

**BRAC University (Department of Computer Science and Engineering)**

**CSE 221 (Algorithms) for Fall 2024 Semester**

**Quiz 2  
Set A**

**Student ID:**

**Section:**

**Name:**

**Full Marks: 25**

**Duration: 40 minutes**

1. Find the time complexity of the following recurrence relation:

[Any method is acceptable as long as steps are shown]

$$T(n) = T(n/2) + T(n/4) + n \quad 4$$

2. 4. Find the time complexity of the following recurrence relation: [Use Master Theorem]

$$T(n) = 6T(n/3) + \frac{n^2}{\log n} \quad 3$$

3. Take a look at the following recursive algorithm which finds the value of  $x^n$ :

```
def power(x, n):  
    if n == 0:  
        return 1  
  
    pow = power(x, n//2)  
  
    # n is odd  
    if n % 2 == 1:  
        return x * pow * pow  
  
    # otherwise n is even  
    return pow * pow
```

Find the recurrence relation of the given algorithm as a function of  $T(n)$ . Also find the runtime of the algorithm using that function.

4

4. Imagine yourself helping Taylor Swift following her "Eras Tour first show." Taylor is curious about her performance and the groups of songs her audience connected most with them. She receives comments for every song on her setlist: some calm the audience down a bit (***and have a negative score***), while others get the crowd quite thrilled (***and have a positive score***).

Taylor can choose any song to start her performance, but she likes to keep the flow in order. So the next song she sings has to be the one right after she has chosen the starting song on the list, regardless of the public reactions.

Given a list of scores for each song (indicating how much they boost or calm the crowd), can you:

**[-3, 7, 12, -8, -2, 83, -7, 4]**

- i. Help Taylor determine which segment of consecutive songs she should perform at her next concerts to maximize audience interest. What is the total comment score of this segment? **Simulate** with proper steps. 4
- ii. **Explain** the time taken by your preferred method, particularly given the “ $n$ ” numbers of songs Taylor has in her setlist. Ideally, your method should not exceed  $O(n \log n)$ . 2

5. Consider the following functions.

$$f_1(n) = (\log n)^{2023}$$

$$f_2(n) = n^2 \log_n(n^n)$$

$$f_3(n) = n^3 + 7n^2$$

$$f_4(n) = 2.023^n$$

$$f_5(n) = n \log n$$

$$f_6(n) = n * \sqrt[3]{n^2}$$

Now do the followings:

- a. Write a correct asymptotic upper bound for each of the above. 6
- b. Sort the functions in ascending order of their growth rate, assuming  $n$  is significantly large. Just write the sorted order, no need to show any simulation. 2

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**CSE 221 (Algorithms) for Fall 2024 Semester**

**Quiz 2**

**Set B**

**Student ID:**

**Section:**

**Name:**

**Full Marks: 25**

**Duration: 40 minutes**

1. Find the time complexity of the following recurrence relation:

[Any method is acceptable as long as steps are shown]

$$T(n) = T(n/3) + T(n/5) + n \quad 4$$

2. Find the time complexity of the following recurrence relation: [Use Master Theorem]

$$T(n) = 64T(n/8) + n^2 \log n \quad 3$$

3. Take a look at the following recursive algorithm which finds the value of  $x^n$ :

```
def power(x, n):
    if n == 0:
        return 1

    pow = power(x, n//2)

    # n is odd
    if n % 2 == 1:
        return x * pow * pow

    # otherwise n is even
    return pow * pow
```

Find the recurrence relation of the given algorithm as a function of  $T(n)$ . Also find the runtime of the algorithm using that function. 4

4. Imagine yourself helping Taylor Swift following her "Eras Tour first show." Taylor is curious about her performance and the groups of songs her audience connected most with them. She receives comments for every song on her setlist: some calm the audience down a bit (***and have a negative score***), while others get the crowd quite thrilled (***and have a positive score***).

Taylor can choose any song to start her performance, but she likes to keep the flow in order. So the next song she sings has to be the one right after she has chosen the starting song on the list, regardless of the public reactions.

Given a list of scores for each song (indicating how much they boost or calm the crowd), can you:

- a) [-3, 7, 12, -8, -2, 83, -7, 4]

i. Help Taylor determine which segment of consecutive songs she should perform at her next concerts to maximize audience interest. What is the total comment score of this segment? **Simulate** with proper steps. 4

ii. **Explain** the time taken by your preferred method, particularly given the “ $n$ ” numbers of songs Taylor has in her setlist. Ideally, your method should not exceed  $O(n \log n)$ . 2

5. Consider the following functions.

$$f_1(n) = (\log n)^{2023}$$

$$f_2(n) = n^2 \log_n(n^n)$$

$$f_3(n) = n^3 + 7n^2$$

$$f_4(n) = 2.023^n$$

$$f_5(n) = n \log n$$

$$f_6(n) = n * \sqrt[3]{n^2}$$

Now do the followings:

- c. Write a correct asymptotic upper bound for each of the above. 6
- d. Sort the functions in ascending order of their growth rate, assuming  $n$  is significantly large. Just write the sorted order, no need to show any simulation. 2