

CSCI 104

HW

HW 1

Problem 3 - Runtime Analysis

Part (a)

```
void f1(int n)
{
    int i=2;
    while(i < n){
        /* do something that takes O(1) time */
        i = i*i;
    }
}
```

$$n = 32$$

$$i = 2$$

$$= 4$$

$$= 16$$

$$= 256$$

①

②

③

④

$$n = 200$$

$$\begin{array}{l} i = 2 \quad \textcircled{1} \\ = 4 \quad \textcircled{2} \\ = 16 \quad \textcircled{3} \\ = 256 \quad \textcircled{4} \end{array}$$

$$n = 500$$

$$\begin{array}{l} i = 2 \quad \textcircled{1} \\ = 4 \quad \textcircled{2} \\ = 16 \quad \textcircled{3} \\ = 256 \quad \textcircled{4} \end{array}$$

$$= 65536 \quad \textcircled{5}$$

$$n = 40$$

$$\begin{array}{l} i = 2 \quad \textcircled{1} \\ = 4 \quad \textcircled{2} \\ = 16 \quad \textcircled{3} \\ = 256 \quad \textcircled{4} \end{array}$$

$$n = 3000 \rightarrow \textcircled{5}$$

$$n = 66000 \rightarrow \textcircled{6}$$

$$\log(32) = 5 \rightarrow \log(5) = 2.3 + 2 = 4.3$$

$$\log(100) = 7.6 \rightarrow \log(7.6) = 2.9 + 2 = 4.9$$

$$\log(500) = 8.9 \rightarrow \log(8.9) = 3.15 + 2 = 5.15$$

$$\log(3000) = 11.5 \rightarrow \log(11.5) = 3.5 + 2 = 5.5$$

$$\log(66000) = 16 \rightarrow \log(16) = 4 + 2 = 6$$

$$\Theta(\log(\log n))$$

Part (b)

```
void f2(int n)
{
    for(int i=1; i <= n; i++){
        if((i % (int)sqrt(n)) == 0){
            for(int k=0; k < pow(i,3); k++){
                /* do something that takes O(1) time */
            }
        }
    }
}
```

$$\sum_{i=1}^n \sum_{k=0}^i$$

$$n = 16 \quad \sqrt{16} = 4$$

the if will trigger for

$$i = 4, 8, 12, 16 \quad (4)$$

$$n = 56 \quad \sqrt{56} = 7$$

the if will trigger for

$$i = 7, 14, 21, 28, 35, 42, 49, 56 \quad (8)$$

$$n = 64 \quad \sqrt{64} = 8$$

the if will trigger for

$$i = 8, 16, 24, 32, 40, 48, 56, 64 \quad (8)$$

$$n = 70 \quad \sqrt{70} = 8$$

the if will trigger for

$i = 8, 16, 24, 32, 40, 48, 56, 64, 72$ ⑨

$$\sqrt{n} \cdot n^3 = n^{3\frac{1}{2}}$$

$$\Theta(n^{3\frac{1}{2}})$$

Part (c)

```
for(int i=1; i <= n; i++){
    for(int k=1; k <= n; k++){
        if( A[k] == i){
            for(int m=1; m <= n; m=m+m){
                // do something that takes O(1) time
                // Assume the contents of the A[] array are not changed
            }
        }
    }
}
```

$\Theta(n)$
 $\Theta(n)$

$\Theta(n^2)$

part d)

```
int f (int n)
{
    int *a = new int [10];
    int size = 10;
    for (int i = 0; i < n; i++)
    {
        if (i == size)
        {
            int newsize = 3*size/2;
            int *b = new int [newsize];
            for (int j = 0; j < size; j++) b[j] = a[j];
            delete [] a;
            a = b;
            size = newsize;
        }
        a[i] = i*i;
    }
}
```

$\rightarrow \Theta(n)$

$\rightarrow \Theta(n)$

$\Theta(n^2)$