

# MAT2440, Classwork26, Spring2025

ID: \_\_\_\_\_ Name: \_\_\_\_\_

## 1. The definition of an **Algorithm**:

An algorithm is a finite sequence of precise instructions for performing a computation or for solving a problem.

## 2. The introduction of **Pseudocode**:

Algorithms in English — —  $\rightarrow$  pseudocode — —  $\rightarrow$  Programming language

## 3. The structure of a pseudocode (procedure, statements, and return):

procedure : Name of the code (input: description of input(s))

statements : Assignments

Conditional statement (**if** condition **then** statement)

Loop Constructions (**for** loop, **while** loop)

return : Variable which is the output(s)

## 4. A pseudocode of summation:

```
procedure summation( $a_1, a_2, \dots, a_n$ : a list of  $n$  numbers)
 $n :=$  the length of  $\{a_i\}$ 
 $sum :=$  0 (which is a variable to store the summation)
for  $i := 1$  to  $n$  (a for loop)
     $sum := sum + a_i$  (adding each number to  $sum$ )
return sum
```

How does this pseudocode work?

Initialization:  $sum = 0$

$i$	$sum$
$i = 1$	$= sum + a_1 = 0 + a_1 = a_1$ ( $sum = 0 \Rightarrow sum = a_1$ )
$i = 2$	$= sum + a_2 = a_1 + a_2$ ( $sum = a_1 \Rightarrow sum = a_1 + a_2$ )
$\vdots$	$\vdots$
$i = n$	$sum + a_n = a_1 + a_2 + a_3 + \dots + a_{n-1} + a_n$

Return:  $sum = a_1 + a_2 + \dots + a_n$

## 5. Algorithm and Pseudocode of Finding the Maximum Element in a Finite Sequence.

**Problem:** Let  $a_1, a_2, \dots, a_n$  be a list of  $n$  numbers. Find the largest value of them.

**Algorithm:**

- (1) Set temporary maximum  $tempMax$  equals the first element  $a_1$ .
- (2) Compare  $a_2$  to  $tempMax$ :  
 if  $a_2 > tempMax$ , then  $tempMax = a_2$ .  
 if  $a_2 < tempMax$ , then do nothing.
- (3) Repeat the previous step for  $a_3, a_4, \dots, a_n$ .
- (4) The variable  $tempMax$  at this point contains the largest value in the sequence.

**Pseudocode:**

```

procedure max( $a_1, a_2, \dots, a_n$ : a list of  $n$  numbers)
 $n :=$  the length of  $\{a_i\}$ 
 $tempMax := a_1$ 
for  $i := 2$  to  $n$ 
    if  $tempMax < a_i$  then  $tempMax := a_i$ 
return  $tempMax$  {  $tempMax$  is the largest element }
    
```

## 6. An example of finding the maximum element in a finite sequence:

Let the sequence be  $\{3, 1, 5, 6, 4\}$ .

Initialization:  $tempMax = 3$  and  $n = 5$ .

*the length of the sequence*

$i$	$a_i$	$tempMax < a_i$ (T or F?)	$tempMax$
$i = 2$	1	$3 < 1$ (F)	<u>3</u>
$i = 3$	5	$3 < 5$ (T)	<u>5</u>
$i = 4$	6	$5 < 6$ (T)	<u>6</u>
$i = 5$	4	$6 < 4$ (F)	<u>6</u>

Return:  $tempMax = 6$ .

## 7. Write down an algorithm of finding the Minimum Element in a Finite Sequence.

```

procedure min( $a_1, a_2, \dots, a_n$ : a list of  $n$  numbers)
 $n :=$  the length of  $\{a_i\}$ 
 $tempMin := a_1$ 
for  $i := 2$  to  $n$ 
    if  $tempMin > a_i$  then  $tempMin := a_i$ 
return  $tempMin$  {  $tempMin$  is the smallest element }
    
```