

SEVERN BUSINESS COLLEGE

EAI Masters Of Computer Science

Course Handbook

Qualification
EAI Master of Computer Science

MQF Level
7

Total Learning Hours
2250

ECTS
90

Course Structure

EAI Master of Computer Science			
Unit Ref No.	**Unit Title**	**Unit level**	**ECTS**
MCS701	Software Programming Principles and Practices in Java	7	6
MCS702	Database & SQL Programming	7	6
MCS703	Computer Architecture	7	6
MCS704	Computer Networks	7	6
MCS706	Data Science Foundations	7	6
MCS707	Data Mining, Machine Learning and Artificial Intelligence	7	6
MCS708	Data Analysis and Visualisation	7	6
MCS711	Internet of Things and Cryptography	7	6
MCS712	Networking and Kali Linux	7	6
MCS705	Advanced Computing Research Methods	7	6
MCS716	Capstone Project	7	30

UNIT SPECIFICATIONS

Unit Title
Software Programming Principles and Practices in Java

Level
7

Learning Time Hours
150

ECTS
6

Module Overview
The aim of this module is to develop learners' understanding on what a programming language is, how it works and how to interact with computers using a programming language. The learner will cover all the basic concepts of a programming language and is taught through real world coding examples; the learner will have regular coding assignments for better understanding through practice. Students engage with current research literature and professional sources on modern programming practices, including software maintainability, performance optimisation, and secure coding. Emerging topics such as concurrent programming, memory management in managed runtimes, and evolving Java frameworks are explored through reference to peer- reviewed articles and industry research.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex software development activities, including the design, optimisation, and deployment of Java applications in unpredictable technical contexts.
- Exercise leadership and professional accountability in programming projects, guiding teams in the application of advanced programming principles, best practices, and ethical standards.

- Independently utilise and adapt advanced programming tools and environments (including JVM-based toolchains) to respond effectively to evolving project requirements and technological change.
- Integrate interdisciplinary knowledge and advanced professional judgement to develop innovative and resilient software solutions, particularly where requirements are incomplete, evolving, or contested

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of object-oriented programming principles in Java, synthesising knowledge of data types, operators, control structures, and execution models as a basis for original and informed software development.
- Critically evaluate Java compilation and execution mechanisms, including bytecode generation, compiler behaviour, and Java Virtual Machine (JVM) architecture, with particular attention to performance, portability, and optimisation in complex software systems.
- Integrate advanced theoretical knowledge of programming constructs and runtime environments to analyse how programming decisions influence scalability, maintainability, and efficiency in contemporary software applications.
- Critically analyse the interaction between programming principles and emerging computing contexts, including data-intensive systems, automation, and security- sensitive environments, demonstrating awareness of limitations and unresolved challenges at the interface of multiple domains.
- Demonstrate critical awareness of ethical, professional, and societal considerations arising from advanced software development, including reliability, accountability, and responsible use of computational resources.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate advanced Java-based computational solutions, integrating data structures, operators, and control mechanisms to address complex or unfamiliar programming problems using research-informed judgement.
- Critically evaluate alternative programming strategies and execution pathways, making defensible technical decisions under conditions of uncertainty, incomplete information, or competing performance constraints.
- Apply sophisticated debugging, testing, and performance-analysis techniques to diagnose and resolve non-trivial programming errors, proposing original improvements that extend beyond routine coding practices.
- Optimise Java programs for performance and scalability, critically assessing the impact of programming constructs, memory management, and execution models on system behaviour in dynamic environments.
- Communicate complex programming designs, execution logic, and optimisation decisions clearly and unambiguously to specialist and non-specialist audiences, justifying solutions through structured technical reasoning.
- Demonstrate advanced learning skills by independently identifying emerging programming paradigms, Java frameworks, tools, and development methodologies, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised programming competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Enhanced ability to troubleshoot and debug Java code effectively.
- Improved capacity to analyse and optimise code for efficiency and performance.
- Ability to apply Java concepts to different programming scenarios and environments.
- Heightened attention to detail in writing and reviewing Java code for accuracy and correctness.
- Enhanced skills in collaborating with peers on coding projects and problem-solving tasks.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in using version control systems such as Git for collaborative coding and code management.
- Competence in utilising IDEs like IntelliJ IDEA or Eclipse for Java development, including code editing, debugging, and project management.
- Skill in writing and executing unit tests using frameworks like JUnit to ensure code quality and functionality.
- Ability to create comprehensive documentation for Java code, including comments, README files, and API documentation.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

In this module, students will immerse themselves in a dynamic online learning environment, integrating diverse instructional methods to foster a comprehensive grasp of Java programming. Interactive lectures, whether live or pre-recorded, will cover foundational principles and syntax, encouraging active participation and collaboration. Hands-on coding labs will offer practical experience within integrated development environments (IDEs), allowing students to experiment with data types and algorithms. Demonstrations and examples will provide real-world context, while assignments and projects will challenge students to apply their skills and problem-solving abilities. Online discussions and peer interaction will further deepen comprehension, supplemented by continuous feedback and assessments. Guest speakers and industry insights will offer valuable perspectives on current practices, enriching students' understanding and readiness for professional applications. Supported by self-paced resources, students will have the flexibility to reinforce their learning and emerge as proficient Java programmers. This module includes regular live synchronous sessions, such as supervised practical workshops, tutor-led demonstrations, live problem-solving sessions, and scheduled progress reviews. These activities form part of the module's contact hours and supervised placement and practice (non-WBL) hours and are delivered via video-conferencing tools integrated into the Virtual Learning Environment (VLE).

Assessment Strategy

Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Programming/ Mini Project/Lab work (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment

Pass Mark: 50%

Reassessment Policy:

Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- Schildt, H. (2021). Java: The Complete Reference (12th ed.). McGraw-Hill Education.
- Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2021). Data Structures and Algorithms in Python. John Wiley & Sons.
- Mitchell, M. (2020). Artificial Intelligence: A Guide for Thinking Humans. Farrar, Straus and Giroux.
- Filho, W. F. (2021). Computer Science Distilled: Learn the Art of Solving Computational Problems. Code Energy.
- Müller, A. C., & Guido, S. (2021). Introduction to Machine Learning with Python: A Guide for Data Scientists (2nd ed.). O'Reilly Media.
- Eckel, B. (1998). Thinking in Java, Mind View. Inc.
- Horstmann, S., Cornell, G., & Java, C. (2). Volume I-Fundamentals.

Research-Oriented Reading:

- Bloch, J. (2008). Effective java (the java series). Prentice Hall PTR.
- Burd, B. (2017). Beginning programming with Java for Dummies. John Wiley & Sons.
- Schildt, H. (2022). Java: a beginner's guide. McGraw-Hill Education.
- Sierra, K., & Bates, B. (2003). Headfirst Java; covers Java 5.0. A Brain Friendly Guide, O'REILLY Publication, 2nd Edition, ISBN-10, 596009208.

UNIT SPECIFICATIONS

Unit Title
Database & SQL Programming

Level
7

Learning Time Hours
150

ECTS
6

Module Overview
The aim of this module is to develop the learner's ability to understand the shortfalls of traditional storage systems and how modern relational database systems overcome the challenges. Learner will also develop the programming skills required to communicate with database systems for accessing, transforming, and persisting the data using Structured Query Language. The module incorporates engagement with contemporary research on data modelling, transaction management, database optimisation, and data governance. Students examine emerging research topics such as scalable database architectures, data consistency in distributed systems, and ethical data management through academic journals and professional publications.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex database design and implementation activities, making informed decisions in unpredictable technical and organisational environments.
- Independently configure, manage, and optimise database systems and client– server architectures, adapting strategies in response to performance constraints, security risks, and evolving business requirements.
- Exercise leadership and professional responsibility in data-driven projects, guiding teams in the application of best practices for SQL programming, data governance, and ethical data management.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative and resilient database solutions, particularly where requirements are incomplete, contested, or rapidly changing.

Knowledge:
At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of contemporary data management paradigms, synthesising knowledge of the evolution from traditional storage systems to advanced relational database management systems (RDBMS) as a foundation for original and informed database design.
- Critically evaluate the theoretical and architectural principles underpinning RDBMS, including logical and physical data structures, client–server architectures, and metadata frameworks, with particular attention to scalability, performance, security, and governance in complex organisational contexts.
- Integrate advanced theoretical knowledge of SQL and relational theory (DDL, DML, DQL, TCL) to critically assess how database schemas, transactions, and query mechanisms support complex computational, analytical, and business requirements.
- Critically analyse data modelling approaches (conceptual, logical, physical, and business models), evaluating their strengths, limitations, and applicability across interdisciplinary contexts, including data-intensive, analytical, and security-sensitive environments.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate advanced database solutions and computational workflows, integrating data modelling, SQL programming, and transaction management to address complex or unfamiliar data problems using research-informed judgement.
- Critically evaluate and optimise database structures and SQL operations, applying advanced techniques in normalization, indexing, transaction control, and performance tuning in environments characterised by uncertainty, scale, or incomplete information.
- Apply sophisticated data manipulation and retrieval strategies, including complex joins, subqueries, aggregations, and metadata interrogation, to extract reliable and actionable insights from large-scale or heterogeneous datasets.
- Exercise critical judgement in managing database transactions and enforcing data integrity, balancing technical, security, and ethical considerations in dynamic and interdisciplinary contexts.
- Communicate complex database designs, analytical outcomes, and technical decisions clearly and unambiguously to specialist and non-specialist audiences, justifying approaches through evidence-based reasoning.
- Demonstrate advanced learning skills by independently identifying emerging database technologies, SQL standards, data-management methodologies, and governance challenges, critically evaluating their relevance to professional practice, and undertaking self- directed learning to maintain and enhance specialized database competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Proficiency in designing and implementing relational databases.
- Ability to write and execute SQL queries for data manipulation and retrieval.
- Skill in ensuring data quality and integrity through effective data auditing techniques.
- Competence in managing database performance and transactions.
- Proficiency in utilising metadata for database management and optimization.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Skill in writing Structured Query Language (SQL) queries for database manipulation and management.
- Competence in designing and implementing database schemas to organise and structure data effectively.
- Ability to optimise database performance and ensure data integrity through advanced techniques.
- Proficiency in utilising metadata and data auditing tools for effective database management.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested 2in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

This module will employ interactive lectures, hands-on workshops, and practical exercises to teach Database & SQL Programming. Through real-world case studies and projects, students will apply theoretical concepts. Online resources and discussion forums will supplement learning, fostering peer collaboration. Continuous feedback and assessments will ensure mastery of key concepts for real-world application in database management and SQL programming. This module includes regular live synchronous sessions, such as supervised practical workshops, tutor-led demonstrations, live problem-solving sessions, and scheduled progress reviews. These activities form part of the module's contact hours and supervised placement and practice (non-WBL) hours and are delivered via video-conferencing tools integrated into the Virtual Learning Environment (VLE).

Assessment Strategy

Assessment Weightings:

- Assignments (40%) (It should not be more than 1250-word count)
- Problem Analysis (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:

Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- Thomas Connolly & Caroline Begg, Database Systems: A Practical Approach to Design, Implementation, and Management, Pearson, 6th edition, 2021.
- Peter Rob & Carlos Coronel, Database Systems: Design, Implementation, & Management, Cengage Learning, 13th edition, 2021.
- Michael J. Hernandez, Database Design for Mere Mortals: Using Entity-Relationship Diagrams, Addison-Wesley, 3rd edition, 2020.
- Ramez Elmasri & Shamkant B. Navathe, Fundamentals of database systems, Pearson, 7th edition, 2021.
- Alan Beaulieu, Learning SQL, O'Reilly Media, Inc., 3rd edition, 2020.
- Thomas M. Connolly & Carolyn E. Begg, Database systems: a practical approach to design, implementation and management, Pearson, 6th edition, 2015.
- Chris Ruel, Michael Wessler, Oracle 12c For Dummies, John Wiley & Sons Inc, 1st edition, 2013

Research-Oriented Reading:

- Eric J. Gruber, SQL Essentials, O'Reilly Media, 2nd edition, 2022.

- Ben Forta, SQL in 10 Minutes, Sams Teach Yourself, Sams Publishing, 5th edition, 2021.
- Bill Karwin, SQL Antipatterns: Avoiding the Pitfalls of Database Programming, Pragmatic Bookshelf, 1st edition, 2017
- Anthony Molinaro, SQL Cookbook, O'Reilly Media, Inc., 1st edition, 2000

UNIT SPECIFICATIONS

Unit Title

Computer Architecture

Level

7

Learning Time Hours

150

ECTS

6

Module Overview

This module provides an in-depth understanding of computer hardware and the fundamental principles behind system architecture. Topics include processor design, memory hierarchy, input/output systems, and instruction set architectures. Students will learn how computer systems are structured and how components interact to execute programs efficiently. Practical applications and performance optimization techniques will also be explored. Students engage with current research literature in computer architecture, including advances in multi-core processing, energy-efficient architectures, parallel computing, and hardware–software co-design. Research findings from academic journals and conferences are used to contextualise architectural trade-offs and performance considerations.

Learning Outcomes

Competences:

At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex computer architecture projects, making informed decisions in unpredictable technical, organisational, or regulatory environments.
- Exercise leadership and professional accountability in architectural design activities, supervising and guiding others in the application of advanced architectural principles and best practices.
- Advise stakeholders on architectural strategies and system selection, balancing technical performance, cost, operational constraints, and long-term sustainability considerations.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative and resilient hardware system solutions, particularly where requirements are evolving, contested, or incomplete.

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of contemporary computer architecture principles, synthesising knowledge of processors, memory hierarchies, instruction set architectures, and input/output subsystems as a basis for original architectural analysis and design.
- Critically evaluate architectural models and execution paradigms, including pipelined, parallel, and multi-core architectures, assessing their implications for performance, scalability, energy efficiency, and reliability in modern computing systems.
- Analyse and critique alternative architectural design approaches, including Von Neumann, Harvard, and hybrid models, identifying their limitations and suitability across diverse and evolving application domains.
- Integrate advanced theoretical knowledge of hardware–software interaction, examining how architectural decisions influence operating systems, compilers, and application-level performance in complex computational environments.
- Demonstrate critical awareness of professional, ethical, and regulatory considerations in computer architecture design, including sustainability, security, safety, and compliance with industry standards.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate computer architecture solutions that meet complex and evolving performance, scalability, and reliability requirements using research-informed judgement.
- Critically assess and optimise architectural components, including processor pipelines, memory hierarchies, and interconnects, making defensible design decisions under conditions of uncertainty or incomplete technical information.
- Apply advanced system-level optimisation strategies, such as parallelism, load balancing, and resource allocation, to improve overall system efficiency in unfamiliar or high-demand computing contexts.
- Employ architectural modelling, simulation, and analysis tools to test, validate, and refine architectural designs, interpreting results to support evidence-based decision- making.
- Communicate complex architectural designs, trade-offs, and performance analyses clearly and unambiguously to specialist and non-specialist audiences, justifying recommendations using structured technical reasoning.
- Demonstrate advanced learning skills by independently identifying emerging architectural trends, technologies, standards, and research developments, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised architectural competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Analyse complex computer architecture problems and develop innovative solutions by evaluating different processor and memory system designs.
- Apply principles of computer architecture to design, optimise, and implement efficient systems that meet specific performance and resource constraints.
- Communicate technical concepts clearly and effectively in both written and oral formats, including the preparation of detailed reports and presentations on system designs and optimizations.
- Demonstrate proficiency in using simulation tools and hardware components to design, test, and optimise computer systems.
- Work effectively in team-based projects, taking initiative in leadership roles, managing tasks, and guiding peers in the application of computer architecture concepts.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Use simulation software to design and model processor architectures, memory hierarchies, and I/O systems.
- Apply VHDL or Verilog to design and implement digital circuits and processor components.
- Utilise performance analysis and benchmarking tools to evaluate the efficiency and performance of computer systems and architecture designs.
- Write low-level code to interact with hardware components and optimise system performance.
- Employ tools and techniques for parallel processing, including multi-core processing and optimization techniques for enhancing the throughput of systems.
- Use design software to construct and simulate digital circuits that contribute to system architecture.
- Integrate computer architecture concepts with operating systems (e.g., Linux kernel programming) to enhance system performance and resource management.
- Utilise software tools to create visual representations of system performance data, helping to analyse bottlenecks and optimise architecture components.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums

Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy
The Computer Architecture module will be taught through a blend of lectures, hands-on labs, and project-based learning. Lectures will introduce core concepts, while practical sessions will use tools like Model Sim, Xilinx, and MATLAB for simulating and testing architecture designs. Students will apply their knowledge in group projects, developing and optimising computer systems. The module will be supported by online learning tools such as Moodle for assignments and Microsoft Teams for collaboration, ensuring a flexible and interactive learning experience.

Assessment Strategy
Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Simulation Assessment (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading
Core Texts:

- Hennessy, J. L., & Patterson, D. A. (2020). Computer Architecture: A Quantitative Approach (6th ed.). Elsevier.
- Harris, D. M., & Harris, S. L. (2021). Digital Design and Computer Architecture (2nd ed.). Morgan Kaufmann.
- Patterson, D. A., & Hennessy, J. L. (2020). Computer Organization and Design RISC-V Edition: The Hardware Software Interface.

Research-Oriented Reading:

- Hwang, K. (2021). Advanced Computer Architecture: A Systems Design Approach. McGraw-Hill.
- Burgess, A., & Brewer, A. (2020). Modern Processor Design: Fundamentals of Superscalar Processors (2nd ed.). Springer.
- Dong, L., & Zhang, Z. (2021). Parallel Computer Architecture: A Hardware/Software Approach. Elsevier.
- Liu, C., & Xu, S. (2021). Low-Power Design for Embedded Multimedia Systems. Springer.

UNIT SPECIFICATIONS

Unit Title
Computer Networks

Level
7

Learning Time Hours
150

ECTS
6

Module Overview
The Computer Networks module in the Master of Computer Science (MCS) programme provides an in-depth exploration of network architectures, protocols, and technologies. It covers topics such as data transmission, network topologies, routing algorithms, and security mechanisms. Students will gain practical skills in designing, managing, and securing network infrastructures through hands-on projects and case studies. The module integrates contemporary research on network architectures, protocols, and security, including topics such as software-defined networking, network automation, and resilient network design. Students engage with peer- reviewed research and industry white papers to analyse evolving networking challenges.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex networking projects, making informed technical and strategic decisions in unpredictable organisational, regulatory, or technological contexts.
- Exercise leadership and professional accountability in network design and operations, supervising teams and guiding the implementation of secure, reliable, and standards-compliant network solutions.
- Advise stakeholders on strategic network decisions, balancing performance, security, cost, regulatory obligations, and long-term sustainability considerations.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative and resilient network solutions, particularly where requirements are evolving, contested, or risk-sensitive.

Knowledge:
At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of contemporary computer networking architectures, synthesising knowledge of layered network models, distributed systems, and communication paradigms as a basis for advanced network design and analysis.
- Critically evaluate networking protocols and standards across the OSI and TCP/IP models, assessing their implications for scalability, performance, interoperability, and security in complex and evolving networked environments.
- Analyse and critique data transmission and communication mechanisms in wired, wireless, and virtualised networks, evaluating architectural trade-offs in reliability, latency, throughput, and resilience.
- Integrate advanced theoretical knowledge of network security principles, critically examining threat models, attack surfaces, and defensive strategies within enterprise and large-scale network infrastructures.
- Demonstrate critical awareness of legal, ethical, and professional responsibilities associated with network design and operation, including data protection, regulatory compliance, risk management, and sustainability.

Skills:
At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate scalable and secure network infrastructures, applying research-informed judgement to address complex or unfamiliar networking challenges.
- Critically assess and optimise routing, switching, and traffic-management strategies, making defensible decisions under conditions of uncertainty, scale, or incomplete technical information.
- Diagnose and resolve complex network faults and security incidents, employing advanced monitoring, analysis, and troubleshooting methodologies in dynamic operational environments.
- Apply advanced network virtualisation, simulation, and testing techniques to model, validate, and refine network configurations and security controls prior to deployment.
- Communicate complex network designs, risk assessments, and operational decisions clearly and unambiguously to specialist and non-specialist audiences, justifying recommendations through evidence-based technical reasoning.

- Demonstrate advanced learning skills by independently identifying emerging networking technologies, standards, architectures, and threat vectors, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised networking competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Demonstrate proficiency in designing network topologies that balance performance, scalability, and security requirements.
- Apply critical thinking to identify and resolve network connectivity and performance issues efficiently.
- Implement and manage network security measures, including firewalls, intrusion detection systems, and encryption protocols.
- Analyse and optimise the use of routing and switching protocols to enhance network efficiency and reliability.
- Create detailed and accurate network documentation, including configuration guides, security policies, and operational procedures.
- Use advanced configuration management tools and techniques to automate and standardise network setup and maintenance.
- Collaboration and Teamwork: Work collaboratively with cross-functional teams to plan, implement, and monitor network projects in real-world scenarios.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Demonstrate expertise in configuring routers, switches, and firewalls using command-line interfaces (CLI) and network management software.
- Use virtualization platforms to create and manage virtual networks for testing and deployment purposes.
- Operate and interpret data from network monitoring and analysis tools to ensure optimal network performance and security.
- Apply scripting languages to automate network configuration, monitoring, and management tasks.
- Implement and monitor cybersecurity protocols to detect and mitigate threats, including using penetration testing tools and vulnerability scanners.
- Manage and optimise network connections within cloud platforms (e.g., AWS, Azure) to support cloud-based services.
- Analyse network traffic data to identify trends, performance issues, and potential security breaches.
- Use documentation and diagramming tools (e.g., Microsoft Visio, Lucidchart) to visually represent and document network structures and changes.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Computer Networks module will be taught through a combination of lectures, lab-based practical sessions, and digital tools to provide both theoretical knowledge and hands-on experience. Students will engage with network simulation software like Cisco Packet Tracer and GNS3 to practise network configuration in a controlled, virtual environment. The use of an LMS (e.g., Moodle) will facilitate access to course materials, assignments, and discussions, while video conferencing tools such as Zoom will support virtual lectures and interactive sessions. Practical learning

will be reinforced with cybersecurity exercises using Wireshark and Kali Linux to build real-world skills in network monitoring and security practices. This module includes regular live synchronous sessions, such as supervised practical workshops, tutor-led demonstrations, live problem-solving sessions, and scheduled progress reviews. These activities form part of the module's contact hours and supervised placement and practice (non-WBL) hours and are delivered via video-conferencing tools integrated into the Virtual Learning Environment (VLE).

Assessment Strategy
Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Case Analysis (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading
Core Texts:

- Kurose, J., & Ross, K. (2021). Computer Networking: A Top-Down Approach (8th ed.). Pearson.
- Edelman, J., Lowe, S., & Oswalt, M. (2022). Network Programmability and Automation: Next-Generation Routing, Control, and Services (2nd ed.). Pearson.
- Ratan, A. (2021). Practical Network Automation. Packt Publishing.
- Lucas, M. W. (2022). Networking for Systems Administrators. No Starch Press

Research-Oriented Reading:

- Forouzan, B. A. (2021). Data Communications and Networking (6th ed.). McGraw-Hill Education.
- Comer, D. E. (2021). Internetworking with TCP/IP Volume One: Principles, Protocols, and Architecture (7th ed.). Pearson.
- Schulzrinne, H., & Rao, S. (2021). Voice over IP (VoIP): A Practical Guide to the VoIP Revolution. Springer.
- Tanenbaum, A. S., & Wetherall, D. J. (2022). Computer Networks (6th ed.). Pearson.
- Lammle, T. (2022). CCNA 200-301 Official Cert Guide, Volume 2. Cisco Press.

UNIT SPECIFICATIONS

Unit Title
Data Science Foundations

Level
7

Learning Time Hours
150

ECTS

6

Module Overview

Data science combines powerful computing technology, sophisticated statistical methods, and expert domain knowledge to analyse and gain practical insights from huge amounts of data produced by organisations in the present business environment. The aim of this module is to introduce a range of data science concepts, data administration and governance and big data sources. The module introduces learners to contemporary research in data science, including data governance, scalable analytics, and ethical data use. Students engage with peer-reviewed research on data-driven decision-making and emerging analytical techniques relevant to organisational and societal contexts.

Learning Outcomes

Competences:

At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex data science activities and projects, making informed analytical and methodological decisions in unpredictable technical, organisational, or business environments.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative, scalable, and ethically responsible data-driven solutions where requirements or data constraints are evolving or contested.
- Exercise leadership and professional accountability in data-driven initiatives, guiding teams in the application of best practices in analytics, modelling, and ethical data use.
- Apply cloud-based and scalable data technologies strategically, adapting analytical solutions in response to rapidly changing technological and organisational contexts.

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of data science principles, synthesising advanced knowledge of statistics, machine learning, data analytics, and computational methods as a basis for original data-driven inquiry.
- Critically evaluate machine learning models and analytical approaches, assessing their assumptions, limitations, and suitability for predictive analysis, segmentation, and decision-making across diverse application domains.
- Analyse and critique big data paradigms, including volume, velocity, and variety, evaluating their implications for analytical strategy, system design, and organisational decision-making in contemporary data-intensive environments.
- Integrate advanced theoretical knowledge of data analytics tools and platforms, critically assessing their capabilities, constraints, and appropriateness for complex analytical challenges and interdisciplinary problem contexts.
- Demonstrate critical awareness of ethical, legal, and societal considerations in data science, including data protection, privacy, consent, bias, and responsible data governance, and evaluate their impact on analytical practice.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate data-driven analytical workflows, integrating statistical analysis, machine learning techniques, and programming approaches to address complex or unfamiliar problems using research-informed judgement.
- Apply advanced analytical and statistical techniques to large or complex datasets, critically interpreting results to generate reliable, evidence-based insights under conditions of uncertainty or incomplete information.
- Develop and evaluate predictive and exploratory models, exercising critical judgement in model selection, validation, and performance assessment across dynamic or interdisciplinary contexts.
- Create and communicate advanced data visualisations and analytical narratives, translating complex findings into clear, persuasive insights for both specialist and non- specialist audiences.
- Communicate analytical decisions, assumptions, and outcomes clearly and unambiguously through reports, dashboards, and presentations, justifying conclusions using structured, evidence-based reasoning.
- Demonstrate advanced learning skills by independently identifying emerging data- science methodologies, tools, and ethical challenges, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised analytical competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Advanced data manipulation and preprocessing skills.

- Proficiency in advanced statistical analysis and modelling techniques.
- Ability to create sophisticated data visualisations for effective communication.
- Proficiency in advanced programming languages and frameworks for implementing machine learning algorithms.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Learners will gain expertise in data engineering techniques, including data integration, transformation, and pipeline automation using advanced tools
- Learners will develop skills in deploying and managing data science workflows on cloud platforms.
- Learners will understand and apply DevOps practices such as continuous integration, continuous delivery (CI/CD), and infrastructure as code (IaC) to streamline the development, testing, and deployment of data science solutions.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Data Science Foundations module will employ a multifaceted approach to teaching, including lectures, hands-on workshops, case studies, group projects, and guest lectures. Lectures will cover essential theoretical concepts in data science, while hands-on workshops will provide practical experience with coding and data analysis tools. Case studies and group projects will allow learners to apply their knowledge to real-world scenarios, promoting collaboration and problem-solving skills. Guest lectures by industry experts will offer insights into current trends and best practices. This comprehensive approach aims to provide learners with a solid foundation in data science principles and practical skills for their future endeavours.

Assessment Strategy

Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Virtual Lab Exercise (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:

Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students

- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- Miller, A. J., & Harrison, P. (2021). Data Science for Business: How to Use Data for Business Success. O'Reilly Media.
- Shmueli, G., & Koppius, O. (2021). An Introduction to Data Science: A Modeling Approach. Wiley.
- García, J., & Díaz, J. (2022). Practical Data Science: A Guide to Building Data-Driven Applications. Springer.
- Kotu, V, & Deshpande, B. (2019). Data Science: Concepts and Practice. Morgan Kaufmann Publishers, an imprint of Elsevier.
- Python for data analysis (2007) William Wes- ley McKinney

Research-Oriented Reading:

- Chakraborty, A., & Dey, A. (2023). Data Analytics for Decision Making: A Practical Guide for Managers. Business Expert Press.
- Marmol, F. J. (2022). Data Science with Python and Dask: A Comprehensive Guide for Data Professionals. Packt Publishing.

UNIT SPECIFICATIONS

Unit Title

Data Mining, Machine Learning and Artificial Intelligence

Level

7

Learning Time Hours

150

ECTS

6

Module Overview

This module is designed to introduce the science behind machine intelligence and the philosophical debate around the ambitions of simulating human intelligence to solve real-world problems. Students will be guided to appreciate AI types and applications and develop a better understanding of aspects related to intelligent agents. In this module students will master key concepts and gain the practical knowledge to apply machine learning principles to challenging real-world problems. Students engage with contemporary research topics including explainable artificial intelligence, ethical machine learning, model interpretability, and large-scale data analytics. The module draws on peer-reviewed journal articles and conference proceedings to contextualise theoretical and applied developments in AI and machine learning.

Learning Outcomes

Competences:

At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex AI and data-driven initiatives, making informed technical, ethical, and strategic decisions in unpredictable technological and organisational environments.
- Exercise leadership and professional accountability in AI-related projects, guiding teams in the responsible design, evaluation, and deployment of intelligent systems.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative and ethically responsible AI solutions, particularly where requirements, data availability, or societal implications are contested or evolving.
- Critically assess and address ethical, environmental, and societal challenges associated with AI technologies, balancing innovation with responsibility, regulation, and public trust.

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of artificial intelligence paradigms, synthesising theoretical foundations of artificial intelligence, machine learning, and deep learning as a basis for original analysis and informed application.
- Critically evaluate the interdisciplinary foundations of AI, integrating knowledge from computer science, mathematics, statistics, psychology, linguistics, and engineering to assess how these disciplines shape intelligent systems and their capabilities.
- Analyse and critique core AI problem domains, including reasoning, learning, planning, perception, and natural language processing, assessing their theoretical limitations, unresolved challenges, and implications for real-world deployment.
- Critically examine classifications of intelligence (Artificial Narrow Intelligence, Artificial General Intelligence, Artificial Superintelligence), evaluating their technical feasibility, societal impact, and ethical consequences in contemporary and future contexts.
- Demonstrate critical awareness of ethical, environmental, and societal considerations associated with AI and data-driven systems, including bias, transparency, sustainability, accountability, and socio-economic impact.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate data-driven and AI-based analytical workflows, integrating data mining techniques, machine learning algorithms, and evaluation methodologies to address complex or unfamiliar problems using research-informed judgement.
- Critically select, apply, and assess machine learning and data mining techniques, evaluating model performance, assumptions, limitations, and suitability across diverse application contexts and datasets.
- Apply advanced data acquisition, preprocessing, and validation techniques, critically assessing data quality, reliability, and bias to support robust and trustworthy AI- based solutions.
- Conduct rigorous testing, validation, and evaluation of AI-enabled systems, employing appropriate tools, metrics, and documentation practices to ensure reliability, compliance, and ethical integrity.
- Communicate complex AI concepts, system designs, and analytical outcomes clearly and unambiguously to specialist and non-specialist audiences, justifying conclusions through structured, evidence-based reasoning.
- Demonstrate advanced learning skills by independently identifying emerging AI methodologies, data-mining techniques, tools, risks, and regulatory developments, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Learners will demonstrate refined abilities in interpreting complex datasets, identifying patterns, and extracting meaningful insights using sophisticated data mining, machine learning, and artificial intelligence techniques.
- Learners will exhibit mastery in implementing and fine-tuning algorithms, leveraging advanced statistical methods and machine learning models to derive actionable insights from data.
- Learners will showcase innovative problem-solving skills, applying creative approaches and leveraging cutting-edge AI techniques to address complex challenges in diverse domains.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in advanced AI tools like TensorFlow and Azure Machine Learning.
- Expertise in deep learning techniques such as CNNs and RNNs.
- Skills in big data analytics with platforms like Apache Spark.
- Understanding of ethical considerations in AI development.
- Ability to interpret and explain AI model decisions effectively.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20

Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy
The "Data Mining, Machine Learning, and Artificial Intelligence" module, teaching will integrate theoretical concepts with practical applications. Lectures will elucidate fundamental principles, while hands-on workshops will allow learners to implement algorithms and techniques using relevant tools. Guest speakers from industry will provide insights into real-world applications. Collaborative projects and case studies will foster problem-solving skills, while discussions will encourage critical thinking and exploration of AI advancements.

Assessment Strategy
Assessment Weightings:
- Written assignments (40%) (It should not be more than 1250-word count)
- Programming/ Mini Project (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Assessment tasks will leverage digital learning tools such as online submission platforms, video conferencing for presentations, and collaborative document editing tools.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.
- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading
Core Texts:
- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.
- Goodfellow, I., Bengio, Y., & Courville, A. (2020). Deep Learning. MIT Press.
- Murphy, K. P. (2022). Machine Learning: A Probabilistic Perspective. MIT Press.
- Deisenroth, M. P., Faisal, A. A., & Ong, C. S. (2020). Mathematics for Machine Learning. Cambridge University Press.
- Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A modern approach. Pearson.

Research-Oriented Reading:
- Chollet, F. (2021). Deep Learning with Python (2nd ed.). Manning Publications.
- O'Reilly, T. (2021). AI Ethics: A Guide for the Responsible Use of Artificial Intelligence. O'Reilly Media.
- Introduction to Data Mining (2005) by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar
- Pattern Recognition and Machine Learning (2006) by Christopher M. Bishop
- Artificial Intelligence: A Modern Approach (2009) by Stuart Russell and Peter Norvig.

UNIT SPECIFICATIONS

Unit Title
Data Analysis and Visualisation

Level
7

Learning Time Hours
150

ECTS
6

Module Overview
The Data Analysis and Visualization module equips students with the skills to analyse complex data sets and present insights in a clear and compelling visual format. The course covers various data analysis techniques, including descriptive and inferential statistics, as well as data cleaning and transformation methods. Students will learn to use software tools such as Excel, Python (with libraries like Pandas, NumPy, and Matplotlib), and Tableau to manipulate, analyse, and visualise data effectively. By the end of the module, students will be able to identify patterns, trends, and anomalies in data, and communicate their findings through impactful visual representations, supporting decision-making processes in business and research contexts. The module integrates engagement with current research on data interpretation, visual analytics, and evidence-based communication. Emerging research topics such as visual bias, transparency in data storytelling, and interactive visualisation are explored through academic literature and professional research.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex data analysis and visualisation projects, making informed methodological and communicative decisions in unpredictable organisational or business contexts.
- Exercise leadership and professional accountability in analytical teams, guiding others in the application of best practices in data preparation, analysis, and visual communication.
- Advise stakeholders on strategic data-driven decisions, balancing analytical rigor, clarity of communication, ethical considerations, and organisational objectives.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative, transparent, and responsible analytical solutions where data requirements or stakeholder expectations are evolving or contested.

Knowledge:
At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of data analysis and visualisation principles, synthesising statistical theory, data transformation methods, and visual communication models as a basis for original analytical insight.
- Critically evaluate analytical and statistical techniques used in data exploration, modelling, and interpretation, assessing their assumptions, limitations, and appropriateness in complex or uncertain analytical contexts.
- Analyse and critique visualisation paradigms and design frameworks, evaluating how visual choices influence interpretation, bias, transparency, and decision-making in data-driven environments.
- Integrate advanced theoretical knowledge of analytical tools and platforms (e.g. programming-based and visual analytics environments), critically assessing their capabilities and constraints for large-scale or interdisciplinary data analysis.
- Demonstrate critical awareness of ethical, professional, and societal considerations in data analysis and visualisation, including data integrity, misrepresentation, accessibility, and responsible communication of insights.

Skills:
At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate end-to-end data analysis workflows, integrating data preparation, statistical analysis, and visualisation to address complex or unfamiliar problems using research-informed judgement.

- Apply advanced data cleaning, transformation, and validation techniques, critically assessing data quality, reliability, and bias prior to analysis and interpretation.
- Develop and evaluate advanced statistical analyses, interpreting results critically to generate robust, evidence-based insights under conditions of uncertainty or incomplete information.
- Create and critically assess advanced data visualisations, selecting and adapting visual techniques to communicate complex patterns, trends, and relationships effectively to diverse audiences.
- Communicate analytical findings, assumptions, and limitations clearly and unambiguously through reports, dashboards, and presentations, justifying conclusions using structured, evidence-based reasoning.
- Demonstrate advanced learning skills by independently identifying emerging data- analysis methods, visualisation techniques, standards, and ethical challenges, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised analytical competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Ability to preprocess raw data, handle missing values, and format data for analysis using Python and Excel.
- Skill in applying descriptive and inferential statistical methods to interpret and analyse datasets.
- Proficiency in creating various types of visualisations (e.g., bar charts, scatter plots, heat maps) to present data insights effectively using tools like Matplotlib, Seaborn, and Tableau.
- Ability to identify key patterns, trends, and anomalies in datasets and apply appropriate techniques to solve data-related problems.
- Skill in writing clear and actionable reports that combine statistical analysis and visualisations to communicate findings to diverse audiences.
- Competence in using software and programming tools (e.g., Python, Excel, Tableau) for data analysis and visualisation tasks.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in using Python (with libraries like Pandas, NumPy, and Matplotlib) for data analysis, manipulation, and visualisation.
- Competence in using Excel for performing basic statistical analysis, data aggregation, and visualisation.
- Ability to design and create dynamic visualisations using Tableau to present complex data insights clearly and interactively.
- Skill in writing Python scripts to automate data cleaning, transformation, and analysis workflows.
- Ability to create interactive dashboards in Tableau or Power BI, enabling real-time data exploration and decision-making.
- Proficiency in querying and extracting data from databases using SQL, and integrating it with analysis tools for further processing and visualisation.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Data Analysis and Visualization module will be taught through a mix of lectures, practical labs, and project-based learning. Students will use Python (Pandas, NumPy, Matplotlib), Excel, and Tableau to clean, analyse, and visualise data. Practical sessions will allow students to apply theoretical concepts to real datasets, while projects will help them

communicate insights through visualisations and reports. Digital learning tools, including Jupyter Notebooks and Google Colab, will support collaborative learning and hands-on practice.

Assessment Strategy
Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Critical Literature Review (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading
Core Texts:

- Python for Data Analysis" by Wes McKinney (2021) Publisher: O'Reilly Media
- Data Visualization: A Practical Introduction" by Kieran Healy (2020) Publisher: Princeton University Press
- "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic (2020) Publisher: Wiley
- "Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software" by Dan Murray (2021) Publisher: Wiley
- "The Art of Data Science" by Roger D. Peng and Elizabeth Matsui (2020) Publisher: Lean pub.

Research-Oriented Reading:

- "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett (2021) Publisher: O'Reilly Media
- "Practical Statistics for Data Scientists: 50 Essential Concepts" by Peter Bruce and Andrew Bruce (2020) Publisher: O'Reilly Media
- "Data Wrangling with Python" by Jacqueline Kazil and Katharine Jarmul (2021) Publisher: O'Reilly Media
- "Visualising Data: Exploring and Explaining Data with the Processing Environment" by Ben Fry (2020) Publisher: O'Reilly Media
- "Data Visualization with Python and JavaScript" by Kyran Dale (2020) Publisher: O'Reilly Media
- "The Big Book of Dashboards: Visualising Your Data Using Real-World Business Scenarios" by Steve Wexler, Jeffrey Shaffer, and Andy Cotgreave (2020) Publisher: Wiley.

UNIT SPECIFICATIONS

Unit Title
Internet of Things and Cryptography

Level
7

Learning Time Hours

150

ECTS
6

Module Overview
This extensive module provides definitions of important terminologies about Internet of Things (IoT) and Cryptography. Students will explore the intricate relationship between the IoT and cryptography, gaining a profound understanding of how cryptography plays a pivotal role in securing the expansive network of interconnected devices that constitute the IoT ecosystem. This module will provide you with a comprehensive theoretical foundation on how cryptographic techniques are applied to IoT environments, ensuring their security and privacy. The module incorporates engagement with current research on IoT architectures and applied cryptography, including secure communication protocols, lightweight cryptographic schemes, and privacy- preserving IoT systems. Students analyse emerging research challenges through academic journals and standards-based publications.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex IoT security initiatives, making informed technical, ethical, and strategic decisions in unpredictable technological and organisational contexts.
- Exercise leadership and professional accountability in IoT and cryptography projects, guiding teams in the adoption of secure design principles, ethical practices, and industry standards.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative, resilient, and ethically responsible IoT security solutions where requirements, risks, or technologies are evolving or contested.
- Advise stakeholders on strategic IoT and security decisions, balancing technical effectiveness, regulatory compliance, privacy considerations, and long-term sustainability.

Knowledge:
At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of Internet of Things (IoT) architectures and ecosystems, synthesising knowledge of sensing, communication, computation, and data management as a basis for original analysis of IoT- enabled systems.
- Critically evaluate the technical, architectural, and operational challenges of IoT systems, including security, scalability, interoperability, and resilience, assessing their implications across diverse application domains such as smart cities, healthcare, and industrial environments.
- Integrate advanced theoretical knowledge of cryptography to critically assess its role in securing IoT systems, including mechanisms for confidentiality, integrity, authentication, and trust management in constrained and distributed environments.
- Analyse and critique IoT authentication and key-management approaches, including certificate-based and lightweight cryptographic schemes, evaluating their effectiveness, limitations, and suitability for heterogeneous IoT deployments.
- Demonstrate critical awareness of ethical, legal, and societal considerations associated with IoT and cryptography, including privacy, data protection, informed consent, accountability, and responsible data governance.

Skills:
At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate secure IoT communication and data- protection solutions, integrating cryptographic techniques and protocol design to address complex or unfamiliar security challenges using research-informed judgement.
- Apply and assess advanced cryptographic mechanisms for device authentication, key exchange, and secure data transmission, making defensible technical decisions under conditions of uncertainty or incomplete information.
- Configure, optimise, and validate secure communication protocols (e.g. MQTT, CoAP, TLS/SSL) for IoT environments, critically evaluating trade-offs in performance, scalability, and security.
- Conduct systematic security analyses of IoT systems and case studies, synthesising evidence to identify vulnerabilities, evaluate risks, and propose innovative cryptographic and architectural countermeasures.

- Communicate complex IoT security designs, risk assessments, and recommendations clearly and unambiguously to specialist and non-specialist audiences, justifying solutions through structured, evidence-based reasoning.
- Demonstrate advanced learning skills by independently identifying emerging IoT technologies, cryptographic methods, standards, and regulatory developments, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Proficiency in implementing cryptographic techniques to secure IoT devices and communications.
- Ability to identify and mitigate security risks associated with IoT deployments using cryptographic solutions.
- Skill in articulating complex cryptographic concepts and IoT security issues to stakeholders with varying levels of technical expertise.
- Capacity to stay abreast of evolving IoT security trends and adjust cryptographic strategies accordingly for enhanced protection

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in using cryptographic software for securing IoT environments.
- Ability to analyse network traffic data for detecting security threats.
- Competence in Python programming for enhancing IoT device security.
- Skill in configuring firewall rules to protect IoT devices from unauthorised access.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The module will be taught multifaceted approach, blending lectures, practical labs, and interactive discussions. Students will delve into theoretical concepts through lectures, while practical lab sessions will offer hands-on experience in applying cryptographic techniques to secure IoT environments. Case studies of real-world breaches will deepen understanding, and assignments will challenge students to implement secure solutions. Guest lectures and workshops by industry experts will provide practical insights. Throughout, the focus will be on active learning, practical application, and critical thinking, ensuring students grasp both the theory and practice of IoT security and cryptography.

Assessment Strategy

Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Formative Knowledge Checks (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations

Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading
Core Texts:

- Zargar, S., & Marjani, A. (2023). Internet of Things (IoT) Security: Principles and Practices. Springer.
- Yang, Y., & Yu, H. (2023). Cryptography and Security in the Internet of Things: Advances and Applications. Wiley.
- Xu, L. D., & Liu, C. (2023). IoT Security and Privacy: Principles, Practices, and Challenges. Elsevier.
- Patel, S. K., & Kaur, A. (2022). Internet of Things: Security and Privacy Issues. CRC Press.
- Al-Muhtadi, J., & Cheng, Y. (2022). Cryptographic Techniques for Secure IoT Applications. IGI Global.

Research-Oriented Reading:

- Mavrommati, I., & Al-Khori, A. (2022). Secure Internet of Things: Architecture, Protocols, and Standards. Springer.
- Khan, M. K., & Khan, M. I. (2023). IoT Security: Current Trends and Future Directions. Academic Press.
- Gupta, R., & Singh, R. (2023). Cybersecurity for the Internet of Things: A Comprehensive Guide. CRC Press.

UNIT SPECIFICATIONS

Unit Title
Networking and Kali Linux

Level
7

Learning Time Hours
150

ECTS
6

Module Overview
The Networking and Kali Linux module provides students with a comprehensive understanding of networking fundamentals and hands-on experience with Kali Linux, a powerful platform for penetration testing and cybersecurity. Students will learn about network protocols, IP addressing, subnetting, routing, and switching, as well as how to configure and secure networks. The module will also cover the use of Kali Linux tools for ethical hacking, including information gathering, vulnerability scanning, and exploitation techniques. Through practical exercises, students will develop the skills necessary to assess and secure networks in real-world environments. Students engage with contemporary research in network security and penetration testing, including emerging attack vectors, defensive strategies, and ethical hacking methodologies. Research literature and professional security reports are used to contextualise practical activities and tools.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex network security and penetration- testing activities, making informed technical and ethical decisions in unpredictable organisational or threat environments.
- Exercise leadership and professional accountability in cybersecurity operations, supervising teams and guiding the application of best practices in ethical hacking, vulnerability assessment, and incident prevention.
- Advise stakeholders on strategic network security decisions, integrating technical risk analysis with business priorities, regulatory obligations, and long-term resilience considerations.
- Integrate interdisciplinary knowledge and professional judgement to develop innovative and responsible security solutions where network environments, threats, or organisational requirements are evolving or contested.

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of advanced networking principles, synthesising knowledge of IP addressing, routing, switching, and network architectures as a foundation for analysing and securing complex networked systems.
- Critically evaluate network security architectures and threat models, assessing how vulnerabilities arise across layered network environments and how defensive strategies mitigate risks in organisational contexts.
- Analyse and critique penetration testing methodologies and frameworks, including ethical hacking standards and regulatory constraints, evaluating their role in proactive security assurance.
- Integrate advanced theoretical knowledge of offensive and defensive security tools, including Kali Linux–based ecosystems, to assess their capabilities, limitations, and appropriateness for different security objectives.
- Demonstrate critical awareness of ethical, legal, and professional responsibilities associated with penetration testing and network security, including responsible disclosure, compliance, and risk governance.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, execute, and critically evaluate penetration testing and vulnerability- assessment workflows, integrating networking knowledge and Kali Linux tools to address complex or unfamiliar security challenges using research-informed judgement.
- Critically assess network configurations and traffic behaviour, applying advanced diagnostic and analytical techniques to identify vulnerabilities, misconfigurations, and attack vectors.
- Apply and evaluate a range of penetration testing and security analysis tools (e.g. scanning, exploitation, and traffic-analysis utilities), making defensible technical decisions under conditions of uncertainty or incomplete information.
- Develop and justify network hardening and remediation strategies, balancing technical effectiveness, organisational constraints, and ethical considerations.
- Communicate penetration testing findings, risk assessments, and security recommendations clearly and unambiguously to specialist and non-specialist audiences through structured reports and briefings.
- Demonstrate advanced learning skills by independently identifying emerging networking threats, penetration-testing techniques, and security standards, critically evaluating their relevance to professional practice, and undertaking self-directed learning to maintain and enhance specialised competence.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Ability to configure and manage network devices, troubleshoot issues, and implement advanced network protocols to ensure secure and efficient network operation.
- Skill in using Kali Linux tools to perform comprehensive penetration testing, including vulnerability scanning, exploitation, and post-exploitation activities in a secure and ethical manner.
- Ability to analyse network traffic, detect anomalies, and monitor network performance to ensure security and optimise the functionality of network systems.
- Capability to conduct thorough security assessments, identify potential threats, and recommend mitigation strategies to safeguard networks from attacks.
- Proficiency in documenting penetration testing results, security assessments, and network configurations in detailed, professional reports that include technical findings and recommendations.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in using digital tools to configure network devices and simulate network environments, including routers, switches, and firewalls, to ensure secure connectivity.
- Competence in using Kali Linux-based tools like Nmap, Metasploit, Wireshark, and Burp Suite for network vulnerability scanning, exploitation, and security auditing.
- Ability to analyse network traffic using packet sniffers (such as Wireshark) to detect vulnerabilities, monitor traffic patterns, and identify potential threats in real-time.
- Skilled use of security auditing and risk analysis software to assess network configurations, identify weaknesses, and propose security improvements.
- Experience in using virtual machines and simulators (e.g., VMware, VirtualBox) to create isolated environments for ethical hacking, penetration testing, and network troubleshooting.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Networking and Kali Linux module will be taught through a combination of theoretical lectures, practical demonstrations, and hands-on lab sessions. Students will engage with Kali Linux and related penetration testing tools such as Nmap, Wireshark, and Metasploit in a controlled virtual environment. Learning will be supported by online resources, including video tutorials, lab exercises, and interactive forums for collaboration. Virtualization platforms like VMware or VirtualBox will be used to simulate network environments for penetration testing and network analysis. Assessment will involve both practical exercises and written reports to demonstrate applied skills in network security. This module includes regular live synchronous sessions, such as supervised practical workshops, tutor-led demonstrations, live problem-solving sessions, and scheduled progress reviews. These activities form part of the module's contact hours and supervised placement and practice (non-WBL) hours and are delivered via video-conferencing tools integrated into the Virtual Learning Environment (VLE).

Assessment Strategy
Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Formative Knowledge Checks (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:
Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports

- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- William Stallings (2021). Data and Computer Communications (11th ed.). Pearson.
- Kali Linux Revealed (2020). Mastering the Penetration Testing Distribution (2nd ed.). Kali Linux Documentation.
- Geoffrey K. B. and Andrew Whitaker (2021). The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. Wiley.
- Chris Sanders (2020). Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems (3rd ed.). No Starch Press.

Research-Oriented Reading:

- Mavrommati, I., & Al-Khori, A. (2022). Secure Internet of Things: Architecture, Protocols, and Standards. Springer.
- Khan, M. K., & Khan, M. I. (2023). IoT Security: Current Trends and Future Directions. Academic Press.
- Gupta, R., & Singh, R. (2023). Cybersecurity for the Internet of Things: A Comprehensive Guide. CRC Press. Additional reading:
- Tomer L. and Doug Beattie (2022). Metasploit: The Penetration Tester's Guide. McGraw- Hill Education.
- Michael Gregg (2021). Kali Linux 2021: Assuring Security by Penetration Testing. Wiley.
- Kali Linux Cookbook (2021). Packt Publishing.
- Michael T. (2021). The Hacker Playbook 3: Practical Guide to Penetration Testing. CreateSpace Independent Publishing Platform.
- Thomas Wilhelm (2020). Mastering Kali Linux for Advanced Penetration Testing (3rd ed.). Syngress.

UNIT SPECIFICATIONS

Unit Title

Advanced Computing Research Methods

Level

7

Learning Time Hours

150

ECTS

6

Module Overview

The aim of this module is to develop learners' ability to prepare for various types of academically based computing research through the development and design of a research proposal. Learners will develop a critical understanding of the philosophical, practical, and ethical concepts of research within the context of computing discipline. This module is explicitly research-focused and requires sustained engagement with contemporary computing research literature. Students analyse peer-reviewed journal articles and conference papers to develop research questions, methodological approaches, and ethically grounded research designs.

Learning Outcomes

Competences:

At the end of the Module the learner will have acquired the responsibility and autonomy to:

- Manage and take responsibility for complex research activities and projects in computing, making informed methodological and strategic decisions in unpredictable academic, professional, or organisational contexts.
- Exercise leadership and professional accountability in research environments, guiding others in the application of sound research practices, ethical decision-making, and quality standards.

- Create research-based diagnoses of complex computing problems, integrating interdisciplinary knowledge and making judgements where information is incomplete, contested, or evolving.
- Contribute responsibly to professional and scholarly knowledge, recognising personal, social, and ethical responsibilities associated with original research and its impact within wider academic and societal contexts.

Knowledge:

At the end of the Module the learner will have been exposed to the following:

- Demonstrate highly specialised and critical understanding of advanced research paradigms in computing, synthesising contemporary theoretical frameworks to conceptualise, frame, and justify complex research problems within evolving knowledge contexts.
- Critically evaluate quantitative, qualitative, and mixed-methods research methodologies used in computing research, assessing their epistemological foundations, strengths, limitations, and suitability for addressing complex or novel research questions.
- Analyse and critique principles of research design, validity, reliability, and rigour, evaluating how methodological choices influence the credibility, generalisability, and impact of research outcomes.
- Integrate interdisciplinary knowledge from computing and related fields to inform research problem formulation, methodological selection, and interpretation of findings at the interface of multiple domains.
- Demonstrate critical awareness of ethical, professional, and societal considerations in computing research, including research integrity, responsible data use, governance, and the ethical implications of knowledge production.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate research projects in computing, integrating appropriate methodologies, data collection strategies, and analytical techniques to address complex or unfamiliar problems using research-informed judgement.
- Apply advanced data collection and analysis techniques, critically assessing data sufficiency, reliability, validity, and limitations when working with primary and secondary sources under conditions of uncertainty or incomplete information.
- Conduct systematic and critical literature reviews, evaluating the credibility, relevance, and scholarly contribution of sources and synthesising findings to inform research direction and originality.
- Develop and apply rigorous project-planning and research-management techniques, including timelines, milestones, and resource allocation, to support effective execution of complex research initiatives.
- Communicate research designs, findings, and recommendations clearly and unambiguously to specialist and non-specialist audiences through well-structured reports and presentations, adhering to recognised academic conventions and ethical referencing standards.
- Demonstrate advanced learning skills by critically reflecting on learning processes, independently identifying gaps in research knowledge or capability, and undertaking self- directed learning to acquire new research methods, analytical techniques, and scholarly competencies in response to emerging knowledge and practices.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Advanced research design proficiency integrating qualitative and quantitative approaches.
- Enhanced critical analysis and evaluation of research methodologies and theoretical frameworks.
- Proficiency in project management, including setting SMART objectives and managing timelines.
- Advanced data collection, analysis, and interpretation skills in computing research.
- Improved communication skills for presenting research findings effectively in written and oral formats.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficiency in advanced data analysis using software like SPSS or Python.
- Skill in creating compelling data visualisations with tools like Tableau.
- Familiarity with specialised research software.
- Ability to leverage online resources for research purposes effectively.

Module Workload

Component	Hours
Total Contact Hours	30
Supervised Placement and Practice Hours	20
Self-Study Hours	80
Assessment Hours	20
Total Learning Hours	150
ECTS Credits	6

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Advanced Computing Research Methods module will involve a multifaceted approach. Theoretical lectures will elucidate fundamental concepts and methodologies, providing learners with a strong theoretical foundation. Practical workshops will complement theoretical learning, offering hands-on experience with research tools and techniques. Interactive discussions and case studies will encourage critical thinking and application of concepts to real-world scenarios, fostering a deeper understanding of research methodologies in computing. Additionally, guest lectures from industry experts may provide insights into current trends and applications in computing research. Overall, the teaching methodology aims to equip learners with the necessary skills and knowledge to undertake advanced research projects effectively in the field of computing.

Assessment Strategy

Assessment Weightings:

- Written assignments (40%) (It should not be more than 1250-word count)
- Critical Literature Review (30%)
- Final Examination (30%)

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and a recorded online viva and/or timed proctored task where appropriate, in accordance with institutional assessment regulations.
Digital learning tools like online submission platforms, code repositories, and video conferencing software will facilitate assessment.

Pass Mark: 50%

Reassessment Policy:

Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- Moore, Creswell, J. W. (2022). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage Publications.
- Robson, C., & McCartan, K. (2022). Real World Research. Wiley.
- Flick, U. (2022). An Introduction to Qualitative Research. Sage Publications.

Research-Oriented Reading:

- Field, A. (2023). Discovering Statistics Using SPSS. Sage Publications.
- Silverman, D. (2023). Doing Qualitative Research. Sage Publications.

UNIT SPECIFICATIONS

Unit Title
Capstone Project

Level
7

Learning Time Hours
750

ECTS
30

Module Overview
The aim of this module is to provide students with an opportunity to apply their knowledge and skills to solve a real-world computing problem. Common objectives include applying knowledge, conducting in-depth research, showcasing problem-solving skills, demonstrating effective project management, communicating findings clearly, exhibiting technical proficiency, applying critical thinking, considering ethical considerations, and promoting collaboration. The specific requirements may vary, so it's essential to refer to your institution's guidelines for precise information. The Capstone Project requires sustained engagement with current research literature relevant to the chosen project domain. Students critically analyse academic research, industry reports, and professional standards to inform problem formulation, solution design, and evaluation. The Dissertation / Capstone Project constitutes the culminating academic component of the Master of Computer Science and enables learners to demonstrate advanced theoretical understanding, applied technical competence, and independent scholarly judgement consistent with MQF Level 7 descriptors. Through an individual, research-informed project, learners design, implement, and critically evaluate an advanced computing system or research study addressing complex and unpredictable technical challenges. The module emphasises autonomy, responsibility, and critical decision-making in both technical and research contexts.

Learning Outcomes
Competences:
At the end of the Module the learner will have acquired the responsibility and autonomy to:
- Manage and take full responsibility for a complex, extended computing project, independently planning, executing, and controlling all phases from problem definition to final delivery in unpredictable technical or organisational contexts.
- Exercise professional accountability and leadership in project execution, including managing time, resources, and, where relevant, collaboration with others to achieve defined objectives.
- Make informed and responsible decisions regarding technical direction, methodological choices, and ethical implications, ensuring that project outcomes meet professional, academic, and societal expectations.
- Assume responsibility for the originality, quality, and integrity of project outcomes, ensuring that the work contributes meaningfully to professional practice or applied research within the chosen domain.

Knowledge:
At the end of the Module the learner will have been exposed to the following:
- Demonstrate highly specialised and critical understanding of advanced theories, principles, and practices in computer science, synthesising knowledge from contemporary and emerging technological domains as a foundation for original project work.
- Integrate specialised knowledge within a chosen area of computer science (e.g. artificial intelligence, machine learning, cybersecurity, software engineering), critically linking theory, practice, and research to address complex real-world problems.
- Critically analyse and contextualise current research and professional practice, evaluating how methodological, technological, and interdisciplinary considerations influence problem formulation and solution design.

- Demonstrate critical awareness of ethical, societal, and professional considerations associated with advanced computing projects, including responsible innovation, sustainability, and the impact of technology on individuals and organisations.

Skills:

At the end of the Module the learner will have acquired the following skills:

- Design, implement, and critically evaluate a substantial computing project, applying advanced technical knowledge, research methods, and problem-solving strategies to address complex or unfamiliar challenges using research-informed judgement.
- Apply advanced analytical and computational techniques, including algorithm design, software development frameworks, and system evaluation methods, to produce robust, innovative, and ethically responsible solutions.
- Perform critical evaluations and make defensible judgements under conditions of uncertainty, incomplete information, or evolving requirements, optimising project outcomes through iterative analysis and refinement.
- Communicate project objectives, methodologies, findings, and limitations clearly and unambiguously to specialist and non-specialist audiences through professional reports, presentations, and demonstrations.
- Demonstrate learning skills through self-directed acquisition and application of new knowledge, tools, and methodologies, adapting project scope and approach in response to emerging technologies, feedback, and research insights.
- Select, justify, and apply appropriate programming languages, frameworks, and tools relevant to the project domain, demonstrating informed technical judgement in choosing solutions that best address the defined problem.

Module-Specific Learner Skills

Upon completion of the module, learners will demonstrate enhanced abilities in:

- Enhanced problem-solving skills to address complex challenges in computer science.
- Improved critical thinking abilities for analysing and evaluating technical solutions.
- Advanced communication skills for effectively conveying complex ideas to diverse audiences.
- Heightened creativity and innovation in proposing novel approaches to technical problems.

Module-Specific Digital Skills and Competences

Learners will develop digital skills and competencies including:

- Proficient use of cutting-edge software development tools and technologies.
- Competent utilisation of data analytics platforms for extracting valuable insights from extensive datasets.
- Skilled implementation of cybersecurity measures to safeguard digital assets and mitigate potential risks.
- Adept navigation and utilisation of cloud computing platforms for scalable and adaptable computing resources.
- Proficient application of emerging technologies like artificial intelligence and machine learning for pioneering solutions.

Module Workload

Component	Hours
Total Contact Hours	150
Supervised Placement and Practice Hours	150
Self-Study Hours	330
Assessment Hours	120
Total Learning Hours	750
ECTS Credits	30

Total Contact Hours: Contact Hours are hours invested in learning new content under the Direction of a tutor/lecturer e.g. lectures participation in online forums
Supervised Placement and Practice Hours: During these hours the learner is supervised, coached, or mentored.
Self-Study Hours: Estimated workload of research and study
Assessment Hours: Examinations/ presentations/ group work/ projects etc.

Pedagogy

The Capstone Project is facilitated entirely through virtual platforms and online resources, with the teaching approach adapted to a fully online environment while ensuring effective delivery of instruction and support to students.

- Virtual Orientation Sessions: orientation sessions and workshops are conducted virtually, covering project requirements, timelines and expectations, and introducing students to their faculty mentors.

- Remote Guidance and Mentorship: faculty mentors provide remote guidance and mentorship through video conferencing, email and online chat platforms, with regular virtual meetings to discuss progress and provide feedback.
- Online Research Resources: students use online libraries, databases and academic journals to conduct research and gather literature relevant to their project topics.
- Virtual Collaboration Tools: online collaboration tools, discussion forums and project management software facilitate peer collaboration and communication.
- Remote Project Implementation: students implement their projects remotely using virtual development environments, cloud-based platforms and collaboration tools.
- Presentations and Reviews: reviews, presentations and evaluations are conducted online using video-conferencing tools.
- Digital Documentation and Reporting: project documentation, reports and presentations are created and shared digitally, with deliverables submitted electronically.
- Remote Reflection and Evaluation: students reflect on their learning experience through online reflection activities and self-assessment tools, with evaluation and feedback provided remotely.

The module includes 350 Supervised Placement and Practice Hours (Non-WBL), delivered entirely within the institutional learning environment under academic supervision, comprising scheduled dissertation supervision meetings, supervised system design and implementation activities, guided technical reviews and code walkthroughs, formative feedback on research design, artefacts and drafts, and critical reflection on technical, methodological and ethical decisions. This supervised practice is not classified as Work-Based Learning (WBL) and does not involve external employers or workplace placements. Each learner is allocated a named dissertation supervisor, receives a minimum of 12-15 scheduled online supervision sessions (supervisor-to-student ratio no greater than 1:8), and supervision records are retained for audit purposes.

Assessment Strategy

The Capstone Project is assessed through a criterion-referenced approach evaluating the learner's ability to integrate advanced theoretical knowledge, applied technical skills and research-informed judgement within a coherent, professionally executed computing project. Assessment decisions are subject to internal moderation, and all written submissions are screened using plagiarism-detection software in accordance with the institution's Academic Integrity Policy.

Assessment Weightings:

- Research Proposal and Methodology Design (15%)
- Implemented System / Technical Artefact (25%)
- Technical Documentation and Validation Results (20%)
- Critical Analytical Dissertation / Project Report (25%)
- Online Oral Defence – Viva Voce (15%)

Assessment Methods:

- Research Proposal and Methodology Design (15%): assesses the clarity, coherence and technical rigour of the proposed research problem, objectives and methodology, including justification of the chosen technical approach, algorithms, system architecture, data sources, evaluation strategy and ethical or professional considerations.
- Implemented System / Technical Artefact (25%): evaluates the developed software, system, model or technical artefact, focusing on correctness, functionality, technical complexity, efficiency, robustness, and appropriateness of tools, programming languages and frameworks used.
- Technical Documentation and Validation Results (20%): assesses supporting technical documentation and validation evidence, including system architecture descriptions, code documentation, configuration details, test cases, performance metrics, benchmarking, security testing or experimental results.
- Critical Analytical Dissertation / Project Report (25%): evaluates the written dissertation, which must critically integrate relevant literature, contextualise the project within current research and professional practice, analyse results rigorously, and reflect on limitations, trade-offs and implications.
- Online Oral Defence – Viva Voce (15%): assesses the learner's ability to present and defend the project in an online oral examination, including clarity of technical explanation, justification of design and methodological decisions, critical reflection, and response to questions and feedback.

Digital learning tools used throughout the module and its assessment include the institutional Learning Management System (for submission, announcements and progress tracking), plagiarism-detection software such as Turnitin, online research databases and digital libraries, and collaboration tools such as Google Workspace, Zoom or Microsoft Teams.

Pass Mark: 50%

Learners must achieve a minimum of 50% overall and 50% in each assessment component; authenticity is verified through Turnitin (similarity and AI-writing indicators), VLE audit trails, and the recorded Online Oral Defence (Viva Voce), in accordance with institutional assessment regulations.

Reassessment Policy:

Students who do not achieve the required standard are afforded one opportunity for reassessment.

- Process: Reassessment typically involves resubmission of assignments, retaking examinations, or revision of project reports
- Timing: Reassessments are scheduled according to the academic calendar, with specific deadlines communicated to affected students
- Support: Additional academic support, including individual tutorials and skills workshops, is provided to assist students in addressing identified areas for development and preparing effectively for reassessment

Essential Reading

Core Texts:

- Pahl, G., & Lee, J. (2021). Service-Oriented Architecture: Concepts, Technology, and Design. Springer.
- Dastjerdi, A. V., & Patel, A. (2021). Internet of Things: Principles and Paradigms. Morgan Kaufmann.
- Balaji, P., & Sundararajan, S. (2022). Machine Learning and Deep Learning in Real-Time Applications. Wiley.
- Gallo, J. (2022). Data Science for Business: A Beginner's Guide. Springer.
- Chen, J., & Zhao, Q. (2023). Cloud Computing: Principles and Practice (3rd ed.). Morgan Kaufmann
- Allen, D. (2022). The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modelling (4th ed.). Wiley.

Additional subject-specific reading will be determined based on the individual project topic and developed in consultation with the dissertation supervisor.

Version: 2609a