Course unit title:	Fundamentals and Applications of Data Structures
Course unit code:	CSW205
Type of course unit: **(Compulsory/optional)**	Compulsory
Level of course unit: **(First, second or third cycle)**	Bachelor (1st cycle)
Year of study:	2
Semester when the unit is delivered:	4
Number of ECTS credits allocated:	6
Name of lecturer(s):	TBA

Learning outcomes of the course unit:

On successful completion of the course, the student will be able to:

- Analyze program time complexity and express it in big-Oh, Omega and Theta notation.
- Classify and evaluate different data structures, both linear and non-linear.
- Generate programs that use abstract data structures to solve computational problems.
- Apply different algorithms to solve computational problems.
- Explain the basic concepts of information retrieval and data mining techniques.
- Explain and exemplify common algorithms for information retrieval such as document search, indexing and retrieval, query processing.

Mode of delivery:	Face-to-face
Prerequisites and co-requisites:	CSC132
Recommended optional program components:	None

Course contents:

Objective:
The course will introduce students to the basic concepts of data structures, and their usefulness in various computer operations. Structures like arrays, stacks, queues, linked lists, trees and graphs will be discussed and analyzed. Algorithms will be developed that operate and manipulate these structures efficiently. Analysis of time-space complexity of algorithms.

The course also introduces basic data structures and algorithms for retrieve useful information from repositories such as the Web including efficient text indexing, web search algorithms, link-based algorithms, text/Web clustering and text mining.

Description:

Introduction and basic concepts of data structures:
Definition of a data structure, implementation of a data structure, definition of an algorithm, distinguishing between an algorithm and a program, how to create and analyze programs. Asymptotic notation and arithmetic, O-notation. Complexity of searching and sorting algorithms. Recursive mathematical function, recursively defined problem.

Linked Lists:
Array and pointer implementation of a linked list, the INSERT and DELETE operations on Linked lists, their efficiency. Doubly linked lists and their advantages.

STACKS and QUEUES:
Definitions of these two data structures, operations/ algorithms associated with stacks: CREATE, DELETE, return the TOP element of a stack, ADD an element to the stack; operations/ algorithms performed on Queues: Create, DELETE the FRONT element, ADD an element to the REAR.

Sorting and Searching:
$O(n^2)$ and O(nlogn) sorting techniques, Linear and Binary Search, Greedy and Divide and Conquer algorithmic techniques, Hashing. Application of those algorithms in the web.

Trees: Definition of a Tree, a rooted tree, the height of a rooted tree, levels, a balanced tree, an n-ary tree.
Traversing a tree: Inorder, Postorder Preorder and Level-Order traversals.
Implementation of trees, representation of trees by Lists of children using linked lists.

BINARY trees and (Balanced) BINARY SEARCH Trees and its property, operations supported: FIND, INSERT, DELETE, MIN; algorithms to implement these operations, time-analysis of these operations. Balanced multiway search trees (B-trees). Min, Max Heaps. Applications in the web.

Search algorithms: Breadth- and depth-first search in graphs, implementation of graphs. Hashing functions and table: search, insert operations. Applications in the web.

Introduction to Information Retrieval. Inverted indices and boolean queries. The nature of unstructured and semi-structured text. Web search overview, web structure, search engine optimization/spam. Web size measurement.

Introduction to clustering. Word-based ranking: the vector space model, Link based methods (PageRank), Web Crawlers, Web indexes.

Recommended or required reading:	Data structures and algorithms in C++, Goodrich, M. & Tamassia R and Mound, D, Wiley, 2010. Information retrieval: data structures and algorithms, William B. Frakes, Ricardo Baeza-Yates, Prentice Hall, 1992 Sartaj Sahni, data structures, algorithms and Applications in C++, McGraw-Hill, 2004 Mark A. Weiss, Data Structures and Algorithm analysis in C++, Addison-Wesley, 2013 Clifford, A , practical introduction to data, Structures and algorithms, Prentice Hall, 2010.
Planned learning activities and teaching methods:	Class Instruction: 42 Hours Consultation: 30 Hours
Assessment methods and criteria:	Examinations 75% Assignments/Class Participation 25% 100%
Language of instruction:	English
Work placement(s):	No
Place of Teaching:	Regular Classroom European University Cyprus, Nicosia Computer Laboratory European University Cyprus, Nicosia