3. The C in C++

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Content

- Operators
- Build_in type
- Variables
- Scoping
- Array
- Const
- Cast
- Function and function pointer

3.1 Creating functions

3.2 Controlling execution

- if-else
- while
- do-while
- for -- *for each*
- break
- continue
- switch-case
- *goto*

3.2 Controlling execution

```
for each (object var in collection_to_loop)
{   // Here are codes…      }
```

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

void main() {
      int array[] = {10, 23, 45, 12, 56};

      for each (int a in array)
            cout << a << endl;
}
```

3.2 Controlling execution

```
for each (object var in collection_to_loop)
{   // Here are codes…     }
```

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

void main() {
    vector<int> v;

    for (int i = 0; i < 5; i++)
        v.push_back(i * 3);

    for each (int x in v)
        cout << x << endl;
}
```

3.3 Operators

- Unary Operators

  new, delete, new[ ], delete[ ],

  ++, --, (), [ ], +, -, *, &, !, ~,

- Binary operators

  +, -, *, /, %, =, +=, -=, *=, /=, %=,

  &, |, ^, ^=, &=, |=, ==, !=, >, <, >=,

  <=, ||, &&, <<, >>, >>=, <<=, ->, ->*

- Other operators

.	member selection
.*	member selection by a pointer
::	scope resolution
?:	ternary conditional expression
sizeof	

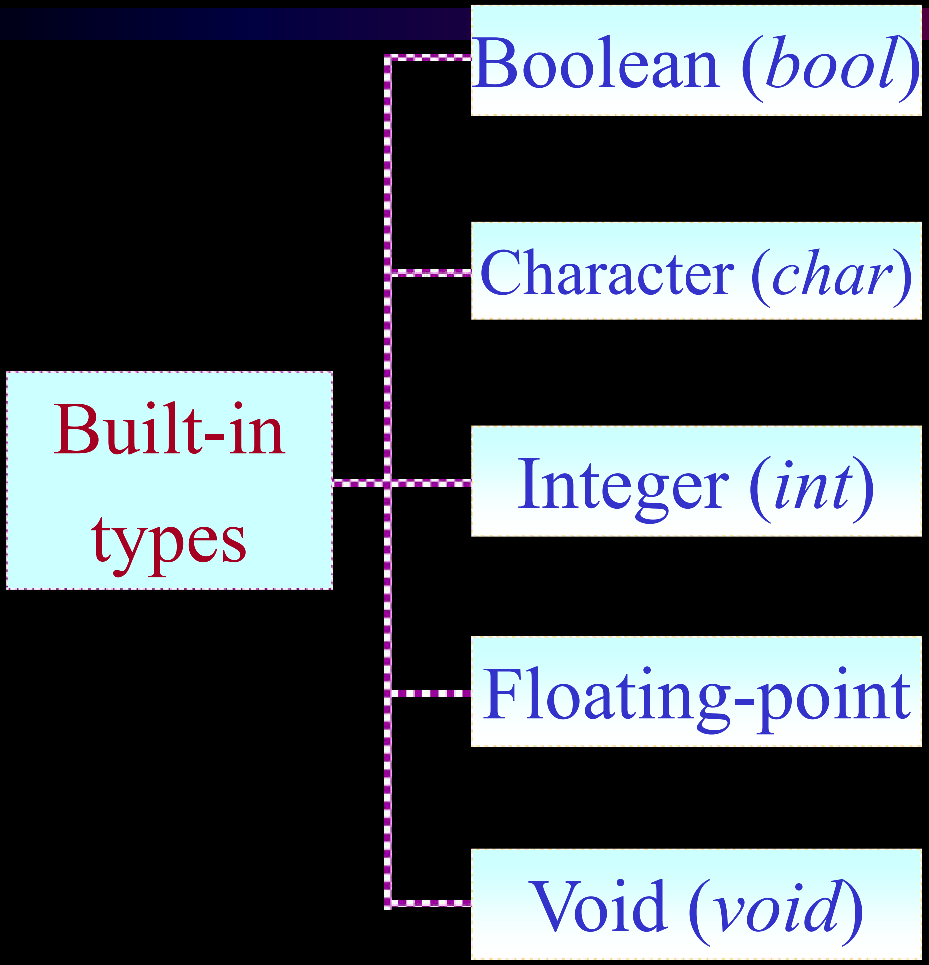
3.4 Introduction to data types

3.4.1 Built-in types

3.4.2 Pointers

3.4.3 references

3.4.1 Built-in types



Built-in types

Boolean (*bool*) — *true* or *false*

Character (*char*) — *signed/unsigned*

Integer (*int*) — *short, long/signed, unsigned*

Floating-point — *float, double, long double*

Void (*void*) — *function doesn't return a value.*

3.4.2 Introduction to pointers

- Every element of your program occupies storage and has an address.
- C++ have a special type of variable that holds an address. This variable is called a ***pointer*****.**

3.4.3 Argument Passing

- Pass by value
- Pass by address (pointer)
- Pass by reference

(1) Pass by value

```
#include <iostream>
using namespace std;
void f(int a)
{
  cout << "a = " << a << endl;
  a = 5;
  cout << "a = " << a << endl;
}
```

```
void main()
{
  int x = 47;
  cout << "x = " << x << endl;
  f(x);
  cout << "x = " << x << endl;
}
```

(2) Pass by address

```
#include <iostream>
using namespace std;
void f(int* p)
{
  cout << "p = " << p << endl;
  cout << "*p = " << *p << endl;
  *p = 5;
  cout << "p = " << p << endl;
}
```

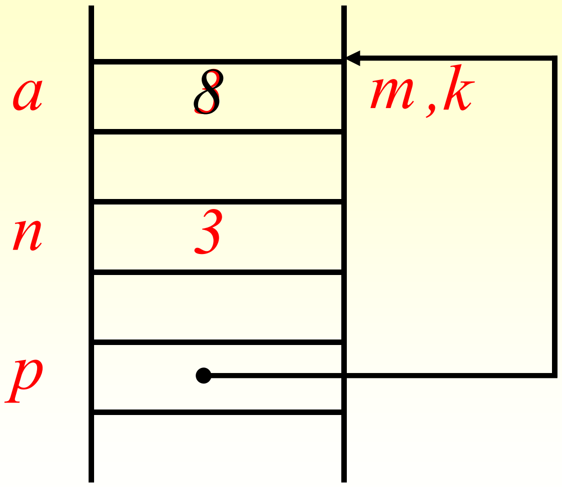
```
void main()
{
  int x = 47;
  cout << "x = " << x << endl;
  cout << "&x = " << &x << endl;
  f(&x);
  cout << "x = " << x << endl;
}
```

(3) references

- ***Pass-by-reference*** *is* an additional way to pass an **address** into a function.
- Pass-by-reference allows a function to modify the outside object, just like passing a pointer does.
- *Calling* a function that takes references is cleaner, syntactically, than calling a function that takes pointers.
- We must *initialize* the reference except as a parameters of the function.

```
int a=3;
int& m=a;        //ok
int& x;          //error

int& k=m;
int n=m;
int* p=&m;
m=m+5;
```



```
//: C01:PassByValue.cpp
#include <iostream>
using namespace std;
void f(int a)
{
  cout << "a = " << a << endl;
  a = 5;
  cout << "a = " << a << endl;
}
void main( )
{
  int x = 47;
  cout << "x = " << x << endl;
  f(x);
  cout << "x = " << x << endl;
} ///:~
```

```
//: C02:PassReference.cpp
#include <iostream>
using namespace std;
void f(int& a)
{
  cout << "a = " << a << endl;
  a = 5;
  cout << "a = " << a << endl;
}
void main( )
{
  int x = 47;
  cout << "x = " << x << endl;
  f(x);
  cout << "x = " << x << endl;
} ///:~
```

```
//: C01:PassByValue.cpp
#include <iostream>
using namespace std;
void f(int *a)
{
  cout << "a = " << a << endl;
  a = 5;
  cout << "a = " << a << endl;
}
void main( )
{
  int x = 47;
  cout << "x = " << x << endl;
  f(&x);
  cout << "x = " << x << endl;
} ///:~
```

```
//: C02:PassReference.cpp
#include <iostream>
using namespace std;
void f(int& a)
{
  cout << "a = " << a << endl;
  a = 5;
  cout << "a = " << a << endl;
}
void main( )
{
  int x = 47;
  cout << "x = " << x << endl;
  f(x);
  cout << "x = " << x << endl;
} ///:~
```

3.5 Scoping

- The scope of a variable is defined by its “nearest” set of brace.
- A variable can be used only when inside its scope.

```
void main( )
{
    int scp1;
    // scp1 visible here
    {      // scp1 still visible here
           int scp2;
           // scp2 visible here
           {           // scp1 & scp2 still visible here
                      int scp3;
                       // scp1, scp2 & scp3 visible here
           } // <-- scp3 destroyed here
           // scp3 not available here
           // scp1 & scp2 still visible here
    } // <-- scp2 destroyed here
    // scp3 & scp2 not available here
    // scp1 still visible here
} // <-- scp1 destroyed here
```

3.6 Specifying storage allocation

3.6.1 Global variables

3.6.2 Local variables

3.6.3 **Static** variables

3.6.4 Extern

3.6.5 Constants

3.6.5 Constants

- #define PI 3.14159 // *replacement.* **Its scope is:**
  from #define to #undef

- const **double** PI=3.14159 ; **// a variable**

- A **const** is just like a variable, except that its value cannot be changed.

3.6.5 Constants

A const must always have an initialization value except as a parameters of the function.

```
int f(int& x)
{
        return ++x;   //OK
}
int g(const int& x)
{
        return ++x;   //ERROR
}
```

```
#include <iostream>
Using namespace std;
void main()
{
      int a = 9;
      f(a);
      g(a);
}
```

3.7 Operators and their use

3.7.1 Assignment

A = 4

- **A:** an lvalue, a distinct, named **variable**
- **4:** an rvalue, a constant, variable, or expression that can produce a **value**

3.7.2 Mathematical operators

- addition (+)
- subtraction (-)
- division (/)
- multiplication (*)
- modulus (**%**); this produces the remainder from **integer** division.
- **x = x + 4;   x += 4;**

3.7.3 Relational operators

- less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), equivalent (==), and not equivalent (!=).
- They produce a Boolean **true** if the relationship is true, and **false** if the relationship is false.
- If you print a **bool**, you'll typically see a '**1**' for **true** and '**0**' for **false**.

3.7.4 Logical operators

- *and* (**&&**) ; *or* (||) ; *not* (**!**)
- The result is **true** if it has a non-zero value, and **false** if it has a value of zero.

```
int i = 10, j = 5;
cout << ((i == 10) && (j > 10));
cout << ((i < 10) || (j < 10));
```

3.7.5 Bitwise operators

- bitwise *and* (&)
- bitwise or (|)
- bitwise *not / complement* (~)
- bitwise *exclusive or / xor* (^)
- &=; |=;   ^=

3.7.6 Shift operators

- left-shift (<<)
- right-shift (>>)
- <<= ; >>=

```
1,  16,  1,  8
```

```
#include <iostream>
using namespace std;
void main()
{
    unsigned int a=1;
    cout<<a<<',';
    unsigned int b=a<<4;
    cout<<b<<','<<a<<',' ;
    a=b>>1;
    cout<<a<<endl;
} ///:~
```

3.7.7 Unary operators

- Bitwise *not* (~)
- *logical not* (**!**)
- unary minus (**-**) ; unary plus (+)
- increment (++); decrement (**--**)
- address-of (**&**)
- dereference (***** and **->**)
- **cast**
- **new** ; **delete**

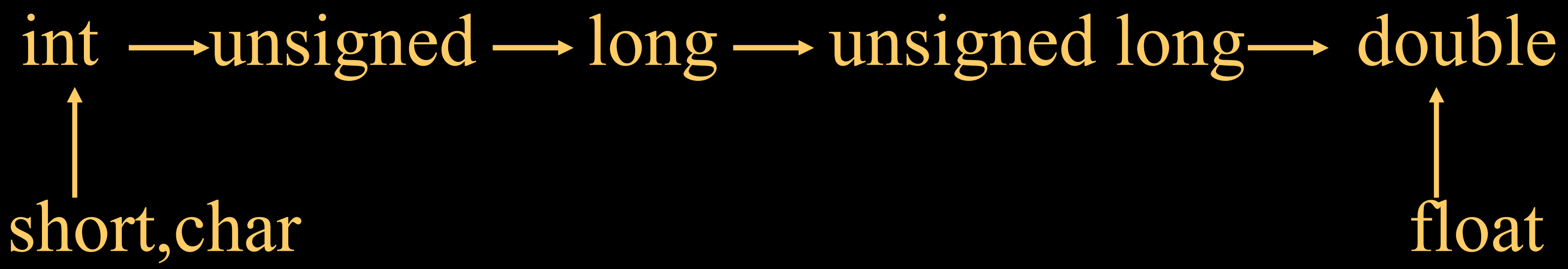
3.7.8 The ternary operator

- **c=a >b ? a : b**
- if (a>b) c = a;
  else   c = b;

3.7.9 The comma operator

3.7.11 Casting operators

- The compiler will automatically change one type of data into another if it makes sense.



int → unsigned → long → unsigned long → double

short,char

float

3.7.12 sizeof– an operator

```
void main()
{
   cout<<"bool:"<<sizeof(bool)<<endl;
   cout<<"char:"<<sizeof(char)<<endl;
   cout<< "int:" <<sizeof(int)<<endl;
   cout<<"float:"<<sizeof(float)<<endl;
   cout<<"double:"<<sizeof(double)<<endl;
   cout<<"long double:"<<sizeof(long double)<
}
```

```
bool:1
char:1
int:4
float:4
double:8
long double:8
```

The results may be *vary* with different machines/operating systems/compilers.

3.8 Composite type creation

- C++ provide tools that allow you to compose more sophisticated data types from the fundamental data types.
- The most important of these is **struct**, which is the foundation for **class** in C++.
- the simplest way to create more sophisticated types is simply to alias a name to another name via **typedef**.

3.8.1 Clarifying programs with enum

- An *enumeration* is a type that can hold a set of values specified by the user.

  enum keyword *{ASM, AUTO, BREAK}***;**

- By *default*, the values of enumerators are initialized increasing from *0*;

  ASM=0, AUTO=1, BREAK=2;

- An enumerator can be initialized by a *constant-expression* of integer type.

enum keyword *{ASM=2, AUTO=5, BREAK}***;**

BREAK==6

3.9 Pointers and arrays

- The name of an array can be used as a *pointer to its initial elements*.
- Access array can be achieved either through a pointer to an array plus an index or through a pointer to an element.
- Notion: Most C++ implementations offer *no range checking* for arrays.

3.10 Function addresses

- Once a function is compiled and loaded into the computer to be executed, it occupies a chunk of memory, and has an address.
- You can use function addresses with pointers just as you can use variable addresses.

3.10.1 Defining a function pointer

void (*funcPtr)( );

- **funcPtr** is a pointer to a function that has no arguments and no return value.
- **void* funcPtr ( );**
- **funcPtr is a function that returns a void* .**

```
// Defining and using a pointer to a function
#include <iostream>
using namespace std;

void func()
{
  cout << "func() called..." << endl;
}
void main()
{
     void (*fp)( );                  // Declare a function pointer
     fp = func;                      // Initialize it
     (*fp)( );                       // Call the function
     void  (*fp2)( ) = func;         // Define and initialize
     (*fp2)( );                      // Call the function
}
```

3.10.2 Call Function with Function Pointer

```
#include <iostream>
#include <tchar.h>
#include <windows.h>
using namespace std;
typedef  int (*CallFunction) (int a, int b);
void main(void) {
    HINSTANCE hDLL;
    CallFunction JIA;
    hDLL = LoadLibrary(_T("MyDll.dll"));
    if (hDLL == nullptr)
    {
            cout << "NULL" << endl;
            return;
    }
    // loading Dynamatic Link Libaray
    JIA = (CallFunction)GetProcAddress(hDLL, "Add");
    cout << (*JIA)(10, 20) << endl;
    FreeLibrary(hDLL);                          // unload DLL file
}
```

Summary

- Operators
- Build_in type
- Variables
- Scoping
- Array
- Const
- cast
- Function and function pointer