

# Data Structures 1 - HW1 - Abraham Murciano

1) a) for ( $i=0$ ;  $i < N$ ;  $i++$ )  
     for ( $j=i+1$ ;  $j < N$ ;  $j++$ )  
         if ( $A[i] < A[j]$ )  
             swap ( $A[i], A[j]$ );

b)  $N+1$   
 $\sum_{i=0}^N i$   
 $(\sum_{i=0}^N i) - 1$   
 $(\sum_{i=0}^N i) - 1$  or  $O$  (best case)

$$\begin{aligned} c) & (N+1) + \frac{N(N+1)}{2} + \frac{N(N+1)}{2} - 1 + \frac{N(N+1)}{2} - 1 \\ &= \frac{1}{2}(2N+2 + N^2+N + N^2+N - 2 + N^2+N - 2) \\ &= \frac{1}{2}(3N^2 + 5N - 2) \\ &= \frac{3}{2}N^2 + \frac{5}{2}N - 1 \end{aligned}$$

worst case complexity:  $N^2$

$$\begin{aligned} & (N+1) + \frac{N(N+1)}{2} + \frac{N(N+1)}{2} - 1 + 0 \\ &= \frac{1}{2}(2N+2 + N^2+N + N^2+N - 2) \\ &= \frac{1}{2}(2N^2 + 4N) = N^2 + 2N \end{aligned}$$

best case complexity:  $N^2$

2) i) for ( $i=n^3$ ;  $i \geq 10$ ;  $i-=2$ )  
     print ( $i$ );

$\frac{n^3-10}{2} + 1$   
 $\frac{n^3-10}{2}$

$$\frac{n^3-10}{2} + \frac{n^3-10}{2} + 1 = \frac{2n^3-20}{2} + 1 = n^3 - 10 - 1 = n^3 - 11 = \Theta(n^3)$$

ii)  $k=2$   
 $i=1$   
     while ( $i < n^k$ )  
          $k=k+5$   
          $i=i*6$

$1$   
 $1$   
 $\frac{n^2}{6^2}$   
 $\frac{n^2}{6^2} - 1$   
 $\frac{n^2}{6^2} - 1$

$f(n) = \Theta\left(\frac{n^2}{6^2}\right)$

iii)

$i=2$

1

$k=2$

1

while ( $i < n$ )

for ( $j=1; j \leq i; j++$ )

$k += j$

$i *= 2$

$\sum_{i=1}^{\log(n)} i^2 - 1$   
 $\log(n) - 1$

$$\begin{aligned}
 & 2 + \log(n) + \frac{2\sqrt{n}(\sqrt{n}+1)(2\sqrt{n}+1)}{6} - 1 + \log(n) - 1 \\
 &= 2\log(n) + \frac{1}{6}(2\sqrt{n}(\sqrt{n}+1)(2\sqrt{n}+1)) - 2 \\
 &= 2\log(n) + \frac{1}{6}(2\sqrt{n}(2n+\sqrt{n}+2\sqrt{n}+1)) - 2 \\
 &= 2\log(n) + \frac{1}{3}(2n\sqrt{n} + n + 2n + \sqrt{n}) - 2 \\
 &= 2\log(n) + \frac{2}{3}n^{\frac{3}{2}} + n + \frac{1}{3}n^{\frac{1}{2}} - 2 = \Theta(n^{\frac{3}{2}})
 \end{aligned}$$