

## Computer Science and Maths wIE BSc (Hons) 2014-2015 Summary

UCAS code	Award	Title	Duration	Mode
GG41	BSc	Computer Science and Maths wIE BSc (Hons)	4 years	FT + Placement year

Schools	Computer ScienceMathematics
Faculty	Engineering and Physical Sciences
Awarding Institution	University of Manchester
Programme Accreditation	BCS
Relevant QAA benchmark(s)	Computing, Mathematics

## **Aims and intended learning outcomes**

The programmes aim to:

- 1) enable graduates to exhibit a high level of practical and theoretical skills over a broad range of Computer Science together with a knowledge of currently available techniques and technologies.
- 2) enable students to acquire a knowledge and understanding of mathematical ideas, including the concepts of rigorous argument and formal proof, and an appreciation of the power and generality of abstract formulation and the analytic method.
- 3) enable students to develop their capacity to learn and apply mathematical ideas and skills.
- 4) give students the opportunity to have studied a combination of mathematics and computer science and have an appreciation of the subjects themselves and their close relationship.
- 5) give students sufficient knowledge of mathematics and computer science principles to be able to meet confidently future developments in a rapidly changing area.
- 6) provide the opportunity for students to study on a programme at the forefront of both computer science and mathematics which is informed by current research and in particular by the research specialisations of the teaching staff.
- 7) In addition, the with Industrial Experience programme aims to: give extensive practical experience of an industrial or business environment where students are able to apply and develop their skills, both technical and personal.

### **Intended learning outcomes**

#### **Knowledge & understanding**

- A1 Know and understand the essential mathematics relevant to computer science.
- A2 Understand and apply a wide range of principles and tools available to the software engineer, such as design methodologies, choice of algorithm, language, software libraries and user interface techniques
- A3 Demonstrate a grasp of the principles of computer systems, including architecture, networks and communication
- A4 Recognise and appreciate the professional and ethical responsibilities of the practising computer professional, including understanding the need for quality
- A5 Know and understand the principles and techniques of a number of application areas informed by the research directions of the subject, such as artificial intelligence, databases and computer graphics
- A6 Apply their knowledge of computing in a commercial or industrial context
- A7 Show a critical understanding of the broad context within which Computer Science resides, including issues such as quality, reliability, enterprise, employment law, accounting and health and safety
- A8 Have a comprehensive knowledge and critical awareness of selected specialist fields at the forefront of computer science, studied at masters level

#### **Intellectual (thinking) skills**

- B1 Solve a wide range of problems related to the analysis, design and construction of computer systems.
- B2 Design and implement a software or hardware system of significant size
- B3 Identify a range of solutions and critically evaluate and justify proposed design solutions
- B4 Solve computer science problems with pressing commercial or industrial constraints
- B5 Generate an innovative design to solve a problem containing a range of commercial and industrial constraints

#### **Practical skills**

- C1 Plan and undertake a major individual project
- C2 Prepare and deliver coherent and structured verbal and written technical reports
- C3 Give technical presentations suitable for the time, place and audience
- C4 Use the scientific literature effectively and make discriminating use of Web resources
- C5 Design, write and debug computer programs in appropriate languages
- C6 Use appropriate computer-based design support tools
- C7 Apply computer science skills in a commercial or industrial environment
- C8 Demonstrate initiative taking, innovation and self-management in an industrially related group project
- C9 Integrate previously acquired skills and apply them to new, demanding situations

**Transferable skills**

- D1 Display an integrated approach to the deployment of communication skills
- D2 Use IT skills and display mature computer literacy
- D3 Work effectively with and for others
- D4 Strike the balance between self-reliance and seeking help when necessary in new situations
- D5 Display personal responsibility by working to multiple deadlines in complex activities
- D6 Employ discrete and continuous mathematical skills as appropriate
- D7 Demonstrate significantly enhanced group working abilities
- D8 Further develop career plans and personal objectives
- D9 Communicate effectively with non-specialist as well as computer scientist professionals at a range of levels
- D10 Undertake a range of technical roles within a team and be able to display leadership

## Teaching, learning and assessment methods

Learning and Teaching on all our programmes aims to combine an understanding of fundamental CS principles, development of strong practical skills and the group-working, learning and communication skills that are essential for any computing professional.

Course units which involve practical elements all have associated laboratory exercises, usually in timetabled sessions with staff and demonstrator support. Most labs operate a system of face-to-face marking in the lab so that students receive immediate feedback on their work. Units without labs all have regular coursework exercises to support skills development and feedback.

Most units are lecture based, with lab or coursework exercises used to reinforce and enhance knowledge and skills first encountered in lectures. The first year team project deviates significantly from this model and takes an Enquiry Based Learning approach. This unit aims to encourage students to be more actively engaged with, and responsible for, their own learning, to develop skills in problem solving, communication, independent learning, and group work, and to signal the importance we attach to independent learning. This approach is followed up in the second year with the workshop based approach used in the compulsory Software Engineering unit, which also contains a major group working component.

All students undertake an individual 3rd year project, supervised by a member of academic task, which usually involves the development of significant software or hardware product. Assessment of this unit involves presentations of plans and results and a major written report

Assessment in almost all units is a combination of lab/coursework and examination.

## Learning, Teaching and Assessment of intended learning outcomes

### Knowledge and Understanding

Learning and Teaching Processes	Assessment
Lectures (A1, A2, A3, A4, A5, A6, A7)	Unseen written examinations (A1, A2, A3, A4)
Laboratory sessions (A2, A3)	Marked tutorial exercises (A1, A2, A3, A4)
Personal tutorials (A1, A2, A3, A4, A7)	Laboratory reports (A2, A3)
Problem solving classes (A1, A2, A3, A4)	Project reports (individual and group) (A3, A4, A5, A6, A7)
Problem-based learning (A2, A3, A4, A5, A6, A7)	Oral presentations (individual and group) (A3, A4, A5, A6, A7)
Projects (A3, A4, A5, A6, A7)	
Industrial seminars (A4, A5, A6, A7)	

### Intellectual Skills

Learning and Teaching Processes	Assessment
Lectures (B1, B2, B4, B5)	Unseen written examinations (B1, B2, B4)
Laboratory sessions (B1, B2)	Marked tutorial exercises (B1, B2)
Personal tutorials (B1, B2, B4)	Laboratory reports (B1, B2)
Problem solving classes (B1, B2, B4)	Project reports (individual and group) (B1, B2, B3, B4, B5)
Problem-based learning (B1, B2, B4)	Oral presentations (individual and group) (B1, B2, B3, B4, B5)
Projects (B1, B2, B3, B4, B5)	

### Practical Skills

Learning and Teaching Processes	Assessment
Lectures (C4, C6)	Laboratory reports (C1, C2, C3, C4, C5, C6, C7)
Laboratory sessions (C1, C2, C3, C4, C5, C6, C7)	Project reports (individual and group) (C3, C4, C5, C6)
Projects (C3, C4, C5, C6, C9)	Oral presentations (individual and group) (C6, C8, C9)
Industrial placement (C8, C9)	Industrial placement reports (C8, C9)

### Transferable skills

Learning and Teaching Processes	Assessment
Lectures (D3, D4, D5, D7)	Laboratory reports (D1, D3, D5, D6)

Laboratory sessions (D1, D3, D5, D6)		Essays (D2, D3)
Personal tutorials (D1,D2, D3, D4, D7)		Project reports (individual and group) (D1, D2, D3,D4, D5, D6, D7)
Problem solving classes (D4)		Oral presentations (individual and group) (D1, D3, D6, D7, D8)
Problem-based learning (D1, D2, D3, D4, D5, D6)		Industrial placement reports (D8)
Projects (D1, D2, D3, D4, D5, D6, D7)		
Industrial placement (D8)		

## Programme structure

MANDATORY UNITS - 110 CREDITS

OPTIONAL UNITS - 10 CREDITS

### Level 1 - compulsory units

All of the units in this pool are mandatory.

Code	Title	Credits
COMP10120	First Year Team Project	20
COMP16121	Object Oriented Programming with Java 1	20
COMP16212	Object Oriented Programming with Java 2	10
MATH10111	Sets, Numbers and Functions	15
MATH10131	Calculus and Vectors	15
MATH10212	Linear Algebra	15
MATH10232	Calculus and Applications	15

### Level 1 - option pool 1

From this option pool choose 10 credits.

Code	Title	Credits
COMP11212	Fundamentals of Computation	10
COMP14112	Fundamentals of Artificial Intelligence	10
COMP18112	Fundamentals of Distributed Systems	10

### Level 2 options

MANDATORY UNITS - 60 CREDITS Choose 40 credits out of option pool 1. Note, if you choose COMP23311 you must also take COMP23412.

OPTIONAL UNITS - 60 CREDITS Choose 20 credits of optional COMP units from option pools 2 and 4. You must choose 40 credits of optional MATH units, 10 from option pool 3 and 30 from option pool 5

If you take a 20 credit whole year course unit you are not permitted to drop this unit when course unit selection reopens at the start of semester 2.

### Level 2 - compulsory units

All of the units in this pool are mandatory.

Code	Title	Credits	Theme
COMP23420	Software Engineering	20	Agile Methods
COMP26120	Algorithms and Imperative Programming	20	Computer Languages
MATH20111	Real Analysis	10	None
MATH20142	Complex Analysis	10	None
MATH20201	Algebraic Structures 1	10	None

### Level 2 - option pool 1

From this option pool choose 10 credits.

Code	Title	Credits	Theme
COMP21111	Logic and Modelling	10	Rigorous Development
COMP23111	Fundamentals of Databases	10	Web and Distributed Systems
COMP24111	Machine Learning and Optimisation	10	Learning and Search in Artificial Intelligence
COMP25111	Operating Systems	10	Computer Architecture
COMP28411	Computer Networks	10	Mobile Computing and Networks

### Level 2 - option pool 2

From this option pool choose 10 credits.

Code	Title	Credits	Theme
MATH10141	Probability	10	None
MATH20411	Partial Differential Equations and Vector Calculus	10	None

### Level 2 - option pool 3

From this option pool choose 10 credits.

Code	Title	Credits	Theme
COMP24412	Symbolic AI	10	Natural Language, Representation and Reasoning
COMP27112	Computer Graphics and Image Processing	10	Visual Computing
COMP28112	Distributed Computing	10	Web and Distributed Systems

## Level 2 - option pool 4

From this option pool choose 20 credits.

Code	Title	Credits		Theme
MATH20122	Metric Spaces	10	None	
MATH20212	Algebraic Structures 2	10	None	
MATH20302	Propositional Logic	10	None	
MATH20602	Numerical Analysis 1	10	None	
MATH20902	Discrete Mathematics	10	None	
MATH20912	Introduction to Financial Mathematics	10	None	

## Level 3 options

MANDATORY UNITS - 30 CREDITS

OPTIONAL UNITS - 90 CREDITS

You must register for the following:

A minimum of 50 COMP units (including the project).

A minimum of 50 MATH units, of which at least 40 credits must be at level 3.

The remaining 20 credits can be either COMP on level 3 or MATH on level 2 or 3.

If you take a 20 credit whole year course unit you are not permitted to drop this unit when course unit selection reopens at the start of semester 2.

Overall from the 120 credits, a minimum of 100 must be level 3

Please note that some combinations of course units may not be possible due to timetable clashes.

If you wish to enrol on optional units (COMP or MATH) that are not listed below you must have permission from the Programme Tutor - Dr Andrea Schalk.

## Level 3 - compulsory units

All of the units in this pool are mandatory.

Code	Title	Credits		Theme
COMP30030	3rd Year Project (Joint Hons 30 Credits)	30	None	

## Level 3 - option pool 1

From this option pool choose a maximum of 40 credits  
and a minimum of 30 credits.

Code	Title	Credits		Theme
COMP31111	Verified Development	10	Rigorous Development	
COMP31212	Concurrency and Process Algebra	10	Rigorous Development	
COMP33411	Software Design using Patterns	10	Software Engineering	
COMP33512	User Experience	10	Software Engineering	
COMP33711	Agile Software Engineering	10	Agile Methods	
COMP33812	Software Evolution	10	Agile Methods	
COMP34120	AI and Games	20	Learning and Search in Artificial Intelligence	
COMP34411	Natural Language Systems	10	Natural Language, Representation and Reasoning	
COMP35112	Chip Multiprocessors	10	Computer Architecture	
COMP36111	Advanced Algorithms I	10	Programming and Algorithms	
COMP36212	Advanced Algorithms II	10	Programming and Algorithms	
COMP36512	Compilers	10	Computer Languages	
COMP37111	Advanced Computer Graphics	10	Visual Computing	
COMP37212	Computer Vision	10	Visual Computing	
COMP38120	Documents, Services and Data on the Web	20	Web and Distributed Systems	
COMP38411	Cryptography and Network Security	10	Mobile Computing and Networks	
COMP38512	Digital Wireless Communication and Networks	10	Mobile Computing and Networks	
COMP39112	Quantum Computing	10	None	

## Level 3 - option pool 2

From this option pool choose a maximum of 70 credits  
and a minimum of 40 credits.

Code	Title	Credits		Theme
MATH31002	Linear Analysis	10	None	
MATH31011	Fourier Analysis and Lebesgue Integration	10	None	
MATH31022	Analytic Number Theory	10	None	
MATH31051	Introduction to Topology	10	None	

MATH31072	Algebraic Topology	10	None
MATH32001	Group Theory	10	None
MATH32012	Commutative Algebra	10	None
MATH32031	Coding Theory	10	None
MATH32051	Hyperbolic Geometry	10	None
MATH32062	Introduction to Algebraic Geometry	10	None
MATH33001	Predicate Logic	10	None
MATH34001	Applied Complex Analysis	10	None
MATH34011	Asymptotic Expansions and Perturbation Methods	10	None
MATH36001	Matrix Analysis	10	None
MATH36032	Problem Solving by Computer	10	None
MATH39001	Combinatorics and Graph Theory	10	None
MATH39012	Mathematical Programming	10	None
MATH39032	Mathematical Modelling in Finance	10	None

Code	Title	CO	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10				
COMP10120	First Year Team Project	C																																				
COMP11212	Fundamentals of Computation	O	DA								DA																											
COMP14112	Fundamentals of Artificial Intelligence	O	D	D		D	D				D		D							D								D	D	D								
COMP16121	Object Oriented Programming with Java 1	C		DA																DA								DA	DA									
COMP16212	Object Oriented Programming with Java 2	C		DA							DA	DA	DA						D	DA							D	D	D									
COMP18112	Fundamentals of Distributed Systems	O		DA									DA																									
COMP21111	Logic and Modelling	O	D	D			D				D									D																		
COMP23111	Fundamentals of Databases	O				D	DA		D		DA		DA					DA								DA		DA		DA								
COMP23420	Software Engineering	C		D		D					D	D	D				D		D	D	D					D	D	D	D									
COMP24111	Machine Learning and Optimisation	O	DA		DA							DA								DA	DA														DA			
COMP24412	Symbolic AI	O	DA				DA				D									D						D									D			
COMP25111	Operating Systems	O		D	D						D	D	D			D				D					D			D	D									
COMP26120	Algorithms and Imperative Programming	C		DA	DA	DA					DA	DA	DA						DA	DA	DA					DA		DA	DA	DA	DA							
COMP27112	Computer Graphics and Image Processing	O	DA																																	DA		
COMP28112	Distributed Computing	O																																				
COMP28411	Computer Networks	O			D						D									D	D							D	D	D								
COMP30030	3rd Year Project (Joint Hons 30 Credits)	C									D	D	D			D	D	D							D	D	D	D	D									
COMP31111	Verified Development	O	DA		DA						DA																									DA		
COMP31212	Concurrency and Process Algebra	O	D	D			D				D		D							D																D		
COMP33411	Software Design using Patterns	O		D		D					D	D	D							D								D										
COMP33512	User Experience	O	DA	D	D		D				DA		D						D																	DA		
COMP33711	Agile Software Engineering	O		DA		DA		DA	DA		DA	DA	DA						DA		D						DA								DA	DA		
COMP33812	Software Evolution	O		DA		DA					DA		DA																									
COMP34120	AI and Games	O																																				
COMP34411	Natural Language Systems	O		DA			DA				DA		DA							DA									DA									
COMP35112	Chip Multiprocessors	O																																				
COMP36111	Advanced Algorithms 1	O		DA							DA	DA	DA								DA															DA		
COMP36212	Advanced Algorithms II	O		DA							DA	DA	DA								DA																DA	
COMP36512	Compilers	O		D	D		D				D		D																									
COMP37111	Advanced Computer Graphics	O	DA	DA		DA					DA																											
COMP37212	Computer Vision	O	D	D			D				D																											
COMP38120	Documents, Services and Data on the Web	O					DA		D		D		D			D	D				D							D										
COMP38411	Cryptography and Network Security	O			D						D									D																		
COMP38512	Digital Wireless Communication and Networks	O			D		D				D		D																									
COMP39112	Quantum Computing	O	D		D						D																										D	
MATH10111	Sets, Numbers and Functions	C																																				
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MATH20122	Metric Spaces	O																																				
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MATH32001	Group Theory	O																																				





## **Mechanisms for programme revision**

Course units are reviewed annually by the Undergraduate Committee, as part of the Annual Review process, taking into account the results and comments from Course Unit Evaluation Questionnaires. Input is also received from the Teaching Assessment Panel, which has a responsibility for monitoring teaching quality in the School.

Programmes have been reviewed regularly by groups created specifically for this purpose; the last major review resulted in a new programme portfolio design which started in the first year in 2008-9. The responsibility for leadership of programme review is now in the hands of the Director of Teaching Strategy (currently Dr Steve Pettifer) who chairs a School Teaching Strategy Committee.