Data Structures and Algorithms – using JAVA

Boro Jakimovski
University of Sts Cyril and Methodius, Skopje

Data Structure course

- The course is organized in the following manner
  - 2 hours lectures
  - 1 hour tutorial
  - 2 hours lab exercises
Data Structures course

- The tutorials and lab exercises are closely coordinated with the lectures.
- The material covered in each lecture is later covered in the tutorials from implementation point of view using Java.
- Lab exercises extend the tutorials where each student implements the assigned exercises.

Lab exercises purpose

- Lab exercises main focus is to teach the students to learn:
  - How to implement certain data structures
  - How to use already implemented data structures
  - Learn how to use Java powerful library of already implemented data structures.
Organization

- The course is organized using moodle as a courseware tool
- The course is organized in weeks and each week the students can download both the lectures and the tutorials
- Also for each week there are materials for laboratory exercises accompanied with assignments

Lab work and Assignments

- The lab work consists of:
  - examples of already implemented problems
  - partial solutions of problems
  - assignments for lab and home work
- Assignments
  - each week the students are obliged to upload the solution for the given problem
  - this is later evaluated and together with the projects make up a part of the final grade
Lab exercises

Following are the lab topics and exercises that are given for each topic:

- Java examples and repetition
- Asymptotical complexity of Java programs
- Basic data structures (arrays and lists)
- Abstract data types
- Stack, Queue, Dequeue
- Lists (different kinds of lists)
- Hash tables
- Binary trees
- Heap
- Search trees
- Graphs

Lab exercises

- Lab 1: Java examples and repetition
  - Usage of data structures
  - Sum up $1+1/2+1/3+...$
  - Implement the class RationalNumber with its methods and attributes

- Lab 2: Asymptotical complexity of Java programs
  - Given short programs with loops and calling other methods with given complexity
  - Calculate the complexity
Lab exercises

Lab 3: Basic data structures
- Given the implementations of CustomArray and LinkedList
- Implement additional methods for this structures
- Usage of this DS

Lab 4: Abstract data types
- Implementation of Abstract Data Type using Java Interfaces
- Implementation of the interface Cardfile

Lab 5: Stack, Queue, Dequeue
- Given are the interface and the implementation of Stack, Queue and Dequeue
- Usage of the Stack in implementation of recursive algorithms
- Adding methods to the Data structures

Lab 6: Lists (different kinds of lists)
- Explanation of the different kinds of lists
- Implementation of Double Linked Lists with given methods
Lab exercises

Lab 7: Hash tables
- Given the interface, implementations and the usage of the hash table
- Implement the hashCode() method

Lab 8: Binary trees
- Given the Binary Tree Implementation
- Implement inorder and preorder traversal
- Implementation of Tree ADT

Lab exercises

Lab 9: Heap
- Given the Heap data structure
- Implement the HeapSort algorithm

Lab 10: Search trees
- Given the implementation of BinarySearchTree
- Implement the method deleteElement
- Implement AVT tree
Lab exercises

- Lab 11: Graphs
  - Given the implementation of Graph
  - Implement the following methods:
    - public Iterator nodes ();
    - public Iterator edges ();
    - public Iterator neighbors (graph.Node node);
    - public Iterator connectingEdges (graph.Node node);

Conclusion

- The course was very well structured and the exercises were shown to be very successful
- Usage of Moodle was a good choice as the students were very pleased of its simplicity
- The main focus on the exercises was not only to learn how to implement the DS but also how to use them