Algorithm

Comp230

Algorithm and Pseudocode

- An algorithm is a procedure or formula for solving a problem.
- Pseudocode is a kind of structured English for describing algorithms. It allows the designer to focus on the logic of the algorithm without being distracted by details of language syntax.

Example 1

- Let's say that you have a friend arriving at the airport, and your friend needs to get from the airport to your house. Here are Four different algorithms that you might give your friend for getting to your home:

Example 1 Cont.

- **The taxi algorithm:**
  - Go to the taxi stand.
  - Get in a taxi.
  - Give the driver my address.

Example 1 Cont.

- **The call-me algorithm:**
  - When your plane arrives, call my cell phone.
  - Meet me outside baggage claim.

Example 1 Cont.

- **The rent-a-car algorithm:**
  - Take the shuttle to the rental car place.
  - Rent a car.
  - Follow the directions to get to my house.

Example 1 Cont.

- **The bus algorithm:**
  - Outside baggage claim, catch bus number 70.
  - Transfer to bus 14 on Jerusalem Street.
  - Get off on Al-Ersal street.
  - Walk two blocks north to my house.

Example 2

- Let’s say we have a bunch of words - say, the names of colors. We want to compute the average number of characters in these words. If we were going to do this by hand.

Example 2 Cont.

- we would use the following algorithm:
  - Create a list of the words
  - Count the number of characters in each word
  - Compute the average from Step 2.

Common Action Keywords

- Input: READ , OBTAIN, GET
- Output: PRINT, DISPLAY, SHOW
- Compute: COMPUTE, CALCULATE
- Initialize: SET
- Add one: INCREMENT

Types of Algorithm operations

- Sequential
- Conditional
- Iterative

Sequential

- Computation operations
- Example:
  - Set the value of “variable” to “value” or “arithmetic expression”
- Variable
  - Named storage location that can hold a data value

Sequential

- Input operations
  - To receive data values from the user.
    - Example: Get a value for r, the radius of the circle
- Output operations
  - To send results to the screen for display.
    - Example: Print the value of Area

Sequential

- Write an algorithm to find and print the sum of two integers ?

1. Ask user to enter first integer
2. Read the integer and save as integer_1
3. Ask user to enter the second integer
4. Read second integer and save as integer_2
5. Add integer_1 to integer_2 and save result as sum
6. Print sum to screen

Sequential

- Write an algorithm to find and print the area of rectangle.

1. Ask user to enter the height of rectangle.
2. Read height and save as rectangle_height.
3. Ask user to enter the width of rectangle.
4. Read width and save as rectangle_width.
5. Multiply rectangle_height by rectangle_width and save the result as area.
6. Display area.

Sequential

- Write an algorithm to reverse any two digits number.
- 1.Ask user to enter two digits number.
- 2.Read number and save as num.
- 3.Divide num by ten and save result as tens.
- 4.Divide num by ten and save remainder as rem.
- 5.Multiply rem by ten and save the result as rev.
- 6.Add tens to rev.
- 7.Print rev.

Suppose num=12
tens=num /10 =12/10→tens=1
rem=num%10=12%10→rem=2
rev=rem*10=2*10→rev=20
rev=rev+tens=20+1→rev=21

Conditional

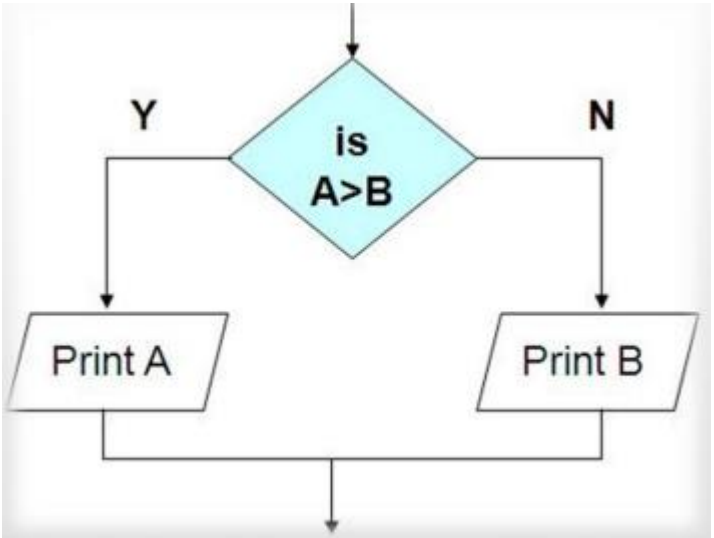
- Selection logic
  - If you want to check to make sure multiple conditions are met then you can use logical statements.

- Case
  - The case is used to allow you to perform different actions based on different conditions.

Conditional

- Ask questions and choose alternative actions based on the answers.

- Example
  - if A is greater than B
    - then print A
  - else
    - print B
  - end if



Conditional

ELSE keyword is optional

```
IF condition THEN
    Sequence
END IF
```

```
IF condition THEN
    Sequence 1
ELSE IF condition THEN
    Sequence 2
ELSE IF condition THEN
    Sequence 3
ELSE
    Sequence 4
END IF
```

Conditional

Logical Operators :

- AND
- OR

Relational Operators :

- Greater than
- Greater than or equal
- Less than
- Less than or equal
- Equal
- Not Equal

Conditional

- Write an algorithm to print passed or failed based on the student grade.

1. Ask user to enter student grade.
2. Read grade and save as student_grade.
3. If student_grade greater than or equal sixty then

```
    print “passed”
else
    print “failed”
end if
```

Conditional

Write an algorithm to find and print the maximum element of a set of 3 integers.

1.Ask user to enter first integer.

2. Read the integer and save as first_integer.

3. Ask user to enter second integer.

4. Read the integer and save as second_integer.

5. Ask user to enter third integer.

6. Read the integer and save as third_integer.

7. Let max equal to the first_integer.

8. If max less than second_integer then

    set max to second_integer

    end if

9. If max less than third_integer then

    set max to third_integer

    end if

10. Print “the maximum integer is” max

Conditional

- CASE: multi way branch based on conditions that are mutually exclusive.

CASE expression OF

Condition 1: sequence 1

Condition 2: sequence 2

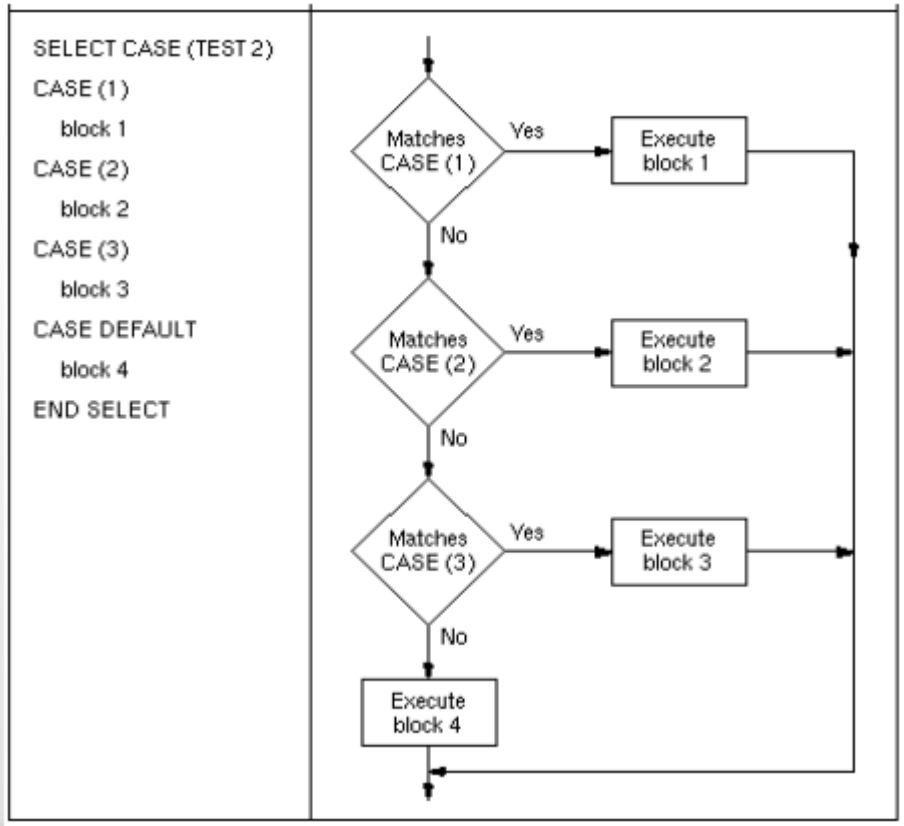
….. : ….

Condition n: sequence n

OTHERS:

default sequance

END CASE



Conditional

- Write an algorithm to find and print the smallest of three given numbers (assume all numbers are different).

Rules for logical And operations		
T	T	T
T	F	F
F	T	F
F	F	F

1. Ask user to enter first number
2. Read the number and save as num1
3. Ask user to enter second number
4. Read the number and save as num2
5. Ask user to enter third number
6. Read the number and save as num3
7. If num1 less than num2 and num1 less than num3 then

        print num1 “is the smallest”

   else If num2 less than num1 and num2 less than num3 then

        print num2 “is the smallest “

   else

        print num3 ”is the smallest “

   end if

Conditional

- Write an algorithm to read a number x and display its sign.

1. Ask user to enter a number
2. Read the number and save as X
3. If x is greater than zero then
   print x “is positive”
   else if x is equal zero then
   print x “is zero”
   else
   print x “is negative”
   end if

Conditional

- Write an algorithm that will input student average. If the average is greater than or equal to 60 and less than or equal to 70, the algorithm should display “Passed”. If it is greater than 70 and less than or equal to 80, print “Good”. If it is greater than 80 and less than 90, print “Very good”. If it is greater than or equal 90 , print “Excellent”. If it is less than 60 the prints “Fail”.

Conditional

1.Ask user to enter student average

2. Read average and save as ag

3. If ag is greater than or equal to sixty and ag is less than or equal to seventy then

    print “Pass”

else if ag is greater than seventy and ag is less than or equal to eighty then

    print “Good”

else if ag is greater than eighty and ag is less than ninety then

    print “Very good”

else if ag is greater than or equal ninety then

    print “Excellent”

else

    print “Fail”

end if

Rules for logical OR operations		
T	T	T
T	F	T
F	T	T
F	F	F

Iterative

- Perform “looping” behavior; repeating actions until a continuation condition becomes false

(1) WHILE condition

sequence

END WHILE

(2) REPEAT

sequence

UNTILE condition

(3) FOR iteration bounds

sequence

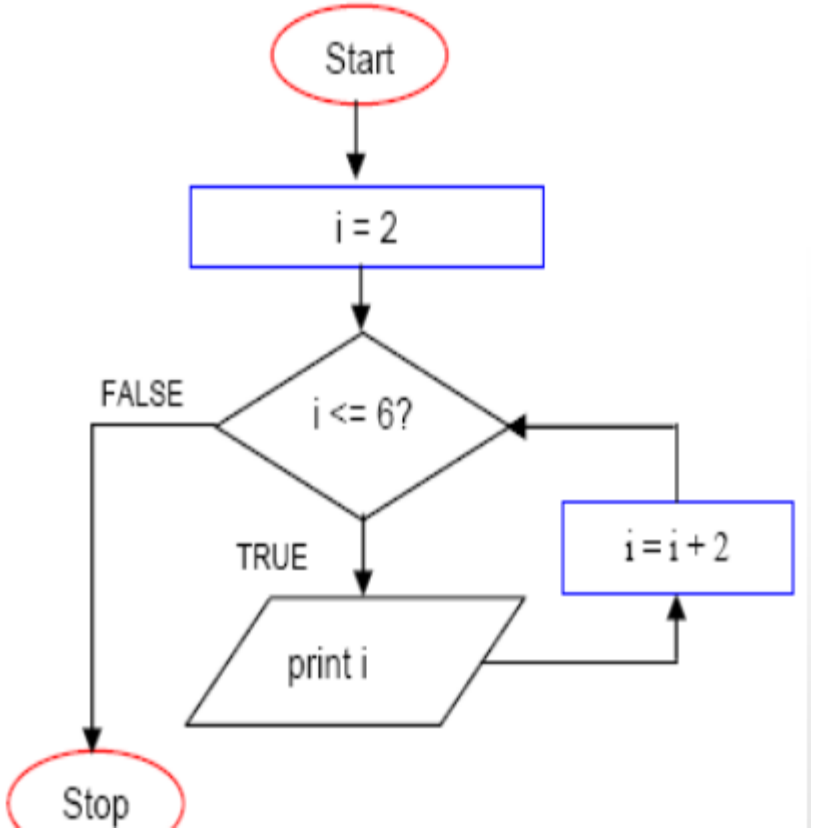
END FOR

Iterative

1. Set i equal to two
2. While i less than or equal six
   print i
   add two to i

end while

Output: 2 4 6



Iterative

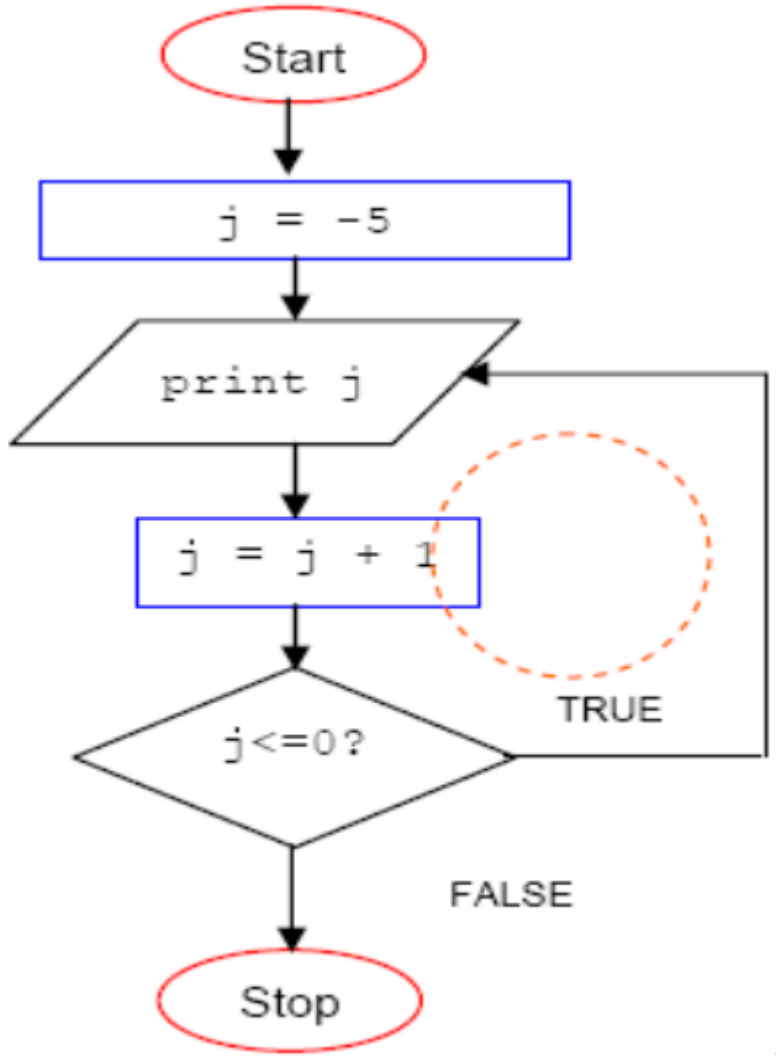
1. Set j equal to negative five
2. Repeat

    print j

    increment j

   until j less than or equal to zero

Output: -5 -4 -3 -2 -1 0



Iterative

Write an algorithm to calculate the average of a set of 10 students.

Solution 1

1. Set counter to zero
2. Set total to zero
3. While counter is less than ten
   Ask user to enter grade
   Read grade and save as gd
   Add the gd into the total
   increment counter
   end while
4. Set the average to the total
   divided by counter
5. Print “the average is ” average

Solution 2

1. Set counter to one
2. Set total to zero
3. While counter is less than or equal ten
   Ask user to enter grade
   Read grade and save as gd
   Add the gd into the total
   increment counter
   end while
4. Set the average to the total divided by 10
5. Print “the average is ” average

Iterative

- Write an algorithm that will count the number of student pass in a class and the amount failed. The pass mark is more than or equal to 65. Suppose the number of students are 30 . The algorithm should output the amount fail and passed.

Iterative

1. Set counter to zero
2. Set passCounter to zero
3. Set failureCounter to zero
4. While counter less than thirty
    Ask user to enter student average
    Read average and save as ag
    if ag greater than or equal sixty five then
        increment passCounter
    else
        increment failureCounter
    end if
    increment counter

end while

6. Print “pass counter =“ passCounter “and failure counter =“ failureCounter

Extra Exercises

- 1. Write an algorithm that takes 20 integers and decides and prints the number of integers divisible by 3 and the number of integers not divisible by 3.

- 2. Write an algorithm that will accept the values of the sides of a square and display its area where the formula is : area = side*side

Extra Exercises

1.Set counter to zero
2.Set divisible_by_3 to zero
3.Set not_divisible_by_3 to zero
4.While counter less than twenty
    Ask user to enter a number
    Read average and save as num
     if num Modula 3 equal zero then
        increment divisible_by_3
     else:
        increment not_divisible_by_3
     end if
     increment counter
end while
6. Print “divisible_by_3 counter =“divisible_by_3 “and not_divisible_by_3 counter =“not_divisible_by_3

Extra Exercises

1. Ask user to enter the side of a square.
2. Read side and save as sq_side.
3. Multiply sq_side by sq_side and save the result as area.
4. Display area.