Control Statements: What do they do?

- **Branching**:
  - Allow different sets of instructions to be executed depending on the outcome of a logical test.
    - Whether TRUE (non-zero) or FALSE (zero).

- **Looping**:
  - Some applications may also require that a set of instructions be executed repeatedly, possibly again based on some condition.

How do we specify the conditions?

- Using relational operators.
  - Four relation operators: <, <=, >, >=
  - Two equality operations: ==, !=

- Using logical operators / connectives.
  - Two logical connectives: &&, | |
  - Unary negation operator: !

The conditions evaluate to …

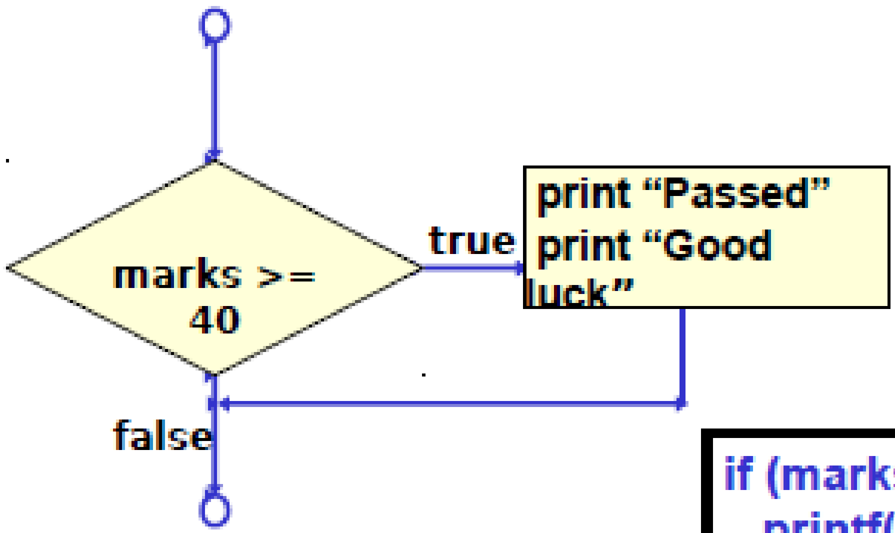
- Zero
  - Indicates FALSE.
- Non-zero
  - Indicates TRUE.
  - Typically the condition TRUE is represented by the value ‘1’.

Branching: *The if Statement*

```
if (expression)
        statement;

if (expression) {
        Block of statements;
}
```

The condition to be tested is any expression enclosed in parentheses. The expression is evaluated, and if its value is non-zero, the statement is executed.



A decision can be made on any expression.

zero - false

nonzero - true

```
if (marks>=40)  {
   printf("Passed \n");
   printf("Good luck\n");
}
printf ("End\n") ;
```

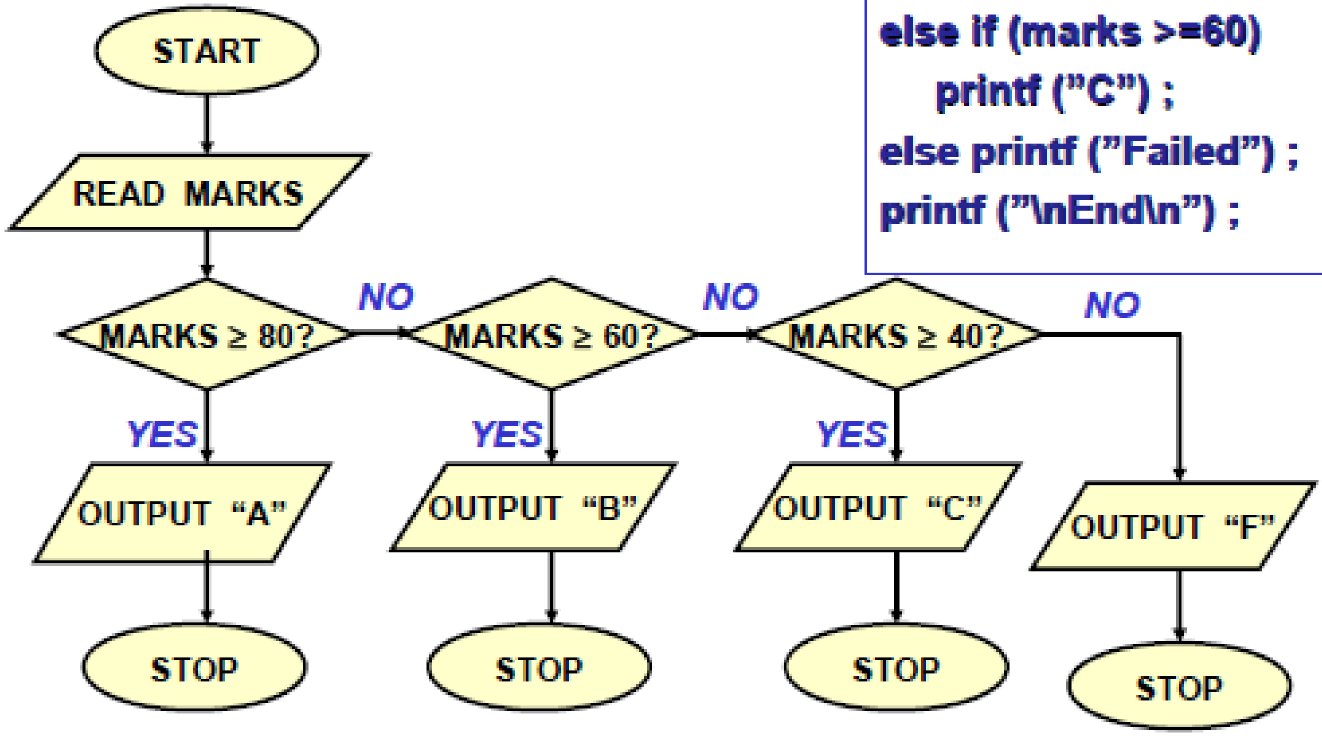
Branching: *if-else Statement*

```
if (expression) {
    Block of statements;
}
else {
    Block of statements;
}
```

```
if (expression) {
    Block of statements;
}
else if  (expression) {
    Block of statements;
}
else {
    Block of statements;
}
```

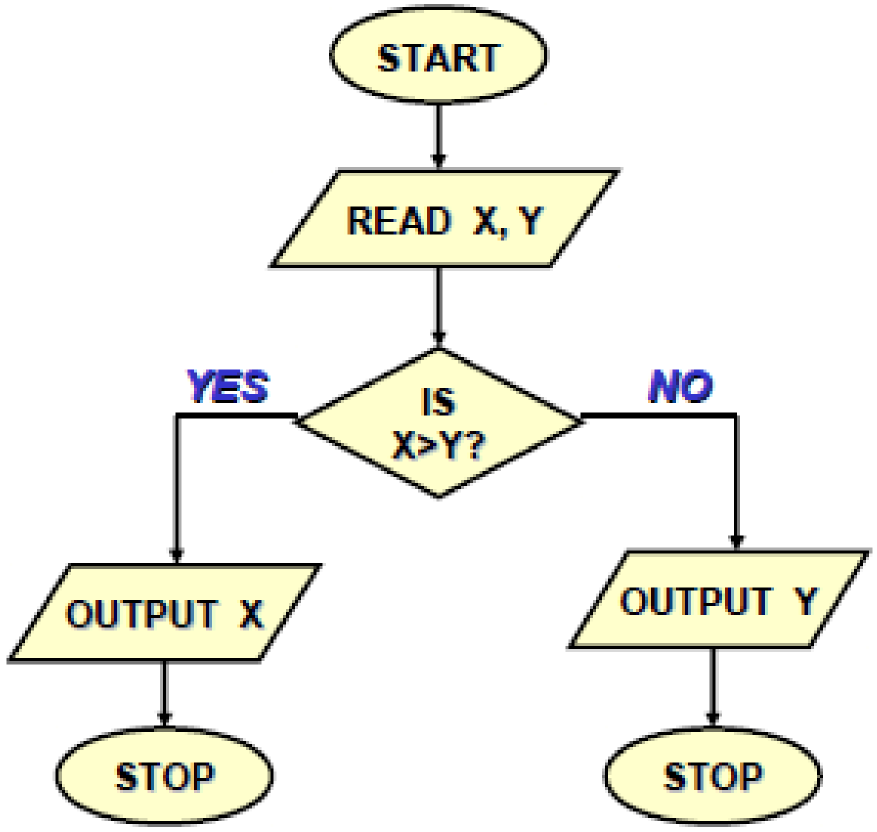
Grade Computation

```
if (marks >= 80)
    printf ("A") ;
else if (marks >= 60)
    printf ("B") ;
else if (marks >=60)
    printf ("C") ;
else printf ("Failed") ;
printf ("\nEnd\n") ;
```



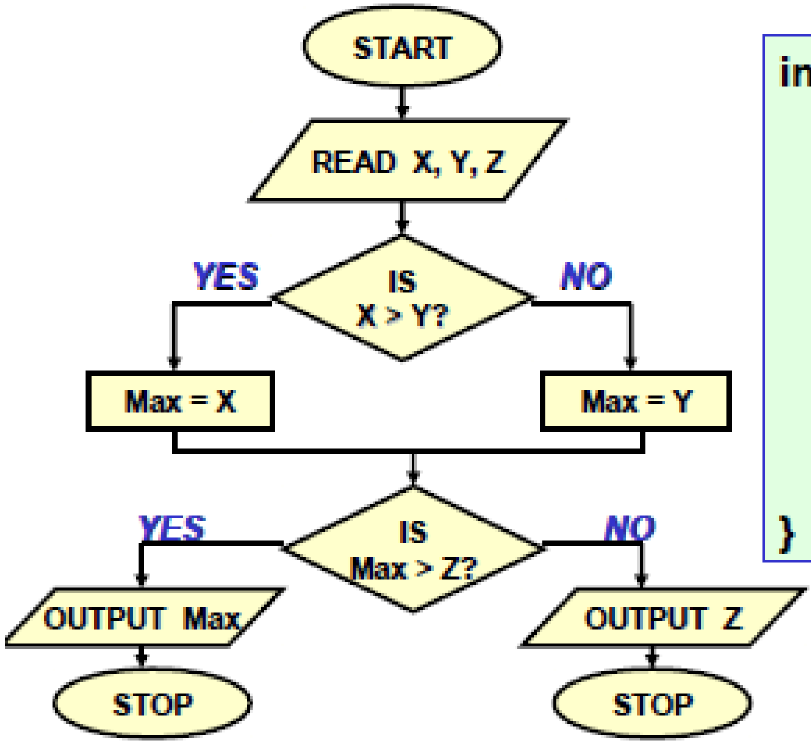
```
int main () {
     int marks;
    scanf (“%d”, & marks) ;
    if (marks>= 80) {
       printf (“A”) ;
       printf (“Good Job!”) ;
    }
    else if (marks >= 60)
       printf (“B”) ;
    else if (marks >=60)
       printf (“C”) ;
    else {
       printf (“Failed”) ;
       printf (“Study hard for the supplementary”) ;
    }
    printf (“\nEnd\n”) ;
}
```

Find the larger of two numbers



```
int main () {
    int x, y;

    scanf ("%d%d", &x, &y) ;
    if (x>y)
          printf ("%d\n", x);
    else
          printf ("%d\n", x);
}
```



```
int main () {
      int x, y, z, max;
      scanf ("%d%d%d",&x,&y,&z);
      if (x>y)
              max = x;
      else max = y;
      if (max > z)
               printf ("%d", max) ;
      else printf ("%d",z);
}
```

Example

```
#include <stdio.h>
main()
{
    int  a,b,c;
    scanf (“%d %d %d”, &a, &b, &c);
    if ((a>=b) && (a>=c))
        printf (“\n The largest number is: %d”, a);
    if ((b>=a) && (b>=c))
        printf (“\n The largest number is: %d”, b);
   if ((c>=a) && (c>=b))
        printf (“\n The largest number is: %d”, c);
}
```

Confusing Equality (==) and Assignment (=) Operators

- Dangerous error
  - Does not ordinarily cause syntax errors.
  - Any expression that produces a value can be used in control structures.
  - Nonzero values are true, zero values are false.

- Example:

```
if ( payCode == 4 )
   printf( "You get a bonus!\n" );
```

```
if ( payCode = 4 )
   printf( "You get a bonus!\n" );
```

WRONG

Nesting of if-else Structures

- It is possible to nest if-else statements, one within another.
- All “if” statements may not be having the “else” part.
  - Confusion??
- Rule to be remembered:
  - An “else” clause is associated with the closest preceding unmatched “if”.
  - Some examples shown next.

Dangling else problem

if (exp1) if (exp2) stmta else stmtb

```
if (exp1) {
    if (exp2)
        stmta
    else
        stmtb
}
```

OR

```
if (exp1) {
    if (exp2)
        stmta
}
else
    stmtb
```

?

Which one is the correct interpretation?

Dangling else problem

if (exp1) if (exp2) stmta else stmtb

```
if (exp1) {
    if (exp2)
        stmta
    else
        stmtb
}
```

More examples

```
if e1 s1
else if e2 s2

if e1 s1
else if e2 s2
else s3

if e1 if e2 s1
else s2
else s3

if e1 if e2 s1
else s2
```

?

Answers

```
if e1 s1
else if e2 s2
```

$\Longrightarrow$

```
if  e1  s1
else  { if  e2  s2 }
```

```
if e1 s1
else if e2 s2
else s3
```

$\Longrightarrow$

```
if  e1  s1
else  { if  e2  s2
             else s3 }
```

```
if e1 if e2 s1
else s2
else s3
```

$\Longrightarrow$

```
 if  e1  { if  e2  s1
              else  s2 }
else  s3
```

```
if e1 if e2 s1
else s2
```

$\Longrightarrow$

```
if  e1  { if  e2  s1
             else s2 }
```

Common Errors

```
c = getchar( );
if ((c == 'y') && (c == 'Y')) printf("Yes\n");
else printf("No\n");
```

```
c = getchar( );
if ((c != 'n') || (c != 'N')) printf("Yes\n");
else printf("No\n");
```

The Conditional Operator ?:

- This makes use of an expression that is either true or false. An appropriate value is selected, depending on the outcome of the logical expression.

- Example:

$$\text{interest = }\underbrace{\text{(balance>5000) ? balance*0.2 : balance*0.1;}}_{\textit{Returns a value}}$$

Equivalent to:

```
if (balance > 5000)
        interest = balance*0.2;
else interest = balance*0.1;
```

More examples

- **Examples:**

```
x = ((a>10) && (b<5)) ? a+b : 0

(marks>=60) ? printf("Passed \n") : printf("Failed \n");
```

The *switch* Statement

- **This causes a particular group of statements to be chosen from several available groups.**
  - Uses "switch" statement and "case" labels.
  - Syntax of the "switch" statement:

```
switch (expression)  {
   case expression-1: { ........ }
   case expression-2: { ........ }

   case expression-m: { ........ }
   default: { ......... }
}
```

where "expression" evaluates to int or char

Examples

```
switch ( letter ) {
    case 'A':
            printf ("First letter \n");
            break;
    case 'Z':
            printf ("Last letter \n");
            break;
    default :
            printf ("Middle letter \n");
            break;
}
```

Will print this statement for all letters other than A or Z

Examples

```
switch (choice = getchar())
{
    case ‘r’ :
    case ‘R’: printf(“Red”);
                break;
    case ‘b’ :
    case ‘B’ : printf(“Blue”);
                break;
    case ‘g’ :
    case ‘G’:
printf(“Green”);
                break;
    default: printf(“Black”);
```

Since there isnt a* break *statement here, the control passes to the next statement* (printf) *without checking the next condition.

Another way

```
switch  (choice = toupper(getchar()))  {

    case 'R':        printf ("RED \n");
                     break;
    case 'G':        printf ("GREEN \n");
                     break;
    case 'B':        printf ("BLUE \n");
                     break;
    default:         printf ("Invalid choice \n");

}
```

Rounding a Digit

```
switch (digit)   {
        case 0:
        case 1:
        case 2:
        case 3:
        case 4: result = 0; printf ("Round down\n"); break;
        case 5:
        case 6:
        case 7:
        case 8:
        case 9: result = 10; printf("Round up\n"); break;
}
```

```
t main () {
  int operand1, operand2;
  int result = 0;
  char operation ;
  /* Get the input values */
  printf ("Enter operand1 :");
  scanf("%d",&operand1) ;
  printf ("Enter operation :");
  scanf ("\n%c",&operation);
  printf ("Enter operand 2 :");
  scanf ("%d", &operand2);
  switch (operation)    {
  case '+' :
       result=operand1+operan
     break;
                             }
```

```
case '-' :
  result=operand1-operand2;
  break;
case '*' :
  result=operand1*operand2;
  break;
case '/' :
  if (operand2 !=0)
      result=operand1/operand2;
  else
      printf("Divide by 0 error");
  break;
default:
  printf("Invalid operation\n");
}
printf ("The answer is %d\n",resu
```

The *break* Statement

- Used to exit from a switch or terminate from a loop.

- With respect to “switch”, the “break” statement causes a transfer of control out of the entire “switch” statement, to the first statement following the “switch” statement.

- Can be used with other statements also …