Control Statements

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What do they do?

- **Allow different sets of instructions to be executed depending on the outcome of a logical test.**
  - **Whether TRUE or FALSE.**
  - **This is called *branching*.**
- **Some applications may also require that a set of instructions be executed repeatedly, possibly again based on some condition.**
  - **This is called *looping*.**

How do we specify the conditions?

- **Using relational operators.**
  - **Four relation operators:** **<, <=, >, >=**
  - **Two equality operators:** **==, !=**
- **Using logical operators / connectives.**
  - **Two logical connectives:** **&&, | |**
  - **Unary negation operator:** **!**

Examples

```
count <= 100
(math+phys+chem)/3 >= 60
(sex='M') && (age>=21)
(marks>=80) && (marks<90)
(balance>5000) || (no_of_trans>25)
!(grade='A')
!((x>20) && (y<16))
```

The conditions evaluate to …

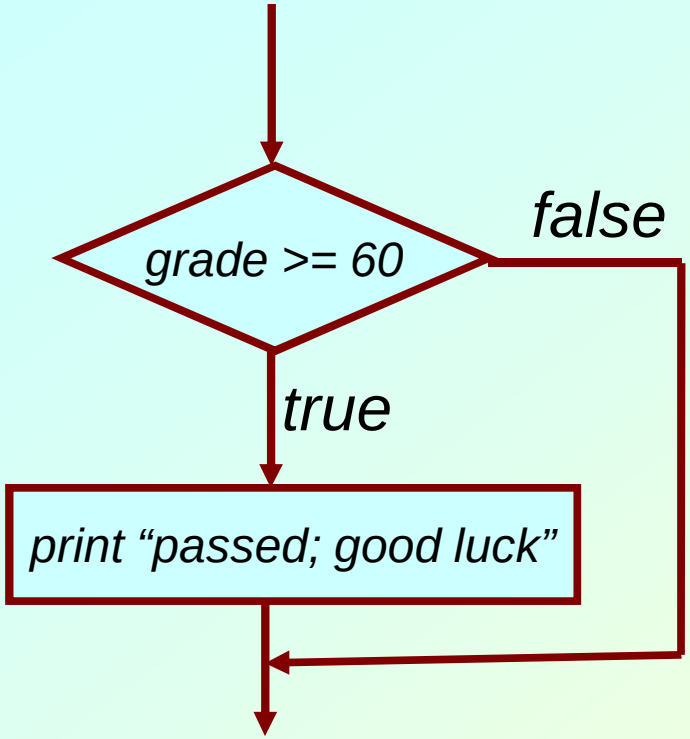
- **Zero**
  - **Indicates *FALSE*.**
- **Non-zero**
  - **Indicates *TRUE*.**
  - **Typically the condition TRUE is represented by the value ‘1’.**

Branching: The if Statement

- Diamond symbol (decision symbol) - indicates decision is to be made.
  - Contains an expression that can be TRUE or FALSE.
  - Test the condition, and follow appropriate path.
- Single-entry / single-exit structure.
- General syntax:

  if (condition) { …….. }

  - If there is a single statement in the block, the braces can be omitted.



A decision can be made on any expression.

zero - false

nonzero - true

```
if (grade>=60)
{
  printf(“Passed \n”);
  printf(“Good luck\n”);
}
```

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" );
```

Some Examples

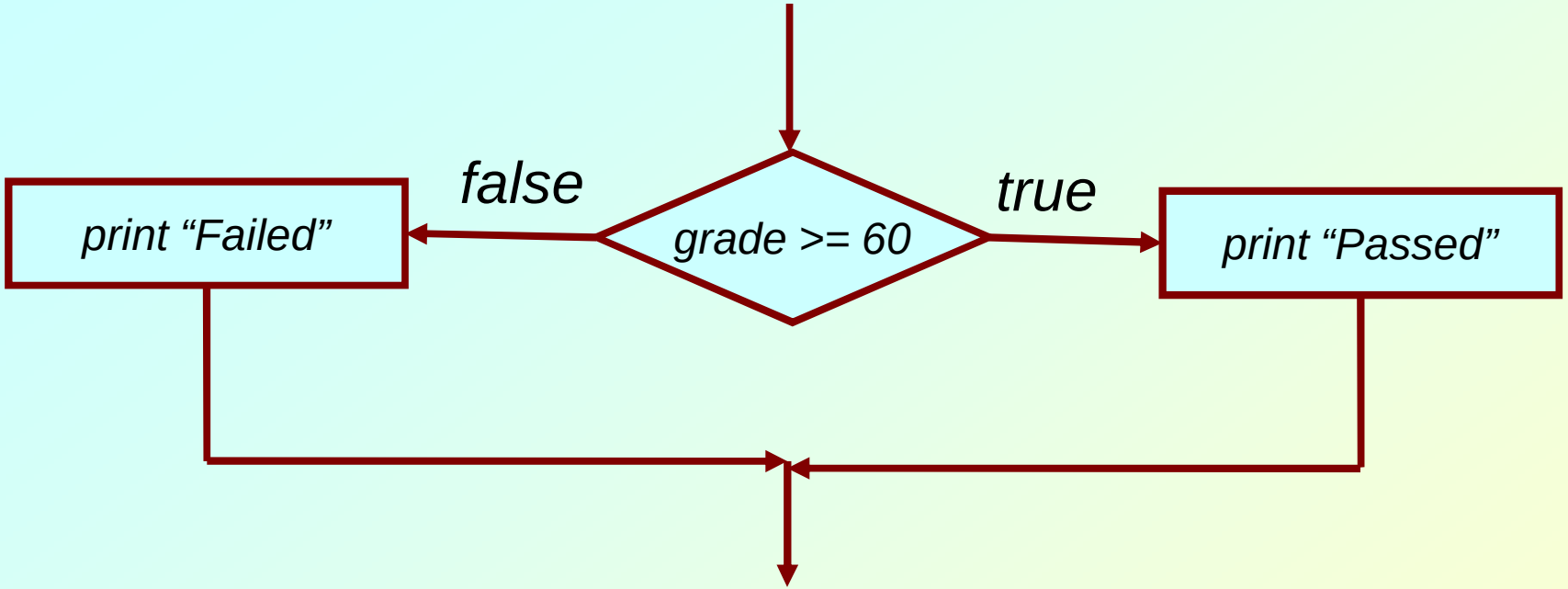
```
if (10<20)  { a = b + c;  printf (“%d”, a);  }

if ((a>b) && (x=10))  { ……. }

if (1)  { …… }

if (0)  { …… }
```

Branching: The if-else Statement

- Also a single-entry / single-exit structure.
- Allows us to specify two alternate blocks of statements, one of which is executed depending on the outcome of the condition.
- General syntax:

```
if  (condition)   { …… block 1 ……. }
else  { ……. block 2 ……. }
```

  - If a block contains a single statement, the braces can be deleted.




```
if ( grade >= 60 )
      printf ("Passed\n");
else
      printf ("Failed\n");
```

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.

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

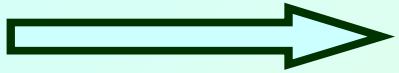
```
if e1 s1
else if e2 s2
else s3
```

?

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

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

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



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

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

```
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
else  s3
```

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

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

Example

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

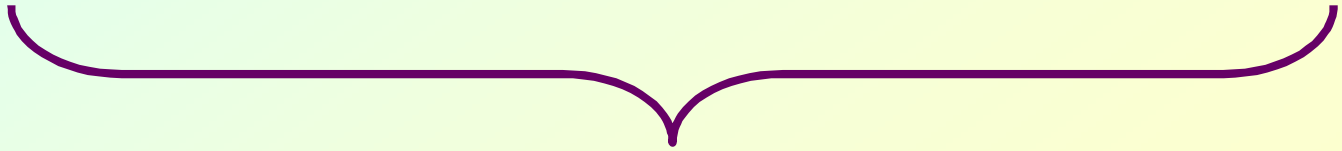
Example

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

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:

```
interest = (balance>5000) ? balance*0.2 : balance*0.1;
```



Returns a value

- **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

Example

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

The break Statement

- Used to exit from a switch or terminate from a loop.
  - Already illustrated in the previous example.
- 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.

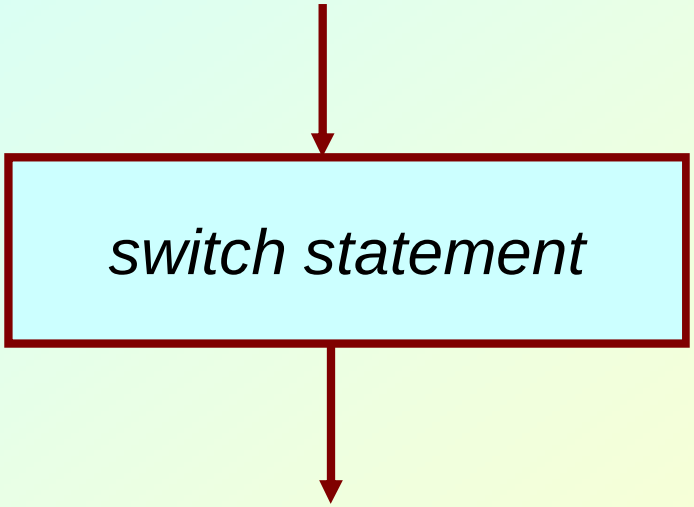
Example

```
switch  (choice = getchar())  {
   case 'r':
   case 'R': printf ("RED \n");
             break;
   case 'g':
   case 'G': printf ("GREEN \n");
             break;
   case 'b':
   case 'B': printf ("BLUE \n");
             break;
   default:  printf ("Invalid choice \n");
}
```

Example

```
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”);

}
```

- **The "switch" statement also constitutes a single-entry / single-exit structure.**



A Look Back at Arithmetic Operators: the Increment and Decrement

Increment (++) and Decrement (--)

- **Both of these are unary operators; they operate on a single operand.**
- **The increment operator causes its operand to be increased by 1.**
  - **Example:** `a++, ++count`
- **The decrement operator causes its operand to be decreased by 1.**
  - **Example:** `i--, --distance`

- **Operator written before the operand (++i, --i))**
  - **Called pre-increment operator.**
  - **Operator will be altered in value *before* it is utilized for its intended purpose in the program.**
- **Operator written after the operand (i++, i--)**
  - **Called post-increment operator.**
  - **Operator will be altered in value *after* it is utilized for its intended purpose in the program.**

Examples

Initial values :: a = 10; b = 20;

`x = 50 + ++a;`	`a = 11, x = 61`
`x = 50 + a++;`	`x = 60, a = 11`
`x = a++ + --b;`	`b = 19, x = 29, a = 11`
`x = a++ – ++a;`	`Undefined value (implementation dependent)`

Called side effects:: while calculating some values, something else get changed.