Module specification

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Module code	COM539
Module title	Data Structures and Algorithms
Level	5
Credit value	20
Faculty	FAST
Module Leader	Vic Grout
HECoS Code	100956
Cost Code	GACP

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BSc (Hons) Computer Science	Core
BSc (Hons) Computer Science (with Industrial Placement)	Core
BSc (Hons) Cyber Security	Core
BSc (Hons) Cyber Security (with Industrial Placement)	Core
BSc (Hons) Applied Software Engineering	Core
BSc (Hons) Applied Cyber Security	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	30 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	0 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	30 hrs
Placement / work based learning	0 hrs
Guided independent study	170 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	30/08/2018

For office use only	
With effect from date	01/09/2018
Date and details of revision	12/11/2021 template update
Version number	2

Module aims

This module aims to give students a thorough grounding in the theories and application of computer algorithms, abstract data types, underlying data structures and their integration to produce efficient programs. This allows students to develop the knowledge and skills to be able to analyse problems and then design, implement, and analyse, effective algorithmic solutions.

Students will become familiar with the implications of algorithmic solutions in terms of their computational complexity (space, time and logical) and develop a working knowledge of optimal and approximate (including heuristic) solutions to problems.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Analyse and interpret a range of problems and produce designs and models for algorithmic solutions
2	Implement computational solutions that demonstrate proficiency in a range of algorithmic techniques and data structures
3	Identify and evaluate problems and solutions in terms of their computational complexity

Assessment

Indicative Assessment Tasks:
Students will build an electronic portfolio of key data structures and algorithms in solving a variety of problems. Approximately half of the portfolio's software will come from exercises worked upon in class with the remainder being extensions or variations developed, under guidance, by the students. The portfolio will include full testing throughout. Where practical the assessment will be related/carried out in the workplace.

Students will also undertake an 'open book' timed class challenge requiring a designed and implemented solution to a given problem. Marking will be based on the appropriateness and effectiveness of the data structures and algorithm(s) selected and used.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1,2,3	Portfolio	75%
2	1, 2	In-class test	25%

Derogations

None

Learning and Teaching Strategies

The delivery for the module will consist primarily of lecture and lab work, split approximately 50/50. However, the time will be used flexibly, when pertinent, to allow other modes of learning to be integrated, such as tutorials, guest speakers, or site visits. Module delivery will be supported by the use of the University's Virtual Learning Environment (VLE).

Lectures are used to deliver the key theories and principles of the module, supported by reflection and practice of these through lab sessions and discussion. Labs will provide students with the opportunity to put their knowledge and theories into practice, coding solutions in a relevant computer programming language, and responding to exercises and briefs that form part of the on-going module portfolio assessment.

Students are expected to work in small groups during lab sessions. Problems and scenarios will start off reasonably constrained, but will increase in complexity, scope, and duration as the module advances.

Indicative Syllabus Outline

- Advanced computational thinking
- Problem solving with algorithms
- Top down design (logical complexity)
- Abstract data types
- Variables
- Linked Lists
- Stacks
- Queues
- Binary trees
- Hashing
- Recursion
- Single and multi-dimensional arrays
- Algorithmic complexity (space and time) and polynomial/exponential growth
- Searching and sorting algorithms
- Combining data structures and algorithms into effective programs
- Examples: Graph problems
- Examples: Automata
- Examples: Security algorithms Secure programming
- Concurrency, threading and parallelism

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

Cormen, T.H. (2009), *Introduction to Algorithms*. 3rd ed. Cambridge, Mass: MIT Press.

Karumanchi, N. (2011), *Data Structures and Algorithms Made Easy in Java: Data Structure Algorithmic Puzzles.* Careermonk Publicatons.

Other indicative reading

Drozdek, A. (2012), *Data Structures and Algorithms in C++*. 2nd ed. Cengage Learning.

Hopcroft, A.V.A.J.E. and Ullman, J. (1983), *Data Structures and Algorithms*. London: Addison-Wesley.

Knuth, D.E. (1997), *The Art of Computer Programming,* Volume 1: Fundamental Algorithms. 3rd ed. London: Addison-Wesley.

Neapolitan, R.E. and Naimipour, K. (2014), *Foundations of Algorithms*. 5th ed. Burlington, MA: Jones & Bartlett Learning.

Sedgewick, R. (2011), *Algorithms*. 4th ed. London: Addison-Wesley

Komm, D. (2016) *An Introduction to Online Computation: Determinism, Randomization, Advice.* Springer.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas.

Core Attributes
Engaged
Enterprising
Creative
Ethical

Key Attitudes
Commitment
Curiosity
Resilience
Confidence
Adaptability

Practical Skillsets
Digital Fluency
Organisation
Critical Thinking
Emotional Intelligence
Communication