

Basic Syntax

Basic Syntax , I/O, Conditions, Loops and Debugging



SoftUni Team

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#c++-fundamentals

1. Introduction

- Structure
- Philosophy
- Compilers and IDEs

2. Primitive Data Types

3. Declaring and Initializing Variables, Scope

4. Operators, Expressions, Conditionals, Loops

5. Basic Console I/O





What is C++?

What is C++?

- General purpose programming language
- Compiles to binary – multi-platform
- Statically typed – data types, classes, etc.
- Multi-paradigm
- Fast

Example: Hello World

- A classic "Hello World" example

Include the input
output library

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

Say we're working with the std
namespace

These are optional

"main" function –
our entry point

```
int main(int argc, char * argv[])  
{  
    cout << "Hello World!" << endl;  
    return 0;  
}
```

Print to the console

For main, 0 means everything went ok

- The **main** function – entry point of the program
 - No other function can be named "**main**"
 - Needs specific function to start from
 - Everything else is free-form – code ordering, namings, etc.
 - Can receive command line parameters
- Termination – **main** finishes (returns), the program stops
 - The return value of main is the "exit code"
 - **0** means no errors – informative, not obligatory

Program Structure: Including Libraries

- Has a lot of functionality in its standard code libraries
- Can also use functionality from user-built code libraries
- Say what libraries to use with the **#include** syntax
- For now, for standard libraries: put the library name in **<>**

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

int main(int argc, char * argv[])
```

iostream contains console I/O functionality

- Basic building block (pun intended) of a program
- Most actual program code is in blocks (bodies)
- Start with **{** and end with **}**, can be nested
- Functions' (**main()**), loops' and conditionals' code is in blocks

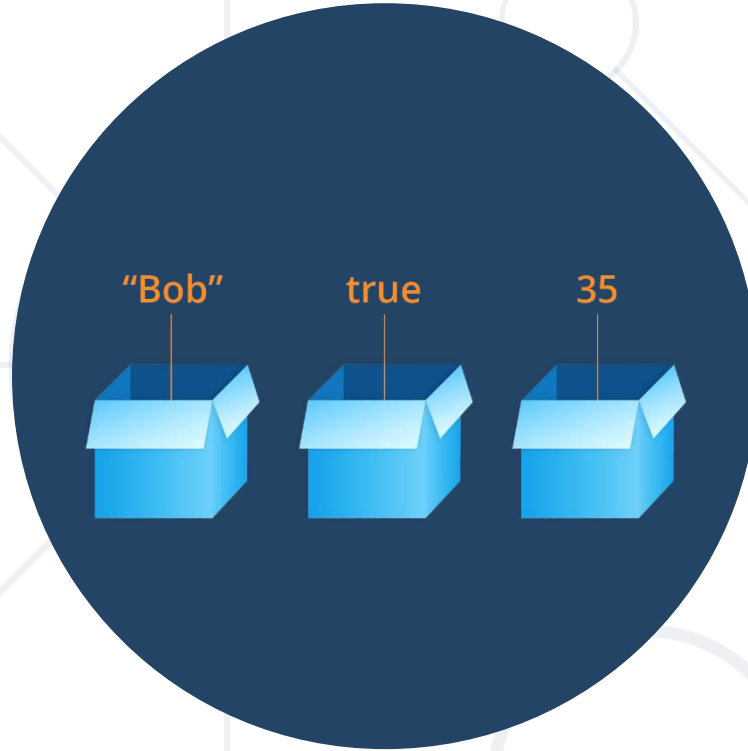
main() code block

```
int main(int argc, char * argv[])  
{  
    cout << "Hello World!" << endl;  
    return 0;  
}
```

- Statement: a piece of code to be executed
 - Blocks consist of statements
- Statements contain C++ code and end with a ;

```
int main(int argc, char * argv[])  
{  
    cout << "Hello World!" << endl;  
    return 0;  
}
```

- Has comments (parts of the code ignored by compiler)
 - // comments a line, /* starts a multi-line comment, */ ends it



Data Types and Variables

Declaring and Initializing Variables

<data_type> <identifier> [= <initialization>];

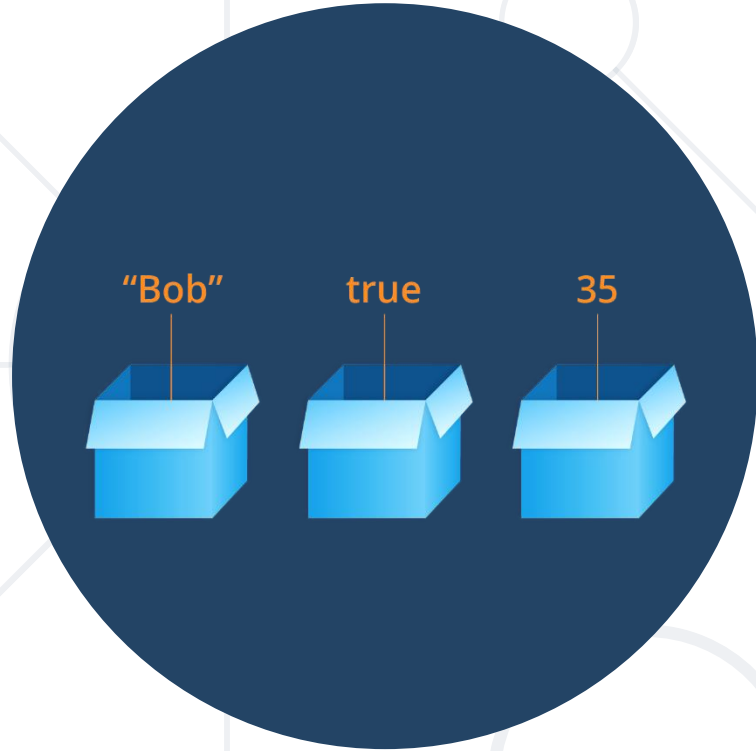
- Declaring: **int num;**
- Initializing: **num = 5;**
- Combined: **int num = 5,**
and additionally **int num(5); int num{5};**
- Can declare multiple of same type by separating with comma ,
 - **int trappist1BMassPct=85, trappist1CMassPct=80;**

- **Global**
 - defined **outside blocks**, usable from all code
- **Local**
 - defined **inside blocks**, usable only from code in their block
 - DO NOT get **initialized automatically**

- Globals get initialized to their "default" value (0 for numerics)

```
int secondsInMinute = 60;
int minutesInHour = 60;
int hoursInDay = 24;
int secondsInHour = secondsInMinute * minutesInHour;

int main()
{
    int days = 3;
    int totalSeconds = days * hoursInDay * secondsInHour;
}
```



Primitive Data Types

- Has "only one" integer type – `int`
- "Width" modifiers control the type's size and sign
 - `short` – at least 16 bits; `long` – at least 32 bits
 - `long long` – 64 bits
- `signed` and `unsigned` – use or not use memory for sign data
- Modifiers can be written in any order
- `int` can be omitted if any modifier is present
- Defaults: `int` "usually" means `signed long int`

- Represent real numbers (approximations)
 - 2.3, 0.7, -Infinity, -1452342.2313, NaN
- **float**: single-precision floating point, usually IEEE-754 32-bit
- **double**: double-precision, usually IEEE-754 64-bit

Name	Description	Size*	Range*
float	Floating point number	4 bytes	$\pm 1.5 \times 10^{-45}$ to $\pm 3.4 \times 10^{38}$ (~7 digits)
double	Double precision floating point number	8 bytes	$\pm 5.0 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$ (~15 digits)
long double	Long double precision floating point number	8 bytes	$\pm 5.0 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$ (~15 digits)

- **char** is the basic character type in C++
- Basically an integer interpreted as a symbol from ASCII
- Guaranteed to be 1 byte – a range of 256 values
- Initialized by either a character literal or a number (ASCII code)

```
int main()
{
    char letter = 'a';
    char sameLetter = 97;
    char sameLetterAgain = 'b' - 1;
    cout << letter << sameLetter << sameLetterAgain << endl;
    return 0;
}
```

- **bool** – a value which is either **true** or **false**, takes up 1 byte
- Takes **true**, **false**, or numeric values
 - Any non-zero numeric value is interpreted as **true**
 - Zero is interpreted as **false**

```
int main()
{
    bool initializedWithKeyword = true;
    bool initializedWithKeywordCtor(false);
    bool initializedWithZero = 0;
    bool initializedWithNegativeNumber(-13);
}
```

- Types which "fit" into others can be assigned to them implicitly
- For integer types, "fit" usually means requiring less bytes
 - Valid: `char a = 'a'; int i = a;`
 - NOT VALID: `int i = 97; char a = i;`
 - For floating point, `float` fits into `double`

- If you really want to store a **bigger** type in a **smaller** type
- Explicitly cast the **bigger** type to the **smaller** type:

```
smallType smallVar = (smallType) bigVar;
```

- Can lose accuracy if value can't be represented in a **smaller** type



Conditionals and Loops

- Represent values in code, match the primitive data types
- **Integer** literals – value in a numeral system

```
unsigned long long num;  
num = 5; num = -5; num = 5L; num = 5ULL; num = 0xF;
```

- **Floating-point** literals – decimal **or** exponential notation
 - Suffix to describe precision (single or double-precision)

```
double num;  
num = .42; num = 0.42; num = 42e-2;  
float floatNum;  
floatNum = .42f; floatNum = 0.42f; floatNum = 42e-2f;
```

- Character literals – letters surrounded by apostrophe (')

```
char letter = 'a';
```

- String literals – a sequence of letters surrounded by quotes (")

```
cout << "Hello World!" << endl;
```

- Boolean literals – **true** and **false**

```
bool cppIsCool = true;
```




Expressions and Operators

- **Operators:** perform actions on one or more variables / literals
 - Can be customized for different behavior **based on data type**
 - Operator precedence and associativity table:
http://en.cppreference.com/w/cpp/language/operator_precedence
- **Expressions:** literals / variables **combined** with operators / functions

Commonly Used Operators

Category	Operators											
Arithmetic	+	-	*	/	%	++	--					
Logical	&&		^	!								
Binary	&		^	~	<<	>>						
Comparison	==	!=	<	>	<=	>=						
Assignment	=	+=	-=	*=	/=	%=	&=	=	^=	<<=	>>=	
String concatenation	+											
Other	.	[]	()	a?b:c	new	delete	*	->	::	(type)	<<	>>

- The **if-else** statement takes in a **boolean expression**
 - If the expression evaluates to **true**, the **if** block is executed
 - If the expression evaluates to **false**, the **else** block is executed
 - The **else** block is optional

- Block **{ }** brackets can be omitted if only 1 statement

```
double value1 = 5 * 5 / 2.f, value2 = 5 * 5 / 2;  
if (value1 > value2)  
{  
    cout << "value1 is larger" << endl;  
}  
else  
{  
    cout << "value2 is larger" << endl;  
}
```

Chaining if-else

- Can **chain** several checks one after the other

```
if (value1 > value2)
{
    cout << "value1 is larger";
}
else if (value1 == value2)
{
    cout << "values are equal";
}
else
{
    cout << "value2 is larger";
}
```



The Switch-Case Statement

- Example of switch-case usage

```
switch (day)
{
    case 1: cout << "Monday"; break;
    case 2: cout << "Tuesday"; break;
    case 3: cout << "Wednesday"; break;
    case 4: cout << "Thursday"; break;
    case 5: cout << "Friday"; break;
    case 6: cout << "Saturday"; break;
    case 7: cout << "Sunday"; break;
    default: cout << "Error!"; break;
}
```


- The switch statement takes in:
 - An **integer** expression or an enumeration type
 - Or something which **converts to an int** (like char)
- The case block can contain case labels and any other code
- Each label has an expression of the same type as the **switch**
- The **case** block can also contain the **break** statement
 - If reached, code continues from after the **case** block
- There is a special **default** label (without an expression)

- **Switch** evaluates the expression and finds the matching **case**
- Any code before the matching **case** is skipped
- Any code after the matching **case** is executed
 - Until **break** or the end of the block is reached
- If there is no matching **case**
 - If the block contains the special **default** label, it is executed
 - Otherwise the case block is skipped



Loops

Code Block Repetition

```
for([init]; [condition]; [increment]) {...}
```

- The **init** statement can declare and initialize variables
- Declared variables are usable only IN the **for**'s body
- The loop runs while the **condition** statement is **true**
- **increment** is executed AFTER the **for**'s body
- Can execute any expression
- Expressions inside **init** and **increment** are separated by comma (,)

```
while (condition) { body code; }
```

- Executes until **condition** becomes **false**, may never execute

```
int age = 0;
while (age < 18)
{
    cout << "can't drink at age " << age << endl;
    age++;
}
cout << "age " << age << ", can finally drink!" << endl;
```

Do - While Loop

do { body code; } while (condition);

- First executes body, then checks condition
- Guaranteed to execute at least once

- Loop control keywords:
 - **break** – interrupts the loop and continues after its block
 - **continue** – the current iteration skips the remaining part of the loop block
- Range - based for loop



Basic Console I/O

Writing to and Reading from the Console

- Classes that either read or write data piece by piece
- **cout**
 - writes data to the console
 - standard output
 - uses the << operator to write
- **cin**
 - reads data to the console
 - standard input
 - uses the << operator to write

```
#include<iostream>
using namespace std;
int main()
{
    int a, b;
    cin >> a >> b;
    cout << a + b << endl;
    return 0;
}
```

- Structure, Specifics, Compilers and IDEs
- Data Types and Variables
- Declaration and Initialization
- Operators and Expressions
- Conditional Statements
 - **if, if-else, switch-case**
- Loops
 - **for, while, do - while**
- Input and Output



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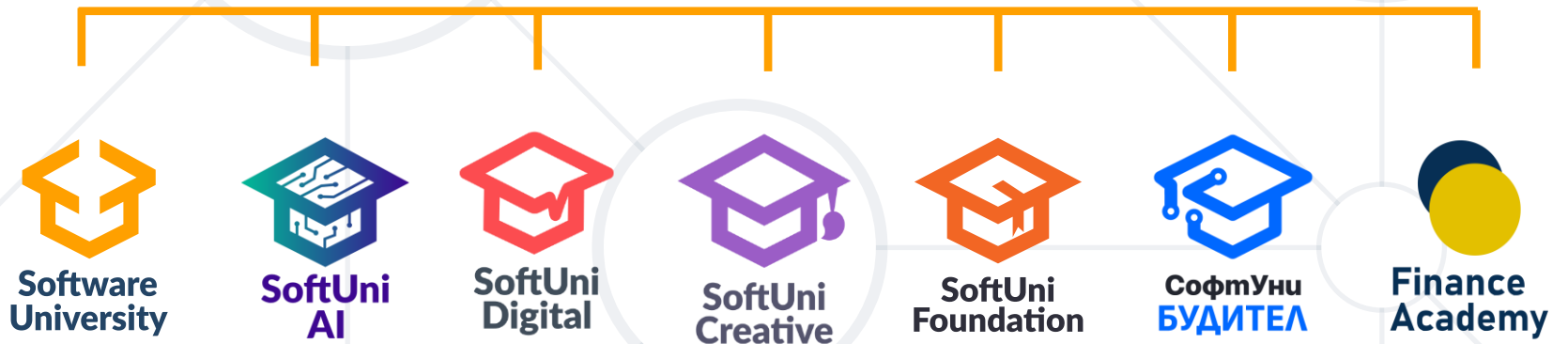
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