Ministry of Higher Education
Karwan University
Faculty of Computer Science

Data Structure

Lecture 0: Course Overview

August 12, 2024

Lectures & other related materials are available here: https://github.com/mujtabaSultani01/data_structure

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Course Information

- Course Name:
  - Data Structures
- Pre-Requirements for the participation
  - *Algorithms and C++ programming*
- Type of Course:
  - Lecture with supporting weekly exercises to repeat and adapt the lecture contents and Projects
- Slides and Extra Notes:
  - Soft Version

Lecture Issues

- Lecture Times per Week
  - Monday 04:30 – 06:00 (Lecture)
  - Monday 06:30 – 07:30 (Lab and Exercises)
- Office hours
  - Sunday 04:00 – 07:00
  - Wednesday 04:00 – 07:00
- Private appointment
  - Contact me through email.

Assignments

- Weekly basis

- Rules
  - The Assignments should be handover Before the deadline...
  - You will work on the homework in Small groups
  - There should be no copy and paste
  - The copy and paste homework has zero points
  - Don't Cheat Yourself, Please!!!...

Examination and Grading

- Exams
  - Mid-term Exam: **20%**
  - Final-term Exam: **60%**
- Others
  - Class Activity: **10%**
  - Homework: **10%**

Class Rules

- Full attendance
- Please come on time
- Turn off your mobile.

Don’t disturb your classmate !!!!

Problems and Question

- Place:
  - Computer Science Faculty (Lecturer room)

- Internet contact :
  - Mujtaba.cs01@gmail.com

Course Contents

- Introduction to Java Programming
- Object Oriented Programming in Java
- Linked Data Structures
- Stacks
- Queues
- Lists
- Recursion
- Trees
- Binary Trees
- Search Trees
- Graphs

Literature

- Data Structures with Java 2nd Edition, John R. Hubbard.
  - This book has been used as the main reference for compiling this syllabus.
- Dietel, P., Deitel, H.; Java How to Program, 9th ed., 2011.
- Data Structures and Algorithms in Java 5th Edition, Michael T. Goodrich and Roberto Tamassia

Data Structures and Algorithms

- A *data structure* is an arrangement of data in a computer's memory (or sometimes on a disk).
- Data structures include arrays, linked lists, stacks, binary trees, and hash tables, among others.

- *Algorithms* manipulate the data in these structures in various ways, such as searching for a particular data item and sorting the data.

Characteristics of Data Structures

Data Structure	Advantages	Disadvantages
Array	Quick insertion, very fast access if index known.	Slow search, slow deletion, fixed size .
Ordered array	Quicker search than unsorted array.	Slow insertion and deletion, fixed size.
Stack	Provides last-in, first-out access.	Slow access to other items.
Queue	Provides first-in, first-out access.	Slow access to other items.
Linked list	Quick insertion, quick deletion.	Slow search.
Binary tree	Quick search, insertion, deletion (if tree remains balanced).	Deletion algorithm is complex.

Data Structure	Advantages	Disadvantages
Red-black tree	Quick search, insertion, deletion. Tree always balanced.	Complex.
2-3-4 tree	Quick search, insertion, deletion. Tree always balanced. Similar trees good for disk storage	Complex.
Hash table	Very fast access if key known. Fast insertion.	Slow deletion, access slow if key not known, inefficient memory usage.
Heap	Fast insertion, deletion, access to largest item.	Slow access to other items.
Graph	Models real-world situations.	Some algorithms are slow and complex.

Overview of Algorithms

Many of the algorithms we'll discuss apply directly to specific data structures. For most data structures, you need to know how to

- Insert a new data item.
- Search for a specified item.
- Delete a specified item.

- You may also need to know how to *iterate* through all the items in a data structure, visiting each one in turn so as to display it or perform some other action on it.
- Another important algorithm category is *sorting*. There are many ways to sort data.
- The concept of *recursion* is important in designing certain algorithms. Recursion involves a method calling itself.

Some Definitions

- Let's look at a few of the terms that we'll be using throughout this course.

- **Database**
  - We'll use the term *database* to refer to all the data that will be dealt with in a particular situation.
  - We'll assume that each item in a database has a similar format.

Some Definitions

- **Record**
  - *Records* are the units into which a database is divided.
  - They provide a format for storing information.
  - A record includes all the information about some entity, in a situation in which there are many such entities.
  - A record might correspond to a person in a personnel file, a car part in an auto supply inventory, or a recipe in a cookbook file.

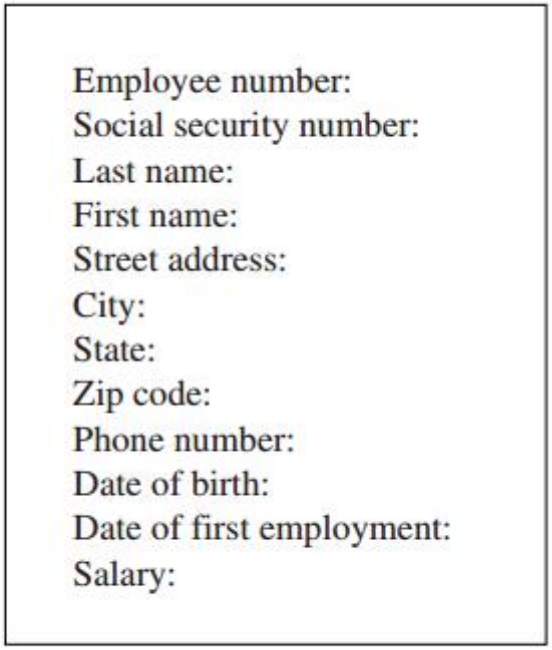
Some Definitions

- **Field**
  - A record is usually divided into several *fields*. A field holds a particular kind of data.
  - On an index card for an address book, a person's name, address, or telephone number is an individual field.
  - More sophisticated database programs use records with more fields.
  - In Java (and other object-oriented languages), records are usually represented by *objects* of an appropriate class. Individual variables within an object represent data fields. Fields within a class object are called *fields* in Java (but *members* in some other languages such as C++).

Some Definitions

- **Key**
  - To search for a record within a database, you need to designate one of the record's fields as a *key* (or *search key*).
  - You'll search for the record with a specific key.
  - For instance, in an address book program, you might search in the name field of each record for the key "Brown." When you find the record with this key, you can access all its fields, not just the key.
  - We might say that the key *unlocks* the entire record.
  - You could search through the same file using the phone number field or the address field as the key.

Example:



A record with multiple fields.

Home Work

- Create groups until next week. (Maximum of two students)

References:

- Data Structures with Java 2nd Edition, John R. Hubbard.