# INTRODUCTION TO DATA STRUCTURES

## Data Structure

- A collection of related data and a set of rules for organizing and accessing it
- An arrangement of data in a computer's memory or disk
- Examples of data structures: arrays, linked lists, stacks, queues, binary trees, hash tables

***Discuss:***
*Are you familiar with these data structures?*
*Which one(s)?*

- The choice of data structures affects the operations that can be done on the data:
  - List: search, insert, delete
  - Tree: search, insert, delete, find parent, find child (and other relationships)
- The choice of data structures will also depend on their advantages and disadvantages

| Data Structure | Advantages | Disadvantages |
|---|---|---|
| **Array** | Quick insertion, very fast access if index is known | Slow search, slow deletion, fixed size |
| **Linked List** | Dynamic size, faster deletion than array, quick insertion | Slow search |
| **Stack** | Provides last-in, first-out access | Slow access to other items |
| **Queue** | Provides first-in, first-out access | Slow access to other items |
| **Binary Tree** | Quick search, insertion, and deletion (if tree remains balanced) | Deletion algorithm is complex |
| **Heap** | Fast insertion, deletion, access to largest item | Slow access to other items |
| **Hash Table** | Very fast access if key known; Fast insertion | Slow deletion, access slow if key not known, inefficient memory usage |
| **Graph** | Models real-world situations | Some algorithms are slow and complex |

***Take Note:***
*Given a specific problem, which data structure should you use to be able solve the problem efficiently?(This is basically why we will go over each of the different data structures.)*

***Watch This:***
*Introduction to Data Structures by mycodeschool*
*https://www.youtube.com/watch?v=92S4zgXN17o*

## Algorithms

- Manipulate the data in the data structures in various ways
- Main Data Structure Operations
  - Insert
  - Delete
  - Search

## Application

What sorts of problems can you solve with your knowledge on data structures and algorithms?

- Real-world data storage
  - E.g. Personnel records, inventory records
- Operating Systems
  - E.g. Stacks and Queues to manage processes and resources
- Graph Modeling
  - E.g. Discovering network topologies, Social Network connections

***Answer:***
*All of the above – and more!*

## Programming

We will be implementing data structures in C#. By now, you must already have C# set up in your machines.

I understand not everyone here has a background in C#. While we are discussing what we know about the different data structures, let's try out what we know about C# Programming. Send me an email or post in the forums if you encounter any programming problems.

***Exercise 0 for Practice:***

*Create a simple calculator using C#. The calculator should:*

1. *Accept two positive numbers x and y as its input*
2. *Output the following: x+y, x-y, x*y, x/y*

***Takeaway Thoughts and Questions:***

1. *Why is it important to learn about data structures?*
2. *How will choosing which data structure to use help in creating efficient programs?*
3. *Which among the data structures highlighted in this course are you familiar with? According to your knowledge, how are they used/implemented in real life?*