Problem Solving Algorithms
Problem Solving and Program

The IF...THEN... ELSE... statement

Simulating Decisions
The IF...THEN... ELSE statement

• Used to simulate choice based on a condition
• The structure:

  **IF** (condition) **THEN**
  Action (if condition is true)

  **ELSE**
  Action (if condition fails)

  **END IF**

• The actions between the THEN and ELSE statements can be any number of statements:
  – READ statements
  – PRINT statements
  – Calculations
  – Even other IF statements
The IF...THEN... ELSE statement:
the structure

The structure:

*IF* (condition) *THEN*

  *Action (if condition is true)*

*ELSE*

  *Action (if condition fails)*

*END IF*
Flowchart: IF... THEN... ELSE

- CONDITION
- Any number of steps
- Any number of steps

CONNECTOR

Can be any number of steps

Symbolizes the END IF
The IF...THEN... ELSE statement: 

*the condition*

• Can be any logic test:
  – Is the rain falling?
  – Is a number greater than another?
  – Is a person’s name equal to someone else’s name

• May contain two or more logic tests:
  – A < B **AND** B > C
  – myName = “Jenoir” **OR** myName = “Latoya”
  – A <= C **OR** S >= T
    • Please note the use of AND and OR
The IF...THEN... ELSE statement: 

\textit{the condition}

- If the \textit{condition} is \textcolor{red}{true} 
  - the \textit{action(s)} after the \textcolor{red}{THEN} part is/are executed.

- If the \textit{condition} is \textcolor{red}{false} 
  - the \textit{action(s)} after the \textcolor{red}{ELSE} part is/are executed.

- \textbf{END IF} – signals the end of the if statement
The IF…THEN… ELSE statement:

Examples

The example – Real World Scenario:

**IF** *(belly is full)* **THEN**

Stop drinking and eating

**ELSE**

Drink and eat all night

**END IF**

• What is the condition?
• What happens if the condition is true?
• What happens if the condition is false?
The IF...THEN... ELSE statement:
Examples

The example – Real World Scenario:

*Sometimes no action needs to be taken if the condition is false*

**IF (jar is empty) THEN**

Fill with cookies

**(ELSE)**

**END IF**

- In this case we have a **NULL ELSE** statement
  - No actions following the else statement
The IF...THEN... ELSE statement: Examples

The example – Closer to pseudocode:

```
IF (A > 10) THEN
  PRINT A, "is greater than 10"
ELSE
  Print A, "is less than 10"
END IF
```

• What is the condition?
• What happens if the condition is true?
• What happens if the condition is false?
The IF...THEN... ELSE statement: Examples

The example – Real World Scenario:

**IF** (surname = “Prentis”) **THEN**

*Print “Nicholas is a Prentis”*

**ELSE**

**END IF**

- What is the condition?
- What happens if the condition is true?
- What happens if the condition is false?
The IF...THEN... ELSE statement:

Examples

The example – Here is a complete code:

```
PRINT “Please enter first number (press enter after)”
READ Num1
PRINT “Please enter second number (press enter after)”
READ Num2
PRINT “Please enter third number”
READ Num3

IF (Num1 > Num 2 AND Num2 > Num3) THEN
    DIFF = Num1 – Num3
ELSE
    DIFF = Num2 - Num3
END IF

SUM = Num1 + Num2 + Num3
Print SUM, DIFF
```
CLASS WORK

• Write a structure algorithm to prompt the user to input the mark the student received in a test. If the mark is less than 60, output the word “Fail”, otherwise output the word “Pass”.

• Write a structure algorithm that prompts the user to input the pass mark and the mark a student received in a test. Output the word “Fail” or “Pass” accordingly.

• Write a structured algorithm that prompts the user to input two unequal values that are stored in variables A and B. It should print the higher value.
Problem Solving and Program

Looping statements
Executing steps many times
Looping

• What if there are a number of steps that must be done several times, would you re-write those steps for each time you needed them to be executed?

• What if you wanted to calculate the total of a set of numbers (say 15 different numbers), would you create a variable for each one?

• What if you wanted to perform an operation as long as a condition exists, how would you know that the condition continues to exist and perform these loops?

• These are some of the questions that the looping structure was created to answer.
Looping

• So what is a Loop?
  – Any number of steps that are being executed a number of times

• How do we govern a loop?
  – A condition (or number of conditions)
  – A number of times (iterations)
Looping

• Real World Examples:

• **A Condition**
  – While my ring is not found, search the house
  – While shoes are dirty, buff with cloth

• **A number of times**
  – Scrub floor 10 times for sheen
  – Knock door three times
Pseudo code constructs

• A Condition – **The While** or **Repeat Until Loop**
  – Condition must be satisfied for loop to continue to be executed.

• A Number of iterations – **The FOR Loop**
  – A number of exact times for the loop to be executed
The FOR loop

- The FOR loop construct syntax (of course this is Pseudo code)

\[
\text{FOR } <\text{variable}> = <\text{beginning value}> \text{ to } <\text{ending value}>
\]
\[
\begin{align*}
\text{Do something} \\
\text{END FOR}
\end{align*}
\]

*Reserved words are in RED*
START
READ name

FOR i = 1 to 5
    PRINT name
NEXT i
END FOR
STOP

- What does the above code do?
- What is the first and last value of the variable i?
- When does the code come stop printing person name?
The FOR loop – adding steps

- The FOR loop construct syntax (of course this is Pseudo code)

```
FOR <variable> = <beginning value> to <ending value> STEP <incremental value>
  Do something
END FOR
```

**Pseudo code:**

```
FOR i = 1 to 10 step 2  
  - counts by 2: 1 => 1, 3, 5, 7, 9
ACTION --
  this action may be any number of other statements ( IF, PRINT, READ, etc)
NEXT i               
  - tells loop to go to next value of i
END FOR              
  - end the for loop
```

Note that the *number* after step can be any particular number even a *variable* if you so choose

* Reserved words are in RED
The FOR loop – adding steps

Example:
Print a table to find the square and cube

Pseudo code:
FOR i = 1 to 10 step 2  
- counts by 2: 1 => 1, 3, 5, 7, 9

ACTION –
this action may be any number of other statements ( IF, PRINT, READ, etc)

NEXT i  
- tells loop to go to next value of i

END FOR  
- end the for loop

Note that the number after step can be any particular number even a variable if you so choose

* Reserved words are in RED
Pseudo code Example – For loops

Print a table finding the square and cube of all even numbers between 2 and 20 inclusive

START
Print “Number”, “Square”, “Cube” {prints the table headings}

FOR i = 2 to 20 STEP 2
Print i, i^2, i^3

NEXT i

END FOR
STOP

• Notice that the beginning value for the loop is 2 and the ending is 20.
• Notice that the incremental value is 2.
• Try to do a trace table for this example
Pseudo code Example – For loops

Try this one:
Print a table finding the square and cube of all odd numbers between 1 and 20 inclusive
Pseudo code Example – For loops

START

FOR i = 0 to 20 STEP 5
Print i

NEXT i

END FOR

STOP

- What does the above code do?
- Notice that the beginning value for the loop is 0 and the ending is 20.
- Notice that the incremental value is 5.
- What will be the various values for i?
The WHILE loop

• The FOR loop construct syntax (of course this is Pseudo code)

```
while some condition exists
    Do something
    Change value
END While
```

Pseudo code:

```
a = 0
- priming the loop
While (a < 10) - starting while loop

ACTION –
this action may be any number of other statements (IF, PRINT, READ, etc)
a = a +1 - manipulating loop condition
END WHILE - ending while loop
```

* Reserved words are in RED / IMPORTANT statements
START
i=0
READ name
WHILE (i<10)
  PRINT name
  i = i + 1
END WHILE
STOP

• What does the above code do?
• What is the first and last value of the variable i?
• When does the code come stop printing person name?
Pseudo code Example – WHILE loop

START
READ name
WHILE (name<> “end”)
    Print “Hello “, name
    Print “Please enter your age”
    Read age
    If age > 50 then
        Print “You qualify for the golden citizen account”
    (Else)
    EndIf
READ name
END WHILE
STOP

• What does the above code do?
• When does the code come stop?
The REPEAT...UNTIL loop

• The FOR loop construct syntax (of course this is Pseudo code)

```
Repeat
    Do something
    Change value
Until some condition is satisfied
```

**Pseudo code:**

```
a = 0
Repeat
    ACTION —
    this action may be any number of other statements {IF, PRINT, READ, etc}
    a = a +1
Until a = 10
```

*Reserved words are in RED / IMPORTANT statements*
The REPEAT...UNTIL loop

```
a = 1
Repeat
   Read Name, Age
   Print "My name is ", Name
   Print "I am ", Age

a = a +1
Until a = 10
```
The **REPEAT...UNTIL loop**

Read student\_name

Repeat

Read grade\_1, grade\_2, grade\_3
average = (grade\_1+ grade\_2+ grade\_3)/3
Print student\_name," - " , average

Read student\_name

Until Name = End

* Reserved words are in RED / IMPORTANT statements
Counting and Running Totals

• One of the most powerful uses of the Loops
• For example:
  – What if you wanted to find the sum or average of 30 numbers? Would you use 30 different variables?
  – What if the amount of numbers were unknown but you still have to find their sum or average etc?

  – The answer:
  • Use a **variable to count**
  • Use a **variable to add the numbers as they are entered**
Pseudocode Example – FOR Loops

• Here is a simple example:
  – Write a pseudocode to add 10 numbers:

  ```plaintext
  START
  sum = 0  (this will store the sum)
  FOR i = 1 to 10
    READ number
    sum = sum + number  (remember work out the right hand side first)
  NEXT i
  END FOR
  Print sum
  STOP
  ```

  – NB
  – sum = sum + number
    • The starting value of sum is 0. therefore if we entered 10 for the number then we would have
      – sum = 0 + 10.
    • At which point sum now becomes 10
Pseudocode Example – FOR Loops

Here is a simple example:
– Write a pseudocode to find the average 10 numbers:

```
START
sum = 0
average =0 (this will store the sum)
FOR i = 1 to 10
    READ number
    sum = sum + number (remember work out the right hand side first)
NEXT i
END FOR
average = sum / 10
PRINT average
STOP

– NB
  • average = sum / 10
    – Note that the average has to calculate after the sum
```
WHAT IF YOU WERE UNCERTAIN ABOUT THE AMOUNT OF NUMBERS TO BE ENTERED?