Welcome to CS106B: Programming Abstractions!

Where in the world are you right now? (put your answers the chat)
Who are we?
Today’s questions

Why take CS106B?
What is an abstraction?
What is CS106B?
Why C++?
What’s next?
Why take CS106B?
Defining key terms

"**Computational thinking** is a problem solving process: ‘a way of solving problems, designing systems, and understanding human behavior that draws on concepts fundamental to computer science... a fundamental skill for everyone, not just computer scientists’’

"**Coding** is a technical skill: the practice of developing a set of instructions that a computer can understand and execute.”

“**Computer science** is an academic discipline: ‘the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society’’

(Wing, 2006)
Defining key terms

- **Coding** as a technical skill
- **Computer science** as an academic discipline
- **Computational thinking** as a problem-solving process

*CS education is more than just “learning how to code”!*
Phases of language development

1. Discovery that language is a pattern of sounds that takes on meaning and purpose

2. Participation in everyday social aspects of language that enable an understanding of encoded cultural values and assumptions

3. Ability to self-reflect on the use of language and to see language as a “tool for thinking” and communicating thoughts, even when not actively speaking or interacting with others

(Wells 1981)
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*the acquisition of literacy* (Wells 1981)
What CS106B is not

- A course to teach you how to program from scratch
- A course that will teach you the specifics of the C++ language
What CS106B is

- A logical follow-up course to an introductory computer science class
- A course that will give you practice with computational thinking skills through basic C++ coding
- A survey of data structures and algorithms to prepare you for future exploration in computing and to build your understanding of technology
What is an abstraction?
What is an abstraction?

Breakout rooms!
**Definition**

**abstraction**
Design that hides the details of how something works while still allowing the user to access complex functionality.
Examples of abstraction
What is an abstraction?

- Another example: Programming languages are abstractions through which we communicate with computers.

- **Key idea**: Through a simpler interface, users are able to take full advantage of a complex system without needing to know how it works or how it was made.

- People are important part of defining abstractions and defining the boundary between usage and implementation (i.e. What should that simpler interface look like?)

- CS106B focuses on the design and/or use of abstractions in computer science.
Moving across the “abstraction boundary”

Your journey into learning abstractions will be like learning to cook.
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You start off by using other people’s recipes – tools that others have created to make it easy to prepare food and ensure you have sustenance.
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Some of these recipes (tools) are better than others, and you learn how to evaluate them and use them in ways that work best for you as you gain more practice.
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The abstraction boundary is the cookbook, with its recipes and cooking techniques.
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The abstraction boundary is the cookbook, with its recipes and cooking techniques.

You begin to learn more about the science of cooking – understanding how different flavors and ingredients work together, what certain cooking techniques do to various foods, and maybe even how to write some of your own recipes.
abstraction boundary
(what the abstraction looks like)

the user/client side
(how the abstraction is used)

the implementation side
(how the abstraction works)
What is CS106B?
(the nuts and bolts)
abstraction boundary
(what the abstraction looks like)

the user/client side
(how the abstraction is used)

the implementation side
(how the abstraction works)
classes
object-oriented programming

abstract data structures
(vectors, maps, etc.)

testing

algorithmic analysis

recursive problem-solving

arrays
dynamic memory management
linked data structures
abstract data structures (vectors, maps, etc.)

arrays
dynamic memory management
linked data structures

How to use abstractions created by others (Stanford C++ libraries)
How to write abstractions for others to use

- abstract data structures (vectors, maps, etc.)

- classes
  - object-oriented programming

- testing

- algorithmic analysis

- recursive problem-solving

- arrays
  - dynamic memory management
  - linked data structures
How lower-level abstractions are used to implement higher-level abstractions
abstract data structures
(vectors, maps, etc.)

classes
object-oriented programming

arrays
dynamic memory management
linked data structures

algorithmic analysis
recursive problem-solving
Roadmap

C++ basics

User/client

diagnostic

Core Tools

testing

Object-Oriented Programming

arrays

dynamic memory management

linked data structures

real-world algorithms

Life after CS106B!

recursive problem-solving

algorithmic analysis
Learning goals
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- I am excited to use programming to solve real-world problems I encounter outside class.
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- I can identify programmatic concepts present in everyday technologies because I understand how computers process and organize information.
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- I can break down complex problems into smaller subproblems by applying my algorithmic reasoning and recursive problem-solving skills.
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- I can evaluate design tradeoffs when creating data structures and algorithms or utilizing them to implement technological solutions.
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3. What makes for a “good” algorithm or data structure? Why?
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3. What makes for a “good” algorithm or data structure? Why?
Course norms
Course culture + norms

- Please put your mental health and wellbeing first this quarter.

- We’re here to learn - including your instructors!
Course culture + norms

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*What makes for good learning?*
Course culture + norms

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- We’re here to learn - including your instructors!

What makes for good learning?

1. Safe environment
   - Be kind and respectful to one another in breakout rooms, section, and Ed.
Course culture + norms

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What makes for good learning?

1. Safe environment
   ○ Be kind and respectful to one another in breakout rooms, section, and Ed.
2. Active engagement
   ○ Put your best foot forward in all parts of your learning process: lectures, assignments, etc.
Course culture + norms

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1. Safe environment
   - Be kind and respectful to one another in breakout rooms, section, and Ed.
2. Active engagement
   - Put your best foot forward in all parts of your learning process: lectures, assignments, etc.
3. Celebration of struggle
Zoom norms

- Avoid video fatigue – it’s okay to turn off your video during lecture.

- But if you can turn on video during breakout rooms and sections, please try to do so for engagement!

- You will be muted by default. If you have questions during lecture, type them into the chat or use the “Raise hand” function if you would like to speak.

- Use the chat only for asking questions and let course staff answer them.

(Your section leader will have separate norms for discussion sections.)
We can center questions around learning.

Thinking about your own learning (metacognition) is important!
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There are two (vastly oversimplified) types of questions:

1. Questions that will enable you to understand the rest of the topic/lecture.
2. Questions will expand your depth of knowledge but that your immediate understanding does not depend upon.
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   **Strategy**: Ask immediately by raising your hand (or putting it in the chat if you’re more comfortable with that). If you found something confusing, someone else probably did, too. And remember, celebrate struggle!
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2. Questions will expand your depth of knowledge but that your immediate understanding does not depend upon.

**Strategy:** Write down your question and ask when it’s clear we’re transitioning to a new topic. We’ll also often stop for questions then.
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**Strategy:** If you can answer the question yourself by writing a small piece of code to test your question, we encourage you to do that, too!
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1. Questions that will enable you to understand the rest of the topic/lecture.
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Think about how to use questions to maximize your concentration and learning!
We can center questions around inclusivity.

There is also a third type of question:

Some students ask questions that are not really questions so much as opportunities to demonstrate knowledge of jargon or facts that are beyond the scope of the topic at hand. This can have a discouraging effect on other students. If you find yourself wanting to make such a question or comment in lecture, I encourage you to consider office hours as a better venue for exploring that topic with me.

- Cynthia Lee, Stanford Senior Lecturer in CS
We can center questions around inclusivity.

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Curiosity is wonderful, and we’re happy to talk about advanced CS topics with you during office hours.

But we also don’t want to send the message that you need to know about these things when entering CS106B.

- In particular, we don’t expect students in this class to have prior C++ knowledge or knowledge of the topics that we explicitly introduce from scratch. So please keep this mind when you’re asking questions!
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Curiosity is wonderful, and we’re happy to talk about advanced CS topics with you during office hours.

But we also don’t want to send the message that you need to know about these things when entering CS106B.

If you do have prior experience in C++ or in the topics we’ll be covering, that’s great! It also benefits your learning to approach these concepts with a beginner’s mindset – you might notice and learn things that you didn’t before.
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It also benefits your learning to approach these concepts with a beginner’s mindset – you might notice and learn things that you didn’t before.

Consider if lecture or individual office hours is the right venue for your question.
Course logistics
Is CS106B the right course for me?

- Where are you in your CS literacy journey?

- **Take the CS106B C++ survey.** This will give you a sense of the core topics we expect you to be familiar with from prior programming experience.

- Read the **course placement guide** on the class website.

- You cannot enroll in both CS106A and CS106B simultaneously, but you are welcome to shop both to figure out which is a better fit.
  - **Note:** This is our first time with a (long) waitlist so please don’t wait to drop if you know you won’t be taking the class!
Welcome to the CS106B Ed Discussion Forum!

Hi everyone! Welcome to Ed Discussion, which is the platform that we will use for the core foundations of our online learning experience this quarter. This forum offers opportunities for students to ask questions about course content, discuss with course staff and other students, and participate in collaborative experiences during lecture and section. We're really excited to be able to use this platform this quarter, and we hope that you find Ed to be empowering and effective.

Getting Started
Here is the Quick Start Guide to using Ed Discussion. We strongly recommend reviewing this guide before you start exploring the website for yourself and getting familiar with all the different features that are offered.

Community Norms and Expectations
In order to cultivate the online experience for all students here, we have a few guidelines that we want to establish as community expectations for using Ed:

1. Always be respectful and kind to other students and members of staff that you are engaging with on Ed. We will not tolerate any insensitive posts or comments on the platform.
2. Stay up to date with announcements and other content posted to have email notifications enabled for Ed. We will be making all important announcements after the first day of class using this platform. We recommend checking Ed on a daily basis to look for newly posted content.
3. Read through prior posts on Ed before asking a question. This means using the “Search” feature to look through previously answered questions to see if you have already been an answer to the question you have. As you start to ask Ed will also start suggesting other posts for you to look at depending on...
How many units?
start here

Are you an undergrad/high school/SCPD student?  

- Yes  
  5 units

- No  
  Do you want to take CS106B for fewer units?  
  
  - Yes  
    3 units - or - 4 units
  
  - No
Why should I come to lecture?
Lecture pedagogy

- Not just us talking at you: active learning exercises
- Quick lecture-to-usage turnaround for concepts covered in class
- We’ll stick around to answer questions afterward!
- Please note that this is a 60-minute long class.
How will I be assessed?
What we will ask you to do

- Programming: 60.0%
- Final project: 20.0%
- Mid-quarter diagnostic: 10.0%
- Section: 10.0%
What we will ask you to do

- Section: 10.0%
- Mid-quarter diagnostic: 10.0%
- Final project: 20.0%
- Programming: 60.0%
Programming assignments

- There will be 7 total
  - A1: C++ Legs
  - A2: Using abstractions (abstract data structures)
  - A3: Recursion
  - A4: Backtracking recursion
  - A5: Defining the abstraction boundary itself
  - A6: Implementation-side of the abstraction boundary
  - A7: Real-world algorithms
Programming assignments

- There will be 7 total
- Graded on **functionality** and **style** using buckets

✓ Meets requirements, possibly with a few small problems
Programming assignments

● There will be 7 total
● Graded on **functionality** and **style** using buckets

✓+ Satisfies all requirements for the assignment
✓ Meets requirements, possibly with a few small problems
✓- Has problems serious enough to fall short of requirements
Programming assignments

- There will be 7 total
- Graded on **functionality** and **style** using buckets

  - ++ Absolutely fantastic submission (extremely rare)
  - + "Perfect" or exceeds our standard expectations
  - ✓+ Satisfies all requirements for the assignment
  - ✓ Meets requirements, possibly with a few small problems
  - ✓- Has problems serious enough to fall short of requirements
  - - Extremely serious problems, but shows some effort
  - -- Shows little effort and does not represent passing work
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  -- Shows little effort and does not represent passing work
Programming assignments

● There will be 7 total
● Graded on functionality and style using buckets
● You can submit revisions if you receive below a check
  ○ Must be turned in up to three days after the next assignment is due.
  ○ We want to give you opportunities to demonstrate learning!
  ○ The revisions must include the updated code, tests to catch previous errors, and must not introduce new errors.
  ○ Grade capped at a check.
Programming assignments

- There will be 7 total
- Graded on functionality and style using buckets
- You can submit revisions if you receive below a check
- 24- or 48-hour grace period for each assignment (specified per-assignment)
  - Most people will submit by the deadline. (“on-time” bonus)
  - The grace period is a free 24- or 48-hour extension that you can use if you have a particularly difficult week.
Programming assignments

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- Graded on functionality and style using buckets
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Programming assignments

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All deadlines are at 11:59pm PDT (including for revisions).
What we will ask you to do

- Programming: 60.0%
- Final project: 20.0%
- Mid-quarter diagnostic: 10.0%
- Section: 10.0%
Assessments

- Mid-quarter diagnostic
- Final project
Assessments

● Mid-quarter diagnostic
  ○ Opportunity to evaluate your understanding of the core, fundamental topics from the first 4 weeks of the course
  ○ Designed to take 1.5 hours; completely open notes
  ○ Available to complete over a 47-hour time span from July 21-23 (between Wednesday and Friday lecture)
  ○ We’ll provide software for you to take the diagnostic on your computer – once you open it, you’ll have 3 hours to complete it

● Final project
Assessments

● Mid-quarter diagnostic

● Final project
  ○ Choose a topic area that you’re interested in and that you would like to improve in
  ○ Write your own section/diagnostic problem + solution
  ○ Present the problem to your section leader at the end of the quarter
  ○ More guidelines will be released on July 26 after the diagnostic
What we will ask you to do

- Section: 10.0%
- Mid-quarter diagnostic: 10.0%
- Final project: 20.0%
- Programming: 60.0%
Section

- Sign up by **Sunday at 5pm PDT** at [cs198.stanford.edu](http://cs198.stanford.edu)
  - Sign-ups will open on Thursday, June 24 at 5pm PDT
  - Sections with remaining spots will open for signups after Tuesday, June 29 at 9am PDT
Section

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- Sections start next Wednesday!
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How do I get help?
Section Leaders
What the course staff do

- Clarify conceptual material
- Help you develop good debugging practices
- Answer any administrative questions
- Chat about CS and life in general!
What the course staff do

- Clarify conceptual material
- Help you develop good debugging practices
- Answer any administrative questions
- Chat about CS and life in general!

We’re always happy to help you apply CS and the concepts you’ve learned in class to real-world applications/areas you’re interested in.
What the course staff **don’t** do

- Write your code for you
- Solve your bugs on assignments
What the course staff don’t do

- Write your code for you
- Solve your bugs on assignments

This is how you learn as a student!
Resources for getting help

● LaIR (general office hours)
  ○ Open Monday through Thursday
    ■ Monday/Wednesday: 7pm-9pm PDT
    ■ Tuesday/Thursday: 5pm-7pm PDT
  ○ Starts Monday, June 28

● Your section leader
● Kylie’s + Nick’s office hours
● Ed
Resources for getting help

- LalR (general office hours)
- Your section leader
- Kylie’s + Nick’s office hours
  - Group office hours
  - Individual office hours - please only sign up for one 15-min slot!
- Ed
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

Conceptual question?
Resources for getting help

- (C)LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

Conceptual question?
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

Debugging help + code questions?
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

Administrative questions?
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

General CS + life questions?
Resources for getting help

- LaIR
- Your section leader
- Kylie/Nick office hours
- Ed

When in doubt, check the Course Communication guidelines!
Honor Code
Stanford’s Honor Code

- All students in the course must abide by the Stanford Honor Code.
- Make sure to read over the Honor Code handout on the CS106B website for CS-specific expectations.
- Acknowledge any help you get outside course staff directly in your work.
- We run code similarity software on all of your programs and check final projects against online resources.
- Anyone caught violating the Honor Code will automatically fail the course.
Why C++?
How is C++ different from other languages?

- C++ is a compiled language (vs. interpreted)
  - This means that before running a C++ program, you must first compile it to machine code.
How is C++ different from other languages?

- C++ is a compiled language (vs. interpreted)

- C++ gives us access to lower-level computing resources (e.g. more direct control over computer memory)
  - This makes it a great tool for better understanding abstractions!
How is C++ different from other languages?

- C++ is a compiled language (vs. interpreted)
- C++ gives us access to lower-level computing resources (e.g. more direct control over computer memory)
- If you’re coming from a language like Python, the syntax will take some getting used to.
  - Like learning the grammar and rules of a new language, typos are expected. But don’t let this get in the way of working toward literacy!
Demo program!
The structure of a program

```cpp
#include <iostream>
#include "console.h"

using namespace std;

// The C++ compiler will look for a function
// called “main”
int main() {
    cout << "Hello, world!" << endl;
    return 0; // must return an int to indicate
    // successful program completion
}
```

```python
import sys

# This function does not need to be called “main”
def main():
    print('Hello, world!')

if __name__ == '__main__':
    # Any function that gets placed here will get
    # called when you run the program with
    # `python3 helloworld.py`
    main()
```

C++           Python
What’s next?
Applications of abstractions
Reminders

- Complete the [C++ survey](#).

- Fill out your section time preferences by Sunday at 5pm PDT.
  - Make sure to check what time you’ve been assigned on the morning of Wednesday, June 30.

- Finish [Assignment 0](#) by Friday.
  - If you’re running into issues with Qt Creator, come to the Qt Installation Help Session Thursday from 5-7pm PDT.
Roadmap

C++ basics

User/client

vectors + grids

stacks + queues

sets + maps

Object-Oriented Programming

arrays
dynamic memory management
linked data structures
real-world algorithms
recursive problem-solving
Life after CS106B!

Diagnostic

Implementation

Core Tools

testing

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We’re excited to move across the abstraction boundary together!