



University of Mosul
College of Computer Sciences and Mathematics
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Algorithms and Structured Programming (I)
First stage

Lecture 4

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Lecture 4 Outline

1. Operators Precedence in C++
2. Operators Associativity in C++
3. Selection Statements (Control statement)
4. If Statement
5. If /else Statement
6. else if Statement
7. Nested if statements
8. Examples
9. Programs

Operator precedence determines which operation is performed first in an expression with more than one operator with different precedence. Operator with higher precedence will be evaluated first.

Ex :

$$10 + 20 * 2 = 50$$

User :

Step 1 : $10 + 20 = 30$

Step 2 : $30 * 2 = 60$



Calculator :

Step 1 : $20 * 2 = 40$

Step 2 : $10 + 40 = 50$



Operator associativity is used when two operators of the same precedence appear in an expression. Associativity can be either from Left to Right or Right to Left.

Ex :

$100 / 5 \% 2 = 0$

User :

Step 1 : $5 \% 2 = 1$

Step 2 : $100 / 1 = 100$



Calculator :

Step 1 : $100 / 5 = 20$

Step 2 : $20 \% 2 = 0$



Ex. $10 - 12/3 + 8*2$ (left to right / then *)
 $10 - 4 + 8*2$
 $10 - 4 + 16$ (left to right - then +)
 $6+16$
 22

- the / and * operators have the same precedence.
- higher precedence than the + and - .
- according to the Left-to-Right associativity of / and * .
- / will be evaluated first.

Operators Precedence and Associativity in C++

Higher Precedence

Lower Precedence

Category	Operators	Associativity
Parenthesis/brackets	() [] -> . ++ --	Left to Right
Unary	! ~ ++ -- + - * & (type) sizeof	Right to Left
Multiplicative	* / %	Left to Right
Additive	+ -	Left to Right
Bitwise Shift	<< >>	Left to Right
Relational	< <= > >=	Left to Right
Equality	== !=	Left to Right
Bitwise AND	&	Left to Right
Bitwise XOR	^	Left to Right
Bitwise OR		Left to Right
Logical AND	&&	Left to Right
Logical OR		Left to Right
Conditional	? :	Right to Left
Assignment	= += -= *= /= %= &= ^= = <<= >>=	Right to Left
Comma	,	Left to Right

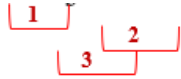
++s--
Postfix(a++,a--)

++s--
Prefix(++a,--a)
+s- Unary(-5,+2)

Ex: Find the result of the following statement:

int i=14, j=5, k=3;

1). $z = (i+j)*2 - (i-2)/3;$



$$z = (14+5)*2 - 12/3;$$

$$z = (19) * 2 - 4;$$

$$z = 38 - 4 = 34$$

2). $x = i \% j + k*5;$



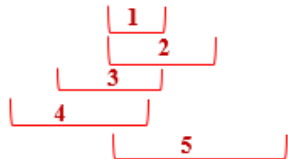
$$x = 14 \% 5 + 3*5$$

$$x = 4 + 15 = 19$$

Ex: Find the result of the following statement:

int i=2, j=3, k=4;

$z = i*(7+(j+3)/2)-k;$



$$z = 2 * (7 + (3+3) / 2) - 4;$$

$$z = 2 * (7 + 6 / 2) - 4 ;$$

$$z = 2* (10) - 4 ;$$

$$z = 20 - 4 = 16$$

Ex: Find the result of the following statement:

int i=3 , j=8;

$p = i + j + 3 < j + i \neq 30$

$p = 14 < 11 \neq 30$

$p = 0 \neq 30$

$p=1$

Ex: Find the result of the following statement:

int m=12, n=5, k=20;

$z = m*12+(m*n\%13+m/n)*k/10;$

$z = 12*12+(12*5\%13+12/5)*20/10;$

$z = 12*12 + (60 \% 13 + 2) * 20 / 10;$

$z = 144 + (8 + 2) * 20 / 10 ;$

$z = 144 + 10 * 20 / 10;$

$z = 144 + 200/10;$

$z = 144+20;$

$z = 164$

جمل الاختيار (جمل السيطرة) *Selection Statements (Control statement)*

جمل السيطرة واتخاذ القرار *Control statements and decision making*

Conditional expressions are mainly used for decision making. C++ provides multiple selection structures: **if**, **if/else**, **else if**, **nested if** and **switch**.

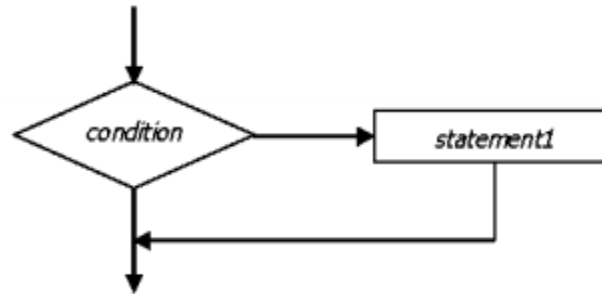
The Single If Statement Structure

The IF statement is used to express conditional expression. If the given condition is true then it will execute the statements; otherwise it will execute the optional statements.

Syntax:

General Form of single-selection If statement:

`if ( expression or condition ) statement1 ;`



عند تحقق الشرط سوف يتم تنفيذ
الجملة بعد if مباشرة

Ex1: `if (av >= 90)`
`cout << "Excellent";`

Ex2: `if (x > 0)`
`sum += x;`

Ex3: `cin >> num;`
`if (num == 0)`
`count = count + 1;`

The Single Block If Statement Structure

The block IF statement are enclosed in { } and to group declaration and statements into a compound statement or a block. These blocks are always considered as a single statement. The structure is:

Syntax:

General Form of single block selection If statement:

```
if ( expression or condition )  
{  
    statement1 ;  
    statement2 ;  
    statement3 ;  
}
```

عند تحقق الشرط سوف يتم تنفيذ
الجملة/الجمل بعد if مباشرة

Ex.

```
cin>>a;
```

```
if ( a >= 0 )
```

```
{
```

```
    a=a+5;
```

```
    cout<<"a is positive";
```

```
}
```

هذه الجملة اذا كانت الاقواس غير موجودة ستعتبر خارج جملة الـ if

The If /else Statement Structure

Syntax:

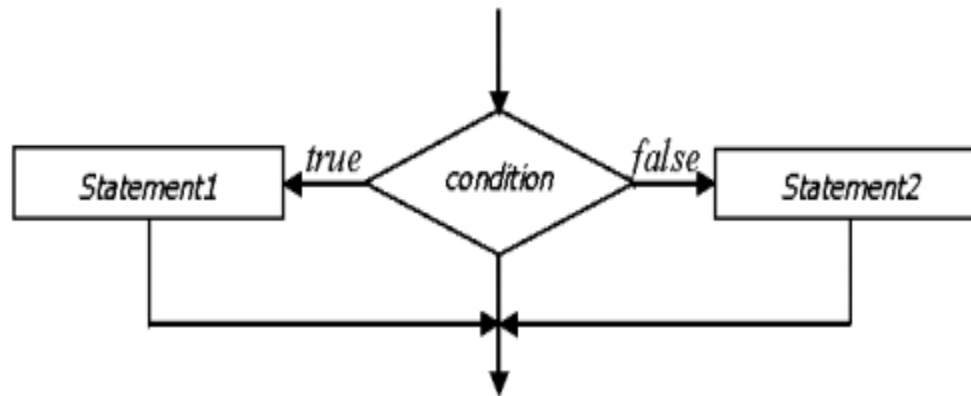
General Form of If/else statement:

```
if ( expression )  
    statement1 ;  
else statement2 ;
```

```
if ( expression )  
    { statements }  
else { statements }
```

عند تحقق الشرط سوف يتم تنفيذ
الجملة/الجملة بعد if مباشرة
وعند عدم تحقق الشرط سوف يتم تنفيذ
الجملة/الجملة بعد else مباشرة

Structure:



Statement1/statement2
يقصد بها اما جملة او عدة جمل

ملاحظة: في كل حالات if السابقة عندما يكون هناك **جملة واحدة** بعد ال if او بعد ال else يمكن وضع هذه الجملة داخل اقواس {} ويمكن عدم وضعها . لكن اذا كانت هناك اكثر من جملة تنفيذية فيجب وضعها بين الاقواس .

```

Ex: void main()
{
    int b,c , d;
    cin>>b>>c;
    if ( b>=0 )
    {
        b+=10;
        b=b+c;
        cout<<" b is positive with new value" <<b;
    }
    else
        cout<<" b is negative " <<b;
    cin>>d;
    cout<<d;
}

```

if (b>0 || b == 0)

يمكن الشرط السابق يكتب بصورة اخرى

((b>0)||(b==0))

القوس صحيح لأنه شامل للشرط لكن اذا قوسين خطأ الا بإحاطة الجميع بقوس

ملاحظة : جملة else جملة واحدة اي الذي بعدها (cin>>d) هو جزء من البرنامج الرئيسي.

Write a program in C++ that read two numbers. If the second number is not zero, calculate and display their division and product of two numbers. Otherwise, display an error message for division by zero and another message to enter another second number.

```
#include <iostream>
using namespace std;
void main()
{
    double num1, num2, result;
    cout << "Enter the first number: ";
    cin >> num1;
    cout << "Enter the second number: ";
    cin >> num2;
    if (num2 != 0)
    {
        // If the divisor is not zero
        result = num1 / num2;
        cout << "The division result is: " << result << endl;
        cout << "The product of two numbers is: " << num1 * num2 << endl;
    }
    else
    {
        // If the divisor is zero
        cout << "divisor is zero, the division is not allowed." << endl;
        cout << "Please enter another second number." << endl;
    }
}
```

Write a program in C++ to Compare between two numbers if equal, not equal, less, greater then print the message about this. Using four if statements.

```
#include <iostream>
using namespace std;

void main()
{
    int n1, n2;
    cout << "Enter 2 numbers: ";
    cin >> n1 >> n2;

    if (n1 == n2)
        cout << n1 << " is equal to " << n2 << endl;

    if (n1 != n2)
        cout << n1 << " is not equal to " << n2 << endl;

    if (n1 > n2)
        cout << n1 << " is greater than " << n2 << endl;

    if (n1 < n2)
        cout << n1 << " is less than " << n2 << endl;
}
```

```
Enter 2 numbers: 6
10
6 is not equal to 10
6 is less than 10
```

Write a program to read a one integer number and explain if the number is positive or negative, odd or even ,divisible or not by 3, equal or not to 100.

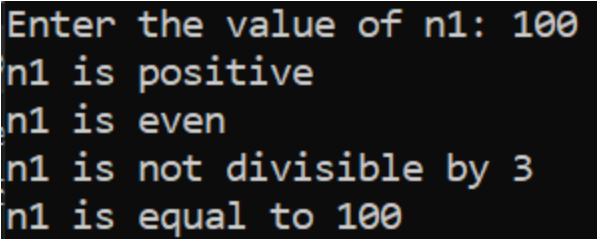
```
#include <iostream>
using namespace std;
int main() {
    int n1;
    cout << "\nEnter the value of n1: ";
    cin >> n1;

    if (n1 >= 0)
        cout << "n1 is positive" << endl;
    else
        cout << "n1 is negative" << endl;

    if (n1 % 2 == 0)
        cout << "n1 is even" << endl;
    else
        cout << "n1 is odd" << endl;

    if (n1 % 3 == 0)
        cout << "n1 is divisible by 3" << endl;
    else
        cout << "n1 is not divisible by 3" << endl;

    if (n1 == 100)
        cout << "n1 is equal to 100" << endl;
    else
        cout << "n1 is not equal to 100" << endl;
    return 0;
}
```

A screenshot of a terminal window showing the output of the C++ program. The input is 100, and the program correctly identifies it as positive, even, not divisible by 3, and equal to 100.

```
Enter the value of n1: 100
n1 is positive
n1 is even
n1 is not divisible by 3
n1 is equal to 100
```

The else if Statement Structure

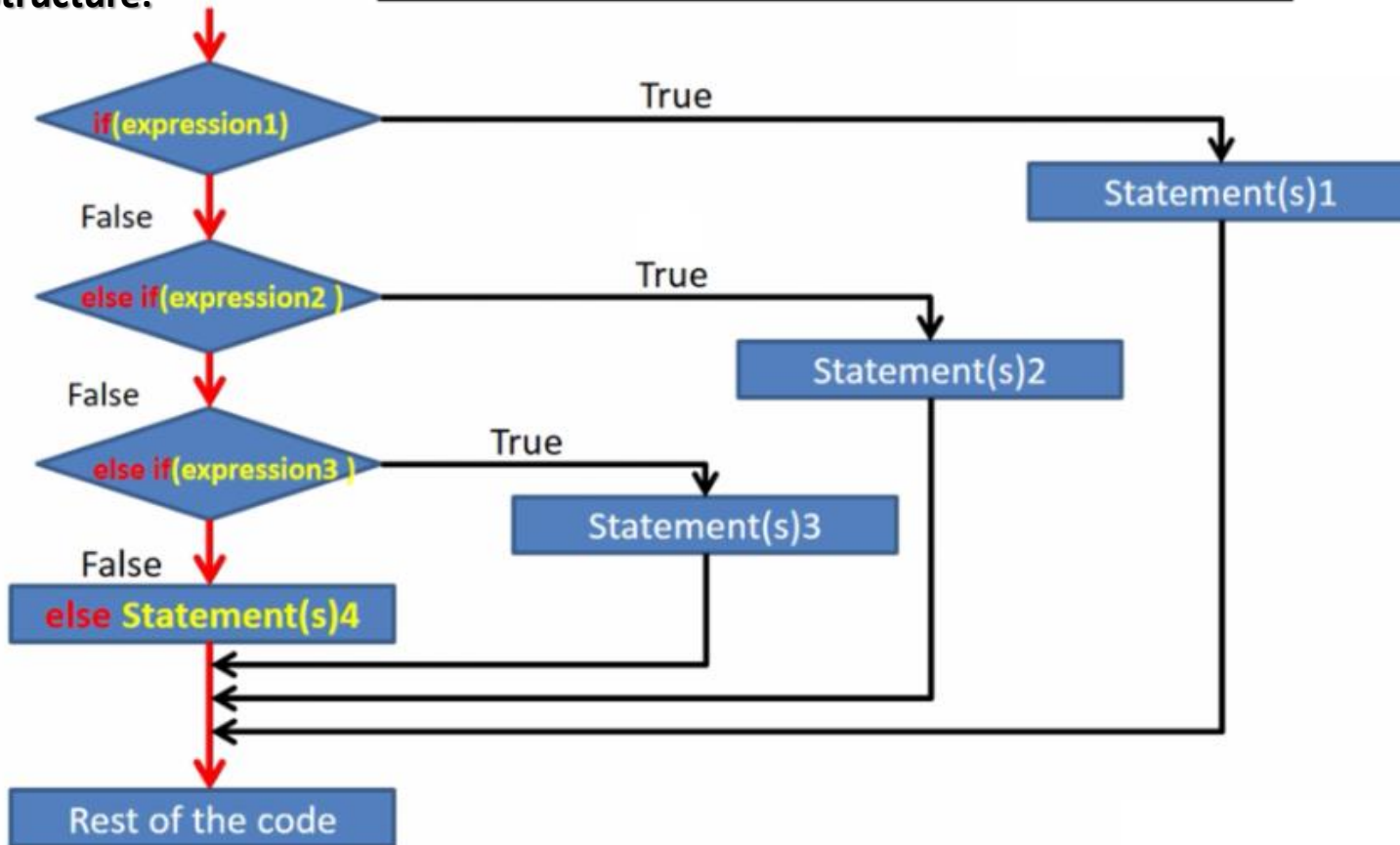
Syntax:

General Form of else if statement:

```
if ( expression or condition 1 ) statement1 ;  
else if ( expression or condition 2 ) statement2 ;  
else if ( expression or condition 3 ) statement3 ;  
:  
else if ( expression or condition n ) statement-n ;  
else statement-e ;
```

عند تحقق الشرط سوف يتم تنفيذ الجملة/الجملة بعد if مباشرة وعند عدم تحقق الشرط سوف يتم تنفيذ الجملة/الجملة بعد else if مباشرة وإذا لم يتحقق هذا سيتم تنفيذ الجملة/الجملة بعد else if الأخرى وهكذا الى النهاية.

Structure:



ملاحظة: في كل حالات if عندما يكون هناك جملة واحدة بعد ال if او بعد ال else if يمكن وضع هذه الجملة داخل اقواس {} ويمكن عدم وضعها. لكن اذا كانت هناك اكثر من جملة تنفيذية فيجب وضعها بين الاقواس.

EX. if (value == 0) cout << "grade is A";
 else if (value == 1) cout << "grade is B";
 else if (value == 2) cout << "grade is C";
 else cout << "grade is X";

Write a C++ program to find the largest number (or maximum number) among three numbers (num1, num2, num3).

```
#include <iostream>
using namespace std;
void main()
{
    int num1, num2, num3;
    cout << "Enter three numbers: ";
    cin >> num1 >> num2 >> num3;
    // Compare the numbers to find the largest
    if (num1 >= num2 && num1 >= num3)
    {
        cout << "The largest number is: " << num1 << endl;
    }
    else if (num2 >= num1 && num2 >= num3)
    {
        cout << "The largest number is: " << num2 << endl;
    }
    else
    {
        cout << "The largest number is: " << num3 << endl;
    }
}
```

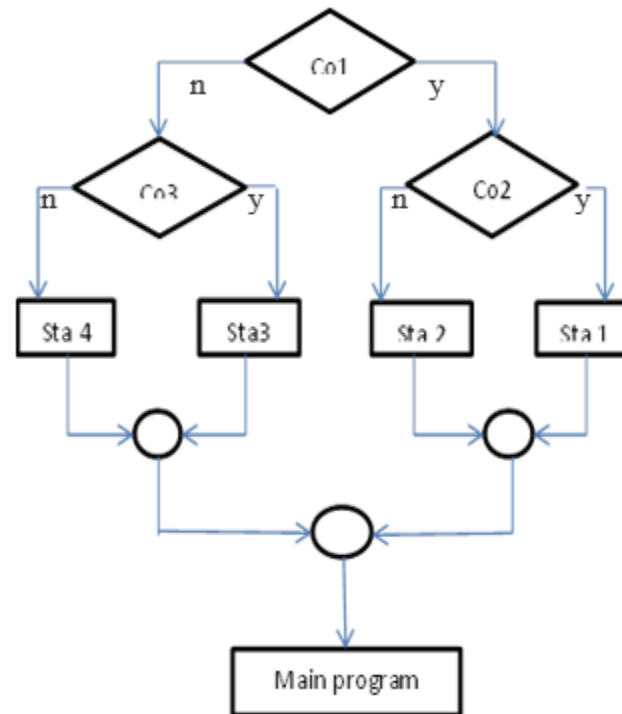
```
Enter three numbers: 80 60 100
The largest number is: 100
```

Nested if statements

جمل if المتداخلة

May be (if) statement followed by another if statement or (else) statement also followed by if statement.

```
if (condition1)
{
    if (condition 2)
    {
        Statements 1;
    }
    else
    {
        Statements 2;
    }
}
else
{
    if (condition 3)
    {
        Statements 3;
    }
    else
    {
        Statements 4;
    }
}
```



2. **if (condition 1)**

{

if (condition 2)

{

Statements 1 ;

}

else

{

statements 2;

}

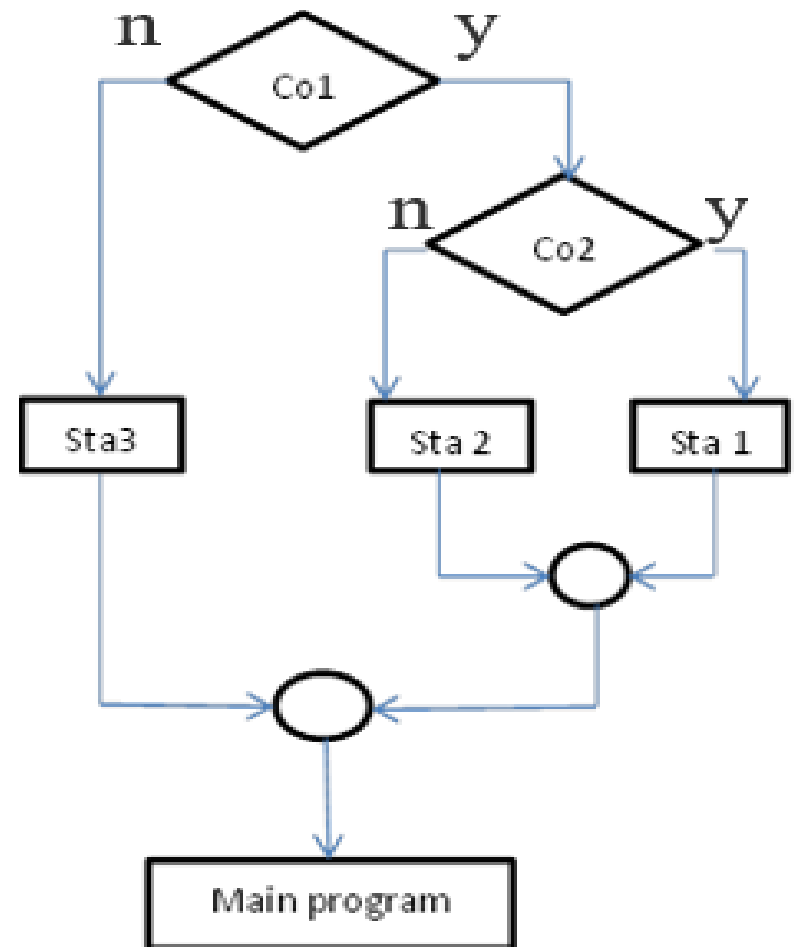
}

else

{

statements 3;

}



3. **if (condition 1)**

{

Statements 1

}

else

{

if (condition 2)

{

Statements 2;

}

else

{

Statements 3;

}

}

