

# CS211: Algorithms & Data structures

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## Lab04

### 1 Laboratory Objectives:

- To practise some algorithms and categorising them into one of growth rate functions.

### 2 Exercises

1. Write Java code for finding the sum of the first  $n$ -odd numbers?

Let's take some example to understand the problem. The sum of first 3 odd numbers is

$$\sum_{i=1}^3 i = 1 + 3 + 5 = 9$$

while the sum of first 4 odd numbers is

$$\sum_{i=1}^4 i = 1 + 3 + 5 + 7 = 16$$

So, algorithm should takes  $n$  as input and outputs the sum.

$$\sum_{i=1}^n i = ?$$

The following solutions to this problem are same in term of the final result, but different in their behaviour. The first solution runs in linear time while the second runs in constant time.

Listing 1: first n-odd numbers

```
public static int sum(int n){
    int s=0;
    for(int i=1;i<=n*2;i+=2)
    {
        System.out.println(i);
        s+=i;
    }
    return s;
}
```

We also can write it as in the following:

Listing 2: first n-odd numbers

```
public static int sum_formula(int n){
    return n*n;
}
```

2. What is the time complexity for java programs in Listing1 and Listing2?
3. What is the time complexity of the following algorithm?

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**Algorithm 1:** algorithm1

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**Input:** nothing  
**Output:**  $a$   
1:  $a \leftarrow 1$   
2: **while** ( $a < b$ ) **do**  
3:    $a \leftarrow a \times 2$   
4: **end while**  
5: **return**  $a$

---

4. What is the time complexity of the following pseudocode?

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**Algorithm 2:** algorithm2

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**Input:** nothing

**Output:**  $i$

```
1:  $i \leftarrow n$ 
2: while ( $i > 1$ ) do
3:    $i \leftarrow i \div 2$ 
4: end while
5: return  $i$ 
```

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5. What is the time complexity of the following Java code?

Listing 3: Program1

```
for (int i = 0; i < n * n; i++)
{
    System.out.println(i);
}
```

6. What is the time complexity of the following Java code?

Listing 4: Program1

```
int i=1;
while (i < n) {
    sum = sum + i;
    i = i*2
}
```

7. What is the time complexity of the following Java code?

Listing 5: Program1

```
for(int i = 0; i < 100000; i++)
{
    sum = sum + i;
}
```

8. What is the time complexity of the following Java code?

Listing 6: Program1

```
int sum = 0;
for(int i = 0; i < n; i++)
    for(int j = 0; j < n; j++)
        sum+=i*j;
```

9. What is the time complexity of the following Java code?

Listing 7: Program1

```
int i = 1, j;
while(i <= n) {
    j = 1;
    while(j <= n){
        statements of constant complexity
        j = j*2;
    }
    i = i+1;
}
```