Taming your first program

Due this week

- **Syllabus Quiz**
- **Homework 0**
  - Submit zip file on Canvas. Check the due date!
  - 5% early bonus if submitted by 11:59 pm tonight
- Start going through the textbook readings and watch the videos
  - Take **Quiz 1**. Check the due date!

Today

1. Finish pseudocode example
2. Analyzing your first program
3. Errors
4. Becoming familiar with your programming environment

Describing an algorithm with Pseudocode (example 1)

Problem Statement:

You are asked to simulate a postage stamp vending machine. A customer inserts dollar bills into the vending machine, selects the number of stamps needed, and then pushes a “purchase” button. The vending machine gives out as many first-class stamps as the customer requested and can pay for, and returns the change in coins. A first-class stamp costs 55 cents. <u>The machine is broken</u>. The only available coins for change are dollar coins and pennies.

Describing an algorithm with Pseudocode

Step 3 Describe each subtask in pseudocode.

Compute change needed
*change_cents = initial_money *100 - purchase_price_cents*

Example:
initial_money = $5
num_stamps = 5
*purchase_price_cents = 5 *55 = 275*
*change_cents = 5 * 100 – 275 = 225*

Describing an algorithm with Pseudocode

Step 3 Describe each subtask in pseudocode.

Give change:
change_dollars = change_cents / 100 (w/o remainder)

*change_pennies = change_cents – 100*change_dollars*

or

change_pennies = change_cents %100 (remainder),
where % is the **modulo** operator

Describing an algorithm with Pseudocode

Step 4 Test your pseudocode by working a problem.

Use these sample values:
Example 1:

initial_money = $5
num_stamps = 5
*purchase_price_cents = 5 * 55 = 275*
*change_cents = 5 * 100 – 275 = 225*
change_dollars = change_cents/100 = 2
change_pennies = change_cents%100 = 25

Describing an algorithm with Pseudocode

Step 4 Test your pseudocode by working a problem.

Use these sample values:
Example 2:

initial_money = $5
num_stamps = 7
*purchase_price_cents = 7 * 55 = 385*
*change_cents = 5 * 100 – 385 = 115*
change_dollars = change_cents/100 = 1
change_pennies = change_cents%100 = 15

Describing an algorithm with Pseudocode

Step 4 Test your pseudocode by working a problem.

Are we ready to implement it into code? Have we thought of all possibilities?

Example 3:

initial_money = $5
num_stamps = 17
*purchase_price_cents = 17 * 55 = 935*
*change_cents = 5 * 100 – 935 = - 435*
change_dollars = change_cents/100 = ?
change_pennies = change_cents%100 = ?

Describing an algorithm with Pseudocode

Step 4 Test your pseudocode by working a problem.

Are we ready to implement it into code? Have we thought of all possibilities?

Example 4:

initial_money = $5
num_stamps = -3
purchase_price_cents = …
change_cents = …
change_dollars = change_cents/100 = …
change_pennies = change_cents%100 = …

Describing an algorithm with Pseudocode

Step 4 Test your pseudocode by working a problem.

Are we ready to implement it into code? Have we thought of all possibilities?

Example 5:

initial_money = $5
num_stamps = r
purchase_price_cents = …
change_cents = …
change_dollars = change_cents/100 = …
change_pennies = change_cents%100 = …

Describing an algorithm with Pseudocode

Step 3 Describe each subtask in pseudocode. **Make changes!**

Ask user to input a whole positive number for the dollar amount inserted into the machine

Save in the variable *initial_money*

Ask user to input a whole positive number for the number of stamps wished to purchase

Save in the variable *num_stamps*

Compute total purchase price

*purchase_price_cents = num_stamps * 55*

Describing an algorithm with Pseudocode

Step 3 Describe each subtask in pseudocode. **Make changes!**

If *purchase_price_cents <= initial_money*100*
    then, Compute change needed
    *change_cents = initial_money *100 - purchase_price_cents*
Otherwise
    print "Not enough money"
    Return money back to user

Give change:
change_dollars = change_cents / 100 (w/o remainder)
change_pennies = change_cents %100 (remainder)

Is this correct?

NO!

Describing an algorithm with Pseudocode

Step 3 Describe each subtask in pseudocode. **Make changes!**

If *purchase_price_cents <= initial_money*100*

    then, Compute change needed

    *change_cents = initial_money *100 - purchase_price_cents*

    Give change:

    change_dollars = change_cents / 100 (w/o remainder)

    change_pennies = change_cents %100 (remainder)

Otherwise

    print “Not enough money”

    Return money back to user

Your first program!

Your first program

- The classic first program that everyone writes: Hello World!
    - (yes, everyone who is anyone started with this one)
- Its job is to write the words *Hello World!* on the screen.

```
#include <iostream>
using namespace std;
int main()
{
  cout << "Hello, World!" << endl;
  return 0;
}
```

the #include

- The first line tells the compiler to include a service for “stream input/output”. Later you will learn more about this but, for now, just know it is needed to write on the screen.

```
#include <iostream>

using namespace std;
int main()
{
      cout << "Hello, World!" << endl;
      return 0;
}
```

using namespace std

- The second line tells the compiler to use the “standard namespace”. This is used in conjunction with the `<iostream>` first line for controlling input and output.

```
#include <iostream>

using namespace std;
int main()
{
        cout << "Hello, World!" << endl;
        return 0;
}
```

`int main()`

- The next set of code *defines* a ***function,*** named **`main`**.
  - Every C++ program must contain its one `main` function.
  - All function names must be followed by parentheses. In `main`'s case, the parentheses are empty.
- Braces `{ }` must enclose all the code that belongs to `main`. The braces tell the compiler where to start reading the `main` code, and where to finish.

```
#include <iostream>

using namespace std;
int main()
{
       cout << "Hello, World!" << endl;
       return 0;
}
```

`cout` statement

- To show output on the screen, we use **`cout`.**
- What you want seen on the screen is "sent" to the **`cout`** entity using the **<<** operator (sometimes called the insertion operator): **`<< "Hello, World!"`**
- **The curious non-word `endl` means end-of-line, which tells the display to move the cursor down to the start of the next line.**

```
#include <iostream>

using namespace std;
int main()
{
	cout << "Hello, World!" << endl;
	return 0;
}
```

Output Statements and Streaming Operator <<

The statement

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

is an *output statement*.

- To display values on the screen, you send them to an entity called cout.
  - Which stands for "character output" or "console output".
- The << operator denotes the “send to” command.

`return` statement

- The **`main`** function “returns” an “integer” (that is, a whole number without a fractional part, called **`int`** in C++)
  with value 0.
- This value indicates that the program finished successfully.

```
#include <iostream>

using namespace std;
int main()
{
       cout << "Hello, World!" << endl;
       return 0;
}
```

Semicolons are Required after Statements

- Each statement in C++ ends in a semicolon;
  - Note that not every line in a program is a statement, so there are no semicolons after the `<iostream>` line and the `main()` line
  - It is a strange idiosyncrasy, but you will get used to it

```
#include <iostream>

using namespace std;
int main()
{
        cout << "Hello, World!" << endl;
        return 0;
}
```

Every program includes one or more headers for required services such as input/output.

Every program that uses standard services requires this directive.

Every program has a `main` function.

The statements of a function are enclosed in braces.

```
#include <iostream>

using namespace std;

int main()
{
   cout << "Hello, World!" << endl;
   return 0;
}
```

Replace this statement when you write your own programs.

Each statement ends in a semicolon.

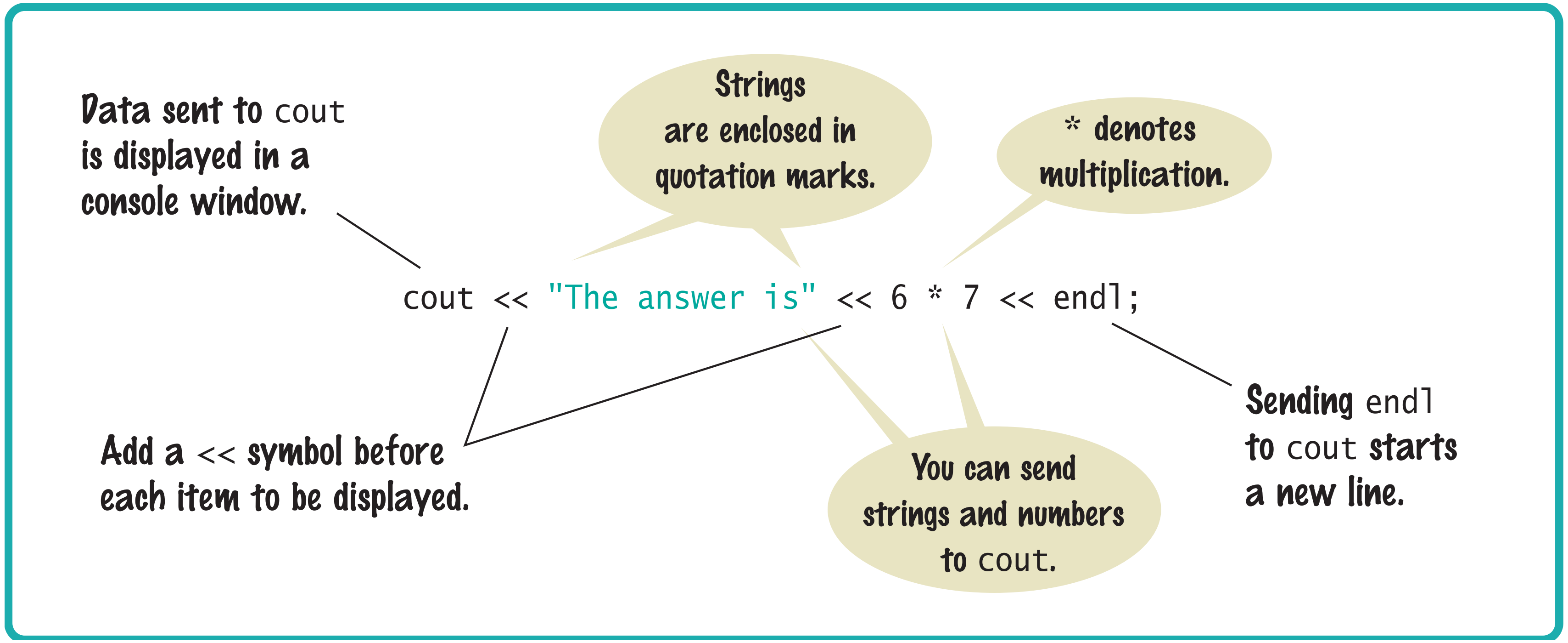
See page 14.

"Strings" and `endl`

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

- **`"Hello World!"`** is called a *`string`*.
- You must put those double-quotes around strings.

- The **`endl`** symbol denotes an *end of line* marker which causes the cursor to move down to the next screen line.


Data sent to cout is displayed in a console window.
Strings are enclosed in quotation marks.
* denotes multiplication.
cout << "The answer is" << 6 * 7 << endl;
Add a << symbol before each item to be displayed.
You can send strings and numbers to cout.
Sending endl to cout starts a new line.

Errors!

Common Error – Omitting Semicolons errors

Omitting a semicolon (or two), in this case at the end of the `cout` statement

```
#include <iostream>

using namespace std;
int main()
{
        cout << "Hello, World!" << endl
        return 0;
}
```

Syntax errors

Without that semicolon you actually wrote:

```
cout << "Hello, World!" << endl return 0;
```

which thoroughly confuses the compiler with the `endl` immediately followed by the `return`!

- This is a *compile-time error* or *syntax error*.
- A syntax error is a part of a program that does not conform to the rules of the programming language.

Errors: Misspellings

- Suppose you (accidentally of course) wrote:

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

- This will cause a compile-time error and the compiler will complain that it has no clue what you mean by cot.
- The exact wording of the error message is dependent on the compiler, but it might be something like

“Undefined symbol cot” or "Unknown identifier".

How many errors?

- The compiler will not stop compiling, and will most likely list lots and lots of errors that are caused by the first one it encountered.
- You should fix only those error messages that make sense to you, **starting with the first one**, and then recompile (after SAVING, of course!).

Logic Errors

Consider this:

```
cout << "Hollo, World!" << endl;
```

- *Logic errors* or *run-time errors* are errors in a program that compiles (the syntax is correct), but executes without performing the intended action.
- The programmer must thoroughly inspect and test the program to guard against logic errors.
  - *Testing and repairing a program usually takes more time than writing it in the first place, but is essential !*

Errors: Run-Time Exceptions

Some kinds of run-time errors are so severe that they generate an *exception*: a signal from the processor that aborts the program with an error message.

For example, if your program includes the statement

```
cout << 1 / 0;
```

Your program may terminate with a “divide by zero” exception.

Errors: extra or misspelled main() function

- Every C++ program must have one and only one **`main`** function.

- Most C++ programs contain other functions besides **`main`** (more about functions next week).

Errors: C++ is Case Sensitive

C++ is *case sensitive.* Typing:

```
int Main()
```

will compile but will not link.

A link-time error occurs here when the linker cannot find the **`main`** function – because you did not define a function named **`main`**. (**`Main`** is fine as a name but it is not the same as **`main`** and there has to be one **`main`** somewhere.)

If you want to learn more about the build process, read this. The content in this webpage is not a part of the syllabus and will not be on any course related assignments.

Making your Program Readable (by Humans)

C++ has *free-form layout*

```
int main(){cout<<"Hello, World!"<<endl;return 0;}
```

- <u>*will*</u> compile (but is practically impossible to read)

A good program is readable:

- code spaced across multiple lines, one statement per line
- follows indentation conventions

Let’s look at our IDE!

Next time

- Variables and arithmetic