

Introduction to C++

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Introduction

- C++
 - widely-used general-purpose programming language
 - compiled
 - procedural and object-oriented support
 - strong library support
 - created by Bjarne Stroustrup starting in 1979
 - based on C
 - first called “C with Classes”
 - also with inheritance, inlining, default function arguments, and strong type checking
 - many C programs compile with C++ compiler
 - major releases in 1983, 1989, 1998, 2011 (C++11), 2014, 2017, 2020, 2023

Structure of a C++ Program

```
1 // my first program in C++
2 #include <iostream>
3
4 int main()
5 {
6     std::cout << "Hello World!";
7 }
```

Hello World!

Structure of a C++ Program

- namespace

```
1 // my second program in C++
2 #include <iostream>
3 using namespace std;
4
5 int main ()
6 {
7     cout << "Hello World! ";
8     cout << "I'm a C++ program";
9 }
```

Strings

```
1 // my first string
2 #include <iostream>
3 #include <string>
4 using namespace std;
5
6 int main ()
7 {
8     string mystring;
9     mystring = "This is the initial string content";
10    cout << mystring << endl;
11    mystring = "This is a different string content";
12    cout << mystring << endl;
13    return 0;
14 }
```

Type Casting

–both OK

```
1 int i;  
2 float f = 3.14;  
3 i = (int) f;
```

```
i = int (f);
```

Input/Output

```
1 // i/o example
2
3 #include <iostream>
4 using namespace std;
5
6 int main ()
7 {
8     int i;
9     cout << "Please enter an integer value: ";
10    cin >> i;
11    cout << "The value you entered is " << i;
12    cout << " and its double is " << i*2 << ".\n";
13    return 0;
14 }
```

```
Please enter an integer value: 702
The value you entered is 702 and its double is 1404.
```

Input/Output

```
1 // cin with strings
2 #include <iostream>
3 #include <string>
4 using namespace std;
5
6 int main ()
7 {
8     string mystr;
9     cout << "What's your name? ";
10    getline (cin, mystr);
11    cout << "Hello " << mystr << ".\n";
12    cout << "What is your favorite team? ";
13    getline (cin, mystr);
14    cout << "I like " << mystr << " too!\n";
15    return 0;
16 }
```

```
What's your name? Homer Simpson
Hello Homer Simpson.
What is your favorite team? The Isotopes
I like The Isotopes too!
```


Iteration

–for loop

```
1 // countdown using a for loop
2 #include <iostream>
3 using namespace std;
4
5 int main ()
6 {
7     for (int n=10; n>0; n--) {
8         cout << n << ", ";
9     }
10    cout << "liftoff!\n";
11 }
```

10, 9, 8, 7, 6, 5, 4, 3, 2, 1, liftoff!

for (n=0, i=100 ; n!=i ; ++n, --i)

→ Initialization
→ Condition
→ Increase

Functions

```
1 // function example
2 #include <iostream>
3 using namespace std;
4
5 int addition (int a, int b)
6 {
7     int r;
8     r=a+b;
9     return r;
10 }
11
12 int main ()
13 {
14     int z;
15     z = addition (5,3);
16     cout << "The result is " << z;
17 }
```

The result is 8

Functions

```
1 // function example
2 #include <iostream>
3 using namespace std;
4
5 int subtraction (int a, int b)
6 {
7     int r;
8     r=a-b;
9     return r;
10 }
11
12 int main ()
13 {
14     int x=5, y=3, z;
15     z = subtraction (7,2);
16     cout << "The first result is " << z << '\n';
17     cout << "The second result is " << subtraction (7,2) << '\n';
18     cout << "The third result is " << subtraction (x,y) << '\n';
19     z= 4 + subtraction (x,y);
20     cout << "The fourth result is " << z << '\n';
21 }
```

```
The first result is 5
The second result is 5
The third result is 2
The fourth result is 6
```

Functions

– return value from main

value	description
0	The program was successful
<code>EXIT_SUCCESS</code>	The program was successful (same as above). This value is defined in header <code><cstdlib></code> .
<code>EXIT_FAILURE</code>	The program failed. This value is defined in header <code><cstdlib></code> .

Functions

–pass by value vs. pass by reference

```
1 // passing parameters by reference
2 #include <iostream>
3 using namespace std;
4
5 void duplicate (int& a, int& b, int& c)
6 {
7     a*=2;
8     b*=2;
9     c*=2;
10 }
11
12 int main ()
13 {
14     int x=1, y=3, z=7;
15     duplicate (x, y, z);
16     cout << "x=" << x << ", y=" << y << ", z=" << z;
17     return 0;
18 }
```

x=2, y=6, z=14

Functions

–inline functions

```
1 inline string concatenate (const string& a, const string& b)
2 {
3     return a+b;
4 }
```

Functions

–inline functions

```
1 inline string concatenate (const string& a, const string& b)
2 {
3     return a+b;
4 }
```

Dynamic Memory

- memory can be allocated during run time with new

```
1 int * foo;  
2 foo = new int [5];
```

- can check for success/failure

```
1 int * foo;  
2 foo = new (nothrow) int [5];  
3 if (foo == nullptr) {  
4     // error assigning memory. Take measures.  
5 }
```


Dynamic Memory

- memory can (and should) be de-allocated during run time with delete

```
1 delete pointer;  
2 delete[] pointer;
```

- can also use malloc/free (from C), but don't mix

Dynamic Memory

```
1 // rememb-o-matic
2 #include <iostream>
3 #include <new>
4 using namespace std;
5
6 int main ()
7 {
8     int i,n;
9     int * p;
10    cout << "How many numbers would you like to type? ";
11    cin >> i;
12    p= new (nothrow) int[i];
13    if (p == nullptr)
14        cout << "Error: memory could not be allocated";
15    else
16    {
17        for (n=0; n<i; n++)
18        {
19            cout << "Enter number: ";
20            cin >> p[n];
21        }
22        cout << "You have entered: ";
23        for (n=0; n<i; n++)
24            cout << p[n] << ", ";
25        delete[] p;
26    }
27    return 0;
28 }
```

```
How many numbers would you like to type? 5
Enter number : 75
Enter number : 436
Enter number : 1067
Enter number : 8
Enter number : 32
You have entered: 75, 436, 1067, 8, 32,
```