Welcome to CS106B!

• Three Handouts

• Today:
  • Course Overview
  • Where are We Going?
  • Introduction to C++
Who's Here Today?

- African Studies
- Applied Physics
- Bioengineering
- Biology
- Business Administration
- Chemical Engineering
- Chemistry
- Classics
- Civil and Environmental Engineering
- Computational and Mathematical Engineering
- Computer Science
- Creative Writing
- East Asian Studies
- Economics
- Education
- Electrical Engineering
- Energy Resource Engineering
- English
- Financial Mathematics
- Film and Media Studies
- French
- History
- International Relations
- Japanese
- Law
- Materials Science and Engineering
- Mathematical and Computational Sciences
- Mathematics
- Mechanical Engineering
- Medicine
- Management Science and Engineering
- Modern Language
- Music
- Neuroscience
- Physics
- Political Science
- Psychology
- Science, Technology, and Society
- Statistics
- Symbolic Systems
- Undeclared!
Course Staff

**Instructor:** Keith Schwarz  
(htiek@cs.stanford.edu)

**Head TA:** Dawson Zhou  
(zhoud@stanford.edu)

The CS106B Section Leaders  
The CS106B Course Helpers
Prerequisites

CS106A

(or equivalent)
Required Reading

Programming Abstractions in C++
Grading Policies
Grading Policies

- 55% Assignments
- 20% First Midterm
- 20% Second Midterm
- 5% Section Participation
Grading Policies

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Seven Programming Assignments
Grading Policies

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First Midterm Exam
Tuesday, May 7
7PM - 10PM
Grading Policies

- 55% Assignments
- 20% First Midterm
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Grading Policies

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- 20% Second Midterm
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Second Midterm Exam

Tuesday, May 28
7PM - 10PM
Grading Policies

55% Assignments
20% First Midterm
20% Second Midterm
5% Section Participation
Discussion Sections

- Weekly discussion sections.
- Section attendance is required in CS106B.
- Sign up between Thursday, April 4 at 5:00PM and Sunday, April 7 at 5:00PM at http://cs198.stanford.edu/section
- You don't need to (and shouldn't!) sign up for a section on Axess; everything is handled through the above link.
How Many Units?
How Many Units?

```c
int numUnits(bool isGrad, bool wantsFewerUnits) {
  if (!isGrad) return 5;
  if (!wantsFewerUnits) return 5;
  if (reallyBusy()) { return 3; }
  else { return 4; }
}
```
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}
```
Getting Help
Getting Help

• LaIR Hours!
  • Sunday – Thursday, 6PM – Midnight
  • Starts next week.

• Dawson's Office Hours in Gates 160
  • Monday/Wednesday 11AM – Noon
  • Tuesday/Thursday 1PM – 2PM

• Keith's Office Hours in Gates 178
  • Tuesday / Thursday, 2PM – 4PM
What's Next in Computer Science?
Goals for this Course

- **Learn how to model and solve complex problems with computers.**

- To that end:
  - Explore common abstractions for representing problems.
  - Harness recursion and understand how to think about problems recursively.
  - Quantitatively analyze different approaches for solving problems.
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To that end:

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Harness recursion and understand how to think about problems recursively.

Quantitatively analyze different approaches for solving problems.
totally rocks my socks
Hey, that's us!
Building a vocabulary of **abstractions** makes it possible to represent and solve a wider class of problems.
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http://1.bp.blogspot.com/-Hwf-U9hRwEI/TX480ONoo6I/AAAAAAAAAcM/fyBi0I5HsUI/s1600/the_great_wave_off_kanagawa.jpg
Finding the Midpoint

- If the width is 1, Karel is standing on the midpoint.
- If the width is 2, either position can be considered the midpoint.
- Otherwise:
  - Take two steps forward.
  - Find the midpoint of the rest of the world.
  - Take one step backward.
A Surprisingly Short Solution
A **recursive solution** is a solution that is defined in terms of itself.
Thinking recursively allows you to solve an enormous class of problems cleanly and concisely.
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Travel Time: $13 + 15 + 17 + 14 + 11 + 9 + 12 = 91$
Travel Time: $10 + 17 + 7 + 14 + 13 + 4 + 7 = 72$
In an $n \times n$ grid, there are at least $\frac{4^n}{n}$ possible paths from one corner to another.

If $n = 154$, this is approximately equal to the number of atoms in the universe.
In an $n \times n$ grid, there are at least $4^n / n$ possible paths from one corner to another.

If $n = 50$, it would take the lifetime of the universe to list off all possible paths.
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If $n = 50$, it would take the lifetime of the universe to list off all possible paths.
from

0 10 17 25 7 32 14 46?

13 7 3 9 13

13 17 5 22 18 38 4 42

5 6 7 10 7 2 4

28 27 8 29 7 36 20 46

17 13 9 14 7 12

45 40 11 38 9 47? 12 53?
This approach is called **Dijkstra's Algorithm**.

Google Maps uses a slightly modified version of this algorithm. For an $n \times n$ grid, it requires (roughly speaking) $n \log n$ operations to find the shortest path.
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For an \( n \times n \) grid, it requires some multiple of \( n^2 \log n \) operations to find the shortest path.
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One more detail...
C++
What is C++?

- Programming language developed in 1983 by Bjarne Stroustrup.
- Widely used for general programming when performance is important.
- Supports a variety of programming styles.
/* File: hello-world.cpp
 * 
 * A canonical Hello, world! program in C++.
 */

#include <iostream>
using namespace std;

int main() {
    cout << "Hello, world!" << endl;
}

/* File: retain-evens.cpp

* A program to filter out odd numbers from a list.
*/

#include <iostream>
#include "vector.h"
using namespace std;

Vector<int> retainEvens(Vector<int> values) {
    Vector<int> result;
    for (int i = 0; i < values.size(); i++) {
        if (values[i] % 2 == 0)
            result += values[i];
    }
    return result;
}

int main() {
    Vector<int> values;
    values += 1, 2, 3, 4, 5;

    Vector<int> processed = retainEvens(values);

    for (int i = 0; i < processed.size(); i++) {
        cout << processed[i] << endl;
    }
}
CS106L

- Optional, one-unit companion course to CS106B.
- In-depth treatment of C++'s libraries and language features.
- Excellent complement to the material from CS106B; highly recommended!
- Not a replacement for section; it's purely an add-on.
Next Time

- **Welcome to C++!**
  - Defining functions.
  - Reference parameters.
  - Introduction to recursion.