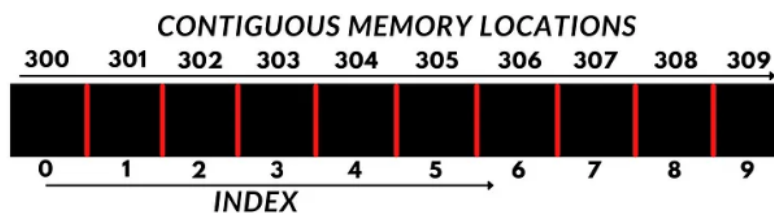# Data Structures Lab - Fall 2023
Lab 1 Tasks

Array as a Data Structure

The Array Sequence data structure is the most commonly used across all languages. It's also the simplest data structure that may be defined as a collection of elements, each stored at contiguous memory locations and each data element can be accessed at random using its index number.

Why do Arrays Exist

Arrays are homogeneous data structures, meaning it allows us to hold several data items of the same type (i.e. numbers, strings, booleans, characters, objects, etc.). Thus, once the type of value that our array is going to hold is defined, all the elements must be of that type. What makes the array so useful is our ability to store a list of data and directly access any element in the array in O(1) time, regardless of the size of the array — this means accessing the element at the 945th index takes the same time as accessing the element in the 2nd index.

Advantages

1. Arrays are used to implement other data structures (i.e. deques, queues, stacks, etc.)
2. Accessing an element is easy (if the index is known) — we simply use that index number
3. 2D arrays can be used to represent matrices

Disadvantages

1. Arrays are a static data structure. We must know how many elements will be stored in the array in advance

2. Allocating more memory than required wastes space and allocating less memory than required results in a loss of data.

3. Only one type of value can be stored in the array since arrays are homogenous

LAB TASK

Question One:
Given two integer arrays nums1 and nums2, return an array of their intersection. Each element in the result must be unique and you may return the result in any order.

Example 1:

Input: nums1 = [1,2,2,1], nums2 = [2,2]
Output: [2]
Example 2:

Input: nums1 = [4,9,5], nums2 = [9,4,9,8,4]
Output: [9,4]
Explanation: [4,9] is also accepted.

Question Two:
An array is **squareful** if the sum of every pair of adjacent elements is a **perfect square**. Given an integer array nums, return *the number of permutations of* nums *that are* **squareful**. Two permutations perm1 and perm2 are different if there is some index i such that perm1[i] != perm2[i].

Example 1:

Input: nums = [1,17,8]
Output: 2
Explanation: [1,8,17] and [17,8,1] are valid permutations.

Example 2:

Input: nums = [2,2,2]
Output: 1

Question Three:

You are given an integer array nums consisting of n elements, and an integer k.
Find a contiguous subarray whose length is equal to k that has the maximum average value and return this value.

Example 1:

Input: nums = [1,12,-5,-6,50,3], k = 4
Output: 12.75000
Explanation: Maximum average is (12 - 5 - 6 + 50) / 4 = 51 / 4 = 12.75

Example 2:

Input: nums = [5], k = 1
Output: 5.00000

Question Four:

In this lab task, you will simulate the process of recommending friends to users on a social media platform using arrays. You will use arrays to represent user interests and user ids and implement an algorithm to suggest potential friends based on shared interests.

Scenario

Create two arrays: one to store user profiles (names or IDs) and another to store their corresponding interest sets (represented as arrays). Implement a function that takes a user's name/ID as input and recommends potential friends based on shared interests.

Sample Data:
```
string user_profiles[num_users] = {"UserA", "UserB", "UserC", "UserD"};
   string user_interests[num_users][3] = {
      {"hiking", "photography", "cooking"},
      {"photography", "travel", "painting"},
      {"cooking", "gaming", "movies"},
      {"hiking", "travel", "photography"}
   };
```

Hint: This problem can be solved using the solution of one of the questions above.