Data Structure and Algorithms

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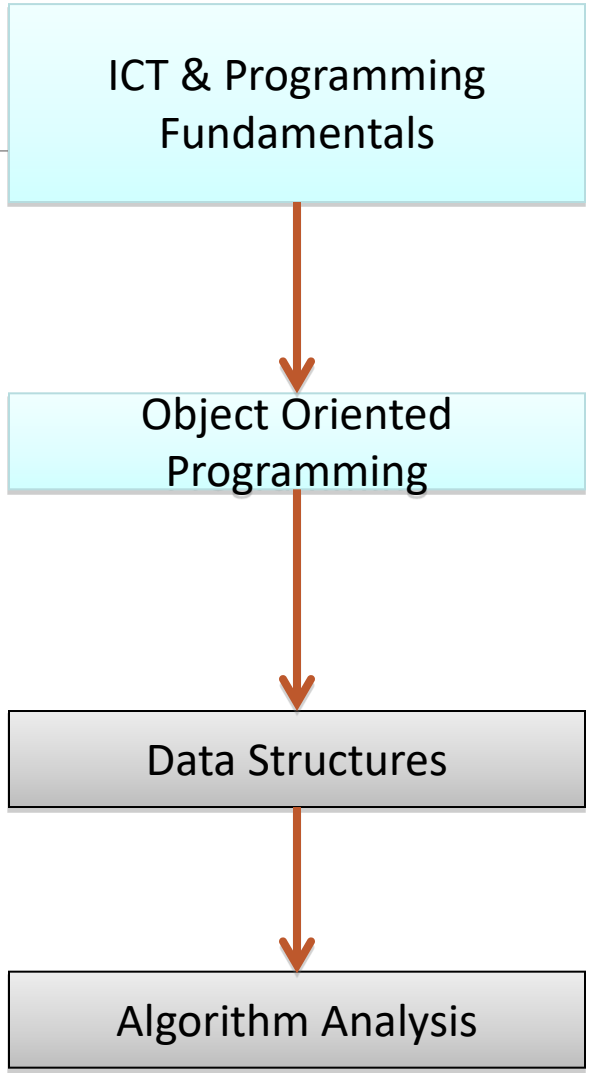
General Overview

What is Hardware, Software, Programming, Operating System etc

How to write software with the help of procedural and object oriented programming?

How to efficiently utilize resources with the help of different data structures?

How to efficiently solve complex problems?



Programming Fundamentals and Object Oriented Programming

These were the basics of programming

- The ability to manipulate the computer to perform the required tasks

You saw data storage techniques:

- Arrays, and

You saw array accessing/manipulation techniques:

- Searching, and
- Sorting

Data Structure and Algorithms

In this course, we will look at:

- *Algorithms* for solving problems efficiently
- *Data structures* for efficiently storing, accessing, and modifying data

We will see that all data structures have trade-offs

- There is no *ultimate* data structure...
- The choice depends on our requirements

Data Structure and Algorithms

Consider accessing the k^{th} entry in an array

- In an array, we can access it using an index `array[k]`
  - You will see in course that there is a single machine instruction for this
- We must step through the first $k-1$ nodes in a linked list

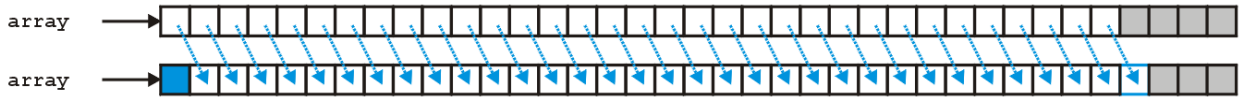
Consider searching for an entry in a sorted array

- In a sorted array, we use a fast binary search
  - Very fast
- We must step through all entries less than the entry we're looking for
  - Slow

Data Structure and Algorithms

However, consider inserting a new entry to the start of an array.

- An array requires that you copy all the elements in the array over
  - Slow for large arrays



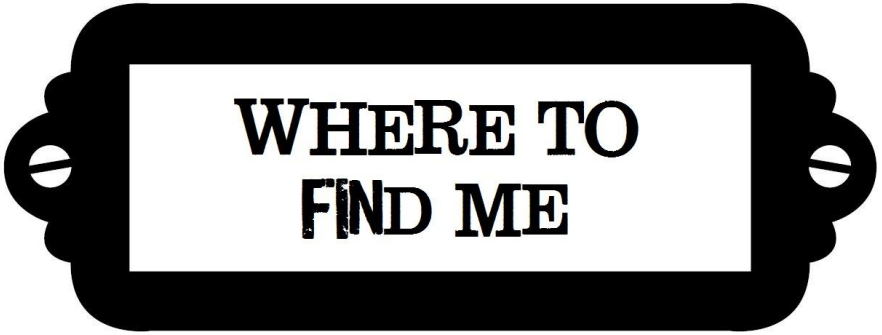
Class Policies and Guidelines

- Attendance will only be marked if you are physically present, with no allowance for late entries.
- Attendance errors must be addressed during the class, and retrospective changes will not be considered.
- Submissions are expected to be made on time, without any exceptions.
- Plagiarism will result in a minimum penalty of a zero for all parties involved, with more severe consequences depending on the circumstances.
- Marking queries should be raised within 24 hours of the release of marks, and no retrospective changes will be entertained.
- Class etiquette requires students to refrain from talking when the instructor is speaking, avoid sleeping in class, and not leave early without prior permission.
- The use of electronic devices, specifically mobile phones, is strictly prohibited during class and must be kept on silent mode.

Course Policies and Guidelines

- Instead of hunting for teachers, drop an email to your teacher and wait!
  - Subject must be BS_Fall23_Section:<Concern>
  - Warning! Facebook or any other social medium is not meant for course communication, anyway so don't include it
- Report your queries within due time to not regret later
- For every assignment, there will be an associated quiz to evaluate your performance.
- No extension in tasks so don't expect ever
  - Deadlines will be based on semester's practical constraints, already
- Warning! Be regular in class for not pleading later
  - Your attendance requirement is **100%** however you are given compensation of 20% considering routine life circumstances.

- Office: A2 (3rd Floor, Academic Block)
- Email: affefah.qureshi@iqraisb.edu.pk



Good News

- You all have achieved a remarkable 100% attendance record, and your marks stand at a perfect 100 as well.

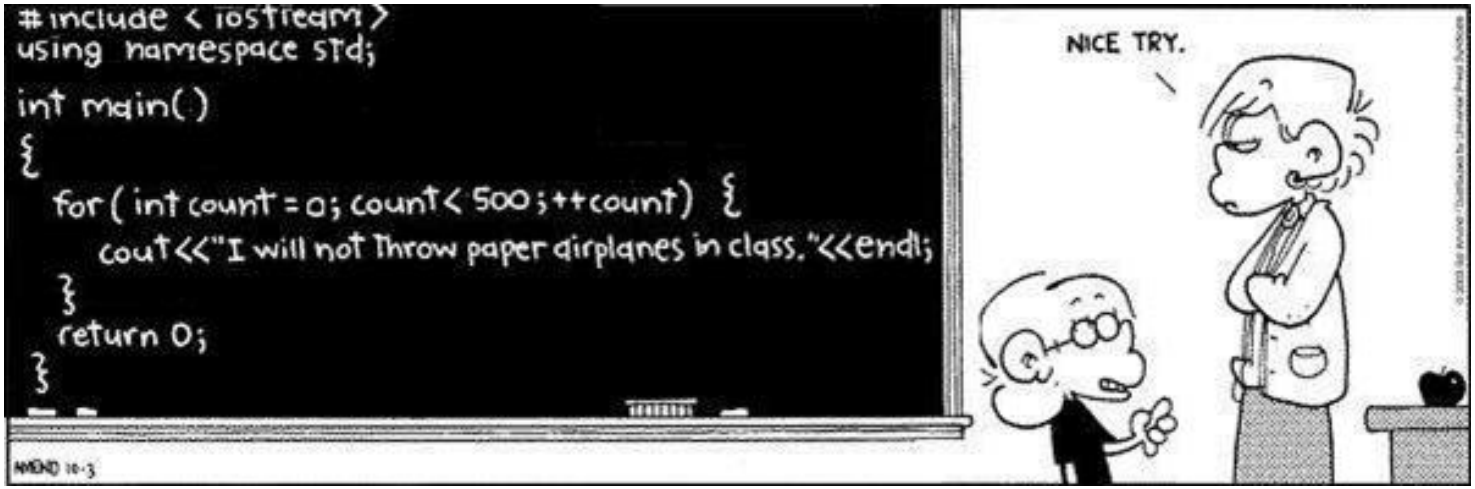
So **Grade = A**

- Remember, your grades are now in your hands.
- The choices and efforts you put forth will determine the path to success.
- Let's strive for excellence and make this semester a journey worth celebrating.

Best of luck, and let's make it a great academic term!"

C++

You will be using the C++ programming language in this course



C++

This course does not teach C++ programming

- You will use C++ to demonstrate your knowledge in this course

One lecture covers:

- Features of C++ and differences with C#

An on-line tutorial is available on the course web site

- It assumes minimal knowledge of programming

Assessment Item Weightage

Assessment Item	Weightage
Quizzes	10
Assignments	10
Mid Term	20
Final Exam	35
Lab + Project	25

Evaluation

- A student who misses either examination must provide:
  - A Verification of Illness form indicating a severe illness, or
  - Other formal documentation, as appropriate
- With proper documentation:
  - Missing the mid-term examination sets $E = F$ in the formula
  - Missing the final examination results in the opportunity to write with the next offering of the course
- Without proper documentation:
  - Missing the mid-term examination results in 0
  - Missing the final examination results in DNW and "Required to Withdraw from Engineering"
- There will be no re-weighting of the mid-term examination under any circumstances

Improving Your Performance

- To transfer information from your short-term memory to your long-term memory, that information must be imposed on your mind at least three times

- You should always try the following:
  - Look at the slides before class
  - Attend lectures
    - You see the information again with commentary
  - Review the lecture during the evening
    - Rewrite and summarize the slides in **your** words

Improving Your Performance

- In addition to this, you should:
  - Get a reasonable nights sleep (apparently this is when information is transferred to your long-term memory), and
  - Eat a good breakfast (also apparently good for the memory)

Improving Your Performance

- Like other courses, this course builds on previous information
  - I will not answer questions about material which I have either previously covered or indicated that you are required to read

- Also, neither the T.A.s nor myself will be available for help either on the day of the mid-term or final examinations
  - There is no help which can be derived in that time, and therefore, to impress this upon you, you must study before-hand if you believe you will need help

What is a data structure?

- In general, any representation that is used for storing information is a data structure

- Example: An integer, structures, classes, linked lists, etc

- More typically, a *data structure* provides a way of *organization for a collection of data items*

Where Data Structure is Helpful?

- The choice of efficient data structure makes the difference between a program running in a few seconds or many days.

What is Data Structure Efficiency?

A solution is said to be efficient if it solves the problem within its resource constraints.

- Space
- Time

The cost of a solution is the amount of resources that the solution consumes.

Costs and Benefits

Each data structure has costs and benefits.

It is very difficult to find a data structure that is better than others in all situations.

A data structure requires:

- space for each data item it stores,
- time to perform each basic operation,
- programming effort.

Books

- Data Structure and Algorithm Analysis in C++ by Mark Allen Weiss.
- Data Structures and Algorithms in C++ by Adam Drozdek