



Faculty of Mathematical Economics

Data Structures and Algorithms

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DSEB Class of 2021 - 2024

Homework Assignment Week 1

Topic: Big O Notation

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Problem 1: Algorithm Analysis Fundamentals

Give the appropriate answers for the questions below:

1. How do you use Big O notation to analyze the time complexity of an algorithm? Why is Big O analysis important?
2. What a worst-case scenario is in the context of Big O Analysis? Is it necessary to calculate exact runtimes when analyzing algorithms with Big O notation? Why or why not?
3. (Optional) What is your understanding of space complexity? Is it different from time complexity? If yes, then how? When would you choose a solution with a better space complexity over one with a better time complexity?

Problem 2: Time Complexity

Find the time complexity for the following algorithms:

1. Algorithm 1:

```
1 def deductOne(num):  
2     num -= 1  
3     return num
```

2. Algorithm 2:

```
1 def s(_list):  
2     prefix_sum = 0  
3     for i in _list:  
4         prefix_sum += 1  
5     return prefix_sum
```

3. Algorithm 3:

```

1 testList = [1, 3, 4, 5, 61, 96, 69, 13, 22, 2001]
2
3 def al(testList):
4     for i in range(len(testList)):
5         for j in range(i+1, len(testList)):
6             if testList[j] < testList[i]:
7                 testList[j], testList[i] = testList[i], testList[j]
8     return testList

```

4. Algorithm 4:

```

1 a = 100
2 N = 40
3
4 def add(a, N):
5     for i in range(N):
6         a = a + 10
7     return a

```

5. Algorithm 5:

```

1 def count(A, B):
2     n = len(A)
3     count = 0
4     for i in range(n):
5         total = 0
6         for j in range(n):
7             for k in range(1+j):
8                 total += A[k]
9             if B[i] == total:
10                 count += 1
11     return count

```

6. Algorithm 6:

```

1 def fibo(n):
2     if n <= 1:
3         return n
4     return fibo(n-1) + fibo(n-2)

```

Problem 3: Binary Search

Implement Binary Search to find value `a` pre-defined in the following lists, and print the iteration time with each search. Print "Not Found" if there is no value `a` in the list

1. List 1:

```

1 a = 5
2 list = [1,2,4,6,7,9]

```

2. List 2:

```

1 a = "f"
2 list = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l',
          'm', 'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y',
          'z']

```

3. List 3:

```
1 a = 5
2 list = [2, 1, 2163, -125, 1, 5, 7, 9, 6, 5, 3, 11, 22, 55, 88, 99,
          111, 222, 555, 321, 653, 963, 654, 998, 651]
```

4. List 4:

```
1 a = "foo"
2 list = ['aac', 'bac', 'cbaasc', 'duc', 'enk', 'fire', 'foo', 'hv',
          'isg', 'loj', 'qwek', 'scsl', 'vfbgm', 'nig', 'go', 'prie', '
          qqqq', 'kkree', 'lis', 'acst', 'qweu', 'vfsv', 'wfefe', 'xsfed'
          , 'yagr', 'zyz']
```

Guidelines for submission

- Your submission must be under the .ipynb format.
- Your submission will be graded and it is likely that homework grade will contribute as a component in your GPA.
- If your submission is later than the due date without special consideration approval, you will receive a penalty on your mark.