developing evaluative conclusions.

LO4 Reflect on the application of research methodologies and concepts

Reflection for learning and practice:

Difference between reflecting on performance and evaluating a research project. The former considers the research process; the latter considers the quality of the research argument and use of evidence.

Reflection on the merits, limitations and potential pitfalls of the chosen methods.

The cycle of reflection:

To include reflection in action and reflection on action.

Considering how to use reflection to inform future behaviour and future considerations.

Reflective writing:

Avoiding generalisation and focusing on personal development and the research journey in a critical and objective way.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine appropriate re approaches as part of the res	search methodologies and search process	
 P1 Produce a research proposal that clearly defines a research question or hypothesis supported by a literature review. P2 Examine appropriate research methods and approaches to primary and secondary research. 	M1 Evaluate different research approaches and methodology and make justifications for the choice of methods selected based on philosophical/theoretical frameworks.	LO1 & LO2 D1 Critically evaluate research methodologies and processes in application to a computing research project to justify chosen research
LO2 Conduct and analyse re business research project	search relevant for a	methods and analysis.
 P3 Conduct primary and secondary research using appropriate methods for a computing research project that consider costs, access and ethical issues. P4 Apply appropriate analytical tools, analyse 	M2 Discuss merits, limitations and pitfalls of approaches to data collection and analysis.	
research findings and data.	ames of a research project to	
identified stakeholders		
P5 Communicate research outcomes in an appropriate manner for the intended audience.	M3 Coherently and logically communicate outcomes to the intended audience demonstrating how outcomes meet set research objectives.	D2 Communicate critical analysis of the outcomes and make valid, justified recommendations.

Pass	Merit	Distinction
LO4 Reflect on the application and concepts	on of research methodologies	
P6 Reflect on the effectiveness of research methods applied for meeting objectives of the computing research project.	M4 Provide critical reflection and insight that results in recommended actions for improvements and future research considerations.	D3 Demonstrate reflection and engagement in the resource process leading to recommended actions for future
P7 Consider alternative research methodologies and lessons learnt in view of the outcomes.		improvement.

Recommended Resources

Textbooks

Cornford, T. (2005) *Project Research in Information Systems: A Student's Guide*. Paperback. Macmillan.

Costley, C., Elliot, G. and Gibbs, P. (2010) *Doing Work Based Research: Approaches to Enquiry for Insider-researchers*. London: SAGE.

Fink, A. (2009) *Conducting Research Literature Reviews: From the Internet to Paper*. 3rd Ed. Sage Inc.

Flick, U. (2011) *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project*. London: SAGE.

Gray, D. (2009) Doing Research in the Real World. 2nd Ed. London: SAGE.

Saunders, M, Lewis, P and Thornhill, A. (2012) *Research methods for Business Students*. 6th Ed. Harlow: Pearson.

Wellington, J. (2000) *Educational Research: Contemporary Issues and Practical Approaches*. Continuum International Publishing Group Ltd.

Journals

International Journal of Quantitative and Qualitative Research Qualitative Research Journal

Links

This unit links to the following related units:

Unit 3: Professional Practice

Unit 6: Managing a Successful Computing Project

Unit 9: Software Development Lifecycles

Unit 14: Business Intelligence

Unit code	M/615/1641
Unit type	Core
Unit level	5
Credit value	15

Introduction

Data and information is core to any organisation and business process. The necessity of having meaningful information is the key driver for effective decision-making and problem-solving. Business intelligence has evolved from technologies such as decision support systems (DSS) to include tools and methods associated with data mining, data integration, data quality and data warehousing in conjunction with other information management systems and applications.

This unit introduces students to a range of tools, techniques and technologies for acquiring data and processing this into meaningful information that can be used to support business functions and processes.

Within this unit students will examine the concept of business processing in terms of data capture, conversion and information output. Students will also be required to define the tools and technologies associated with business intelligence functionality. The use of a business intelligence tool/s and techniques is also required to demonstrate an understanding of a given problem. Finally, students will be expected to evaluate the impact of business intelligence for effective decision-making.

On successful completion of this unit students will be able to appreciate the importance of business intelligence in terms of optimising decision-making and performance. By exploring the tools, techniques and systems that support business intelligence students will have an awareness of the role and contribution that these technologies and methodologies have and their importance to organisations.

As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1 Discuss business processes and the mechanisms used to support business decision-making.
- LO2 Compare the tools and technologies associated with business intelligence functionality.
- LO3 Demonstrate the use of business intelligence tools and technologies.
- LO4 Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used.

LO1 Discuss business processes and the mechanisms used to support business decision-making

Business process model:

Data input and capture, data processing/conversion and information output, security considerations; unstructured and semi-structured data.

Tactical and operational decisions, the business process model, business intelligence functionality.

Analyse and compare the systems and technologies associated with business intelligence.

Mechanisms:

Application software, databases, which are used to collect and store intelligence.

Systems that are used to manage, analyse and display business intelligence to support the decision-making process; the importance of reliable data; impacts of reliable data in businesses.

Business processes:

Management e.g. supporting decision-making, problem-solving; operational e.g. sales, purchasing and marketing; support e.g. accounting, technical supporting processes; improving the efficiency of a business process e.g. forecasting, decision-making, predictive reasoning; automating processes e.g. print runs, salary slips etc.

LO2 Compare the tools and technologies associated with business intelligence functionality

Support for business decisions:

Operational tactical and strategic. Operational examples could include product positioning or pricing. Tactical decisions could include financial outlays to gain competitive advantage. Strategic business decisions could include priorities, goals setting and forecasting for the future, global diversification etc.

Business intelligence functionality:

Analysing data, decision-making, problem-solving, designing more intuitive/innovative systems.

Systems and technologies:

Information systems at an operational, tactical and strategic level. Transaction processing, management information systems, decision support systems, expert systems.

LO3 Demonstrate the use of business intelligence tools and technologies

Tools and techniques:

Descriptive and predictive analysis, predictive modelling e.g. forecasting, use of statistical models to predict and identify trends. Data mining techniques to find anomalies, cluster patterns and/or relationships between data sets. Converting data into visual information using charts, graphs, histograms and other visual mediums.

Solutions:

Supporting a business process e.g. end user requirements, systems requirement, application to automate procedures. Designing a tool, program or package that can perform a specific task to support problem-solving or decision-making at an advanced level.

Uses:

For example, designing an application to solve a specific user need or system requirement. Create an e-commerce function for a website to support a specific business process, design a program for a specific end user that will support another application or process.

Design considerations:

Addressing a user or system requirement; designing a user-friendly and functional interface; considering user engagement and interaction with the designed solution; customisation of the solution to satisfy the user and system requirements.

LO4 Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used

Recognise the legal, social, ethical and professional issues involved in the exploitation of computer technology.

Cybersecurity management:

Understanding the personal, organisational and legal/regulatory context in which these tools could be used, the risks of such use and the constraints (such as time, finance and people) that may affect how cybersecurity is implemented.

Evaluation criteria:

Enhanced or improved operations e.g. more efficient, faster results, more user-friendly, higher productivity, extended target audience, more competitive, more profitable, improved customer service.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Discuss business processes and the mechanisms used to support business decision-making		
P1 Examine, using examples, the terms 'Business Process' and 'Supporting Processes'.	M1 Differentiate between unstructured and semi- structured data within an organisation.	D1 Evaluate the benefits and drawbacks of using application software as a mechanism for business processing.
LO2 Compare the tools and to business intelligence function	technologies associated with nality	
P2 Compare the types of support available for business decision-making at varying levels within an organisation.	M2 Justify, with specific examples, the key features of business intelligence functionality.	D2 Compare and contrast a range of information systems and technologies that can be used to support organisations at operational, tactical and strategic levels.
LO3 Demonstrate the use of and technologies	business intelligence tools	
 P3 Determine, with examples, what business intelligence is and the tools and techniques associated with it. P4 Design a business intelligence tool, application or interface that can perform a specific task to support problem-solving or 	M3 Customise the design to ensure that it is user- friendly and has a functional interface.	D3 Provide a critical review of the design in terms of how it meets a specific user or business requirement and identify what customisation has been integrated into the design.
problem-solving or decision-making at an advanced level.		

Pass	Merit	Distinction
LO4 Discuss the impact of but technologies for effective decorded the legal/regulatory context is	usiness intelligence tools and cision-making purposes and in which they are used	
 P5 Discuss how business intelligence tools can contribute to effective decision-making. P6 Explore the legal issues involved in the secure exploitation of business intelligence tools. 	M4 Conduct research to identify specific examples of organisations that have used business intelligence tools to enhance or improve operations.	D4 Evaluate how organisations could use business intelligence to extend their target audience and make them more competitive within the market, taking security legislation into consideration.

Recommended Resources

Textbooks

Boyer, J. (2010) Business Intelligence Strategy. MC Press (US).

Jeston, J. and Nelis, J. (2014) Business Process Management. 3rd Ed. Routledge.

Kolb, J. (2013) *Business Intelligence in Plain Language: A practical guide to Data Mining and Business Analytics*. CreateSpace Independent Publishing Platform.

Marr, B. (2015) Big Data: Using Smart Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance. 1st Ed. John Wiley & Sons, Ltd.

Journals

International Journal of Business Intelligence and Data Mining International Journal of Business Intelligence Research (IJBIR)

Websites

businessintelligence.com	Business	Intelligence	(General	Reference)
business-intelligence.ac.uk	Business	Intelligence	Project fo	or HE
	(General	Reference)		

Links

This unit links to the following related units: Unit 6: Managing a Successful Computing Project Unit 12: Data Analytics

Unit 22: Applied Analytical Models

Unit 33: Analytical Methods

Unit 23:	Cryptography
Unit code	T/615/1656
Unit level	5
Credit value	15

Introduction

Although confidentiality in the communication between two parties is very often linked with electronic data transfer, methods for ensuring confidentiality have been used for centuries. That is how cryptography started as a methodology, practice and discipline, ensuring confidential communication in the presence of third parties called 'adversaries'. However, encrypting the message for confidentiality purposes is only one aspect of cryptography. It also provides means of ensuring that the parties involved in communication are 'who they say they are'. Cryptography underpins many aspects of security, and is a crucial component in protecting the confidentiality and integrity of information. It is now a prevalent part of our day-today lives despite many people being unaware of its usage or importance. Almost every interaction we make with an electronic device will involve cryptography in some form. Cryptography is an indispensable tool for protecting information in computer systems.

This unit introduces students to the theoretical principles of cryptography and looks at some practical applications, many of which we use on a daily basis. Students are expected to investigate the inner workings of cryptographic systems and how to correctly use them in real-world applications. Students are expected to explore the mathematical algorithms in relation to cryptography and their applications. Students are also expected to analyse the symmetric and asymmetric encryption methods and ciphers, public key cryptography and the security issues related to their implementation. In addition, students are expected to investigate advanced encryption protocols and their applications.

Among the topics included in this unit are: the mathematical algorithms used in cryptography, the mechanisms by which symmetric and asymmetric cryptography work, 3DES and AES block ciphers, the operations of public key cryptography, Public Key Infrastructure (PKI), primality testing and factoring, discreet logarithms, El Gamal encryption, security issues with cryptography, common attacks on cryptographic schemes, and some practical applications of cryptography.

On successful completion of this unit students will be able to examine the symmetric encryption algorithms and ciphers, assess public key encryption protocols and signatures and their uses in the message and key exchanges, analyse the security issues related to symmetric and asymmetric encryption methods and evaluate advanced encryption protocols and their applications in secure message exchanges.

As a result they will develop skills such as critical thinking, analysis, and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1. Examine the symmetric encryption algorithms and ciphers.
- LO2. Assess public key encryption protocols and signatures and their uses in the message and key exchanges.
- LO3. Analyse the security issues related to symmetric and asymmetric encryption methods.
- LO4 Evaluate advanced encryption protocols and their applications in secure message exchanges.

LO1 Examine the symmetric encryption algorithms and ciphers

Exploring mathematical algorithms:

Examining modular arithmetic, groups, finite fields and probability; random number generation, exploring elliptic curves and projective coordinates.

Examining symmetric encryption and ciphers:

Exploring historical ciphers, Cezar cipher, Enigma machine and information theoretic security (probability and ciphers, entropy and spurious keys); explaining one time pad.

Investigating stream ciphers, the historical Lorenz cipher, modern stream ciphers (linear feedback shift registers and their combinations, RC4).

Examining block ciphers, Feistel cipher and Data Encryption Standard (DES), operation of 3DES, Rijndael cipher and its mode of operation, explaining Advanced Encryption System (AES).

Analysing symmetric key distributions, hash functions and message authentication codes – key management, secret key distribution, designing hash functions, investigating message authentication codes.

LO2 Assess public key encryption protocols and signatures and their uses in the message and key exchanges

Analysing public key cryptography:

Examining public key encryption algorithms, one-way functions, Rivest Shamir Adleman (RSA) algorithm; explaining El Gamal encryption.

Explaining primality testing and factoring and discrete logarithms, prime numbers, factoring algorithms, modern factoring methods; examining Pohlig-Hellman logarithm, logarithmic methods for finite fields, methods for elliptic curves.

Examining key exchange and signature schemes, Diffie-Hellman key exchange, explore digital signatures, using hash functions in signature schemes, digital signature algorithm (DSA), and authenticated key agreement.

Analysing implementation issues and, exponentiation in RSA and DSA, finite field arithmetic.

Obtaining authentic public keys, confidentiality and integrity, digital certificates and Public Key Infrastructure (PKI), analysing examples of PKI.

LO3 Analyse the security issues related to symmetric and asymmetric encryption methods

Analysing attacks on public key schemes:

Exploring most common attacks on public key encryption schemes, Wiener's attack on RSA, Lattice-based attacks on RSA, partial key exposure attacks, Meet-in-the-Middle attack, brute force attack and fault analysis.

Analysing different definitions of security:

Examining security of encryption, security of actual encryption algorithms, semantically secure systems, security of signatures.

Analysing provable security, explaining random oracles, security of encryption algorithms and encryption algorithms with random oracles.

Explaining provable security without random oracles, using examples such as strong RSA assumption, signature schemes and encryption schemes.

Analysing hybrid encryption, security of symmetric ciphers, security of hybrid ciphers, explaining the construction of Key Encapsulation Mechanisms (KEMs)

LO4 Evaluate advanced encryption protocols and their applications in secure message exchanges

Assessing advanced encryption protocols and their applications:

Evaluating access structures for secret sharing schemes, general secret sharing, Reed-Solomon codes, Shamir sharing scheme.

Applying shared RSA signature generation; explaining commitment schemes and oblivious transfers.

Analysing Zero-Knowledge proofs, demonstrating a Graph Isomorphism in Zero-Knowledge, Sigma protocols, electronic voting systems.

Examining secure multi-party computation, the two-party case, multi-party cases: honest-but-curious adversaries, malicious adversaries.

Evaluating different applications of cryptography, quantum cryptography, digital cash, Bitcoin, Transport Layer Security and IPSec.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction	
LO1 Examine the symmetric encryption algorithms and ciphers			
 P1 Examine mathematic algorithms and their use in cryptography. P2 Explain, with the use of examples, the operation of stream cipher and block cipher. 	 M1 Compare the operational differences between stream cipher and block cipher. M2 Analyse issues with symmetric key distribution and how they are solved by hash functions and message authentication codes. 	LO1 & LO2 D1 Evaluate the improvement introduced by AES compared to DES and 3DES encryption standards.	
LO2 Assess public key encryption protocols and signatures and their uses in the message and key exchanges			
 P3 Discuss common public key cryptographic methods and their uses. P4 Explain by the use of examples public key exchange and digital signatures, and their implementation issues. 	M3 Analyse, with examples, the Public Key Infrastructure (PKI).		
LO3 Analyse the security issues related to symmetric and asymmetric encryption methods			
 P5 Discuss the common attacks on public key encryption schemes. P6 Explain, with examples, provable security in signature schemes and encryption schemes. 	M4 Critically analyse the security of hybrid ciphers and the construction of Key Encapsulation Mechanisms (KEMs).	D2 Evaluate different definitions of provable security.	

Pass	Merit	Distinction
LO4 Evaluate advanced encryption protocols and their applications in secure message exchanges		
 P7 Examine, by the use of examples, secret sharing schemes. P8 Evaluate secure multi-party computation using the two-party and multi-party cases. M5 Analyse the implementation of public key cryptography in electronic voting systems. 		D3 Critically evaluate the access structures for secret sharing schemes.

Recommended Resources

Textbooks

Martin, K. (2012) *Everyday Cryptography: Fundamental Principles and Applications*. UK: Oxford.

Stallings, W. (2013) *Cryptography and Network Security: Principles and Practice*. UK: Pearson.

Journals

International Association for Cryptologic Research, Online International Journal of Applied Cryptography, Online

Websites

www.gov.uk/government/publications

Department of Business Innovations and Skills "Guidelines for managing projects – How to organise, plan and control projects." (Report)

Links

This unit links to the following related units:

Unit 5: Security

Unit 19: Data Structures & Algorithms

Unit 24: Forensics

Unit 25: Information Security Management

Unit 29:	Application Program Interfaces
Unit code	M/615/1669
Unit level	5
Credit value	15

Introduction

Many applications in use today are a composite of other software. This is true of an application, be it web based, mobile or on a desktop where the functionality of another is used to build upon. Think of an application that locates nearby restaurants – this may utilise an already existing map service as its basis. Or a game application that enables players to invite other players, chat and post high scores to social media all within the game environment. How an application interacts with another is through an Application Program Interface (API).

Typically, APIs consist of methods and tools which are developed by the software author and can provide services and functionality to other application developers without having to 'reinvent the wheel'. Existing APIs provide a huge range of functionality which can be integrated into an application by following the rules of the relevant API. One of the benefits in using APIs is access to existing and proven services that can help speed up development and help standardisation.

The aim of this unit is to introduce students to the nature of APIs by developing proof-of-concept application that utilises existing APIs for common tasks that can include communication, displaying interactive visuals, audio playback and handling a range of user inputs.

Among the topics included in this unit are: identifying what an API is and the need for APIs; types of APIs; application design and development utilising relevant APIs in a suitable development environment; testing of the application; and a critical review of the APIs used.

On successful completion of this unit students will be able to identify and select relevant APIs to use within an application of their own choice or from a given scenario, in addition to testing and documenting the review process against the initial design requirement.

As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

- LO1. Examine what an API is, the need for APIs and types of APIs.
- LO2. Apply the knowledge of API research to design an application that incorporates relevant APIs for a given scenario or a substantial student chosen application.

- LO3. Implement an application in a suitable development environment.
- LO4 Document the testing of the application, review and reflect on the APIs used.

LO1 Examine what an API is, the need for APIs and types of APIs

Research existing APIs, their role and the need for an API.

Identify types of API uses e.g. visual, social media, device manipulation.

Critically evaluate suitable APIs for use in an application (web/mobile/desktop) for a given scenario or a substantial student chosen application.

LO2 Apply the knowledge of API research to design an application that incorporates relevant APIs for a given scenario or a substantial student chosen application

Develop relevant wireframes diagrams, concept the design of the application.

Consider the application design/its purpose.

Consider the target platform (web/mobile/desktop).

Identify the scope of the application.

Justify the selection/relevancy/purpose of the chosen APIs for the application. Take the security of APIs into consideration.

LO3 Implement an application in a suitable development environment

Develop the application based on LO2.

Consider the use of a suitable development environment.

Utilise best practices for implementing the application.

LO4 Document the testing of the application, review and reflect on the APIs used

Document the testing procedure carried out to satisfy the design requirements/purpose of application.

Review/reflect on the application development process; identifying the chosen APIs strengths weaknesses, ease of use, access to features within the APIs.
Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine what an API is, the need for APIs and types of APIs		
P1 Examine the relationship between an API and a software development kit (SDK).	M1 Asses a range of APIs for a particular platform that covers a range of uses.	D1 Evaluate potential security issues surrounding APIs
LO2 Apply the knowledge of API research to design an application that incorporates relevant APIs for a given scenario or a substantial student chosen application		
P2 Analyse an existing application that could be extended with a suitable API.	M2 Design an application that will utilise an API for a given purpose.	D2 Create a design for a chosen substantial application that will utilise a range of APIs, justifying choices.
LO3 Implement an application in a suitable development environment		
P3 Build on an existing application framework to implement an API.	M3 Develop an application that utilises an API.	D3 Construct an application utilising multiple APIs, following the designs in LO2.
LO4 Document the testing of the application, review and reflect on the APIs used		
P4 Design and complete a 'white box' test of the application, recording the results.	 M4 Conduct 'black box' tests of your application, recording the results. M5 Update the application accordingly with the results. 	D4 Critically evaluate the APIs used within your application. Provide a data security report of your application.

Recommended Resources

Textbooks

Spencer, T. et al. (2015) *Securing the API Stronghold: The Ultimate Guide to API Security.* 1st Ed. Kindle. Amazon.

Websites

www.khronos.org	The Khronos Group "Vulkan API" (Development Tool)
developers.google.com	Google Developers (Development Tools)

Links

This unit links to the following related units: Unit 9: Software Development Lifecycles Unit 30: Application Development

Unit 40:	User Experience and Interface Design
Unit code	H/615/1684
Unit level	5
Credit value	15

Introduction

User Experience (UX) and User Interface (UI) Design is the process by which software applications and user interactions can be designed to be simple, accessible, effective and attractive for the end user. The objective of UX and UI Design is to create user interactions and software application experiences that are appropriate for specific platforms or devices and provide desirable end user outcomes utilising insight and understanding about the practical, emotional and experiential motivations and values of the end user. UX and UI Design explores the motivations and desires of the end user and seeks to design user's interactions that best satisfy those motivations and desires in a concise manner.

This unit introduces students to the role, basic concepts and benefits of UX and UI Design in the development process of software applications. The aim of the unit is to enhance the student's understanding of the methodology, terminology and benefits of UX and UI Design in the development of software applications.

Among the topics included in this unit are: classification and terminology of UX and UI Design techniques, the relationship between UX and UI Design, how UX and UI Design relates to the rest of the software development lifecycle, understand a user's emotions, desires and attitudes about using a particular feature, product, system, platform or software application, modes of interaction, human-computer interaction models, usability, accessibility, aesthetics, design thinking, value proposition design, user journey mapping and gathering meaningful insights from users feedback and research.

On successful completion of this unit students will be able to explain the basic concepts of UX and UI Design. Plan, build and measure the success of an appropriate UI Design. Design an interface and experience with a specific end user in mind. Conduct testing to gather meaningful feedback to evaluate the success or failure of a user interface. As a result they will develop skills such as communication literacy, design thinking, team working, critical thinking, analysis, reasoning and interpretation, computer software literacy which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Research what aspects of User Experience and Interface Design are necessary and appropriate to satisfy end user emotions, desires and attitudes when using a user interface concept.
- LO2. Plan an appropriate User Experience map and Interface Design for a User Interface concept with a specific target end user in mind and also outline the tests you mean to conduct.
- LO3. Build a User Interface concept and test it with users to see if it satisfies their emotions, desires and attitudes as planned.
- LO4. Evaluate user feedback, test results and insights gained from end users interacting with your User Interface concept to determine success or failure and steps to improve in future versions.

Essential Content

LO1 Research what aspects of User Experience and Interface Design are necessary and appropriate to satisfy end user emotions, desires and attitudes when using a user interface concept

Identify formats, characteristics and appropriateness of UX and UI Design

Present an overview of UX and UI Design, how they are produced and their appropriate use in software development.

Identify what UX and UI Design is by researching the role, purpose, terminology and methodology of UX and UI Design.

Recognise the various forms of UX and UI Design by researching the history of, current trends and use in the product development lifecycle.

Recognise the use of appropriate UX and UI Design patterns.

Define the characteristics of UX and UI Designs by investigating how they can be used to satisfy end user emotions, desires and attitudes.

Recognise specific forms, patterns and trends of UX and UI Design:

Research, debate and agree current functionality, patterns and trends in UX and UI Design.

Identify various forms of UX and UI Design.

Define the advantages and disadvantages of using UX and UI Design.

Define standard tools available for use in UX and UI Design:

Identify standard tools available to create UX and UI Designs.

The advantages and disadvantages of UX and UI Design tools.

How UX and UI Design tools can be used to capture end user feedback.

Appropriateness of various tools for different end user testing outcomes.

LO2 Plan an appropriate User Experience map and Interface Design for a User Interface concept with a specific target end user in mind and also outline the tests you mean to conduct

Identify a specific end user and an appropriate UX and UI Design to test with this user type:

Choose a specific end user to conduct tests against.

Evaluate the benefits, features, advantages and disadvantages of different UX and UI Design methodologies for various end user testing outcomes.

Review different end user categorisations, classifications and behaviour modelling techniques.

Select the most appropriate form of UX and UI Design to achieve desired end user testing and outcomes.

Describe a plan to use appropriate UX and UI Design methodology and tools to conduct end user testing:

Apply end user classification and behaviour modelling to select an appropriate UX and UI Design methodology.

Outline the end user characteristics, desired testing criteria and results your UX and UI Design addresses.

Select an appropriate form of UX and UI Design necessary to achieve desired results.

Use your selected end user, appropriate UX and UI Design methodology and desired testing criteria to create a plan for a UI concept.

LO3 Build a User Interface concept and test it with users to see if it satisfies their emotions, desires and attitudes as planned

Utilise appropriate tools to develop a UX and UI Design:

Employ an appropriate set of tools to develop your plan into a UI.

Run end user experiments and examine feedback.

Reconcile and evaluate end user feedback and build a new iteration of your user interface modified with the most important feedback and enhancements.

Make multiple iterations of your user interface and modify each iteration with enhancements gathered from user feedback and experimentation.

LO4 Evaluate user feedback, test results and insights gained from end users interacting with your User Interface concept to determine success or failure and steps to improve in future versions

Asses the success of your UX and UI Design:

Assemble and appraise end use feedback from multiple iterations of your user interface.

Undertake a critical review and compare your final user interface and your test results with the original plan.

Evaluate the advantages, disadvantages, strengths and weaknesses of your UX and UI Design methodology.

Critique the overall success of your UI and discuss your UX insights.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Research what aspects of User Experience and Interface Design are necessary and appropriate to satisfy end user emotions, desires and attitudes when using a user interface concept		
 P1 Recognise specific forms of User Experience and Interface Design and end user testing requirements. P2 Assess standard tools available for use in User Experience and Interface Design. 	 M1 Evaluate the impact of common User Experience and Interface Design methodology in the software development life cycle. M2 Review specific forms of User Experience and Interface Design and advantages and disadvantages of end user testing requirements for appropriateness to different testing outcomes. 	D1 Evaluate specific forms of User Experience and Interface Design and justify their use in a User Interface concept.
LO2 Plan an appropriate User Experience map and Interface Design for a User Interface concept with a specific target end user in mind and also outline the tests you mean to conduct		
P3 Review different end user categorisations, classifications and behaviour modelling techniques.	M3 Apply end user classification and behaviour modelling to select an appropriate Interface Design methodology.	LO2 & LO3 D2 Make multiple iterations of your User Interface concept and modify, each iteration
P4 Appraise a specific end user and an appropriate User Experience and Interface Design methodology to test with this user type.	M4 Devise a plan to use appropriate User Interface Design methodology and tools to conduct end user testing.	with enhancements gathered from user feedback and experimentation.

Pass	Merit	Distinction
LO3 Build a User Interface concept and test it with users to see if it satisfies their emotions, desires and attitudes as planned		
P5 Examine appropriate tools to develop a user interface.	M5 Employ an appropriate set of tools to develop your plan into a user interface.	
P6 Run end user experiments and examine feedback.	M6 Reconcile and evaluate end user feedback and build a new iteration of your user interface modified with the most important feedback and enhancements.	
LO4 Evaluate user feedback, test results and insights gained from end users interacting with your User Interface concept to determine success or failure and steps to improve in future versions		
P7 Evaluate end use feedback from multiple iterations of your user interface.	M7 Undertake a critical review and compare your final user interface and your test results with the original plan.	D3 Critique the overall success of your User Interface concept and discusses your insight using prototyping.

Recommended Resources

Textbooks

Hanington, B. (2013) Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions. Rockport Publishers.

Kalbach, J. (2015) *Mapping Experiences: A Complete Guide to Creating Value through Journeys, Blueprints, and Diagrams*. 1st Ed. O'Reilly Media.

Lidwell, W. (2010) Universal Principles of Design, Revised and Updated: 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach through Design. 2nd Ed. Rockport Publishers.

Tidwell, J. (2011) *Designing Interfaces.* 2nd Ed. O'Reilly Media.

Links

This unit links to the following related units:

Unit 10: Website Design & Development

Unit 28: Prototyping

Unit 45:	Emerging Technologies
Unit code	R/615/1695
Unit level	5
Credit value	15

Introduction

Emerging Technologies have the ability to disrupt industries, radically change the progress and thinking of humankind, affect society at large and solve huge problems. Computing underpins many Emerging Technologies and allows rapid development and sharing of ideas, products and scientific understanding to occur across multiple fields in shorter and shorter timeframes. The objective and effect of Emerging Technologies is usually to change the status quo. This change might be to solve problems, increase performance, improve efficiency, or create entirely new scientific fields and novel technologies by converging different systems, technology, thinking or disciplines together. Emerging Technologies explore a variety of changing technologies that display radical novelty, have the potential for significant commercial or social impact, fast growth, scalability and affect the future in uncertain ways.

This unit introduces students to the role, benefits, disadvantages and potential outcomes Emerging Technologies have in the development of software applications. The aim of the unit is to enhance the student's understanding of the current state, terminology, advantages, disadvantages, potential impact and benefits of Emerging Technologies on the development of software applications.

Among the topics included in this unit are: classification and terminology of Emerging Technologies, review the most promising and impactful Emerging Technologies, trends of convergence, the impact of computers in the development of Emerging Technologies, the hardware, software, data, platforms and services used to enable development of Emerging Technologies, understand the scale, scope, advantages and disadvantages Emerging Technologies may have on humankind.

On successful completion of this unit students will be able to explain some of the most promising and impactful Emerging Technologies. Have an awareness of the impact, advantages and disadvantages Emerging Technologies may have on humankind. Understand the impact Emerging Technologies will have on the development of software applications.

As a result they will develop skills such as communication literacy, design thinking, team working, critical thinking, analysis, reasoning, interpretation and computer software literacy, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Assess what Emerging Technologies are necessary and appropriate when designing software applications for the future.
- LO2. Research state-of-the-art Emerging Technologies and choose one you believe will have significant impact in the future.
- LO3. Discuss the current state and future impact of your chosen Emerging Technology.
- LO4. Evaluate the political, economic and social factors which play a role in the competition between Emerging Technologies and their success or failure in the future.

Essential Content

LO1 Assess what Emerging Technologies are necessary and appropriate when designing software applications for the future

Evaluate formats, characteristics and trends of Emerging Technologies:

Present an overview of Emerging Technologies and their appropriate use in software development.

Assess what Emerging Technology is by researching its role, purpose and terminology.

Recognise the various forms of Emerging Technology by researching its history and current trends.

Define the characteristics of Emerging Technology by investigating how they can be used and how they differ from and converge with developed technology.

Recognise specific Emerging Technologies:

Research, debate and agree current trends in Emerging Technology.

Assess various forms of Emerging Technology, focusing on their relevance to software development and computing.

Define the advantages and disadvantages of Emerging Technology.

How Emerging Technologies can converge with existing technologies or replace them.

Appropriateness of using of Emerging Technology to disrupt the status quo throughout industries, markets, user adoption and established practices.

LO2 Research state-of-the-art Emerging Technologies and choose one you believe will have significant impact in the future

Investigate a specific Emerging Technology and how it will affect the status quo of an industry, end user group and the current state of technology development:

Investigate a specific Emerging Technology for discussion choosing one you believe will have the most impact to software application design and development in the future.

Choose a specific industry and end user group that will be the most influenced by this Emerging Technology.

Evaluate the benefits, features, advantages and disadvantages of this Emerging Technology.

LO3 Discuss the current state and future impact of your chosen Emerging Technology

Develop a report and presentation using research gathered about your chosen Emerging Technology, industry and end user:

Organise your research and findings.

Contrast the benefits, features, advantages and disadvantages of your chosen Emerging Technology.

Relate how your chosen Emerging Technologies can converge with existing technologies or replace them.

Defend your choice of Emerging Technology in relation to your belief it will have the most impact on software application design and development in the future.

Develop a report of your research and findings.

LO4 Evaluate the political, economic and social factors which play a role in the competition between Emerging Technologies and their success or failure in the future

Assess the success of your research:

Arrange a presentation to demonstrate your findings, gather feedback and answer questions.

Assemble and appraise your report findings and research.

Evaluate the political, economic and social factors which play a role in the competition between Emerging Technologies and their success or failure in the future.

Discuss how your chosen Emerging Technologies can converge with existing technologies or replace them.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Assess what Emerging Technologies are necessary and appropriate when designing software applications for the future		
 P1 Assess formats, characteristics and trends of Emerging Technologies. P2 Explore the advantages and disadvantages of Emerging Technology. 	 M1 Evaluate the ability of Emerging Technology to disrupt the status quo throughout industries, markets, user adoption and established practices. M2 Review various forms of Emerging Technologies, focusing on their relevance to software development and computing. 	D1 Evaluate Emerging Technologies and justify their use when designing software applications for the future.
LO2 Research state-of-the-art Emerging Technologies and choose one you believe will have significant impact in the future		
 P3 Select a specific Emerging Technology. P4 Review a specific industry and end user group that will be the most influenced by this Emerging Technology. 	 M3 Evaluate the benefits, features, advantages and disadvantages of this Emerging Technology. M4 Show how Emerging Technologies can converge with existing technologies or replace them. 	LO2 & LO3 D2 Defend your choice of Emerging Technology in relation to your belief it will have the most impact on software application design and
LO3 Discuss the current stat chosen Emerging Technology	e and future impact of your	future.
 P5 Organise your research and findings. P6 Contrast the benefits, features, advantages and disadvantages of your chosen Emerging Technology. 	 M5 Relate how your chosen Emerging Technologies can converge with existing technologies or replace them. M6 Develop a report of your research and findings. 	

Pass	Merit	Distinction
LO4 Evaluate the political, economic and social factors which play a role in the competition between Emerging Technologies and their success or failure in the future		
P7 Evaluate your report findings and research.	M7 Arrange a presentation to demonstrate your findings, gather feedback and answer questions.	D3 Critique the benefits, features, advantages and disadvantages of your chosen Emerging Technology.

Recommended Resources

Textbooks

Christensen, C. (2015) *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail (Management of Innovation and Change).* Harvard Business Review Press.

Masters, B. (2014) From Zero to One: Notes on Startups, or How to Build the Future. Virgin Digital.

Schwab, K. (2016) The Fourth Industrial Revolution. World Economic Forum.

Links

This unit links to the following related units:

Unit 14: Business Intelligence

Unit 47:	Games Development
Unit code	D/615/1697
Unit level	5
Credit value	15

Introduction

In the field of computing, games development is a multidisciplinary art form that creates worlds that blend player psychology, problem-solving and artificial intelligence with knowledge about dedicated hardware and software platforms. This level of ability can often require significant effort on the part of the student with regards to time and practice. However, as more experience is gained, the skills and abilities quickly improve. In addition, once completed it is important to know that the capabilities and flexibility of a good games developer can easily be transferred to other roles in the business sector.

This unit introduces students to games development and is designed to simulate the roles and responsibilities of a games developer working in a suitable games development studio with access to a small team of colleagues. Students are expected to discuss and review a number of original game ideas before synthesising them into a single game concept. Once defined they will need to adopt and use appropriate methods and practices to analyse, breakdown and discuss the issues – then, decide, design, create and test a functional game. Students should be free to debate, evaluate and select different design and development methodologies depending on their own judgement and consideration. On completion, and in addition to the student reviewing and reflecting on the experience, they will be expected to formally evaluate their completed game against their Games Design Document and original concept.

Among the topics included in this unit are: game design and developer documentation, problem analysis, research, system and user requirements, design methodologies and principles, development methodologies, unified modelling language (UML), software development lifecycles, games engines, hardware platforms, graphic manipulation, physics, maths for games, sound, networking, collision detection, teamwork, peer-reviews, development tools and techniques, integrated development environments, debugging, testing, software versions and quality assurance.

On successful completion of this unit students will be able to develop a Game Design Document by evaluating and synthesising game ideas into an original video game concept, select and use different design and development methodologies with tools and techniques associated with the creation of a video game, work individually and as part of a team to plan, prepare and produce a functional video game including support documentation, assess and plan improvements to a video game by evaluating its performance against its Game Design Document and original concept.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1. Develop a Game Design Document by evaluating and synthesising game ideas into an original video game concept.
- LO2. Use different design and development methodologies with tools and techniques associated with the creation of a video game.
- LO3. Work individually and as part of a team to plan and produce a functional video game, including support documentation.
- LO4. Evaluate the performance of a video game against its Game Design Document and original concept.

Essential Content

LO1 Develop a Game Design Document by evaluating and synthesising game ideas into an original video game concept

Research and compare different game genres and ideas:

Discuss and compare common game elements such as: type, story, characters, environment, levels, gameplay, loops, art, sound, user interface and controls.

Determine possible game ideas and predict the overall success of fully developing your game.

Develop a Game Design Document:

Review and discuss the value of Game Design Documents with regards to games development.

Evaluate and synthesise your game ideas into a single document that describes (in detail) your game concept.

Research and use information relating to games testing to create a suitable test plan for your game.

LO2 Use different design and development methodologies with tools and techniques associated with the creation of a video game

Discuss different design and development methodologies:

Present overviews on current design and development methodologies.

Debate various strengths and weaknesses commonly associated with each methodology.

Select or synthesise a design and development methodology for use with the creation of your video game.

Use appropriate tools and techniques:

Evaluate different tools and techniques available to create a video game.

Establish your development plan by debating the advantages and disadvantages of your preferred or selected tools and techniques.

LO3 Work individually and as part of a team to plan and produce a functional video game, including support documentation

Work as a small team to plan and prepare your functional video game:

Peer-review and debate your development plan and Games Design Document by effectively communicating and defending your ideas and reasoning. Discuss differences with regards to the possible strengths and weakness of each Game Design Document and development plan.

Modify your design document or plans to reflect any new insights or considerations.

Prepare and produce a functional video game:

Use your Game Design Document with your development plan to produce a functional video game.

Create and quality check appropriate support documents for your video game.

LO4 Evaluate the performance of a video game against its Game Design Document and original concept

Assess the performance of a video game:

Analyse factors that influence the performance of a video game with regard to its system requirements.

Undertake a critical review of the performance and development of your video game against all identified factors and any adopted design and development methodologies.

Measure the overall success of the video game against your original prediction and identify any new areas of personal insight.

Plan improvements to a video game:

Evaluate the overall strengths and weaknesses of your video game against its Game Design Document and original concept.

Discuss and plan in detail possible revisions (including implementation) with regard to improving your video game's performance.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Develop a Game Design Document by evaluating and synthesising game ideas into an original video game concept		
 P1 Explore different game- based ideas, blending them into an original video game concept. P2 Examine any areas of risk related to the successful completion of your video game. 	M1 Analyse and combine common game design elements (such as type, story, characters, environment, levels, gameplay, loops, art, sound, user interface and controls) with your original video game concept to create a suitable Game Design Document.	D1 Evaluate common game design elements and justify their use when designing a suitable Game Design Document.
LO2 Use different design and development methodologies with tools and techniques associated with the creation of a video game		
P3 Research the use of different design and development methodologies, tools and techniques and determine which have been selected for the development of this video game.	M2 Compare the differences between the various design and development methodologies, tools and techniques researched and justify your preferred selection.	LO2 & LO3 D2 Evaluate any new insights, ideas or potential improvements to your concept, methodology or use of tools and justify the reasons why you have chosen to include (or not to include) them as part of this development.

Pass	Merit	Distinction
LO3 Work individually and as part of a team to plan and produce a functional video game, including support documentation		
 P4 Create a formal presentation that effectively reviews your video game concept together with your preferred design and development methodologies and selected tools and techniques. Use this presentation as part of a peer-review and document any feedback given. P5 Develop a functional video game based on a specified game concept. 	 M3 Interpret your peer- review feedback and identify opportunities not previously considered. M4 Develop a functional video game based on a specific Game Design Document with supportive evidence of using the preferred design and development methodologies and selected tools and techniques. 	
LO4 Evaluate the performance of a video game against its Game Design Document and original concept		
P6 Evaluate the performance of your video game against your original concept.	M5 Critically analyse the factors that influence the performance of a video game and use them to undertake a critical review of the design, development, game elements and testing stages of your video game. Conclude your review by reflectively discussing your previously identified risks.	D3 Critically evaluate the strengths and weaknesses of your video game and fully justify opportunities for improvement and further development.

Recommended Resources

Textbooks

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Gregory, J. (2014) Game Engine Architecture. United States: Taylor.

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Links

This unit links to the following related units:

Unit 9: Software Development Lifecycles

Unit 31: Games Engine & Scripting

Unit 32: Game Design Theory

Unit 47:	Games Development
Unit code	D/615/1697
Unit level	5
Credit value	15

Introduction

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