

CS284: Exercise Booklet 2 - Basic Complexity

Exercise 1

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for(int i=0; i<n; i++) {  
    for(int j=i; j>0; j--) {  
3      System.out.println(i + " " + j);  
    }  
5  }
```

Exercise 2

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for(int i=1; i<n; i++) {  
    for(int j=1; j<n; j*=2) {  
3      System.out.println(i + " " + j);  
    }  
5  }
```

Exercise 3

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for(int i=1; i<n; i++) {  
    for(int j=1; j<n; j*=2) {  
3      break;  
    }  
5  }
```

Exercise 4

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for(int i=n-1; i>=0; i--) {  
    for(int j=n-1; j>i; j--) {  
3      System.out.println(i + " " + j);  
    }  
5  }
```

Exercise 5

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for(int i=n-1; i>=0; i--) {  
    for(int j=9; j>0; j--) {  
3      System.out.println("hello");  
    }  
5  }
```

Exercise 6

Consider the following snippet of code

```
1  for(int i=0; i<n; i++) {  
    ...  
3  }
```

where the missing line is not provided to you. Can you assert that this code will run in $\mathcal{O}(n)$ independently of the missing line of code? If your answer is no, then provide a counterexample.

Exercise 7

Let $f(n) = 100n^4 + 5000n + 3$. Is $f(n) \in \mathcal{O}(n^4)$? If yes, then justify your answer by supplying the appropriate positive constants c and n_0 .

Exercise 8

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for (int i=0; i<n; i++) {  
    if (i%2==0) {  
3      for (int j=0; j<n; j++) {  
        System.out.println("Hi");  
5      }  
    }  
7 }
```

Exercise 9

Determine the time growth rate of the following code. You must provide details on how it was established. You may assume that $n > 1$.

```
1  for (int i=0; i<n; i++) {  
    if (i%2==0) {  
3      for (int j=0; j<i; j++) {  
        System.out.println("Hi");  
5      }  
    }  
7 }
```

Exercise 10

Consider the code below. Indicate:

1. How many times it prints a message.
2. Its complexity.

You may assume that $n > 1$.

```
1  for (int i=0; i<n; i++) {  
    for (int j=0; j<n; j++) {  
3      if (i%2==0) {  
        System.out.println("Hi");  
5      }  
    }  
7 }
```

Exercise 11

Provide an example of code that has time growth rate of $\mathcal{O}(n \log n)$.