

Data Structures and Algorithms – CS2402

Quiz 1

20 points - 15 minutes

Make sure that you justify all your answers. 2 additional points will be given for clarity of presentation, readability, and complete explanations.

For all the following exercises, find the running time function. Detail the steps that lead you to the result.

Exercise 1 (4 points)

```
int sum=0; for (int j = 0; j < n - 2; j + = 2)
{
    sum++;
    sum--;
}
```

Solution:

int sum=0;	1 step
int j=0;	1 step
per valid loop:	
$j < n - 2$	1 step
$j + = 2$	1 step
sum++;	1 step
sum--;	1 step
exit condition, when $j \not< n - 2$	1 step
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TOTAL:	3+4(n-2) steps

Exercise 2 (4 points)

```
for (int i = 0; i < n; i = ++)
    my_procedure;
// where my_procedure is known to run in running time p(n)
```

Solution:

int i=0;	1 step
per valid loop:	
$i < n$	1 step
$i ++$	1 step
my_procedure;	p(n) step
exit condition, when $i \not< n$	1 step
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TOTAL:	2+n(2+p(n)) steps

Exercise 3 (5 points)

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

Solution:

Let us first rewrite the fragment of code as follows:

```
// Part 1:  
for (int i = 0; i < n; i = ++)  
    my_procedure;
```

where my_procedure is defined as follows:

```
// Part 2:  
for (int j = 0, j < n, j = ++)  
    sum++;
```

Following from Exercise 2, we know that the time complexity of Part 1 is $2 + n(2 + p(n))$. Following the same decomposition as done in Exercises 1 and 2, we obtain that the time complexity of Part 2 is $2 + 3n$, which actually defines $p(n)$. As a result, the time complexity of Part 1 (which is equivalent to the original fragment of code to analyze) is $2 + n(2 + 2 + 3n)$.

Exercise 4 (5 points) *In class we spoke about an algorithm to determine, in a text file, which word is the most frequent. Explain in a few words what is the complexity of your algorithm, and justify your answer.*

Solution:

cf. lab assignment.