What to Add or Edit

- Make all the edits for “C” rather than “C++”
- Add Commons License Information
- Add better “objective” slide
- Add “what is needed” slide

Programing C Chapter 0

CPA: PROGRAMING IN C

Developed As Additional Instructor Led Slides For CPA: Programing Essentials In C

Cisco NetAcademy https://www.netacad.com/

Supplemental Slides Developed by topClown@SteamClown.org

Chapter 1 Objectives

After completing this module, the student will be able to:

- Explain how a sample C++ program works
- Explain the concept of include and using directives
- Explain the concept of integers, floating-point numbers, operators and arithmetic operations in C++ programming
- Discover and fix basic syntax errors
- Modify the structure of a C++ program
- Perform basic calculations
- Understand the precedence and associativity of C++ operators and the proper use of parentheses
- Use the shortcut and pre/post increment/decrement operators
- Build simple expressions
- Translate verbal description into programming language
- Test code using known input and output data
- Compare values using relational operators
- Build Boolean expressions using logical operators

Where to Begin?

- Every Creative Activity Needs Tools
- Many Factors Affecting Programing and Compiling Tools:
  - Hardware platform
  - Operating system
  - Operating system version
- Location Of Tools
  - Locally installed IDE
  - On-line tools

What is an IDE?

- **IDE (Integrated Development Environment)**
- Software application that typically consists of a
  - Code editor
  - Compiler
  - Debugger
  - and a graphical user interface (GUI) builder

eclipse

Visual Studio

Code::Blocks

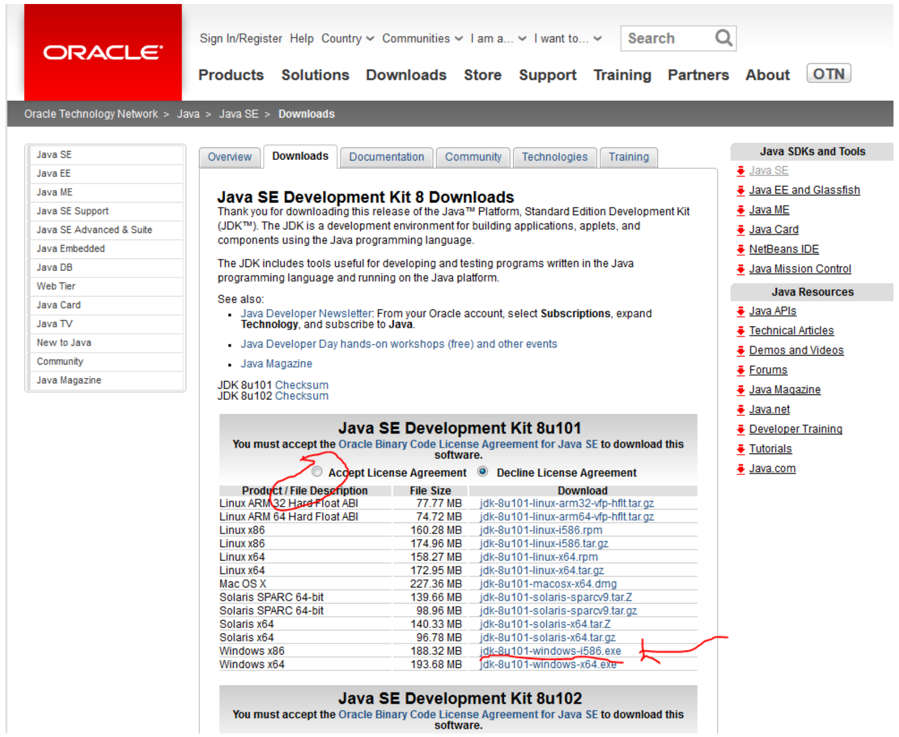
NetBeans

Local or On-Line

- Local IDE has many advantages:
  - toolkit containing everything you may need
  - Real programmers usually use an IDE too
  - An IDE gives tools and apps in one place
- Local IDE disadvantages:
  - May consume a lot of resources
  - Don’t need most of the functions they can perform.
- On-line tools allows
  - Write, store and run your code without installing anything
  - Simplified IDE accessible remotely via the Internet
  - Required: an Internet browser and Internet access.

CHOOSE YOUR IDE

- Oracle JDK
  - http://www.oracle.com/technetwork/java/javase/downloads/index.html
- NetBeans
  - https://netbeans.org/



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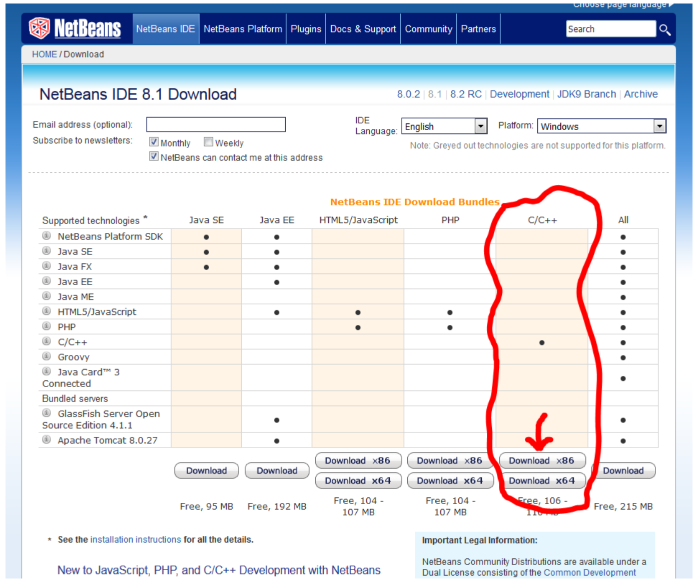
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IDE Language: English
Platform: Windows

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Java ME						●
HTML5/JavaScript		●	●	●		●
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* **See the installation instructions for all the details.**

New to JavaScript, PHP, and C/C++ Development with NetBeans

Important Legal Information:

NetBeans Community Distributions are available under a Dual License consisting of the Common Development

On-Line IDE → ideone.com

- http://ideone.com/
- At this point it's also good to install adblock+… so you don't have to see all the adds.
- Also it seem to only work in IE and Firefox… 'cause Chrome does not run Java plugins

Natural Language vs. Programming Language

- language is a tool for expressing and recording human thoughts
- programming languages Have Specific Structures
- Lexicon
  - Set of rules determine which symbols (letters, digits, punctuation marks, and so on) could be used in the language
- syntax
  - Set of rules determines the appropriate ways of collating the symbols
- semantics
  - recognize the meaning of every statement expressed in the given language

Error Free…

Any program we write must be error-free in these three ways:

- **Lexically**
- **Syntactically**
- **Semantically**

This is because the message embedded inside a computer program is not intended for a human, but for a machine.

Technically sophisticated, but devoid of even a trace of intelligence

- Computers respond only to a predetermined set of known commands
  - Instruction list
- Machine language
  - tedious, time-consuming to code by hand
  - highly susceptible to a programmer's mistakes
  - difficult to understand for humans
- High-level programming language, Like C++
  - bridge between the people's language (natural language) and computer language (machine language)
  - an intermediate common language for both humans and computers working together
- Portability
  - translated into any number of different machine languages

Compiler

- The translation we are referring to is made by a specialized computer program called a **compiler**. The process of translating from a high-level language into a machine language is called **compilation**.

More Reading

1.2.1 – Your First Program

Add Slides for First Program

```
#include <stdio.h>
int main(void)
{
  puts("Hi, I'm your first Program");
  return(0);
}
```

See GITHUB code_1_2_1

Lab 1.2

- Make some changes to yourFirstProgram

Edit this text

```
#include <stdio.h>
int main(void)
{
  puts("Hi, I'm your first Program");
  return(0);
}
```

1.3.1 - Numbers and How Computers See Them

Numbers & How Computers See Them

- binary system
  - system computers use for storing numbers
  - can perform any operation upon them
- Type: integers vs floating-point
  - the characteristic of a number which determines its kind, range and application
- integers
  - whole numbers or those which are devoid of the fractional part,
- floating-point
  - numbers (or simply floats) that contain (or are able to contain) the fractional part.

Integers

- How does the C & C++ language recognize the integers?
- The same as when you write them on a piece of paper
- They're simply **a string of digits** that make up a number.
- But there's a catch – you can't include any characters that are not digits inside the number.
  - 12,392,267 X
  - 12.393.267 X
  - 12393267 √

More on Integers

- Positive numbers don’t need to be preceded by the plus sign, but you can do it if you want. The following lines describe the same number:
  - +123 √ (though not typical)
  - 123 √

Octal vs Hex

- Octal
  - If an integer number is preceded by the 0 digit, it will be treated as an octal value
  - must contain digits taken from the 0 to 7 range only
  - **0123** This is an octal number with the (decimal) value equal to 83
- Hex
  - Hexadecimal numbers. Such number should be preceded by the prefix written as 0x or 0X
  - **0x123** is a hexadecimal number with the (decimal) value equal to 291

Variables

- Special “containers” for that purpose and these containers are called **variables**
- As the name ***variables*** suggests, the content of a container can be varied in (almost) any way
- What does every variable have?
  - a name
  - a type
  - a value

Variable Names

- the name of the variable can be composed of upper-case or lower-case Latin letters, digits and the character **_** (underscore),
  - ABCdef_ghi
  - abcDEF_GHI
  - A123_456
  - a123_456
- the name of the variable **must begin with a letter**,
- the underline character is a letter (strange but true),
- upper- and lower-case letters are treated as different
  - Alice and ALICE are **<u>different</u>**

Variable Names - Cont

- Programing Style Guide And Conventions
- This is what I do:
    - myVariable ← start lowercaseNoSpaceUpercase
    - myVariable_1 ← start lowercaseNoSpaceUpercase_ThenSomeTimesASpace
- Make Your variableNames mean something!
    - They can be very long…
- Which do you like?
    - i
    - t10
    - Exchange_Rate ← exchangeRate
    - counter
    - DaysToTheEndOfTheWorld ← daysToTheEndOfTheWorld
    - TheNameOfAVariableWhichIsSoLongThatYouWillNotBeAbleToWriteItWithoutMistakes
    - _thisVariableHasA_AtTheFront

Variable Names - cont

- Which do you like?
  - i
  - t10
  - Exchange_Rate ← exchangeRate
  - counter
  - DaysToTheEndOfTheWorld ← daysToTheEndOfTheWorld
  - TheNameOfAVariableWhichIsSoLongThatYouWillNotBeAbleToWriteItWithoutMistakes
  - _thisVariableHasA_AtTheFront

- What's Wrong?
  - 10t
  - Adiós_Señora
  - Exchange Rate

Type Attribute

- **type** is an **attribute** that uniquely defines which values can be stored inside the variable
  - Only an integer value can be assigned to an integer variable (int)
  - The compiler will not allow a floating-point number for type (int)
- Variable exists as a result of a **declaration**
  - syntactic structure that binds a **variable name**, with a specific **type** offered by the C++ language

Declaring a Variable

- Declare a variable of type int named *counter*
  - **int** counter;
- What is declared by the following fragment of a program?
  - **int** variable1, accountBalance, invoices;
  - declares three variables of type *int* named (respectively) *variable1*, *accountBalance* and *invoices*
- You are allowed to use **as many variable declarations as you need**

Assigning a Value to a Variable

- **assignment operator… wait for it…**
  - =
- examples:
  - counter = 1;
- The above statement says: *assign the value of 1 to a variable named Counter or, a bit shorter, assign 1 to Counter*.
- What is the default value of
  - int counter;
  - Go find out…

This is where I still need to update with "C" rather than "C++" syntax…

Default Values

```
// This code is to show that the default assignment of a variable,
// is compiler dependent, and the default could be 0 or something else...
// like 134514688 -- what is that number?
// ------------------------------------------------------------------------
#include <iostream>
using namespace std;
int main(void) {
		int variableWithValueAssigned = 3;
		int variableWithValueNotAssigned;
		cout << "\n this is the value of variableWithValueAssigned \t ";
		cout << variableWithValueAssigned;
		cout << "\n this is the value of variableWithValueNotAssigned \t ";
		cout << variableWithValueNotAssigned;

return 0;
}
```

See GITHUB code_1_3_5

Lab 1.3

Floating Point 1.4.1

Floating Point Numbers

- data type
  - int
  - Float
- Designed to represent and store the numbers that have **a non-empty decimal fraction**
- Can have a fractional part after the decimal point
- “two and a half” or “zero point four”
- 2.5 or 0.4 or just .4

What's the difference? It's just a "."

- 4.0 could be written as 4.
- But 4 and 4.0 are different types
  - **4** is an **int**.
  - **4.0** is a **float**.
- We can say that **the point makes a float**. Don't forget that.

4.

Exponents are "Type" Float Too

- $300000000 = 3 \cdot 10^8$
  - It means: *three times ten to the power of eight*
- In C++ it's represented as **3E8**
- The letter **E** or **e** is the **exponent**
  - *times ten to the power of*
  - the exponent (the value after the "E") **must be** an integer.
  - the base (the value in front of the "E") **may or may not be** an integer.

Big or Small Floats are the Way to Go

- Planck's constant, is a very small number 6.62607 · 10-34
  - float planks = 6.62607E-34;
- $503 billion is the current US deficit, because the government spending of $4.147 trillion is higher than its revenue of $3.644 trillion
  - float deficit = 4.147E12 - 3.644E12;
  - int deficit = 4.147000000000 - 3.644000000000;

int can actually only store a number this big → 2147483647

The Difference is "Significant"

- What is the value of the integer i ?
  - $10 \div 4 = 2$
- What is the value of the integer x ?
  - $10.0 \div 4.0 = 2.5$

```
int i;
float x;
i = 10 / 4;
x = 10.0 / 4.0;
```

Can You Say Rounding Error?

- What happens when we have to convert integer values into float values or vice versa?
- Can lead to **a loss of accuracy**.
- *int* to *float*
- *f* is 100.0, because type *int* (100) is automatically converted into a *float* (100.0).
- **computers store *floats* and *ints* differently in their memory**.

```
int i;
float f;
i = 100;
f = i;
```

See GITHUB code_1_4_11

Can you say Rounding Error?

- Result in a loss of accuracy
- The value of the variable i will be 100
- The .25 gets thrown away when you recast
- Converting a **float** into an **int** is not always feasible

```
int i;
float f;
f = 100.25;
i = f;
```

See GITHUB code_1_4_10

Can You Say More Rounding Error?

- Again, converting a **float** into an **int** is not always feasible
- Integer variables (unlike floats) have a limited capacity
  - They cannot contain arbitrarily large (or arbitrarily small) numbers
- Four bytes (i.e. 32 bits) to store int values
  - numbers from the range of -2147483648 to 2147483647

```
int i;
float f;
f = 1E10;
i = f;
```

See GITHUB code_1_4_11

Lab 1.4.1 (Parentheses)

See GITHUB lab_1_4_1 Parentheses

Fix Github number for the lab

Operators = + - * /

An Assignment Operator

```
int myVariable;
int hitCouonter, lifeForce;

myVariable = 9;
myVariable = 9 * hitCounter;
myVariable = lifeForce - hitCounter;
```

Multiplication

- A asterisk * is **a multiplication operator**
- What is the value of k?
- What is the value of z?

```
int i,j,k;
float x,y,z;
i = 10;
j = 12;
k = i * j;
x = 1.25;
y = 0.5;
z = x * y;
```

Division

- A slash / is **a divisional operator**
- The value in front of the slash is a **dividend**
- The value behind the slash is a **divisor**.

```
int i,j,k;
float x,y,z;
i = 10;
j = 5;
k = i / j;
x = 1.0;
y = 2.0;
z = x / y;
```

Divide by 0?

- Dividing by zero is strictly forbidden
- Dividing by zero will generate
  - a compilation error, runtime error, or some message at runtime
- Run time error: When executing this code, the result of the operation is not a number
  - Special featured value named inf (as in infinitive)
  - This kind of illegal operation is a so-called exception

```
float x;
x = 1.0 / 0.0;
```

```
float x,y;


x = 0.0;
y = 1.0 / x;
```

ADDITION

- The **addition operator** is the **+** (plus) sign
- What is the value of k?
- What is the value of z?

```
int i,j,k;
float x,y,z;

i = 100; j = 2;
k = i + j;
x = 1.0; y = 0.02;
z = x + y;
```

SUBTRACTION

- The **subtraction operator** is obviously the – (minus) sign
- Note that this operator also has another meaning – it can change the sign of a number.

```
int i,j,k;
float x,y,z;

i = 100; j = 200;
k = i - j;
x = 1.0; y = 1.0;
z = x - y;
```

Unary Minus

- In “subtracting” applications, the minus operator expects two arguments:
  - The left (a minuend in arithmetical terms)
  - The right (a subtrahend).
- The subtraction operator is considered to be one of the binary operators, just like the addition, multiplication and division operators
- The minus operator can also be a **unary operator**, as it expects only one argument - the right one

```
int i,j;
 i = -100;
 j = -i;
```

Remainder

- The **remainder operator** is not traditional arithmetic operators.
- Its graphical representation in the C++ language is the **%** (percent) character
  - It's a binary operator (it performs **the modulo operation**) and both arguments cannot be floats
- You cannot compute the remainder with the right argument equal to zero
  - Division by 0 invokes undefined behavior, the modulo operation, is undefined, too.

```
int i,j,k;
i = 13;
j = 5;
k = i % j;
```

Priorities & Binding

- operators of larger (higher) priority perform their operations before the operators with lower priority
- Most operators in the C++ language have the **left-sided binding**
  - which means that the calculation of this sample expression is conducted from left to right
  - 3 will be added to 2, and 5 will be added to the result.

```
x = 2 + 3 * 5;

y = 2 + 3 + 5;
```

List of priorities

- operators in order **from the highest to the lowest priority**
- Unary?
- Binary?

+ -	unary
* / %	
+ -	binary

LIST OF PRIORITIES QUIZ

```
x = 2 * 3 % 5;
```

Parentheses

- Parentheses change the natural order of calculation
- subexpressions in parentheses are always calculated first

```
int i,j,k,l;
i = 100;
j = 25;
k = 13;
l = (5 * ((j % k) + i) / (2 * k)) / 2;
```

Increment a Variable by One

int SheepCounter;

SheepCounter = 0;

SheepCounter = SheepCounter + 1;

++ (plus plus) incrementor operator

SheepCounter++;

-- (minus minus) decrementor operator

SheepCounter = SheepCounter - 1;

SheepCounter--;

Ahhhh I ran out of time…

LAB 1.4.1 (FLOAT)

See GITHUB lab_1_4_1_float

Fix Github number for the lab

Reference Slides

Source Material

- Google search for C++ Sides
  - http://stroustrup.com/Programming/lecture-slides.html

Variable Names - Cont

- Which do you like?
  - i
  - t10
  - Exchange_Rate ← exchangeRate
  - counter
  - DaysToTheEndOfTheWorld ← daysToTheEndOfTheWorld
  - TheNameOfAVariableWhichIsSoLongThatYouWillNotBeAbleToWriteItWithout Mistakes
  - _
- What's Wrong?
  - 10t (does not begin with a letter)
  - Adiós_Señora (contains illegal characters)
  - Exchange Rate (contains a space)