Data Structures
CSE207

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What is Data Structure?

- A Data Structure can be defined informally as an organized collection of values and a set of operations on them.
- In computer science, a data structure is a particular way of organizing data in a computer so that it can be used efficiently.

Data Structure Operation

- Four Operations:
  - *Traversing:* Accessing Each record exactly once
  - *Searching:* Finding the location of data/record
  - *Inserting:* Adding a new data/record
  - *Deleting:* Removing a data/record

Pseudo-Code

- Not computer programs, but are more structured than usual prose.
- Facilitate the high level analysis of a data structure or algorithm.
- Pseudo code is for human reader, not for a computer.
- To communicate high-level ideas, not low level implementation details.

An example of a Pseudo-code

Procedure ArrayMax(A, n):

Input: An array A storing n≥1 integers

Output: The maximum element in A

```
currentMax ← A[1]
for i ← 2 to n do
    if currentMax < A[i] then
    currentMax    A[i]
return currenMax
```

Algorithm

- A procedure for solving a problem in terms of
  - the actions to be executed, and
  - the order in which these actions are to be executed
- is called an algorithm.
- Correctly specifying the order in which the actions are to be executed is important.

Algorithm

- Consider the "rise-and-shine algorithm" followed by one junior executive for getting out of bed and going to work
- Consider the "rise-and-shine algorithm"
  - (1) Get out of bed,
  - (2) take a shower,
  - (3) get dressed,
  - (4) eat breakfast,
  - (5) carpool to work.
- This routine gets the executive to work well prepared to make critical decisions.

Algorithm

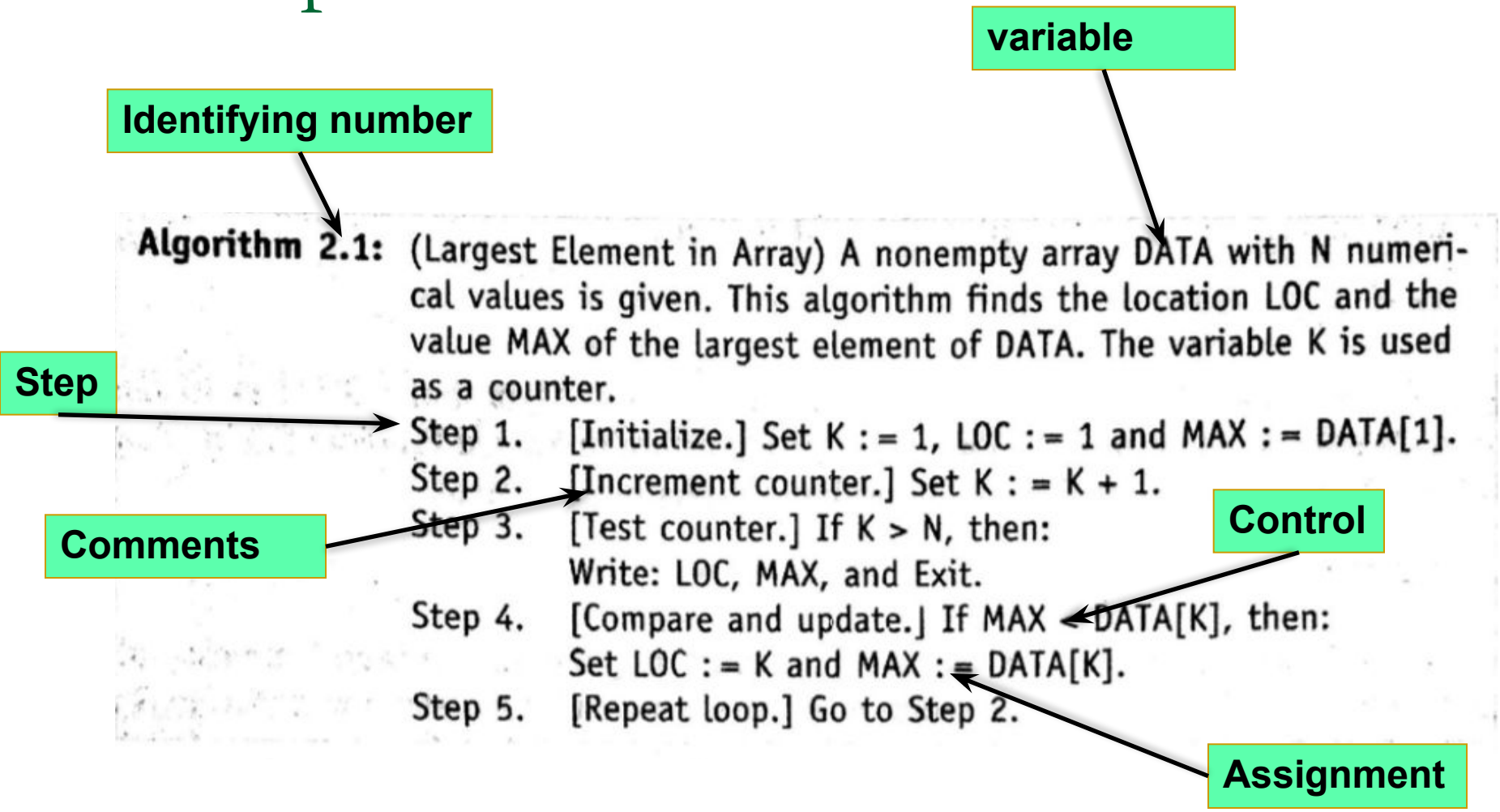
- Suppose that the same steps are performed in a slightly different order:
  - (1) Get out of bed,
  - (2) get dressed,
  - (3) take a shower,
  - (4) eat breakfast,
  - (5) carpool to work.
- In this case, our junior executive shows up for work soaking wet.
- Specifying the order in which statements are to be executed in a computer program is called program control.

Algorithm

- An algorithm is a finite step-by-step list of well-defined instruction for solving a particular problem.

  - **Identifying number**
  - **Step**
  - **Control**
  - **Exit**
  - **Comments**
  - **Variable Name**
  - **Assignment State**
  - **Input / output**

Example



Algorithm 2.1: (Largest Element in Array) A nonempty array DATA with N numerical values is given. This algorithm finds the location LOC and the value MAX of the largest element of DATA. The variable K is used as a counter.

Step 1. [Initialize.] Set K := 1, LOC := 1 and MAX := DATA[1].
Step 2. [Increment counter.] Set K := K + 1.
Step 3. [Test counter.] If K > N, then:
Write: LOC, MAX, and Exit.
Step 4. [Compare and update.] If MAX < DATA[K], then:
Set LOC := K and MAX := DATA[K].
Step 5. [Repeat loop.] Go to Step 2.

Control structure

- Three types of logic/control logic:
  - *Sequential logic or sequential flow*
  - *Selection logic or conditional flow*
  - *Iteration logic or repetitive flow*

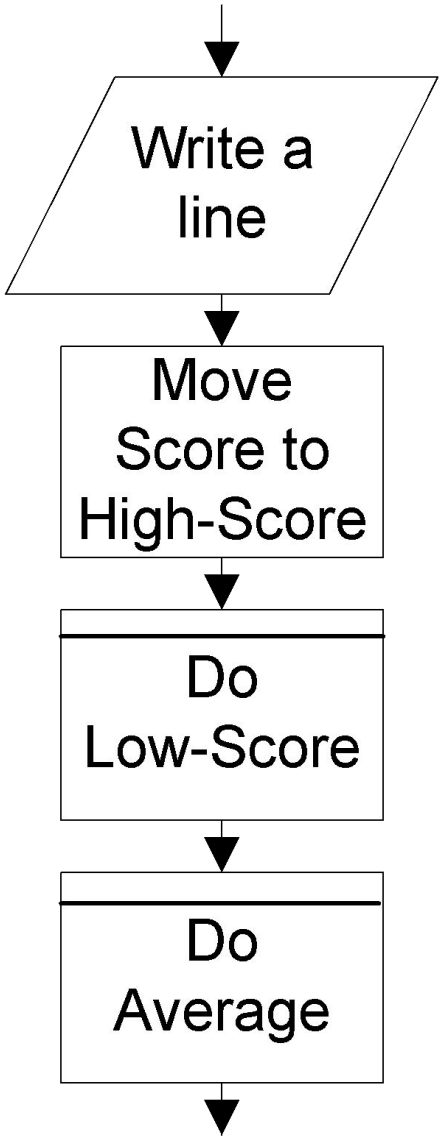
Control structure

<u>3 basic structures</u>

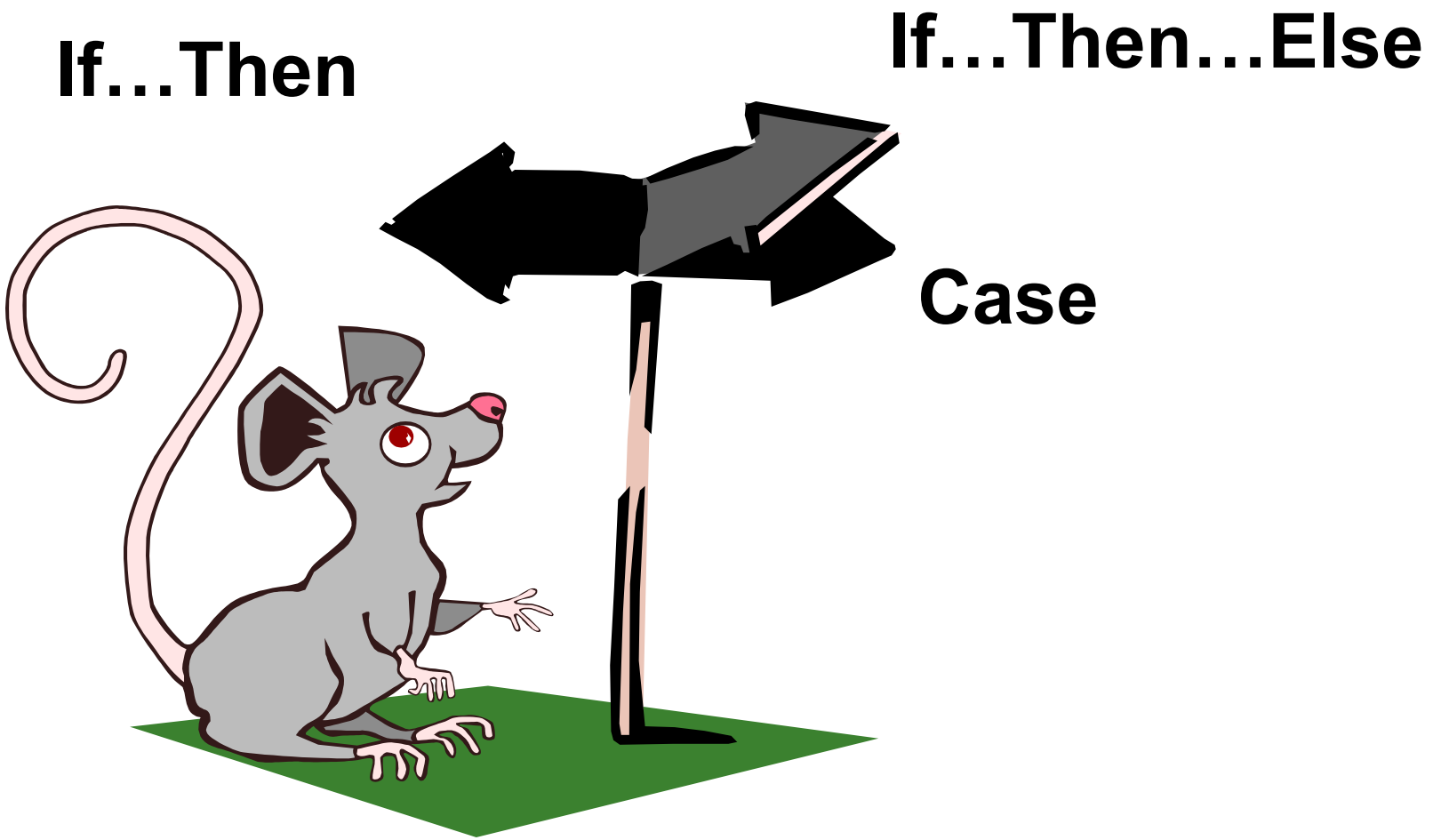
- Sequence
- Decision (selection)
- Repetition (looping or iteration)

Sequence Structure

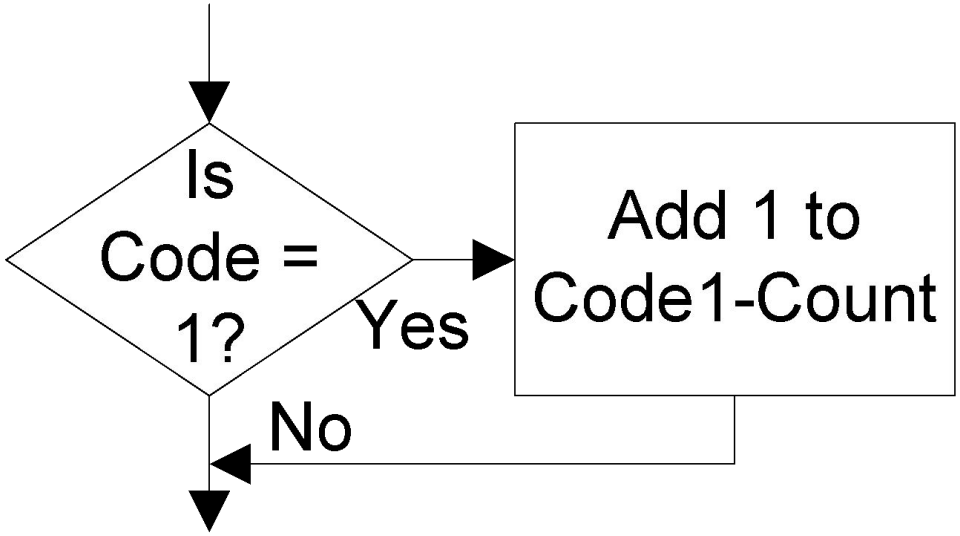
- Can contain any symbol except for the decision symbol
- Steps are executed in sequence with no instruction changing the order



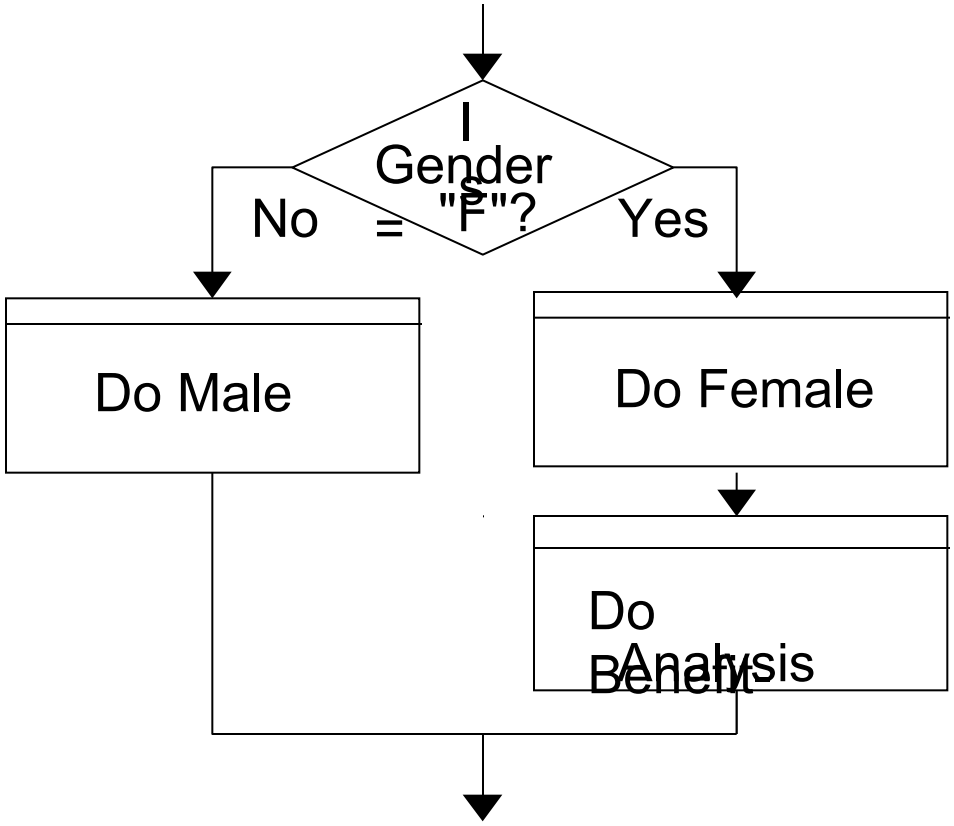
Decision Structures



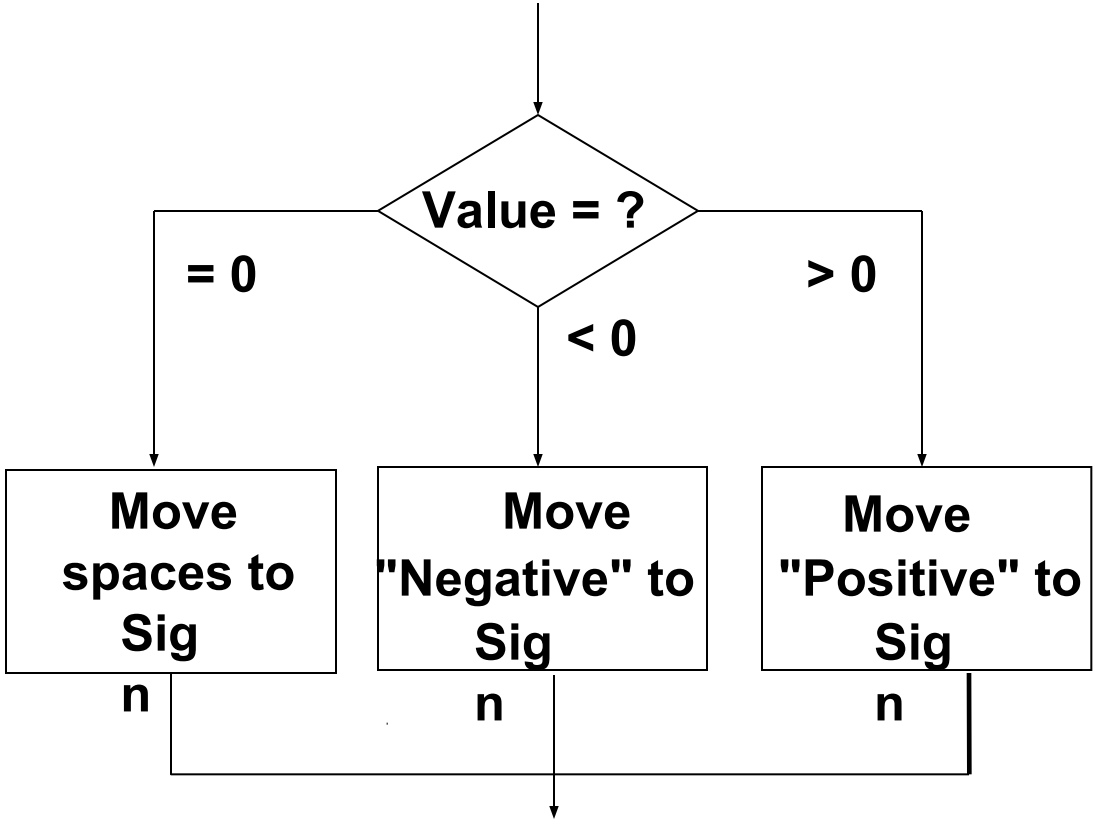
If…Then



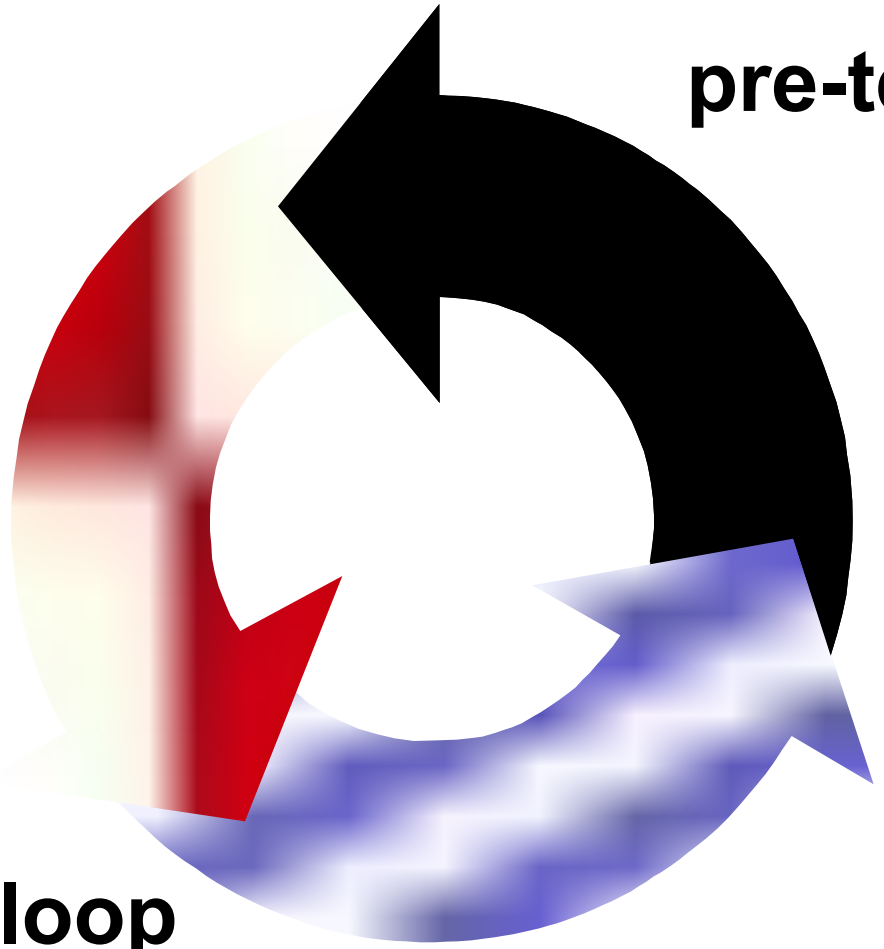
If…Then…Else



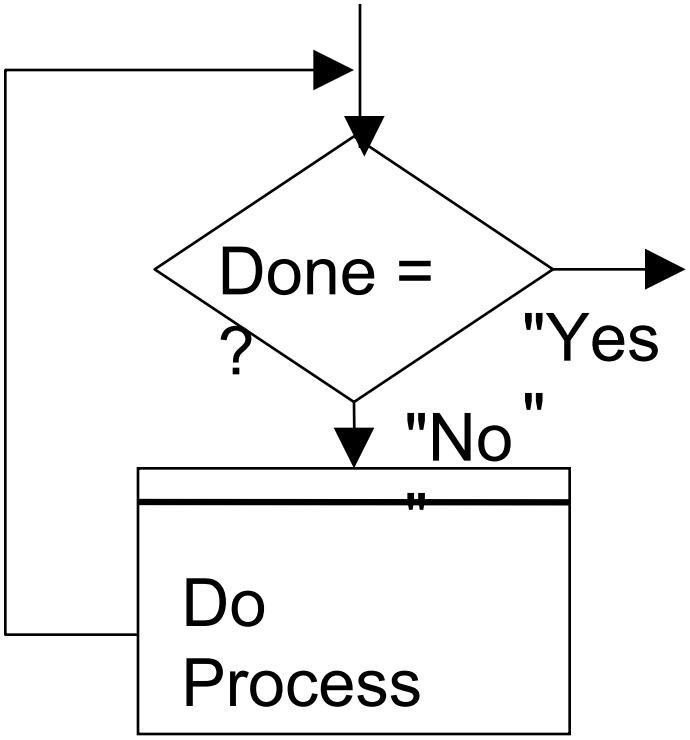
Case


Value = ?
= 0
< 0
> 0
Move spaces to Sign
Move "Negative" to Sign
Move "Positive" to Sign

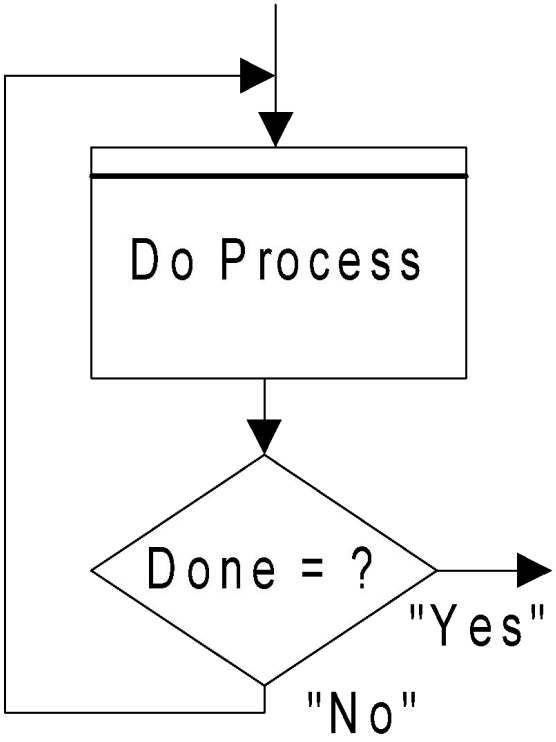
Repetition (Looping or Iteration)



How Many Times is Each of the Following Loops Executed?



Pre test



Post test

Any Question?