Welcome to CS 106L!

...

Stick around!

Today

- **Introductions**
- Course Logistics
- The Pitch
- C++ Basics

Frankie

Into:

- Outside
- My Toyota Sienna
- Crosswords
- Programming Language Theory
- Magic

Frankie

Not Into:

- Inside
- People who drop 106L

Sathya

Into:

- EE + Physics
- Computational Physics
- Violin
- Climbing
- LoL/Valo

Sathya

Not Into:

- Blisters
- Leetcode 

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Lecture

- Held Tuesdays and Thursdays 1:30-3 in STLC 111
- We will usually try to keep lectures closer to an hour+ish, just wanted to give ourselves time to get into the cool stuff!
- No lecture week 10!
- You can find a screen recording of a lecture on Canvas but we want you to come in person!

Office Hours

- OH time TBD, will be in person and virtual
- We want to talk to you! Come talk!
- Extra office hours when assignments are due!
- Watch the website (cs106l.stanford.edu) and Ed for more info

cs106l.stanford.edu

Assignments

- There will be 3 ***very short*** assignments
- You only need to do 2 to pass the class
- Pairs are allowed! (Not at all necessary)
- 3 late days, more if you fill out feedback forms!
- Email us to work out any extensions
- Check out the assignment setup page ASAP!
- Assignment Setup after class Thursday!

Questions?

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- ~~Course Logistics~~
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- C++ Basics

Why CS106L?

CS106B

- Focus is on **concepts** like abstractions, recursion, pointers etc.
- Bare minimum C++ in order to use these concepts

CS106L

- Focus is on **code**: what makes it good, what **powerful** and **elegant** code looks like
- The real deal: No Stanford libraries, only STL
- Understand how and **why** C++ was made

Why C++?

C++ is still a very popular language

May 2021	Programming Language	Ratings	Chart Ratings
1	C	13.38%	
2	Python	11.87%	
3	Java	11.74%	
4	C++	7.81%	
5	C#	4.41%	
6	Visual Basic	4.02%	

Tiobe Index, 2021

Classes that use C++

BIOE 215: Physics-Based Simulation of Biological Structure

CME 253: Introduction to CUDA (deep learning)

CS 144: Introduction to Computer Networking

CS 231N: Convolutional Neural Networks for Visual Recognition

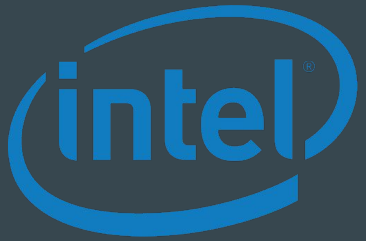
GENE 222: Parallel Computing for Healthcare

ME 328: Medical Robotics

MUSIC 256A: Music, Computing, Design I

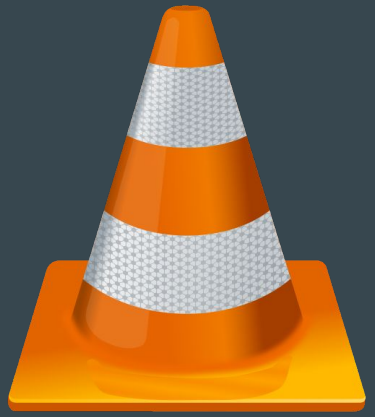
MUSIC 420A: Signal Processing Models in Musical Acoustics

Companies that use C++



Browsers written in C++

Software written in C++

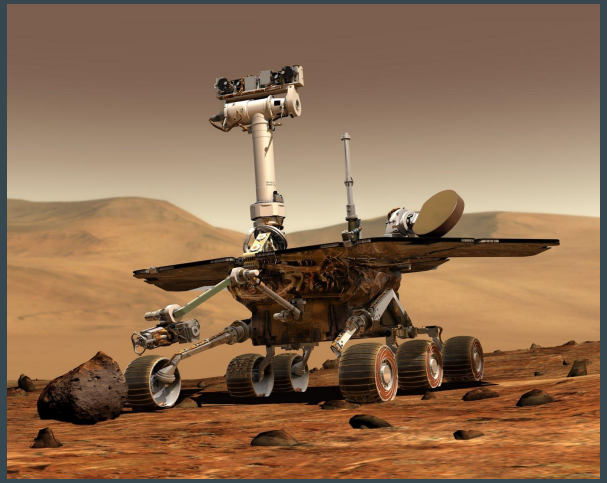


Games written in C++

Lots of cool stuff written in C++

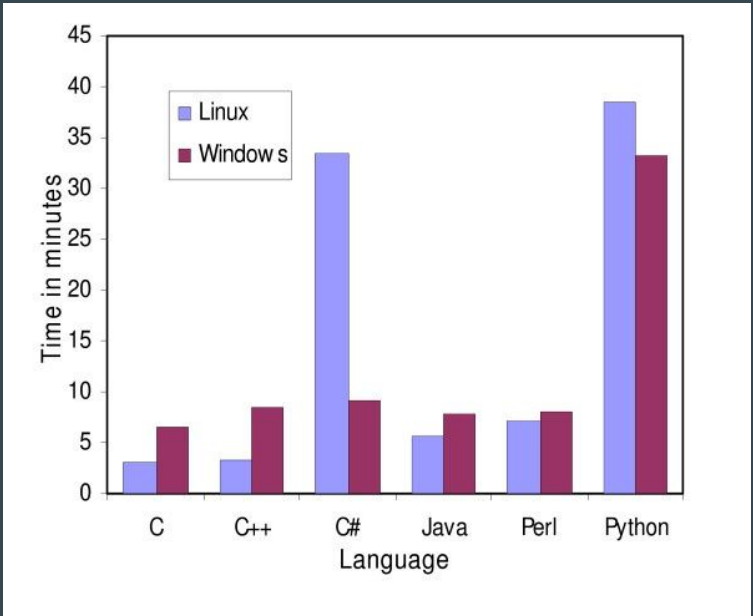
Had a stranglehold on the internet during quarantine, tbh I never played it

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

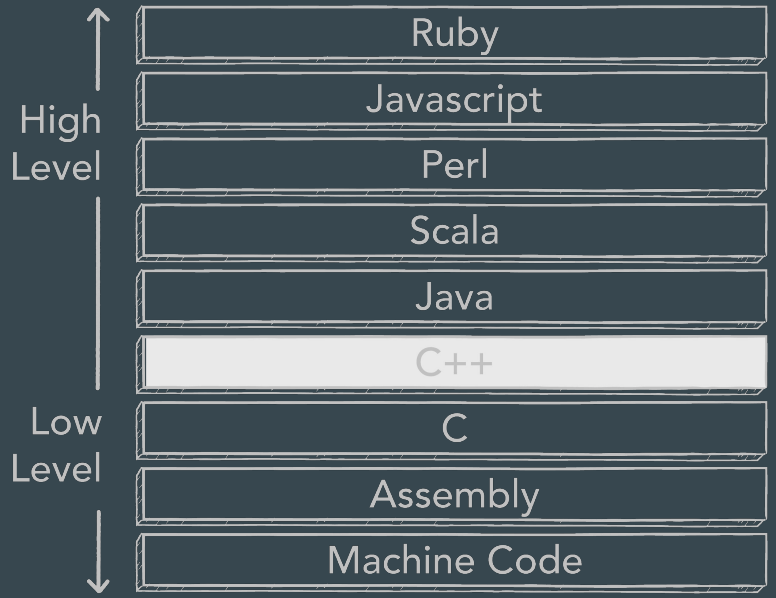


Why C++?

FAST



Lower-level control



What is C++?

Some C++ Code

```cpp
#include <iostream>

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

Also some C++ Code

```
#include "stdio.h"
#include "stdlib.h"

int main(int argc, char *argv) {
    printf("%s", "Hello, world!\n");
    // ^a C function!
    return EXIT_SUCCESS;
}
```

Also (technically) some C++ code

```
#include "stdio.h"
#include "stdlib.h"

int main(int argc, char *argv) {
    asm(  "sub    $0x20,%rsp\n\t"                    // assembly code!
          "movabs $0x77202c6f6c6c6548,%rax\n\t"
          "mov    %rax,(%rsp)\n\t"
          "movl   $0x646c726f, 0x8(%rsp)\n\t"
          "movw   $0x21, 0xc(%rsp)\n\t"
          "movb   $0x0,0xd(%rsp)\n\t"
          "leaq    (%rsp),%rax\n\t"
          "mov    %rax,%rdi\n\t"
          "call   __Z6myputsPc\n\t"
          "add    $0x20, %rsp\n\t"
     );
     return EXIT_SUCCESS;
}
```

C++ History: 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
```

C++ History: Assembly

Benefits:

- Unbelievably simple instructions
- Extremely fast (when well-written)
- Complete control over your program

Why don't we always use Assembly?

Assembly looks like this

```
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
```

C++ History: Assembly

Drawbacks:

- A LOT of code to do simple tasks
- Very hard to understand
- Extremely unportable (hard to make work across all systems)

Next in C++ History: Invention of C

Problem: computers can only understand assembly!

- Idea:
  - Source code can be written in a more intuitive language
  - An additional program can convert it into assembly
    - This additional program is called a **compiler**!
    - Take CS143 to learn more!

C++ History: Invention of C

- T&R created C in 1972, to much praise
- C made it easy to write code that was
  - Fast
  - Simple
  - Cross-platform
- Learn to love it in CS107!

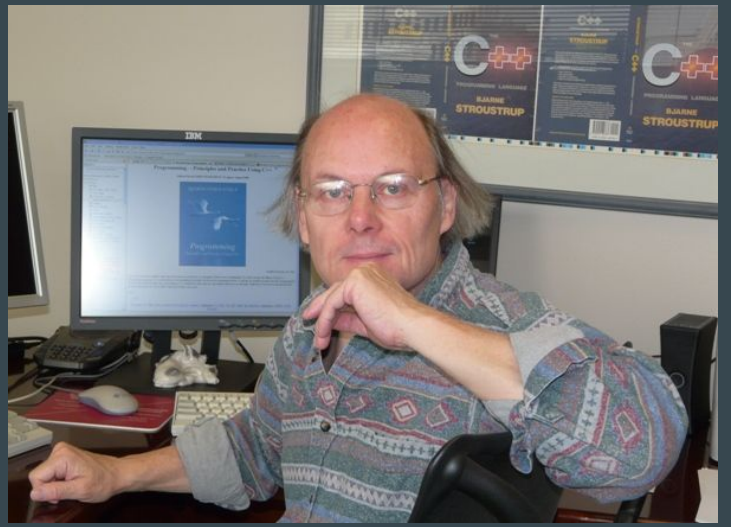
Ken Thompson and Dennis Ritchie, creators of the C language.

C++ History: Invention of C

- C was popular because it was simple.
- This was also its weakness:
  - No **objects** or **classes**
  - Difficult to write **generic code**
  - **Tedious** when writing **large programs**

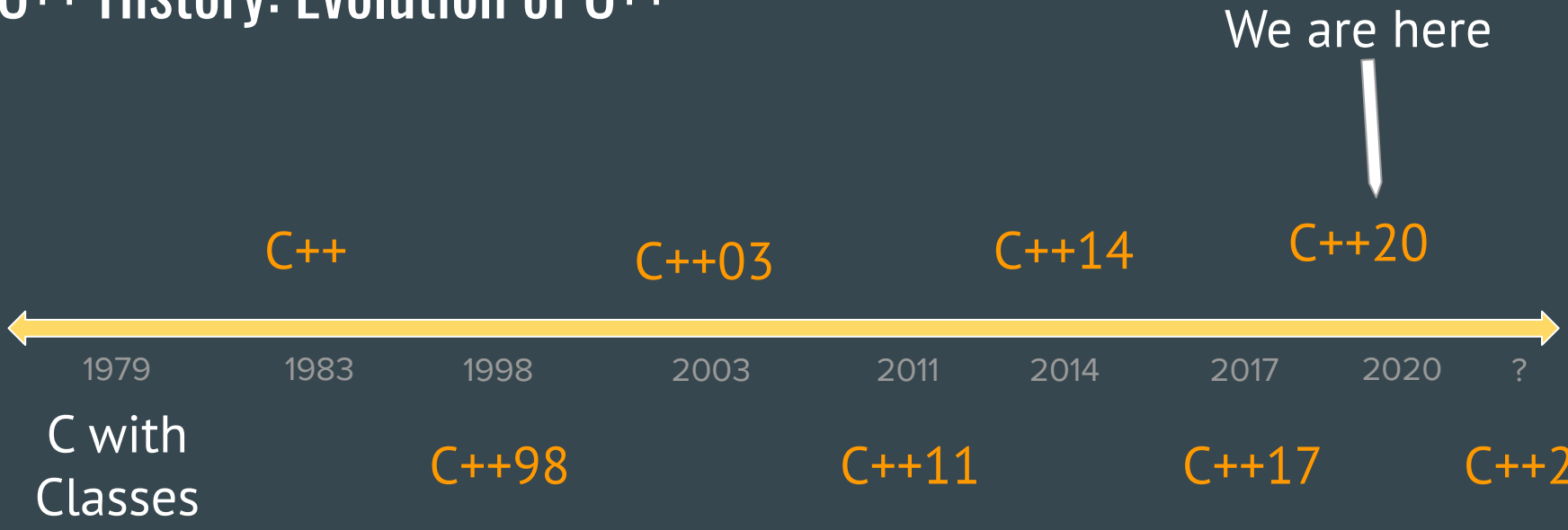
C++ History: Welcome to C++!

- In 1983, the beginnings of C++ were created by Bjarne Stroustrup.
- He wanted a language that was:
  - Fast
  - Simple to use
  - Cross-platform
  - Had high-level features



The man himself <3

C++ History: Evolution of C++



Design Philosophy of C++

Design Philosophy of C++

- Only add features if they solve an actual problem
- Programmers should be free to choose their own style
- Compartmentalization is key
- Allow the programmer full control if they want it
- Don’t sacrifice performance except as a last resort
- Enforce safety at compile time whenever possible

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CS106B

- Stanford libraries abstract away messy details of C++
- C++98*
- “Use this function we made for you called getInteger”
- ““““style””””

*plus range-based for-loops

CS106L

- All the messy details
- C++17 (sneak peak at 20)
- Learn how cin is used to make getInteger
- Learn how to abstract away messy details for others

NOT: memorize c++ syntax

Questions?

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C++: Basic Syntax + the STL

Basic syntax

- Semicolons at EOL
- Primitive types (ints, doubles etc)
- Basic grammar rules

The STL

- Tons of general functionality
- Built in classes like maps, sets, vectors
- Accessed through the namespace std::

Standard C++: Basic Syntax + std library

Basic s

- Sem
- Prin
  dou
- Basi

The STL

- Tons of general functionality
- Built in classes like maps, sets, vectors
- Accessed through the namespace std::
- Extremely powerful and well-maintained

Our first C++ program: HelloWorld.cpp