# Introduction to Computer Science and Programming 1 – CSCI120

Chapter 13: Algorithm Complexity Analysis

Assignment 13

Solution

# Problem1

* Define complexity class of each of the following algorithms (operations) – Complete the table below:

1. Adding an item to a list
   1. O(1) or constant
2. Adding an item to a specific index
   1. If n is the len of the list -> O(n) or O(len(list))
3. Removing an item from the end of the list
   1. O(1) or constant
4. Searching for an item in the list
   1. O(n) or O(len(list))

# Problem2

* Think about a solution for each problem and then figure out the time complexity order and the class of complexity for the proposed solution:

1. A list of numbers is given and we want to know how many numbers our greater than 0.

O(n) n is the length of the list

1. A number is given and we want to know whether the number is prime or not.

O(n)

1. A list of numbers is given and we would like to know how many numbers in the list are prime.

To check whether prime or not: O(n)

m = len(list)

O(n)\*m = O (n\*m) = O(n^2)

1. A list is given which may or may not have repeated numbers in it. We would like to create a set from the list.
   * Adding an item to set -> O(1)
   * n = len(list)
   * n\*O(1) = O(n)

# Problem3

What is the time complexity order of the following flowchart?



# Problem4

Consider the following two scenarios and decide what algorithms would you use in each scenario and why.

Suppose, there is a list of numbers (not sorted) and we want to search for an item (a number) in the list.

**Scenario1:** If the size of the list is 10 (there are only 10 numbers in the list) and we want to search for a number only once then what algorithms (merge sort, selection sort, linear search, binary search, combinations of these, …) would you use and why?

* Searching:
  + Linear: worst case -> O(n) -> 10 seconds -> this one is better
  + Binary search (sort the list) -> n = 10
    - Mergesort to sort -> O(nlong). -> 10log10 -> 10\*3 = 30
    - Binary search -> (logn). -> log 10 = 3
      * 30 + 3 -> 33 seconds

**Scenario2:** If the size of the list is 150 (there are 150 numbers in the list) and we want to search for a number only once then what algorithms (merge sort, selection sort, linear search, binary search, combinations of these, …) would you use and why?

* Linear -> 150 seconds. -> this one is better
* Binary Search = 150log150 + log150 -> 150\*7 + 7

**Scenario3:** If the size of the list is 150 (there are 150 numbers in the list) and we want to search for a number 10 times. (running the search algorithm 10 times) then what algorithms (merge sort, selection sort, linear search, binary search, combinations of these, …) would you use and why?

* Linear -> 150\* 10 times = 1500 seconds
* Binary Search: -> Binary search is more efficient
  + MergeSort: 150log150 = 150\* 7 = 1050 seconds
  + Binary search = log 150 = 7 \* 10 = 70 seconds
  + Total = 1050 + 70 = 1120

# Problem5

* What data structure would you use in order to represent the following pieces of information.

1. To represent the annual income of a person
   * Int or float
2. To represent the number of trees in a park
   * Int
3. To represent the weather temperature
   * Int, float
4. An item (which contains name, price) from a grocery shop.
   * Dictionary or class

# Problem6

The table below represent the courses should be completed in order to the corresponding certificate is awarded. Please look at the table and answer the following questions:

|  |  |
| --- | --- |
| Certificate | Courses |
| Web development | Java core, Javascript, html, React JS |
| Mobile development | Java core, Swift, Kotlin, Data structure |
| Business | Business Management, Micro Economics, Accounting |
| UI/UX program | Core of arts and interactivity, Media information, UI Design |
| Chemistry | Chemistry, Organic products |

* What Data Structure would you use to represent the table shown above?

Dictionary:

key: is certificate name

value: list of courses (course: string)

* What is time complexity of adding a new certificate and the courses.

Dance: [course1, course2, …]

Time complexity -> O(1) or constant

* What is the order of complexity of finding the list of courses for a specific program.

O(1) or constant

* What is the order of complexity of finding whether a specific course is needed to complete a program.

First I need to get the list of courses: O(1)

Search for the course in the list: Linear search -> O(n) n is len(table[certificate]) - Complexity class linear

**Good Luck ☺**