Faculty of Health, Science and Technology
Computer Science

Syllabus

Programming and Data Structures

Course Code:	DVGA12
Course Title:	Programming and Data Structures *Programmering och datastrukturer*
Credits:	15
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has only upper-secondary level entry requirements (G1N)

Major Field of Study:
DVA (Computer Science)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2025-02-11, and is valid from the Autumn semester 2025 at Karlstad University.

Prerequisites
General admission requirements and upper secondary level Mathematics 3c/D

Learning Outcomes
Module 1 (5 ECTS cr)
Upon completion of this module, students should be able to:
- describe the structure and function of a computer,
- use a programming environment to compile and run simple programs,
- independently design simple programs in a high-level language, and
- explain and document simple programs in writing.

Module 2 (5 ECTS cr)
Upon completion of this module, students should be able to:
- give an account of object-oriented principles such as abstraction, modularisation,

encapsulation, inheritance, polymorphism, and dynamic binding,
- apply object-oriented design principles to write simple programs in an object-oriented programming language,
- analyse a problem and design and model an object-oriented program based on the analysis,
- use exceptions and other techniques to handle and signal errors, and
- systematically test and document software.

Module 3 (5 ECTS cr)
Upon completion of this module, students should be able to:
- give an account of the role of abstraction in software development and computer science,
- give an account of abstract data structures and their relevance in software development,
- give an account of the algorithms commonly used in computer science,
- give an account of the concepts behind complexity theory,
- combine and use abstract data structures as a general design tool,
- apply the algorithms commonly used in computer science,
- apply complexity theory to simple algorithms and programs, and
- document laboratory work in writing.

Content
Module 1
This module covers the basics of problem-solving in a high-level language. The following content is included:

Structure and function of a computer
Basic syntax and semantics
Sequence, selection, and iteration
Data types and references
Operators and expressions
Debugging and testing
Functions
Algorithms
Sorting and searching
Memory management
Recursion
File handling
Documentation techniques

Module 2
This module covers both programming in an object-oriented language and techniques in software development that promote abstraction, modularisation, and reusability. Additionally, software testing and code documentation are introduced. The following content is included:

Object-oriented programming
Abstraction
Modularisation
Modeling
Analysis
Testing (unit and end-user tests)
Documentation
Exceptions and error handling
Basic data structures (e.g., lists, queues, stacks, trees)
Development models and software quality

Module 3
This module covers basic data structures (sequence, list, stack, queue, tree, graph) and operations on these data structures. The module also covers a number of algorithms that use the aforementioned data structures: sorting, searching, hashing, and navigating within a specific data structure, as well as the shortest path between two nodes in a graph, shortest path trees, cycle detection, minimum spanning trees, strong components, and spanning forests. The concept of heuristics is introduced. Evaluation of algorithms and elementary complexity theory are also introduced.

Both theory and practice are included. The theory is conveyed through literature supported by lectures and reading instructions. The practical component consists of exercises and laboratory sessions.

Reading List
See separate document.

Examination
Assessment is based on mandatory laboratory and hand-in assignments and written exams. There are several laboratory and/or hand-in assignments and a written exam for each module.

If students have a decision from Karlstad University entitling them to Targeted Study Support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades
One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course. For students in Engineering, one of the grades 5 (Pass with Distinction), 4 (Pass with Some Distinction), 3 (Pass), or U (Fail) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.

The course DVGA12 cannot be included in the same degree programme as the courses DVGA01, DVGA02, and DVGB03.