CS 101: Computer Programming and Utilization

07- Scratch to C++ basics

Instructor: Sridhar Iyer
IIT Bombay

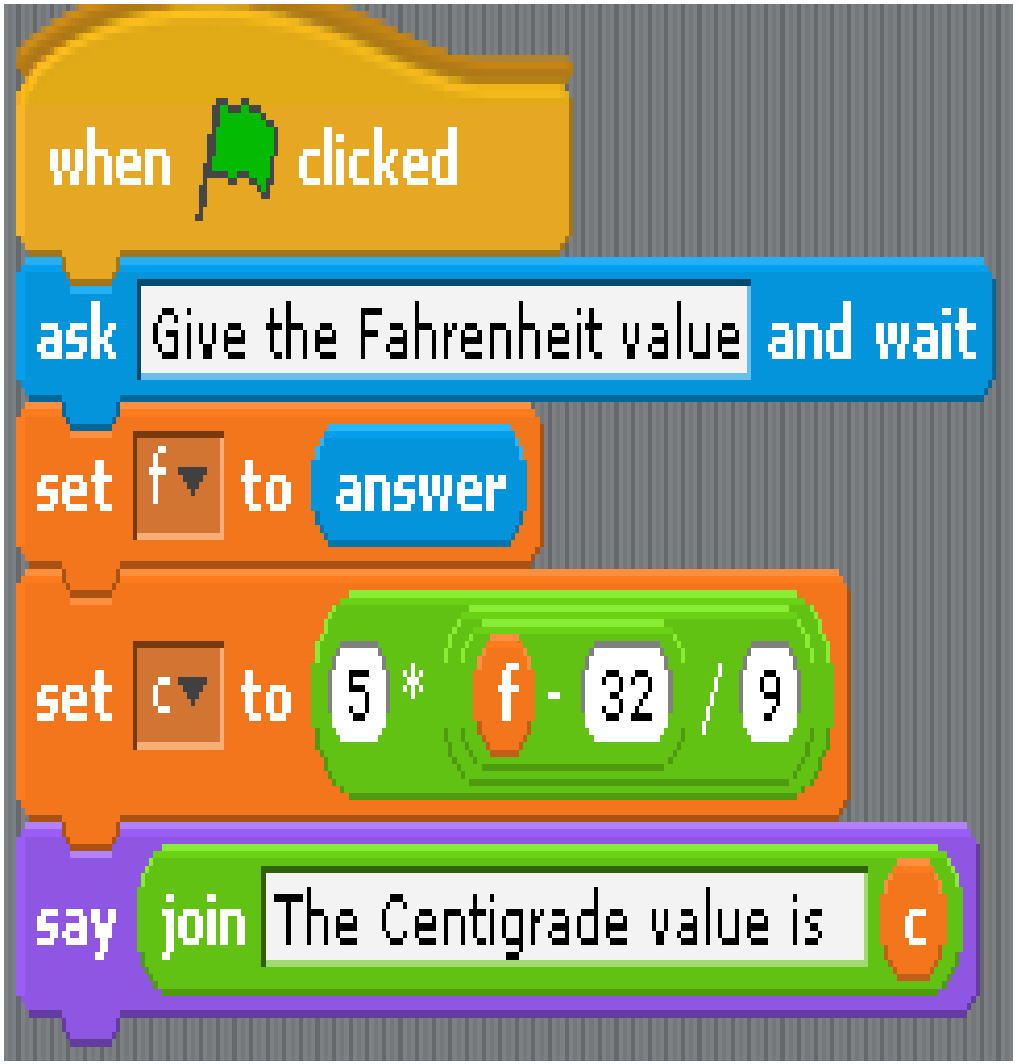
Activity: Write a program

to convert Fahrenheit to Centigrade

Write it in at least 2 of the following:

- psuedo-code
- Scratch
- C++

- Input F from keyboard
- Set C to 5*(F-32)/9
- Output C to display




```
#include <iostream>
using namespace std;
main() {
  float f, c;
  cin >> f;
  c = 5*(f-32)/9;
  cout << c;
}
```

C++: More detail

Procedure name

Data type

Variable declaration

```
main() {
  float fahrenheit;
  cin >> fahrenheit;
  float centigrade = 5*(fahrenheit-32)/9;
  cout << centigrade;
}
```

Arithmetic expression

- What is a procedure?
- What are data types?
- Where did `cin` and `cout` come from?
- Rules of writing arithmetic expressions

Procedure or function

- Encapsulates a piece of computation and gives it a name
  - E.g. `main` is the default procedure that is run when your program is executed from the shell
- May accept input values stored in named variables
  - E.g. `int max(int a, int b)`
- And return output value
  - E.g. `max(-3, 2)` should return 2

Class discussion: Why bother with having functions?

Points made by students in both batches:

- Code can be reused
- Ease of testing and debugging
- Modularity is useful for understanding
- Re-implementation is possible
- Abstraction and Encapsulation

Variables - data types

- Computer memory is a 2d array of bits
  - Eight columns (one **byte** or “B”)
  - Rows depends on how much memory you have; “1 GB” means 1,073,741,824 rows
  - Hard disk is similar, only larger and slower

- What programmers want:
  - Integers, real numbers, complex numbers
  - Characters, strings of characters
  - Arrays, variable length lists, mappings
  - Windows, buttons, menus
- Later we will study how these are represented

Variable declaration

- `float fahrenheit;`
  - Uninitialized, may get garbage on read
- `float fahrenheit = 95;`
- `const float fahrenheit = 9.52e14;`
  - Value will never change
  - Scientific notation saves typing lots of zeros
- `int x = 3, y = x/2;`
  - Can initialize variables based on others already initialized

- Why bother to declare variable names and types?

Why bother to declare

- Variable names
  - What if you type it incorrectly later?
  - To initialize before any use
- Types
  - To check all assignments to the variable
  - To interpret a bit sequence as intended in your program (e.g. `float` and `int` are both 32 bits)

- There are languages that do not enforce variable name and type declarations
  - Can be lazy, but generally a Bad Idea

Choosing names

- C++ allows any sequence of characters A—Z, a—z, 0—9, and underscore
- Not starting with a digit
- Up to some maximum number of characters
- `old_style_variable_name`
- `newStyleVariableName` (“camel case”)

- Using single characters for variable names, like 'c' and 'f' as shown on slide 3, is BAD practice!

`cin` and `cout`

- "Console in" (keyboard) and "console out" (display)

- These variables are not defined magically
- To use them, must prefix our C++ code with instruction to **include** a **header** file like this:

```
#include <iostream>
```

- The operating system and compiler work together to let your code access the keyboard and display through `cin` and `cout`
- Not quite…

Namespaces

- We must write **`std::`**`cin` and **`std::`**`cout`

- Two different Ravi Vermas in hostels 2 and 5
- To avoid confusion, write as
  `H2::RaviVerma` and `H5::RaviVerma`

- "Namespace::" lets libraries written by different people avoid variable and function name clashes
- `std` is the "standard" namespace within which C++ predefined variables and functions are provided

The `std` namespace and `using`

- Tedious to type `std::` in front of everything

- If you are not using too many namespaces simultaneously, you can choose a default by saying

```
using namespace std;
```

before using things defined inside `std`.

Compiling your source code

```
#include <iostream>
using namespace std;
main() {
  float fahrenheit;
  cin >> fahrenheit;
  float centigrade = 5*(fahrenheit-32)/9;
  cout << centigrade;
}
```

Save to file “convert.cc”

g++ compiler

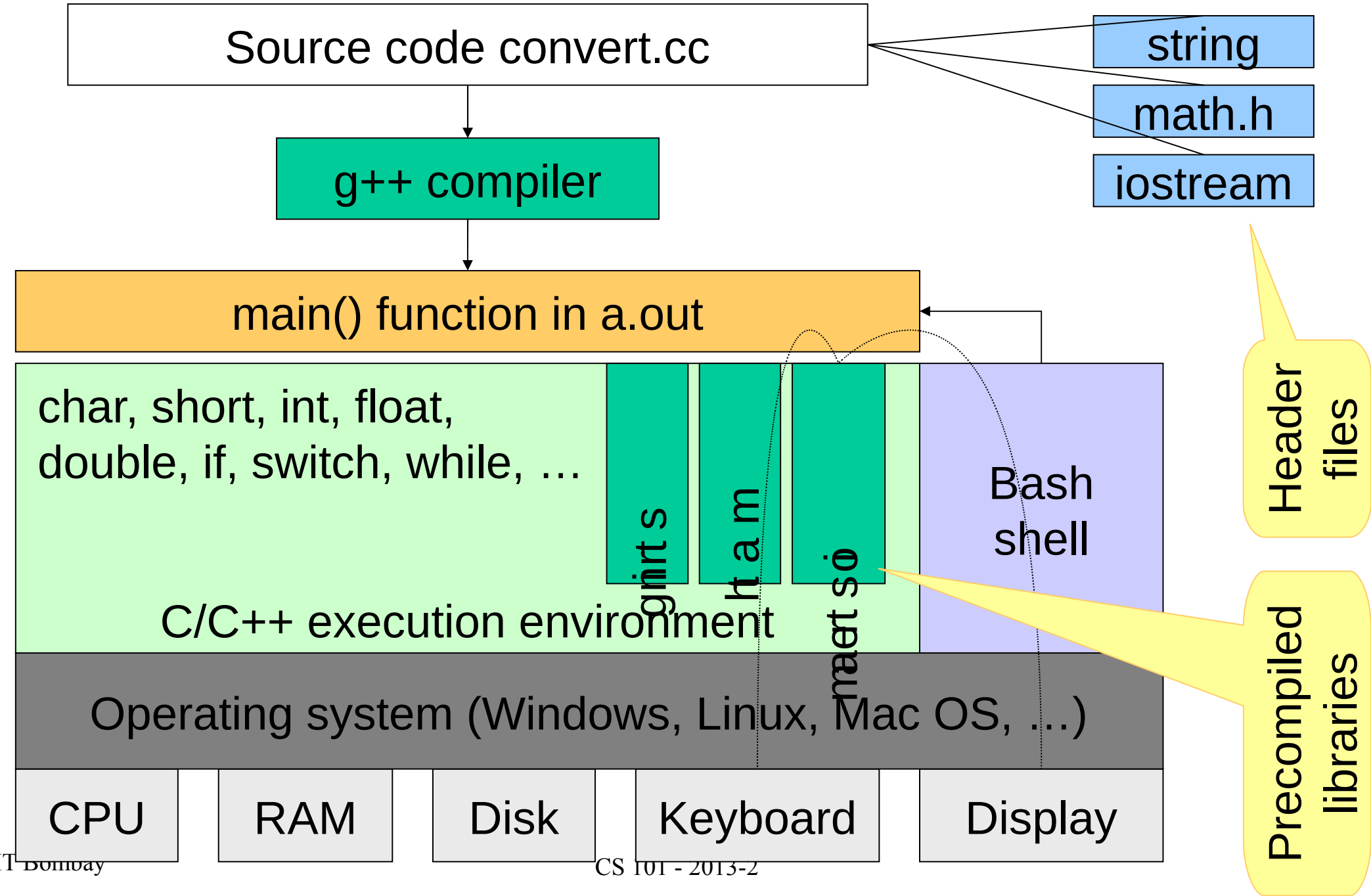
Executable a.out

- At your shell, type
  `g++ cf.cc`
- Now run resulting file as
  `./a.out`

Program files and executables

- convert.cc and a.out are **files**
- A file is a sequence of bytes
- These bytes can be interpreted differently depending on the applications that read or write the files
  - convert.cc is a **text file** to be written by a programmer and read by the C++ compiler
  - Any name ending in .cc or .cpp is ok
  - a.out is an **executable file** to be run from the shell command line
  - You can rename this file as you wish – Geany does this automatically for you.

Compilation and execution summary



Think-Pair-Share: Write a program

A petroleum company has erected a number of cylindrical tanks on a rectangular field. External surfaces of these are to be painted, including the flat circular cover on top.

Write a program that, given appropriate inputs, will output the cost of painting.

Think: Identify variables; Write pseudo-code

Pair: Check each others' pseudo-code, converge on one answer and convert into C++

Share: Check with next slide demo06-painting.cpp

*demo06-painting.cpp - /home/sri/Desktop/courses/cs101-2013 - Geany

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Symbols

- Functions
  - main [3]
- Other
  - std [2]

demo06-painting.cpp

```cpp
#include <iostream>
using namespace std;
int main() {
float r, h, price, cost, pi = 3.14159;
int Ntanks;

cout << "give the radius and height of cylinder: ";
cin >> r >> h;
cout << "give number of tanks: "; cin >> Ntanks;
cout << "give price per sq meter for painting: "; cin >> price;
cost = price * Ntanks * (2 * pi * r * h + pi *r *r);
cout << "Cost of painting is: " << cost;
return 0;
}
```

Status

Compiler

g++ -Wall -c "demo06-painting.cpp" (in directory: /home/sri/Desktop/courses/cs101-2013)

Compilation finished successfully.

What next?

- Next class: Statements, Conditions, Loops, ...
  - You are already familiar with these concepts in Scratch, so you only need to learn C++ syntax!
  - We will move quickly onto advanced constructs

- Next lab: C++ programming
  - Using Geany (Development Environment)
  - Completing your Scratch projects