

### Handson 3

Q1.) Function  $x = f(n)$  will run as follows (2)

```
x = 1;  
for i = 1:n  
    for j = 1:n  
        x = x + 1;
```

1) Inner loop runs  $n$  times for each iteration of the outer loop.

outer loop runs  $n$  times

Total Executions  $\Rightarrow n \times n = n^2$

Time Complexity  $\Rightarrow O(n^2)$

$$T(n) = \sum_{i=1}^n \sum_{j=1}^n 1 = n \times n = n^2$$

3.) Big O  $\Rightarrow$  Runtime grows quadratically with  $n \Rightarrow O(n^2)$

Big omega  $\Rightarrow$  Best case runtime  $\Omega(n^2)$ , no cases where the function runs in less than  $n^2$  times.

Big Theta  $\Rightarrow$  From the above two function is  $\Theta(n^2)$ , [both  $O(n^2)$  and  $\Omega(n^2)$ ]

Modified function.

$x = f(n)$

$x = 1;$

$y = 1;$

for  $i = 1:n$

for  $j = 1:n$

$x = x + 1;$

$y = i + j;$

4.) The Modified function will take slightly more time to run because of the added operation  $y = i + j$ , within the loop.



5.) No, adding the line  $T = i+j$  will not ~~not~~ affect the result. From the runtime analysis in terms of asymptotic notation because the operation is  $O(1)$ . Runtime remains  $O(n^2)$ .

Big O :  $O(n^2)$

Big omega :  $\Omega(n^2)$

Big theta :  $\Theta(n^2)$