

COMP 251 – Summer, 2017

Assignment #1 – Due Wednesday, May 17th, 2017 IN CLASS

Part 1:

Do *the first five exercises* of the “IN SHORT” AND the “IN THEORY” exercises from *each* of the first four chapters (Part 1) of your textbook. In other words, if the number of problems in a section is less than or equal to five, then do them all. However, if a section has more than five questions, then stop after the fifth question in that section.

Part 2:

Do Examples #4 and #5 from PPT 2.1 (Computational Complexity).

Example #4

Determine the time complexity of matrix multiplication, which is defined for $n \times n$ matrices as follows:

$$c_{ij} = \sum_{k=1}^n a_{ik} b_{kj}$$

$$i.e., \quad \mathbf{AB} = \begin{pmatrix} a & b & c \\ p & q & r \\ u & v & w \end{pmatrix} \begin{pmatrix} \alpha & \beta & \gamma \\ \lambda & \mu & \nu \\ \rho & \sigma & \tau \end{pmatrix} = \begin{pmatrix} a\alpha + b\lambda + c\rho & a\beta + b\mu + c\sigma & a\gamma + b\nu + c\tau \\ p\alpha + q\lambda + r\rho & p\beta + q\mu + r\sigma & p\gamma + q\nu + r\tau \\ u\alpha + v\lambda + w\rho & u\beta + v\mu + w\sigma & u\gamma + v\nu + w\tau \end{pmatrix},$$

ALGORITHM 1 Matrix Multiplication.

```
procedure matrix multiplication(A, B: matrices)
  for i := 1 to m
    for j := 1 to n
      cij := 0
      for q := 1 to k
        cij := cij + aiqbqj
  return C {C = [cij] is the product of A and B}
```

Example #5

Compare the time complexities of the following:

ALGORITHM 5 The Insertion Sort.

```
procedure insertion sort( $a_1, a_2, \dots, a_n$ : real numbers with  $n \geq 2$ )
for  $j := 2$  to  $n$ 
     $i := 1$ 
    while  $a_j > a_i$ 
         $i := i + 1$ 
     $m := a_j$ 
    for  $k := 0$  to  $j - i - 1$ 
         $a_{j-k} := a_{j-k-1}$ 
     $a_i := m$ 
{ $a_1, \dots, a_n$  is in increasing order}
```

ALGORITHM 4 The Bubble Sort.

```
procedure bubblesort( $a_1, \dots, a_n$ : real numbers with  $n \geq 2$ )
for  $i := 1$  to  $n - 1$ 
    for  $j := 1$  to  $n - i$ 
        if  $a_j > a_{j+1}$  then interchange  $a_j$  and  $a_{j+1}$ 
{ $a_1, \dots, a_n$  is in increasing order}
```

FORMAT: You do NOT have to type this assignment, but it must be legible for a grade. You will NOT receive a grade for any portion that I cannot read.