Description of HY240

The course focuses on the study of basic data structures, like arrays, stacks, queues, lists, trees, as well as on more complex data structures such as balanced trees, graphs and others. Additionally, hashing techniques, as well as data structures for the implementation of dynamic dictionaries, simple sets and sets with special operations are taught. Selected topics on sorting and basic techniques of algorithm design are also taught. The syllabus is provided below.

Introduction: Basic concepts on algorithms and data structures, Proof techniques, RAM model, Analysis of algorithms, Time complexity, Asymptotic analysis, Standard complexity classes, Mathematical background, Recursive algorithms and their analysis, Recursive relations, Experimental analysis.

Basic data structures: Arrays (operations on Arrays, multi-dimensional arrays, symmetric and triangular Arrays, sparse arrays), Stacks (abstract data type, static and dynamic implementations, static implementation of multiple stacks, applications, complexity, stacks that support the multipop() operation, Queues (abstract data type, static and dynamic implementation, complexity, applications), Lists (unsorted and sorted lists, guard node, list traversals, zig-zag traversals, doubly linked lists, complexity, applications), Trees **(**definition, types of trees and their properties, implementation, tree traversals, ordered trees).

Sets & Dictionaries: Abstract data type, Implementation using linked lists, Move-to-front and Transpose heuristic, Binary search, Expected analysis, Binary Search Trees.

Balanced Trees: AVL Trees, (2,3)-trees, Red-Black trees.

Hashing: Chain hashing (separate and coalesced chaining), Open addressing strategies (linear probing, double hashing), Analysis of different strategies, Ordered hashing, Extendible hashing, Hash Functions, Universal Hashing.

Priority queues: Abstract data type, Implementation using balanced binary search trees, Partially ordered trees, Implementation using Heaps.

Sorting: InsertionSort, SelectionSort, MergeSort, HeapSort, QuickSort.

Sets with special operations: Disjoint sets that support Union-find, Up-Trees.

Graphs: Representation, implementation, traversal, applications.

Books: (1) Harry Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins Publishers, Inc., New York, 1991, (2) Cormen, Leiserson and Rivest, Introduction to Algorithms, MIT Press, 1990.

Three sets of theoretical exercises on the taught material. Project (in two parts) which includes programming in C, C++ or Java.