


Ch.6 Conditional Statements

What you will learn in this chapter

- 
- What is a conditional statement ?
 - if statement
 - if, else statement
 - nested if statements
 - switch statement
 - break statement
 - continue statement
 - goto statement

Ability to change the execution order of statements when conditions are met, as needed .

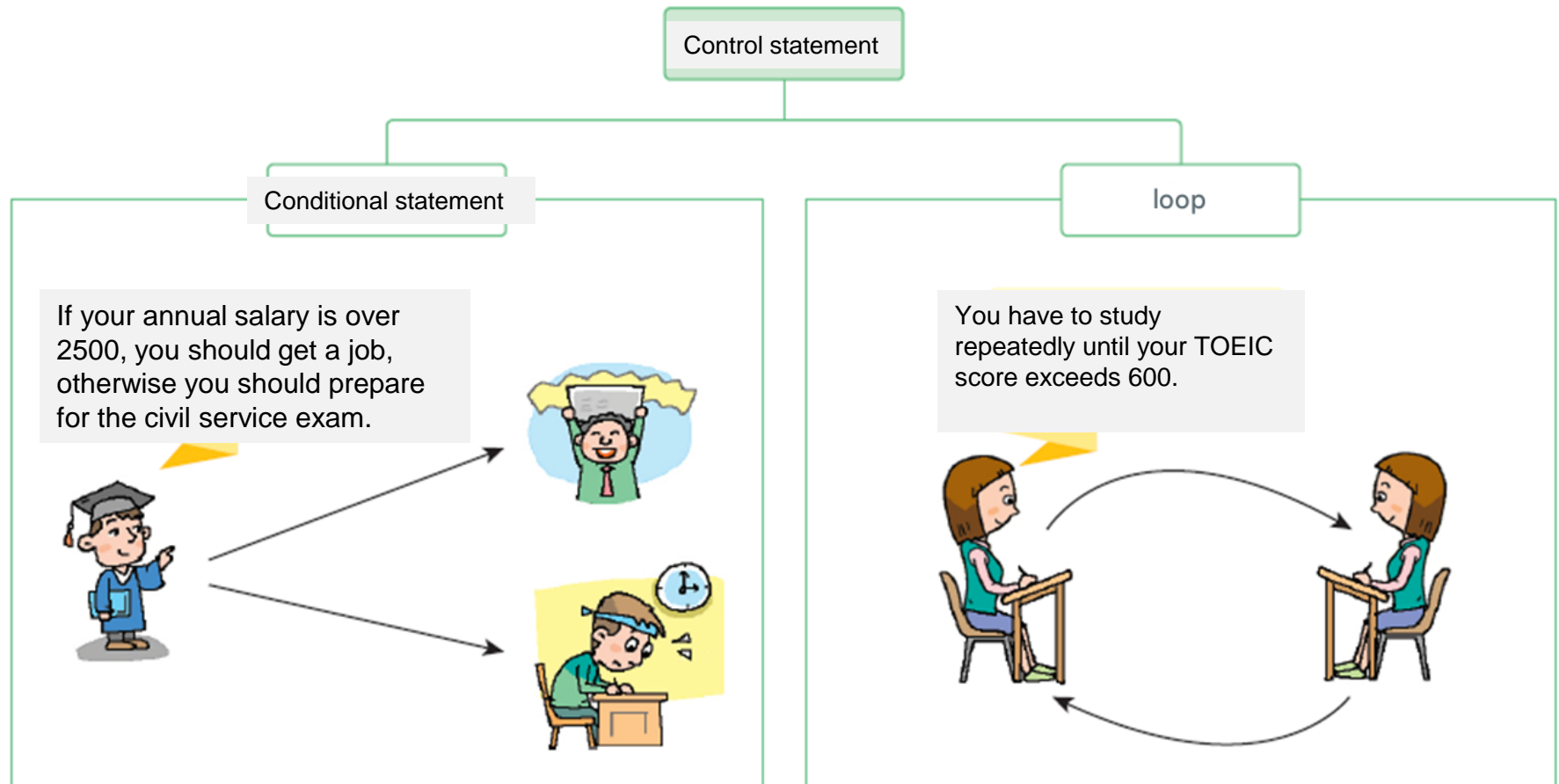


Conditional statement

- If a program does not have a selection structure, the program will always repeat the same actions .

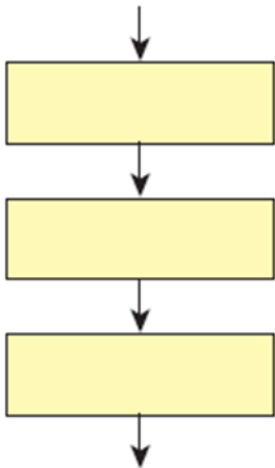


Control statement

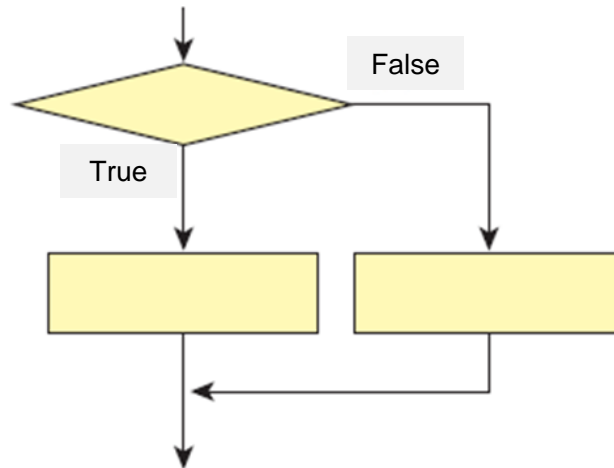


3 types of control structures

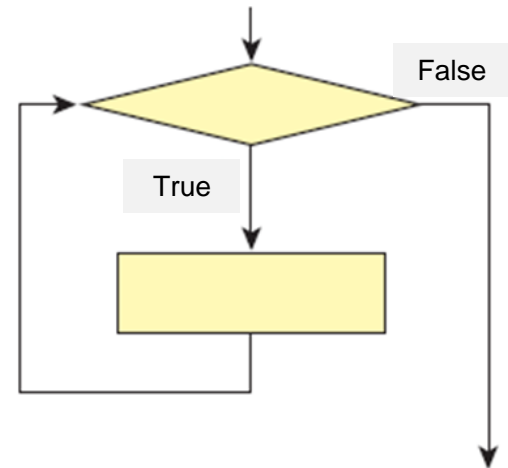
Sequential structure



Selection structure

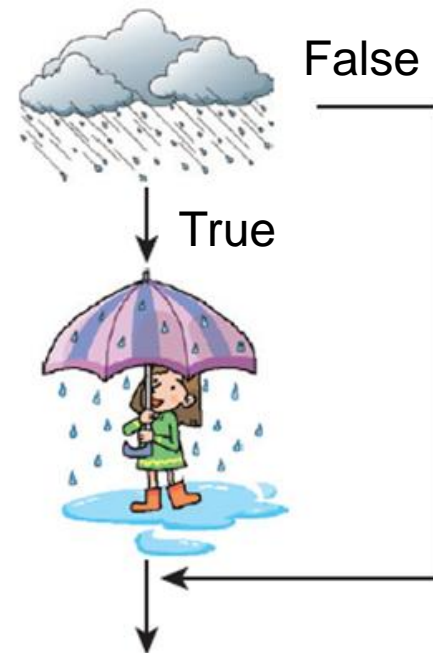
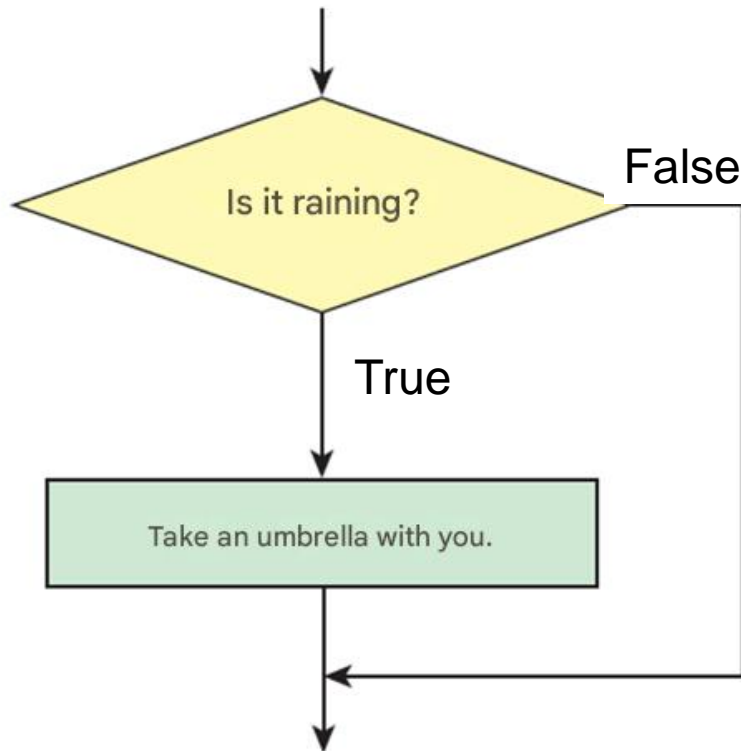


Repeat structure

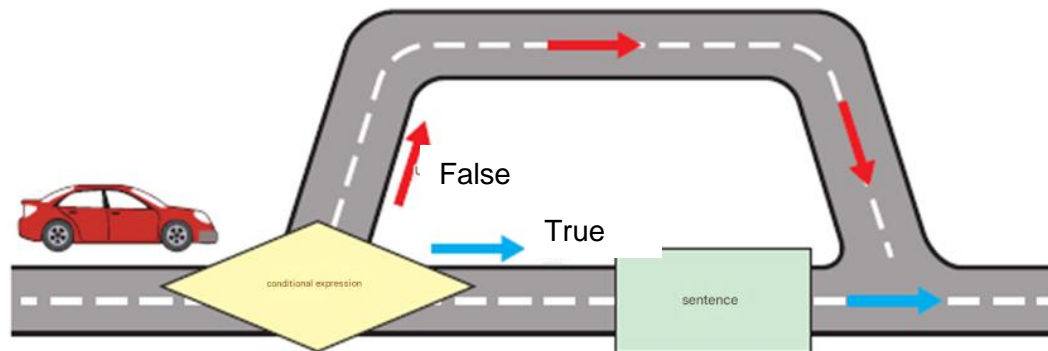
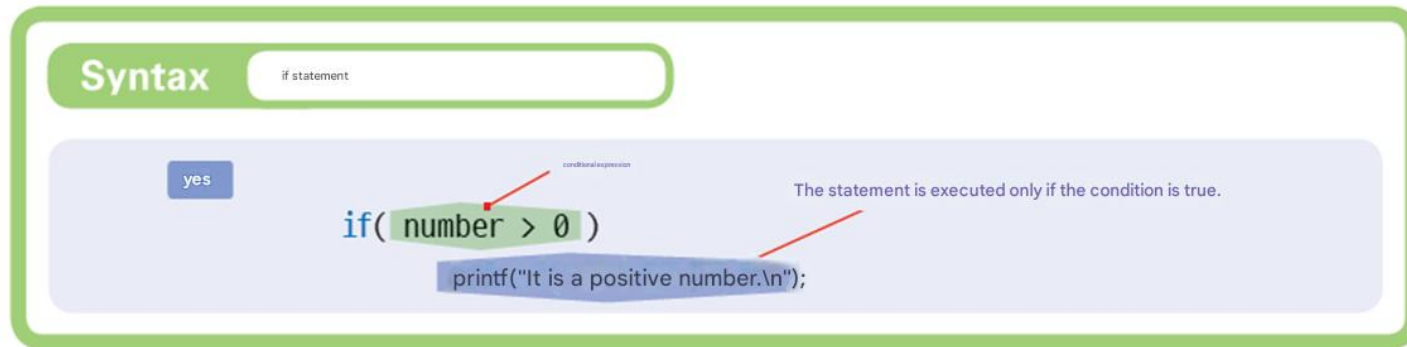


if statement

- In everyday life, there are many instances where decisions must be made based on conditions .



if statement structure



if statement example

If number is greater than 0

```
if ( number > 0 ) { // can omit, but do not omit  
    printf ( " It is a positive number \n " );  
} // can omit, but do not omit
```

Prints " It is a positive number"

```
if ( temperature < 0 )  
    printf ( " It's below zero now .\n " ); // Only run when the condition is true  
  
printf ( " Current temperature is % degrees .\n" , temperature); // Always run
```

if statement ends,
the following line of the if-statement
is executed .

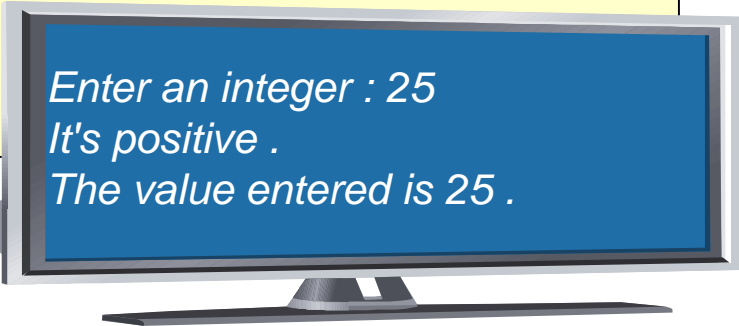
Example

```
#include <stdio.h>
int main( void )
{
    int number;

    printf ( " Enter an integer : " );
    scanf ( "%d" , &number);

    if ( number > 0 ) {
        printf ( " It is a positive number ." );
    }
    printf ( " The entered value is %d .", number );

    return 0;
}
```



*Enter an integer : 25
It's positive .
The value entered is 25 .*

Example

```
// Program to find absolute value using if statement
```

```
#include <stdio.h>
```

```
int main( void )
```

```
{
```

```
    int number;
```

```
    printf ( " Enter an integer : " );
```

```
    scanf ( "%d" , &number);
```

```
    if ( number < 0 )
```

```
        number = -number;
```

```
    printf ( " The absolute value is %d .\n" , number);
```


```
    return 0;
```

```
}
```

if

If the user entered -5

-5 Since it is < 0 ,
the conditional statement
is executed.



Enter an integer : -5
The absolute value is 5 .

Compound sentence

- compound statement
 - Grouping sentences using curly braces,
 - Also called block .

```
if ( score >= 60 )  
{  
    printf (" You passed .\n");  
    printf (" You can also get a scholarship .\n ");  
}
```

If the condition is true,
two statements are
grouped and executed .

A brief notation for conditional statements

standard method	concise notation
<pre>if(x != 0) printf("x is not 0.\n");</pre>	<pre>if(x) printf("x is not 0.\n");</pre>
<pre>if(x == 0) printf("x is 0.\n");</pre>	<pre>if(!x) printf("x is 0.\n");</pre>

Error Alert

Warning: Error Caution #1

You should not put a semicolon after the conditional expression of an if statement as follows. An if statement is a single sentence made up of a conditional expression and a statement. If you write it as follows, the if statement ends with `if(x > 0);` and the `printf` statement is executed regardless of the condition.

```
if( x > 0 );  
    printf("It is a positive number.\n");
```

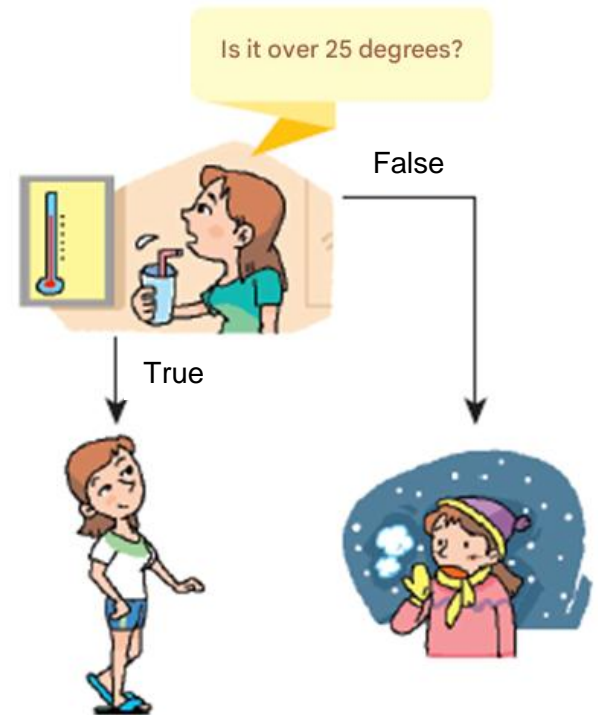
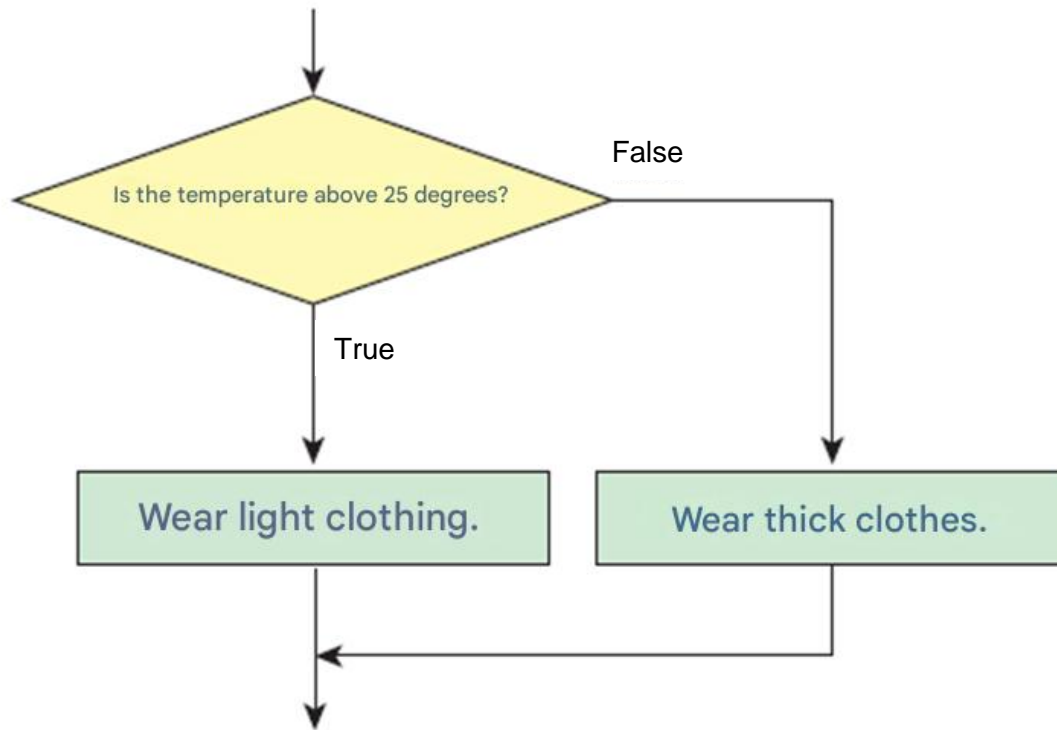
Warning: Error Note #2

A very common mistake is to use the `=` operator instead of the `==` operator when comparing two values. In this case, no comparison is made, and the values are simply assigned to the variable. True or false is determined based on the assigned value.

```
if( x = 0 )  
    printf("x is 0.");
```

In this case, 0 is assigned to x, so it is always false. You should write `x == 0`. To avoid this error, some people write `0 == x`. If `0 = x`, a syntax error occurs.

if-else statement



if-else statement

Syntax

if-else statement

yes

Conditional expression
`if(number > 0)`

`printf("It is a positive number.\n");`

`else`

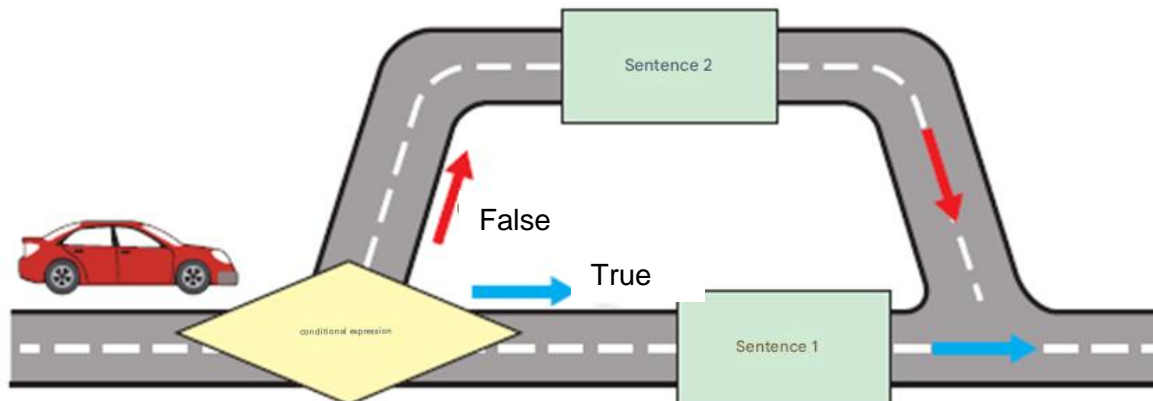
`printf("Not a positive number.\n");`

If the condition is true

Statement 1 is executed.

Otherwise, sentence 2 is true.

It is done.



if-else statement

```
if ( score >= 60 )  
    printf ( " Pass .\n" );  
else  
    printf ( " Failed .\n " );
```

Run if score is 60 or higher

Run if score is less than 60

```
if ( score >= 60 )  
{  
    printf ( " Pass .\n" );  
    printf ( " You can also get a scholarship .\n" );  
}  
else  
{  
    printf ( " Failed .\n " );  
    printf ( " Try again .\n" );  
}
```

Run if score is 60 or higher

Run if score is less than 60

Complex conditional expressions are also possible

- Credit Decision Code

```
if ( score >= 80 && score < 90 )  
    grade = 'B' ;
```

- Code to count the number of space characters

```
if ( ch == ' ' || ch == '\n' || ch == '\t' )  
    white_space ++;
```

Conditional operator

- A simple if-else statement can also be expressed using the conditional operator we learned in Chapter 4.

```
(score >= 60 ) ? printf ( " Pass .\n " ) : printf ( " Fail .\n " );
```

```
bonus = (( years > 30 ) ? 500 : 300 );
```

if-else statement style

style

If-else statements usually use one of the following two styles. This book mainly uses the first method, but the second method is also used when space is limited.

Compound sentences are easier to read if indented.

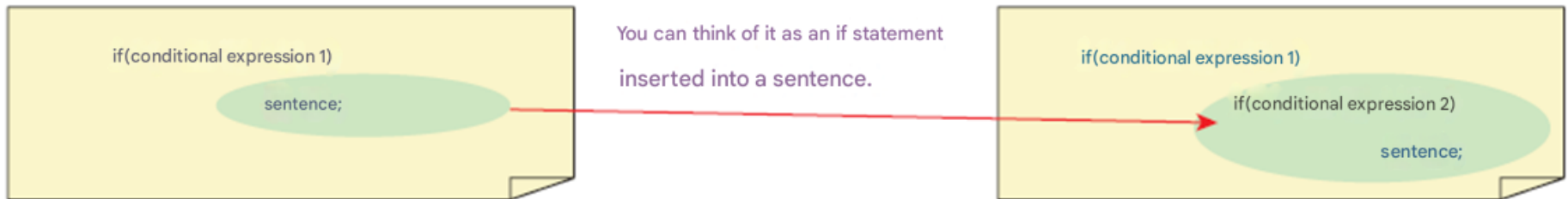
```
if( expression )  
{  
    → statement11;  
    statement12;  
    ...  
}  
else  
{  
    → statement21;  
    statement22;  
    ...  
}
```

It is sometimes written in this format to save space.

```
if( expression ){  
    statement11;  
    statement12;  
    ...  
}  
else {  
    statement21;  
    statement22;  
    ...  
}
```

nested if

- if statement contains another if statement



nested if

```
if ( score >= 80 )  
    if ( score >= 90 )  
        printf ( " Your grade is A. \n" );
```

if in the sentence position of the greeting
If the if statement is entered

```
if ( score >= 80 )  
    if ( score >= 90 )  
        printf ( " Your grade is A. \n" );  
    else  
        printf ( " Your grade is B. \n" );
```

if in the sentence position of the greeting
If an if-else statement is included

Matching problem of if and else

The else clause matches the nearest if clause .

if(score > 80)

if(score >= 90)

printf (" Your grade is A \n");

else

printf (" Your grade is B \n")

if (score >= 80)

{

if (score >= 90)

printf (" Your grade is A. \n ");

}

else

printf (" Your grade is neither an A nor a B. \n");

If you want to match different if clauses with different else clauses, use curly braces to group them into a block .

Consecutive if

Syntax

consecutive if statements

grammar

```
if(conditional expression 1)
```

sentence 1;

```
else if(condition2)
```

Sentence 2;

```
else if(condition 3)
```

Sentence 3;

else

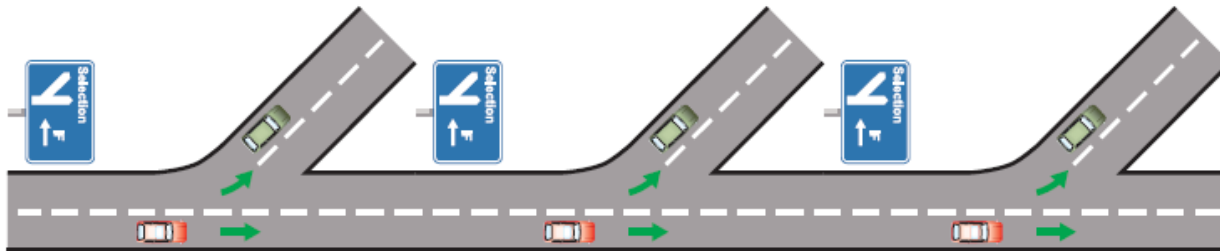
Sentence 4;

- If condition 1 is true, statement 1 is executed.

Otherwise, if condition 2 is true, statement 2 is executed.

Otherwise, if condition 3 is true, statement 3 is executed.

Otherwise, sentence 4 is executed.



Example of determining grades

- Let's write and run a program that receives students' grades and prints out their grades .



Example of determining grades

```
#include <stdio.h>
```

```
int main( void )
```

```
{
```

```
    int score;
```

```
    printf ( " Enter your grades : " );
```

```
    scanf ( "%d" , &score);
```

```
    if (score >= 90)
```

```
        printf ( " Passed : Grade A\n" );
```

```
    else if (score >= 80)
```

```
        printf ( " Passed : Grade B\n" );
```

```
    else if (score >= 70)
```

```
        printf ( " Passed : Grade C\n" );
```

```
    else if (score >= 60)
```

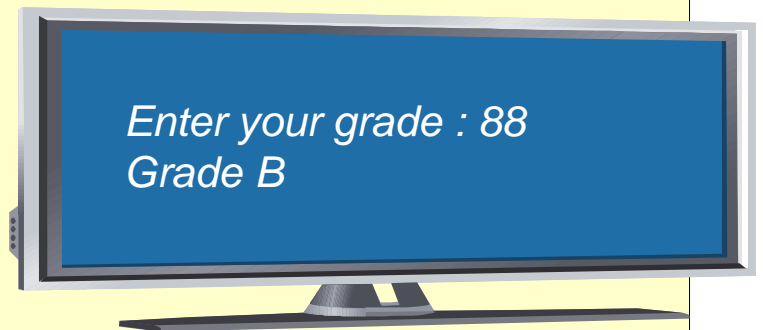
```
        printf ( " Passed : Grade D\n" );
```

```
    else
```

```
        printf ( " Failed : Grade F\n" );
```

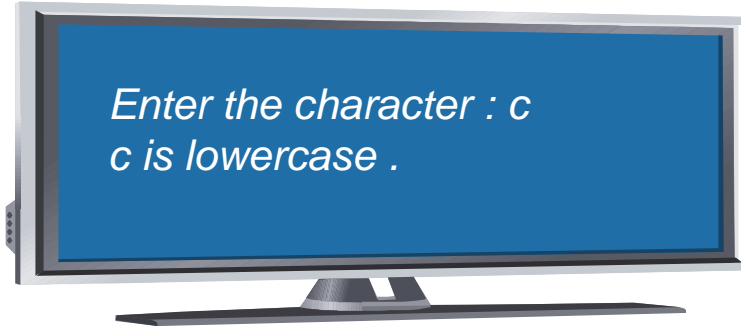
```
    return 0;
```

```
}
```



Character classification example

- take characters from the keyboard and separate them into uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), and other characters .
- Let's use `getchar ()` as a function that accepts characters.



Character classification example

```
// Program to classify characters
#include <stdio.h>
int main( void )
{
    char ch ;
    printf ( " Enter a character : " );

    ch = getchar ();
    if ( ch >= 'A' && ch <= 'Z' )
        printf ( "%c is uppercase .\n" , ch );
    else if ( ch >= 'a' && ch <= 'z' )
        printf ( "%c is a lowercase letter .\n" , ch );
    else if ( ch >= '0' && ch <= '9' )
        printf ( "%c is a number .\n" , ch );
    else
        printf ( "%c is a miscellaneous character .\n" , ch );

    return 0;
}
```



*Enter the character : c
c is lowercase .*

Algorithm

Read a, b, c from the user .

if a == 0

Find the roots of a linear equation .

Prints the actual root .

else

Compute the discriminant .

if Discriminant ≥ 0

Find the real roots using the root formula .

Prints the actual root .

else

Prints a message saying there is no real work

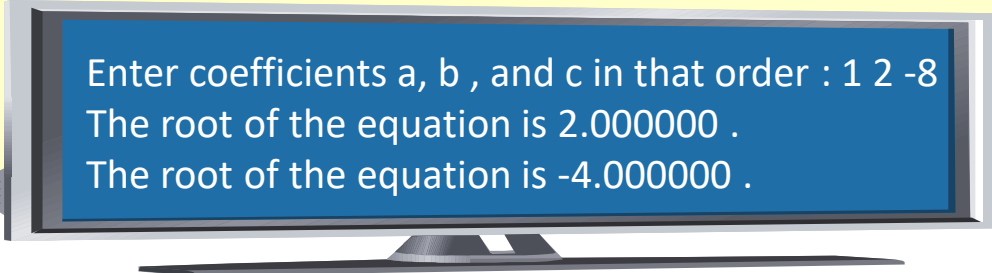
source

```
#define _CRT_SECURE_NO_WARNINGS
#include <stdio.h>
#include <math.h>
int main( void )
{
    double a, b, c, dis;

    printf ( " Enter coefficient a, coefficient b, coefficient c in order : " );
    scanf ( "% lf % lf % lf " , &a, &b, &c);
```

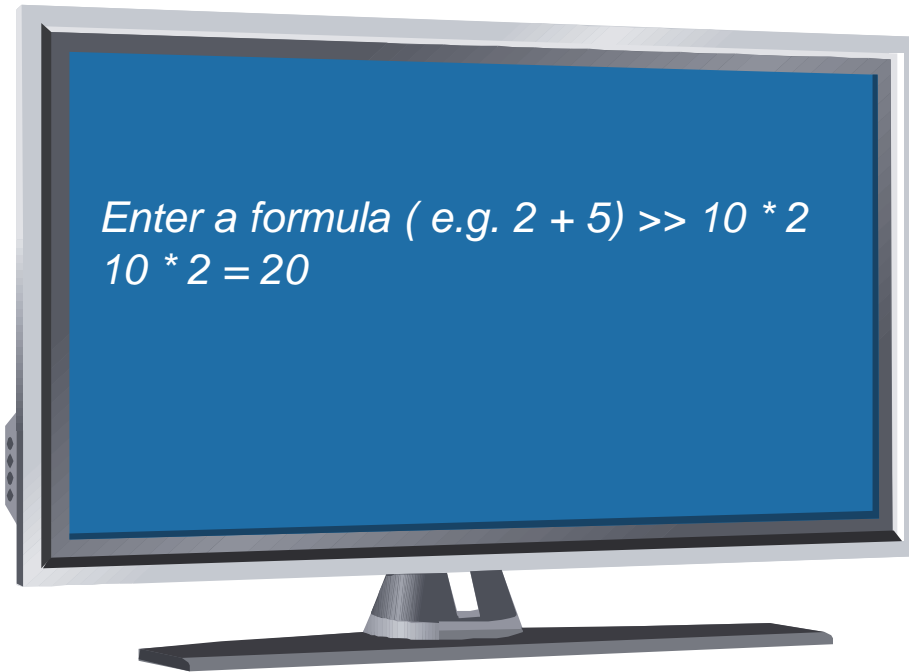
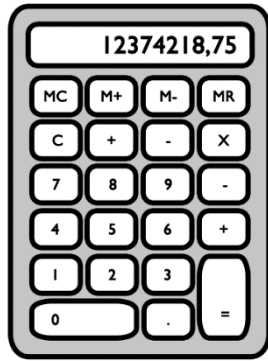
source

```
if (a == 0)
    printf ( " The root of the equation is %f ." , -c / b);
else
{
    dis = b * b - 4.0 * a * c;
    if (dis >= 0)
    {
        printf ( " The root of the equation is %f .\n" , (-b + sqrt(dis)) / (2.0 * a));
        printf ( " The root of the equation is %f .\n" , (-b - sqrt(dis)) / (2.0 * a));
    }
    else
        printf ( " The root does not exist \n" );
}
return 0;
}
```



Enter coefficients a, b , and c in that order : 1 2 -8
The root of the equation is 2.000000 .
The root of the equation is -4.000000 .

Lab: Arithmetic Calculator



Solution

```
#include <stdio.h>

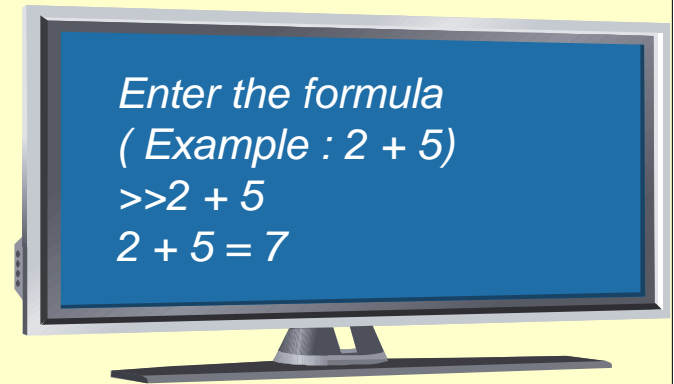
int main( void )
{
    char op;
    int x, y, result;

    printf ( " Enter a formula ( e.g. 2 + 5) >> " );
    scanf ( "%d %c %d" , &x, &op, &y);
```


Solution

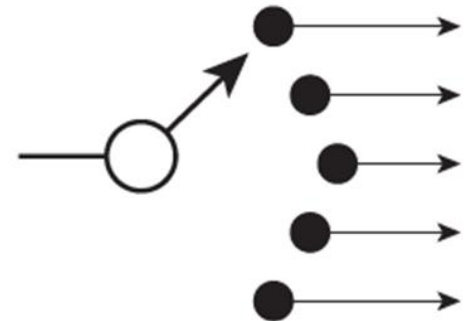
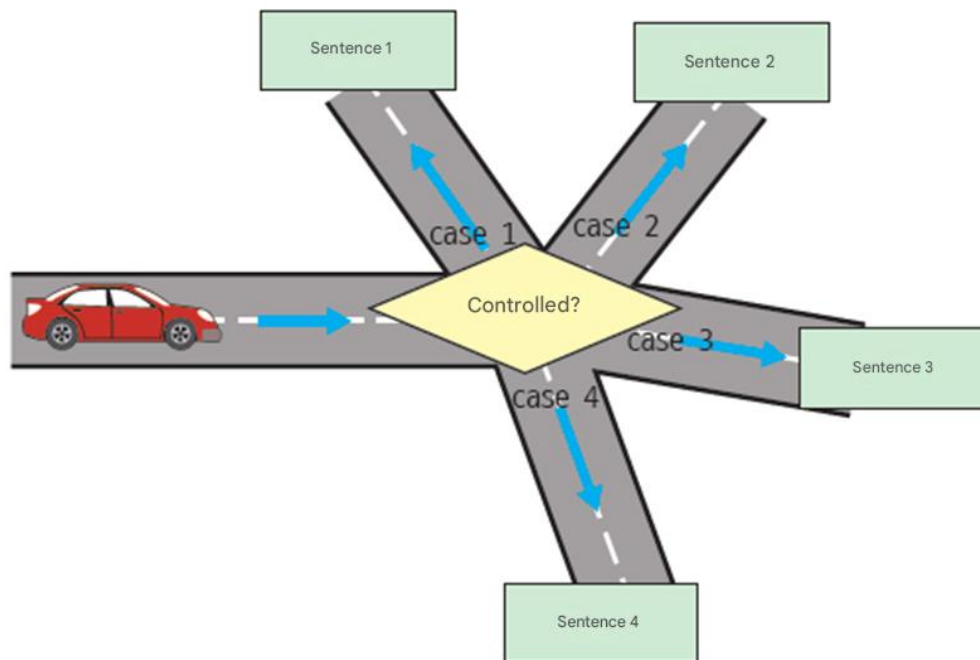
```
if ( op == '+' )
    result = x + y;
else if ( op == '-' )
    result = x - y;
else if ( op == '*' )
    result = x * y;
else if ( op == '/' )
    result = x / y;
else if ( op == '%' )
    result = x % y;
else
    printf ( " Unsupported operator ." );

printf( "%d %c %d = %d \n" , x, op, y, result);
return 0;
}
```



switch statement

- A control structure that can select one of several paths depending on the value of the control expression.



switch statement

Syntax

switch statement

grammar

switch (controlled)

{

case c1:

 sentence 1;

 break;

— If the value of the control expression is 1, it is executed.

case c2:

 Sentence 2;

 break;

— If the value of the control expression is c2, it is executed.

...

default:

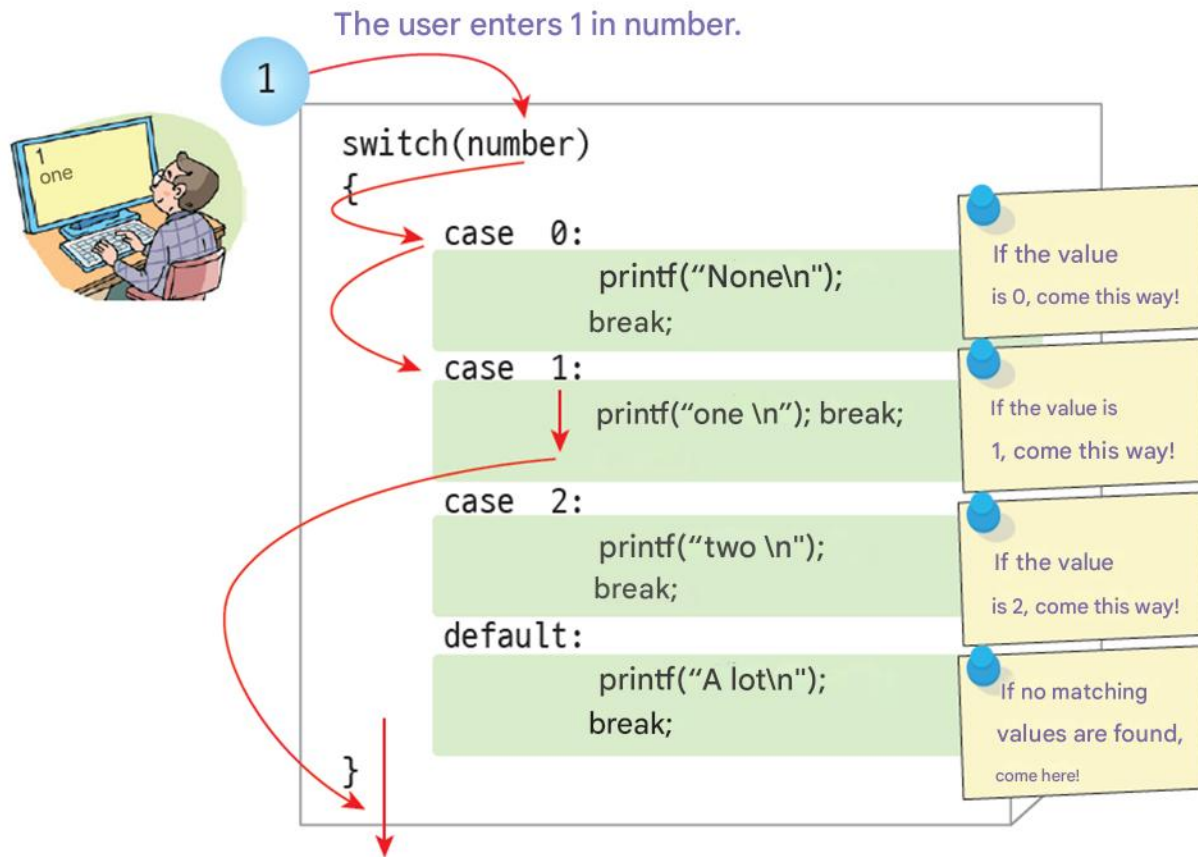
 sentence d;

 break;

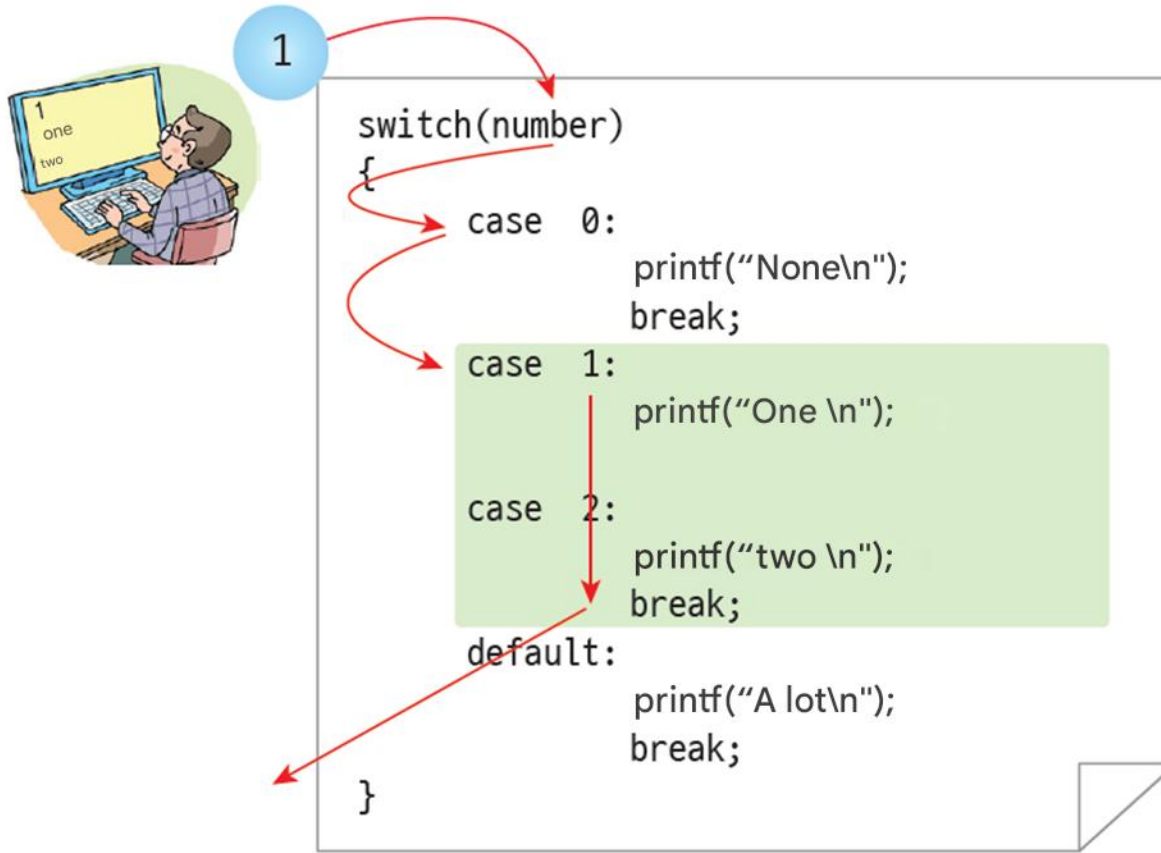
— Executed if no matching value is found.

}

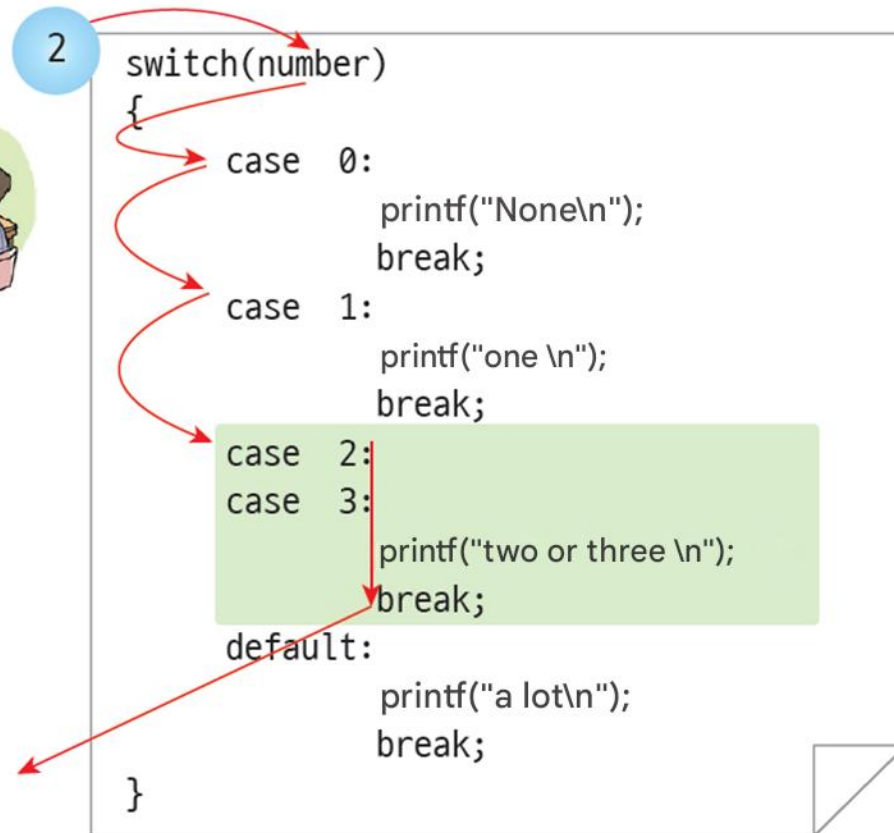
the user enters 1



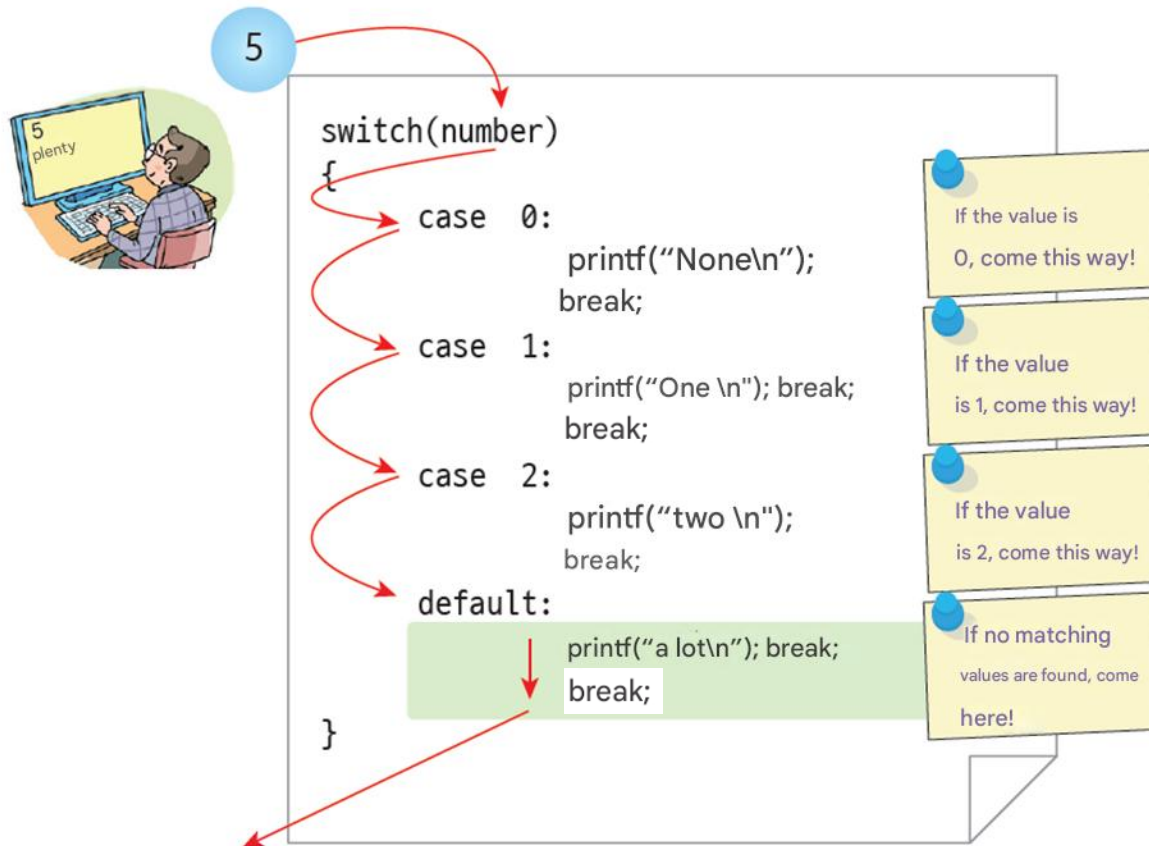
If break is omitted



Intentional omission of break



default statement



switch statement and if-else statement

```
switch (number) {  
    case 0:  
        printf ( " None \n" );  
        break;  
    case 1:  
        printf ( " one \n" );  
        break;  
    case 2:  
        printf ( " two \n" );  
        break;  
    default :  
        printf ( " many \n" );  
        break;  
}
```



```
if ( number == 0 )  
    printf ( " None \n" );  
else if ( number == 1 )  
    printf ( " one \n" );  
else if ( number == 2 )  
    printf ( " two \n" );  
else  
    printf ( " many \n" );
```


Caution: In the switch statement Things to note

```
switch (number)
{
    case x:          // Variable cannot be used .
        printf ( " Matches x . \n " );
        break ;
    case (x+2):      // Formulas containing variables cannot be used .
        printf ( " Matches formula . \n " );
        break ;
    case 0.001:      // Real numbers cannot be used .
        printf ( " error \n " );
        break ;
    case 'a' :       // OK! The character is Can be used .
        printf ( " character \n " );
        break ;
    case "abc":      // String cannot be used .
        printf ( " string \n " );
        break ;
}
```

When indicating a range of integer

```
switch (score) {  
    case 100:  
    case 99:  
    case 98:  
    ...  
    case 90:  
        printf("It's an A.\n");  
        break;  
    ...  
}
```



```
if( score >= 90 && score <= 100 )  
    printf("It's an A.\n");
```

It is also possible to express a range of integers, but this is cumbersome.

When indicating a range of integer

```
int iscore;
...
iscore = score/10;           // In case of integer division, the remainder is lost.
switch (iscore) {
    case 9: grade = 'A'; break; // 90-100 is an A grade
    case 8: grade = 'B'; break; // 80-89 is a B grade
    case 7: grade = 'C'; break; // 70-79 is a C grade
    case 6: grade = 'D'; break; // 60-69 is a D grade
    default: grade = 'F'; break; // 59 points or less is an F grade
}
```

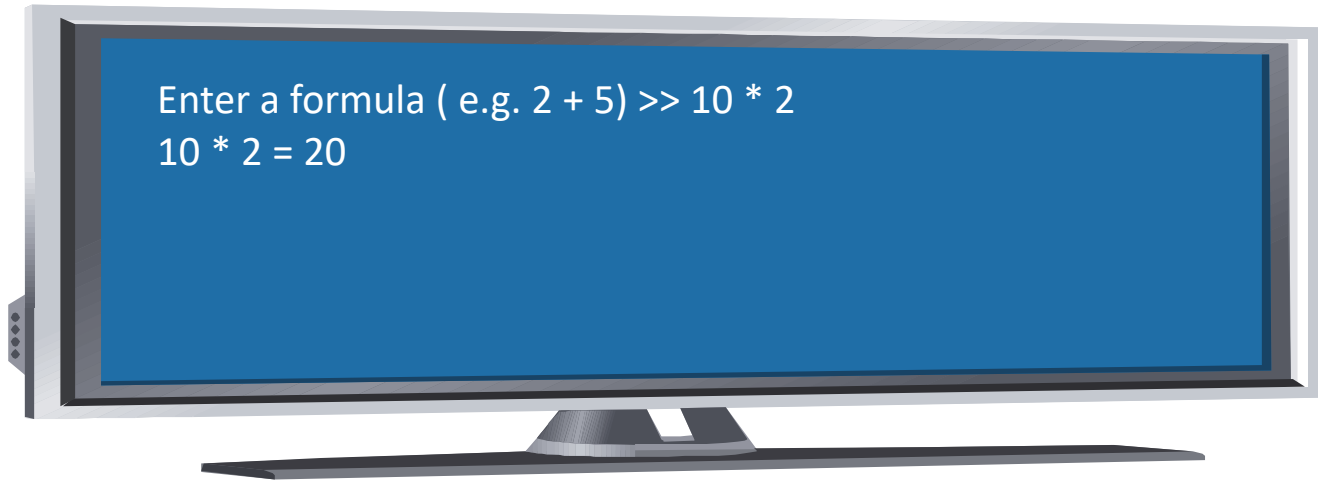


Which is more efficient: a switch statement or an if/else chain?

The difference is subtle. However, the switch statement is designed to be implemented efficiently with a simple jump table. Therefore, in most cases, it is better to use switch. The code is concise and probably a little more efficient.

Lab: Arithmetic Calculator (switch version)

- Let's rewrite the previous arithmetic calculator example using a switch statement .



Lab: Arithmetic Calculator

```
// Simple arithmetic calculator program
#include <stdio.h>

int main( void )
{

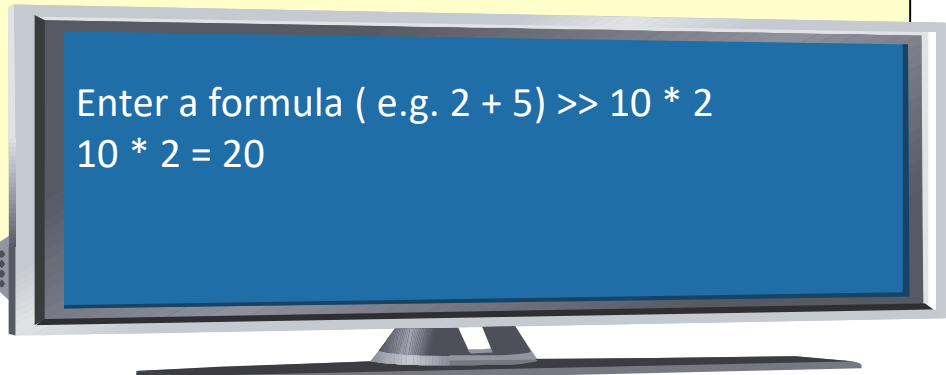
    char op;
    int x, y, result;
    printf ( " Enter a formula ( e.g. 2 + 5) >> " );
    scanf ( "%d %c %d" , &x, &op, &y);
```

Lab: Arithmetic Calculator

```
switch (op)
{
    case '+':
        result = x + y;
        break ;
    case '-':
        result = x - y;
        break ;
    case '*':
        result = x * y;
        break ;
    case '/':
        result = x / y;
        break ;
}
```

Lab: Arithmetic Calculator

```
case '%' :  
    result = x % y;  
    break ;  
default :  
    printf ( " Unsupported operator . \n" );  
    break ;  
}  
printf( "%d %c %d = %d \n" , x, op, y, result);  
return 0;  
}
```



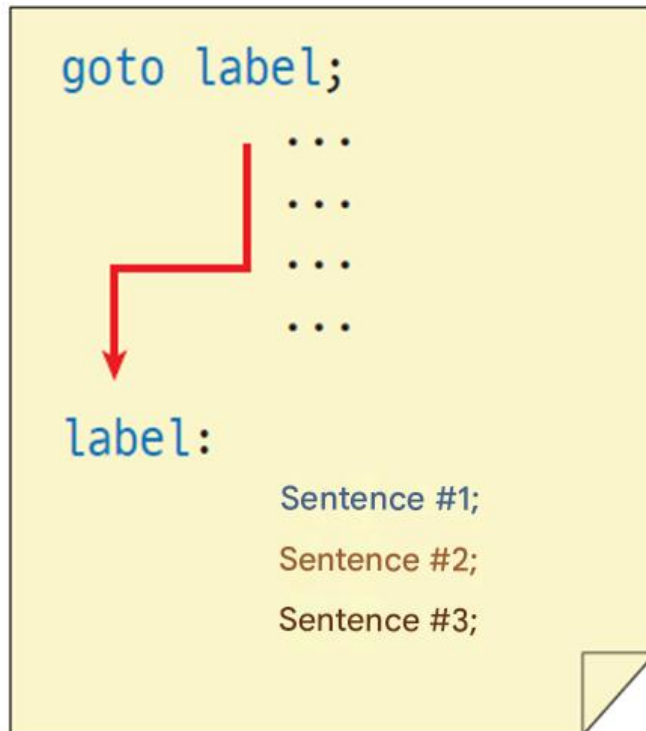
Enter a formula (e.g. 2 + 5) >> 10 * 2
10 * 2 = 20

goto statement

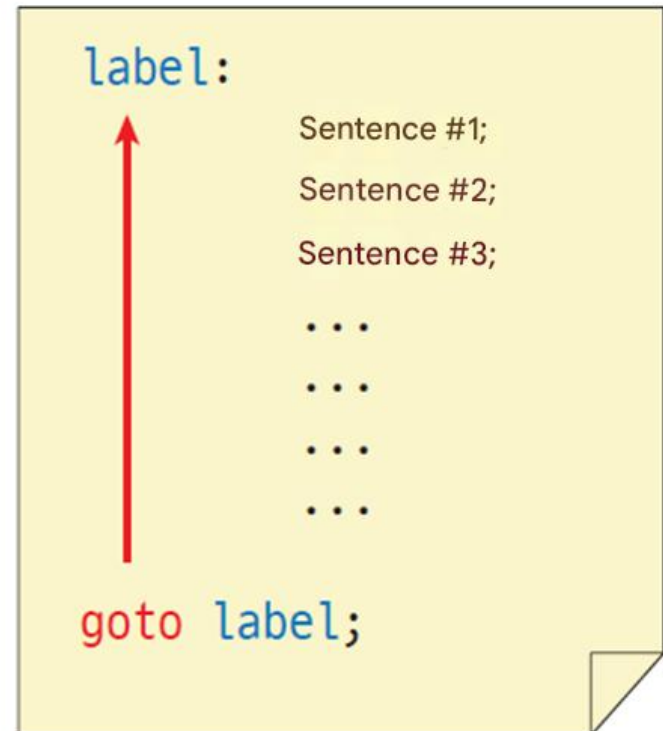
- Jump to any location unconditionally
- It is not recommended to use it



goto door



forward looking



retrospective reference

Example

```
// Multiplication table output program
```

```
#include < stdio.h >
```

```
int main( void )
```

```
{
```

```
    int i = 1;
```

```
loop:
```

```
    printf ( "%d * %d = %d Wn" , 3, i , 3 * i );
```

```
    i ++;
```

```
    if ( i == 10 ) goto end;
```

```
    goto loop;
```

```
end:
```

```
    return 0;
```

```
}
```

3 * 1 = 3

3 * 2 = 6

3 * 3 = 9

3 * 4 = 12

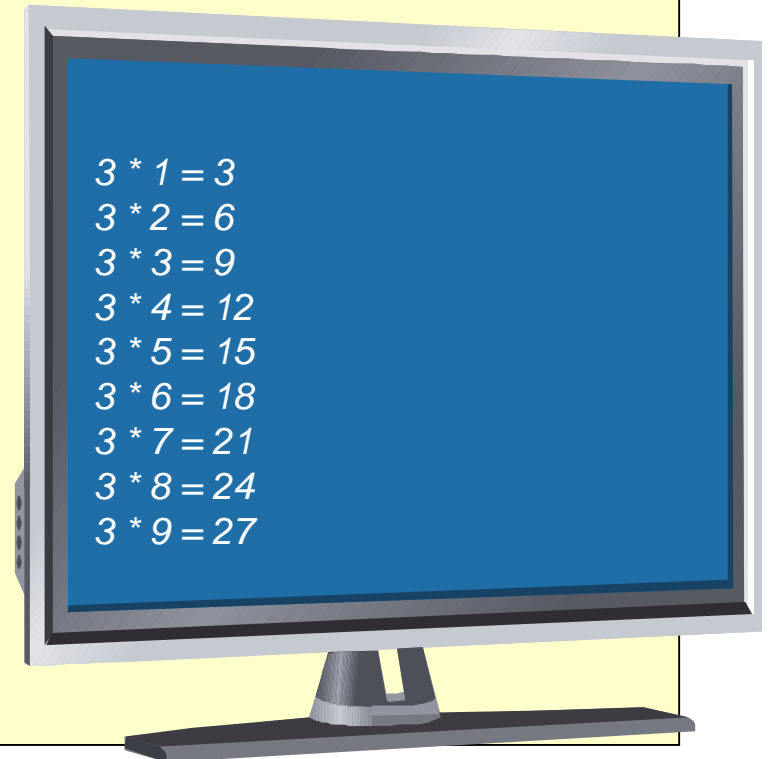
3 * 5 = 15

3 * 6 = 18

3 * 7 = 21

3 * 8 = 24

3 * 9 = 27



Q & A

