Welcome to CS106L

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Lecture 0: Syllabus Week

- Administrivia
- Why this class exists
  - and why you should take it
- What can C++ do for you?
  - What is C++?
  - C++ in the real world

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Administrivia

- Instructor:
  - Cristian Cibils (ccibils@stanford.edu)
  - Please feel free to talk to me about anything. I love hearing from you guys.
- Office Hours:
  - TBD
- Website:
  - cs106l.stanford.edu

Administrivia

- 3 Assignments
  - You must complete 2 **satisfactorily** to get credit
- Late Days
  - You have three 24 hour late days you may use
  - No assignments will be accepted more than 24 hours after it is due without prior permission from instructor
- Honor Code
  - Don’t cheat… seriously

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What is CS106L?

- CS106B: Programming Abstractions
  - Uses C++ to teach recursion, classes, and pointers
- CS106L: Standard C++ Programming
  - Learn how to write powerful and elegant C++ code
  - Learn what “good” C++ looks like

Hello World in C++

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

Hello World in C++

```
#include <stdio.h>
#include <stdlib.h>
int main(int argc, char *argv[]) {
   puts("Hello world");
   return EXIT_SUCCESS;
}
```

Some Pertinent Questions

- Why does CS106B/X use C++?
- Why does industry use C++?
- Is C++ useful to learn?
- Can knowing C++ get me a job?

Some Pertinent Questions

- Why does CS106B/X use C++?
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- Is C++ useful to learn?
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To answer, we must first answer what is C++?

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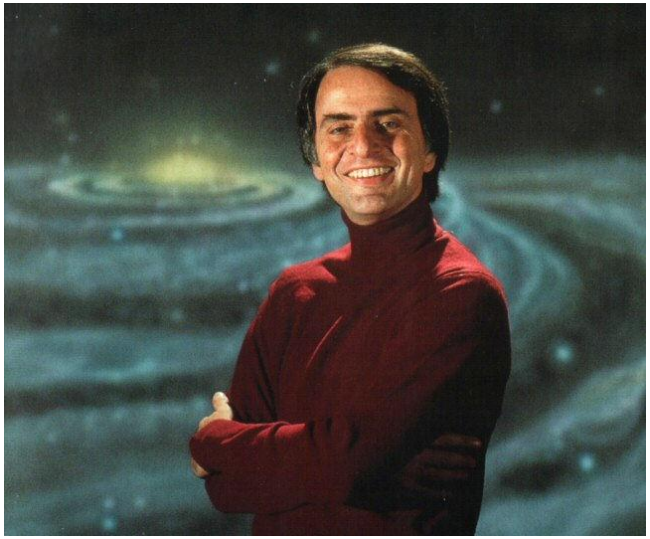
The Universe of Programming

"If you wish to make an apple pie from scratch, you must first invent the universe"

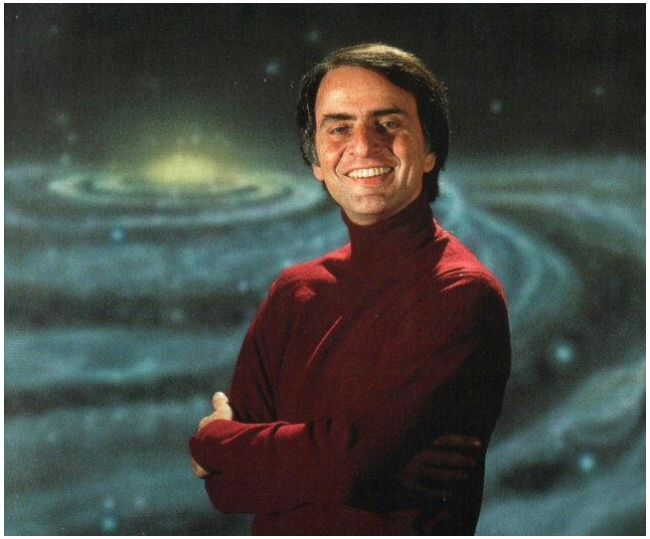
-- Carl Sagan



The Universe of Programming

"If you wish to understand C++, you must first invent the universe"

-- Carl Sagan



The Universe of Programming

To understand the universe of programming, we'll start by looking at the most basic programming language used, assembly.

Assembly

Here's an example of a "hello world" program in assembly.

```
section     .text
global      _start                              ;must be declared for linker (ld)

_start:                                         ;tell linker entry point

    mov     edx,len                             ;message length
    mov     ecx,msg                             ;message to write
    mov     ebx,1                               ;file descriptor (stdout)
    mov     eax,4                               ;system call number (sys_write)
    int     0x80                                ;call kernel
    mov     eax,1                               ;system call number (sys_exit)
    int     0x80                                ;call kernel

section     .data
msg     db  'Hello, world!',0xa                 ;our dear string
len     equ $ - msg                             ;length of our dear string
```

Assembly

- Computers operate by executing a series of **instructions**.
  - Instructions are things like "add two numbers", or "store this value into memory"
- **Assembly language** describes exactly which instruction the computer should execute
- When you write assembly, you have complete control over your program
- You'll learn more about assembly in CS107

Assembly

- Well written assembly is extremely fast
  - Any construct which the computer can execute can be expressed in assembly

If all computer programs **can** be written in assembly, why don't we just learn assembly?

Assembly

- Assembly code can be extremely difficult to understand
  - Specifying **exactly** what the computer should do can take a very long time!
  - A 5 line C++ program might involve hundreds of lines of assembly code
- Assembly code written for one type of computer might not work on another
  - Laptops typically use a set of instructions called **x86**, while phones typically use **ARM**

Higher Level Programming

- Writing assembly is too difficult
- **Source code** is written in a **programming language** like Java or C++.
- **Compilers** transform source code into assembly

Higher Level Programming

Source Code

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

Compiler

Assembly

```
section     .text
global      _start

_start:
    mov     edx,len
    mov     ecx,msg
    mov     ebx,1
    mov     eax,4
    int     0x80
    mov     eax,1
    int     0x80

section     .data
msg     db  'Hello World!',0xa
len     equ $ - msg
```

Programming Languages

What is “good” source code?

Programming Languages

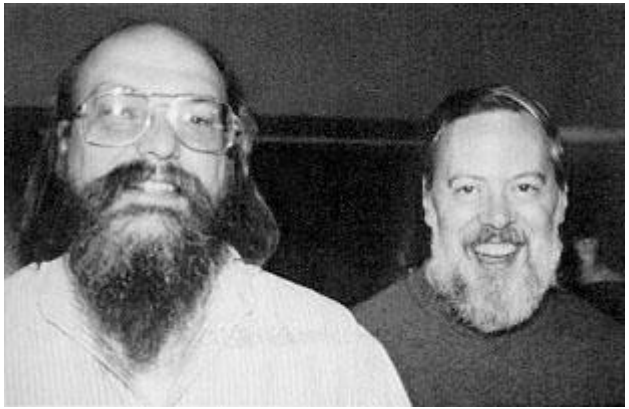
- As you all know, there are many different programming languages and many different views on which languages are “good”
  - Some languages focus on making programs run fast
  - Some languages focus on making easy to write code
  - Some languages focus on performing a single task extremely well

History of C++

Where does C++ fit in?

History of C++: C

- C was created in 1972 to much praise
- C made it easier to write fast cross platform code
- Learn to love it in CS107!



Ken Thompson and Dennis Ritchie, creators of the C language

History of C++: C

- C was popular since it was simple
  - Not much useless syntax
  - Runs extremely fast
  - Runs on any computer with a C compiler
- C was criticized since it was simple
  - No objects or classes (e.g. no maps)
  - Sometimes even simple tasks are extremely difficult to program

Hello World in C

```
#include <stdio.h>
#include <stdlib.h>
int main() {
   puts("Hello world");
   return EXIT_SUCCESS;
}
```

History of C++

- C++ was created in 1983 by Bjarne Stroustrup, this guy:

What is C++?

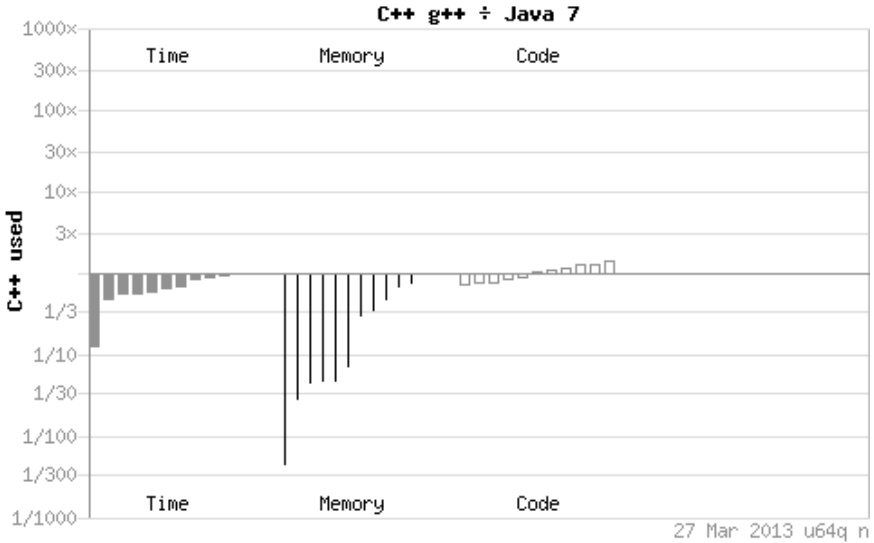
C++ is a programming language which simplifies complex tasks without sacrificing performance

What is C++?

- All C code is valid C++ code (few exceptions)
- What constitutes valid C++ code is well defined
  - ~1400 page C++ Standard that documents all of C++
  - Definitely not a simple language
- Why is C++ popular?

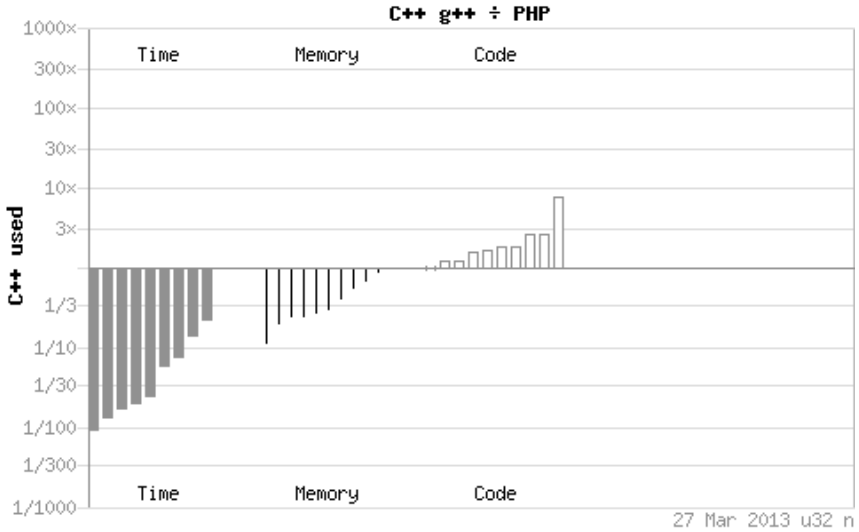
Why C++: Performance

Well written C++ offers some of the highest performance of any language currently used



Why C++: Performance

Facebook began using C++ and C++ based tools to help them handle their traffic

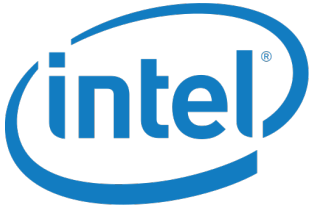


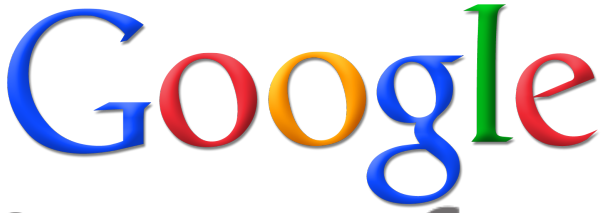
Why C++: Users

C++ is one of the most widely used languages in the world.

Let's peek at some examples...

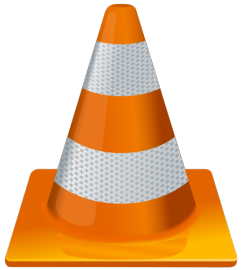
Why C++: Users (companies)





Why C++: Users (web browsers)

Why C++: Users (software)

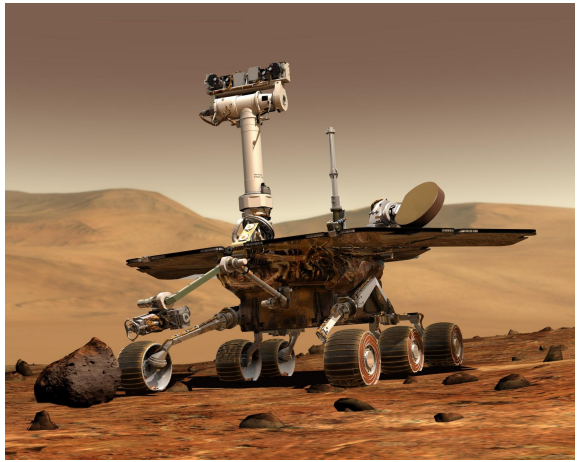


Why C++: Users (games)

Why C++: Users (cool things)

The F-35 Lightning II (Joint Strike Fighter) relies extensively on C++

The Spirit rover was operational for over 6 years when the mission was only planned to run for around 3 months



Why C++: Users (Java)

The most widely used Java runtime is written in C++

The Big Picture?

C++ is a programming language which simplifies complex tasks without sacrificing performance

The Big Picture?

If you are ever finding the need to write complex code that runs fast, C++ may very well be the tool to use

Learning good C++ practices is a great way to better understand computer programming

The Big Picture?

```
template <typename T>
Widget<T>& Widget<T>::operator=(const Widget& other) {
    Widget copy(other);
    swap(copy);
    return *this;
}
```

Next Time

- Start writing some code!
- Streams
- Check the website for more details

QT Creator

- This quarter we will be using QT creator for lecture and assignments
- To Install, follow the instructions on the website