

Introduction

CSCD 300 – Data Structures

Eastern Washington University

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A few announcements

- This course needs proficient Java programming skills. It is assumed that you all are already good at Java programming and understand the OOP design philosophy well.
- Lecture attendance is not mandatory. However, the chance of getting good scores from the homeworks and exams without attending lectures is often very low.
- Regularly check your email accounts that you registered with the EagleNet and Canvas systems. Many announcements will be sent via emails.
- Please make sure you are in the Canvas site of this course already.
- Please refer to the syllabus for other policies relevant to this course.
- Email me for any questions:
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“Data structures” in life and why we need them

- We collect and organize all the words in a dictionary using *the alphabetical order* → for fast search for any particular word.
- We collect and organize the library books using a *hierarchical category-based indexing system* → for good organization of the books and fast locating of any particular book.
- We organize the computer files using a file system with *the logically hierarchical directory-based structure* → for good organization of the files and fast searching for any particular file.
- We request the customers wait in a *first-in-first-served queue* at a grocery store's checkout desk → for quick and fair services to all customers.
- ...

What do we learn ?

We are given a set of “data” elements (such as words, people, books, computer files, ...), on which we will perform some operations (search, organize, update, add, delete, ...).



In order to make those operations efficient both space and time wise, we want to organize the data in a **special kind of structure**, depending on:

- 1 where the data will be stored (a dictionary book, checkout desk, library building, computer hard drive).
- 2 what operations are to be performed on the data.
- 3 ...

“Data structures” on computers and why we need them

Computers are of course designed for data storage, processing, and management. We need to perform all different kinds of operations on the data for various reasons and purposes depending on the applications.



In order to make these operations efficient, we need to design different “data structures” to organize these data, depending on:

- 1 what computer data storage mediums are being used.
- 2 what operations are to be performed on the data.
- 3 ...

Data structures for different computer data storage mediums

The usefulness of a data structure heavily depends on the characteristics of the data storage medium. For example,

- data structures for magnetic harddrives.
- data structures for random access memory (RAM).
- data structures for flash drivers.
- data structures for optical discs.
- ...

In this class, we focus on ...

the design, analysis, and implementation of various **RAM-based data structures for different applicational purposes**, because most applications process their data in the RAM.

The logical view and characteristics of RAM

- The RAM can be viewed as a linearly collected memory storage unit cells.
- Every unit cell has a unique address, which continuously increases.
- Any unit cell can be accessed directly using constant time (a.k.a. random access) by knowing the address of that unit cell, no matter where the storage unit cell locates.



RAM

The theme of data structure design

The job of data structure design on the RAM is to figure out how to organize and manage data on this device in a well design *logical structure* by utilizing the characteristics of RAM, so that operations on the data will be efficient.

The goal of this course

- We will learn several classic and basic data structures: **linked list, stack, queue, hashing table, binary search trees, ...**, which were particularly designed for efficient data management on RAM by using the characteristics of the RAM.
- We will also learn a few classic sorting algorithms that work particularly well on the RAM model: **quick sort, merge sort, selection sort, insertion sort, bubble sort**, replying on the relevant data structures that organize the data being sorted on the RAM.

Why are data structures important ?

- It is one of the fundamentally important the computer science courses. Efficient solutions for applications become possible only if appropriate data structures have been picked.
- It is an important course for its successor: CSCD320 Algorithms, which studies the design and analysis of solutions for various problems. Data structures and algorithms work collectively most of the time.
- A big part of industrial interview questions from well known companies (such as Microsoft, Google, Facebook, Amazon, Oracle, ...) will be about problem solving using data structures and algorithms.