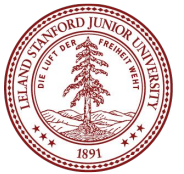
Welcome to CS106B: Programming Abstractions!

Where in the world are you right now?

(put your answers the chat)



Today's questions

Why take CS106B?

What is an abstraction?

What is CS106B?

Why C++?

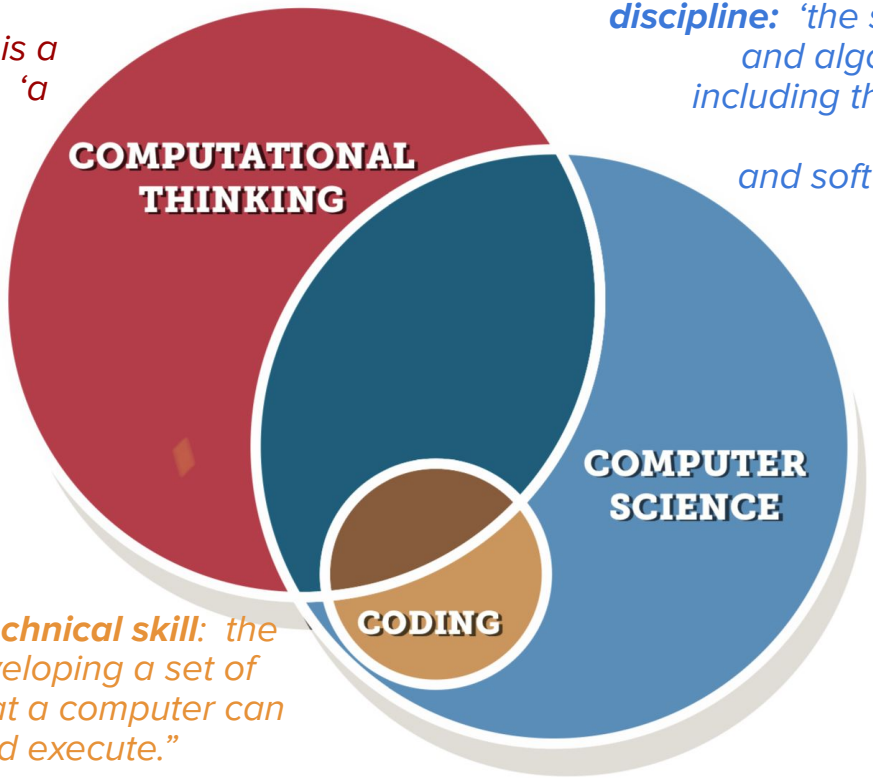
What's next?

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'"*

*"**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'"*

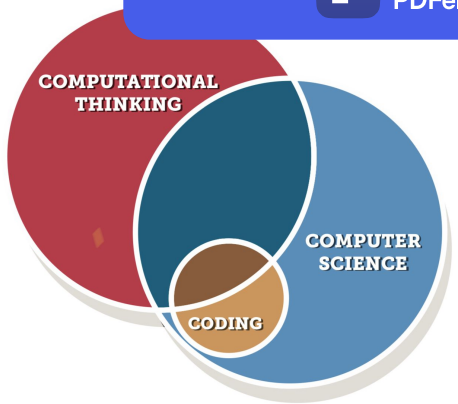


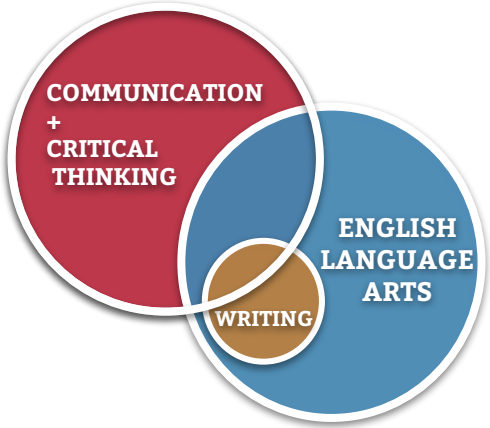
*"**Coding** is a **technical skill**: the practice of developing a set of instructions that a computer can understand and execute."*

(Digital Promise 2017)
(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)

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?

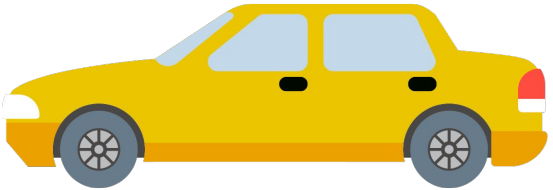
Breakout rooms!

Definition

abstraction

Design that hides the details of how something works while still allowing the user to access (访问) complex functionality (功能)

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.

实现

Moving across the “abstraction boundary”

Your journey into learning abstractions will be like learning to cook.

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.

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.

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)

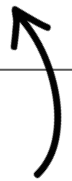
the user/client side
(how the abstraction is used)

the implementation side
(how the abstraction works)

classes

object-oriented programming

abstract data structures
(vectors, maps, etc.)



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

arrays

dynamic memory management

linked data structures

testing *algorithmic analysis* *recursive problem-solving*

classes

object-oriented programming

How to write abstractions for others to use

abstract data structures
(vectors, maps, etc.)

arrays

dynamic memory management

linked data structures

testing

algorithmic analysis

recursive problem-solving

classes

object-oriented programming

abstract data structures
(vectors, maps, etc.)

arrays

dynamic memory
management

linked data structures

How lower-level abstractions are used to implement higher-level abstractions

testing *algorithmic analysis* *recursive problem-solving*

classes

object-oriented programming

abstract data structures
(vectors, maps, etc.)

arrays

dynamic memory
management

linked data structures

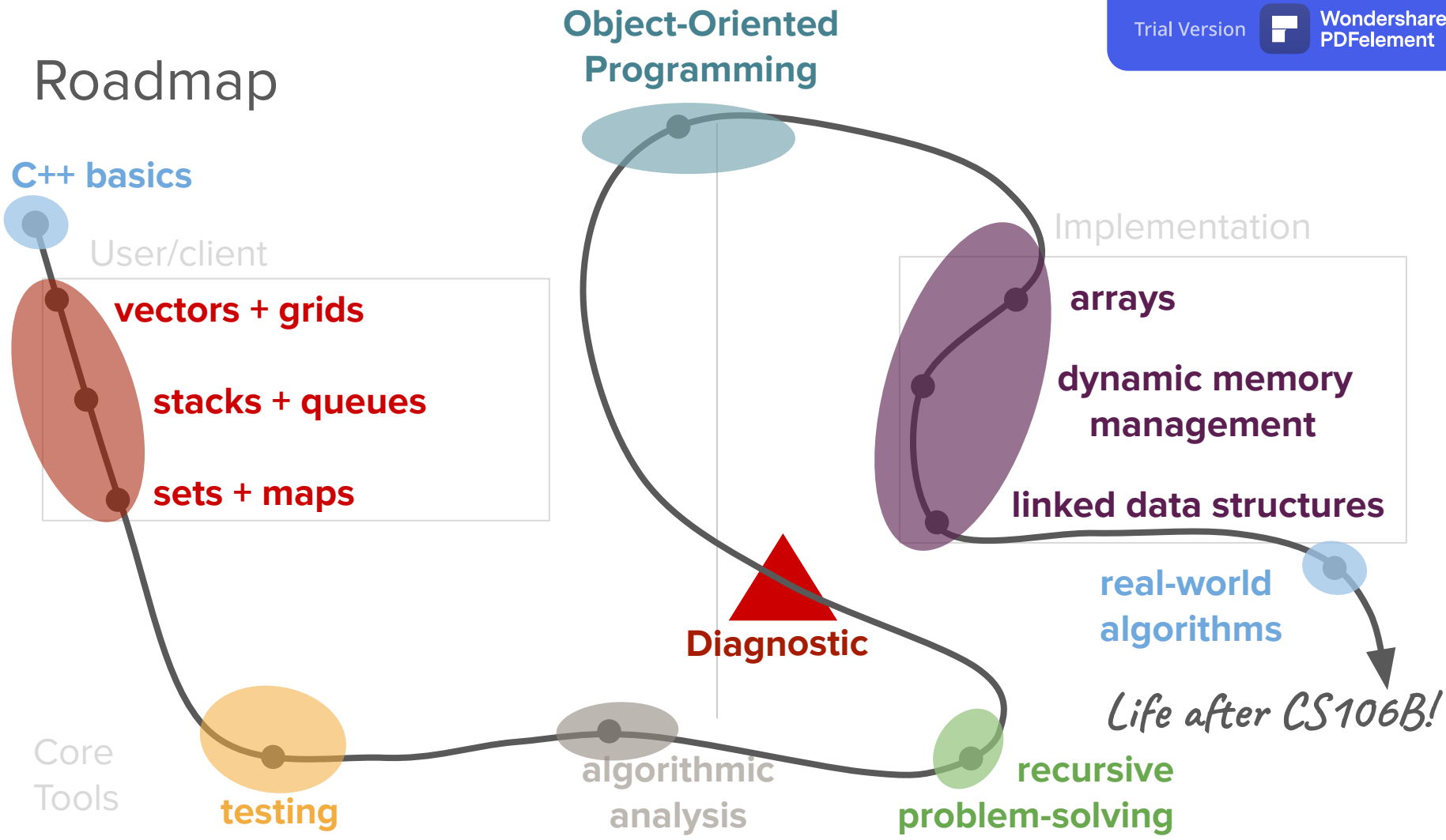
Core Tools

testing

algorithmic analysis

recursive problem-solving

Roadmap



Learning goals

Learning goals

- I am excited to use programming to solve real-world problems I encounter outside class.
- I recognize and understand common abstractions in computer science.
- I can identify programmatic concepts present (存在) in everyday technologies because I understand how computers process and organize information.
- I can break down complex problems into smaller subproblems by applying my algorithmic (算法推理) reasoning and recursive (递归) problem-solving skills.
- I can evaluate design tradeoffs when creating data structures and algorithms or utilizing them to implement technological solutions.

Overarching questions

Overarching questions

1. What is possible with technology and code? What isn't possible?

2. How can I use programming to solve problems that I otherwise would not be able to?

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!

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.
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 answering questions and asking questions.

  (Your section leader will have separate norms for discussion sections.)

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.

CS106B COURSE LECTURES ASSIGNMENTS SECTION ASSESSMENTS SCHEDULE

CS106B Programming Abstractions

Summer 2020, Lectures: MTWTh 11:30am-12:20pm (Pacific Daylight Time, GMT-7)

TEACHING TEAM

Lecturer: Nick Bowman
nbowman@stanford.edu

Lecturer: Kylie Jue
kyliej@stanford.edu

Head TA: Trip Master
tmaster@stanford.edu

ANNOUNCEMENTS

Welcome to CS106B!

3 days ago by Nick and Kylie

Earlier today, we sent out an email announcement to everyone in the class, welcoming them to CS106B. If you did not receive this email but were expecting to, please confirm your enrollment status on Axess. We have replicated a summary of some of the action items of the email announcement here. Please make sure to work through this list of to-do items before the first day of class:

- Black Lives Matter in CS106B. The course teaching staff is committed to cultivating an equitable and socially-conscious learning environment this summer. Please take the time to read our full statement of solidarity and familiarize yourself with the variety of resources presented there.
- Read the course syllabus.
- Join the CS106B Ed Discussion Forum. This is where we'll post weekly announcements and important updates for the course. Additionally, you will be able to use this forum to ask questions and have discussions with course staff and your fellow students.
- Read the guide linked in this form and fill out the associated questions so we can find out what you're interested in reviewing about core programming concepts in C++.
- Get started on Assignment 0! Due on Wednesday, June 24, this assignment will help us get to know you and will introduce you to some of the tools we'll be using in the course.
- Discussion sections are an important part of CS106B, and section sign-ups will open on Sunday. You'll be able to rank section time preferences on the CS198 website from Sunday at 5pm until Tuesday at 5pm. Section assignments will be made and announced by Wednesday morning, so keep an eye out for an email from the CS198 coordinators then.
- Our first class will be on Monday, June 22 from 11:30am-12:20pm. Go to Canvas to find the Zoom info.
- Keep an eye on the course website (where you are at right now), our central hub for lectures, assignments, and other resources.

Computer science is a tool that allows us to make constructive and powerful contributions to the world, and we hope to help unlock those opportunities for you through this course. Please don't hesitate to reach out to us if

QUICK LINKS

Statement of Solidarity with
Course Communication
Office Hours
LaIR Signup
Paperless
Zoom Details
Ed Discussion Forum
Qt Creator
Common Build/Run Issue
Python-to-C++ Guide
Blank Qt Project
C++ Standard Library Doc
Stanford Library Docume
CS106B Style Guide
CS106B Testing Guide
Submission Checklist

cs106b.stanford.edu

ed CS106B – Discussion

New Thread

Search

Filter

COURSES

CS106B
CS 106B 1449
CS 298 1
Code in Place 7182
Code in Place Small Group 1 8
41 more

CATEGORIES

General
Lectures
Sections
Assignments
Diagnostic
Final Project
Announcements

Pinned

Welcome to the CS106B Ed Discussion Forum!
Announcements Nick Bowman INSTRUCTOR 3d 2 12

Last Week

Code input for non-English speakers
General Anonymous 4h 1

Qt Setup Being Really Slow
Assignments – Assign 0 Shirley Li 10h 6

Unable to Access Google Form
Assignments – Assign 0 Michael Hu 16h 2

Mystery number rejected by Google form
Assignments – Assign 0 Richie Ling 1d 2

sample-project Build Error
General Anonymous 1d 3

Debugger not working
Assignments – Assign 0 Runze Yu 1d 7

CS106B without CS106A
General Arul Saxena 1d 2

CLion as a C++ IDE
General Dima Timofeev 1d 1

Nick Bowman INSTRUCTOR
3 days ago in Announcements

UNPIN STAR

12

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

Getting Started

Here is the Quick Start Guide to using Ed Discussion. We strongly recomm
this guide before you start exploring the website for yourself and getting
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
guidelines that we want to establish as community expectations for using

1. **Always be respectful and kind to other students and members staff that you are engaging with on Ed.** We will not tolerate inapp 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 imp announcements after the first day of class using this platform. We a recommend checking Ed on a daily basis to look for newly posted co announcements.
3. **Read through prior posts on Ed *before* asking a question.** This m "Search" feature to look through previously answered questions to have already been an answer to the question you have. As you start Ed will also start suggesting other posts for you to look at depending

https://us.edstem.org/

How many units?

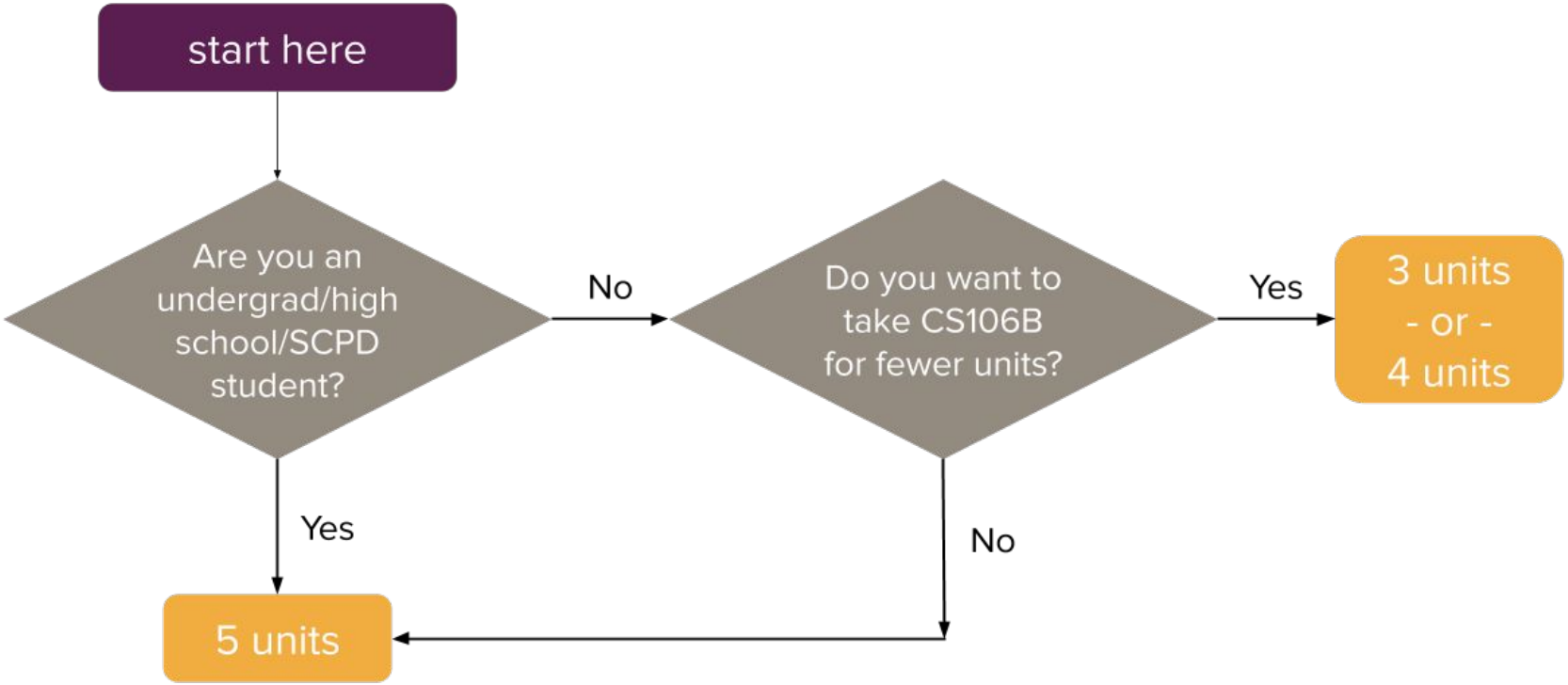


Diagram courtesy of Chris Piech

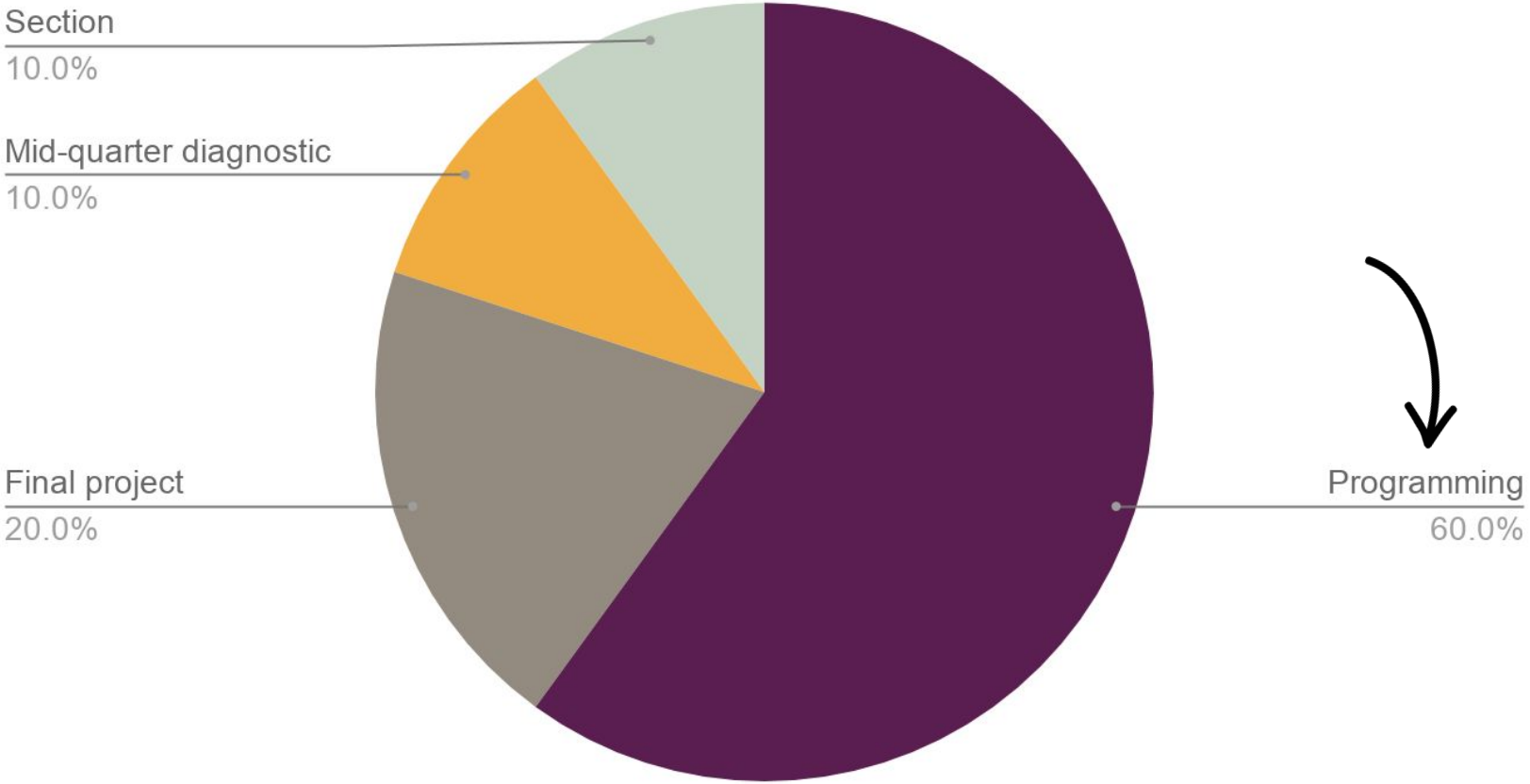
Why should I come to lecture?

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!

How will I be assessed?

What we will ask you to do



Programming assignments

- There will be 6 total
  - A1: C++ Legs
  - A2: Using abstractions (abstract data structures)
  - A3: Recursion
  - A4: Defining the abstraction boundary itself
  - A5: Implementation-side of the abstraction boundary
  - A6: Real-world algorithms

Programming assignments

- There will be 6 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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-	Extremely serious problems, but shows some effort
--	Shows little effort and does not represent passing work

Programming assignments

- There will be 6 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

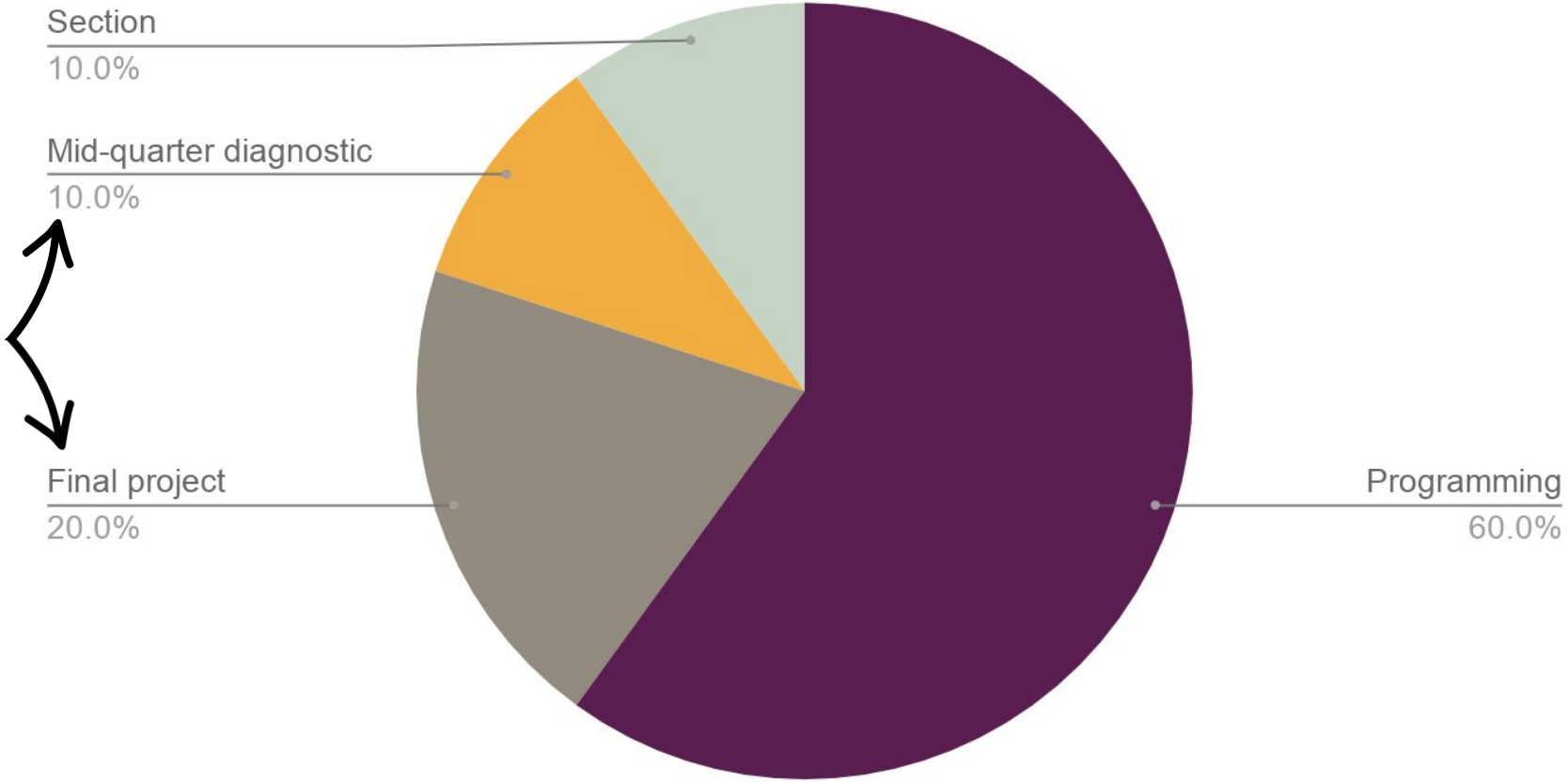
- There will be 6 total
- Graded on functionality and style using buckets
- You can submit revisions if you receive below a check
- 24-hour grace period for each assignment
  - Most people will submit by the deadline. (“on-time” bonus)
  - The grace period is a free 24-hour extension that you can use if you have a particularly difficult week.

Programming assignments

- There will be 6 total
- Graded on functionality and style using buckets
- You can submit revisions if you receive below a check
- 24-hour grace period for each assignment

All deadlines are at **11:59pm in your local time zone** (including for revisions).

What we will ask you to do



Assessments

- Mid-quarter diagnostic
- Final project

Assessments

- Mid-quarter diagnostic
  - Opportunity to **evaluate your understanding of the core, fundamental topics** from the first 3 weeks of the course
  - Designed to take 1.5 hours; completely open notes
  - Available to complete over a 72-hour time span from July 17-19
  - We'll provide software for you to take the exam on your computer – once you open the file, you'll have 3 hours to complete it
  - Post-exam feedback and self-reflection

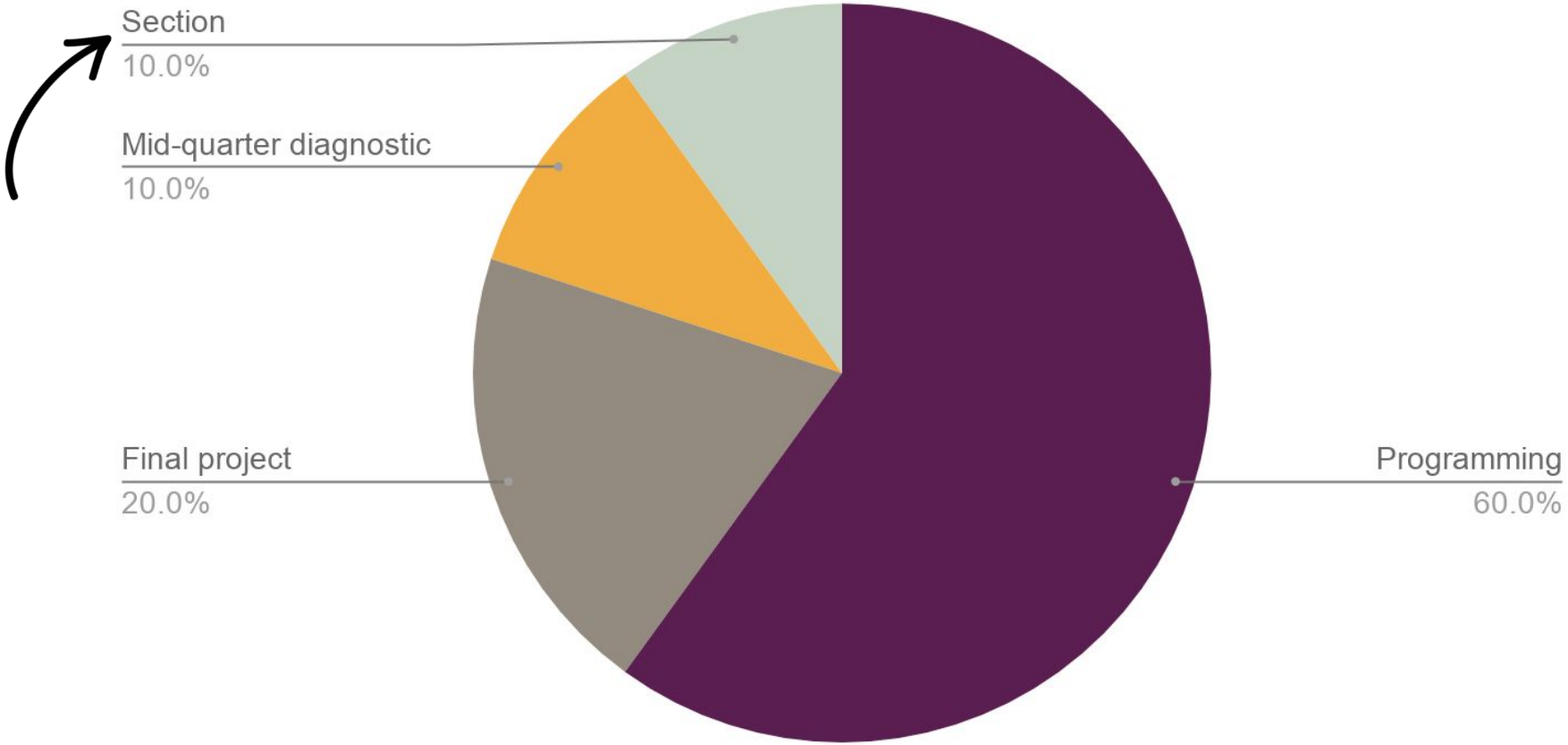
- Final project

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/exam problem + solution**
  - Present the problem to your section leader at the end of the quarter
  - More guidelines will be released on July 20 after the diagnostic

What we will ask you to do



Section

- Sign up by **Tuesday at 5pm PDT** at cs198.stanford.edu
  - Sections with remaining spots will open for signups after Wednesday at 9am PDT

Section

- Sign up by Tuesday at 5pm PDT at cs198.stanford.edu
- Sections start this Wednesday!

Section

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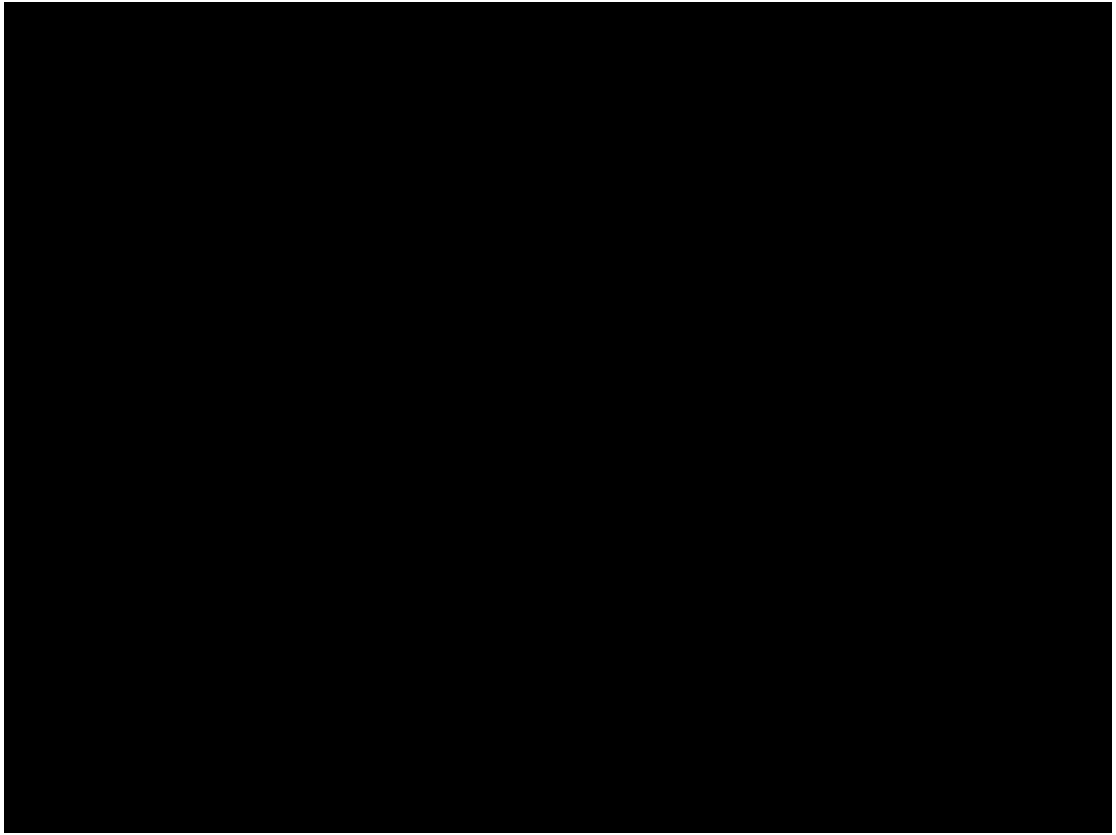
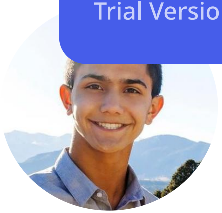
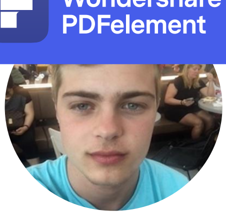
How do I get help?

Trip Master (Head TA)



















Section Leaders


Staff who can work with minors (under 18)

- Kylie and Nick
- Lauren Saue-Fletcher
- Eric Bear
- Jonathan Kula
- Garrick Fernandez
- Kara Eng
- Ricardo Iglesias
- Sidhika Balachandar
- Nicholas Negrete
- Jesse Doan
- Jillian Tang

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

This is how you learn as a student!

Resources for getting help

- LaIR (general office hours)
  - Open Sunday through Wednesday, 5pm-9pm
    - Check for minors vs. non-minors LaIR hours (alternate by day)
    - Morning LaIR once a week for each group
  - Starts this Tuesday evening
- Your section leader
- Trip's office hours (no minors)
- Kylie's + Nick's office hours
- Ed

Resources for getting help

- LaIR (general office hours)
- Your section leader
- Trip's office hours (no minors)
- 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

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

Conceptual question?

Resources for getting help

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

Debugging help + code questions?

Resources for getting help

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

Administrative questions?

Resources for getting help

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

General CS + life questions?

Resources for getting help

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

When in doubt, check the Course Communication guidelines!

The Summer Academic Resource Center (SARC) also offers tutoring and academic support separate from our course.

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 submissions.
- We run code similarity software on all of your programs.
- 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

- C++ is 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!

- 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 "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
}
```

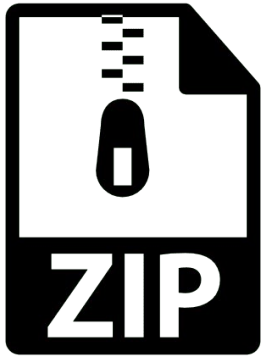
C++

```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()
```

Python

What’s next?

Applications of abstractions



Announcements

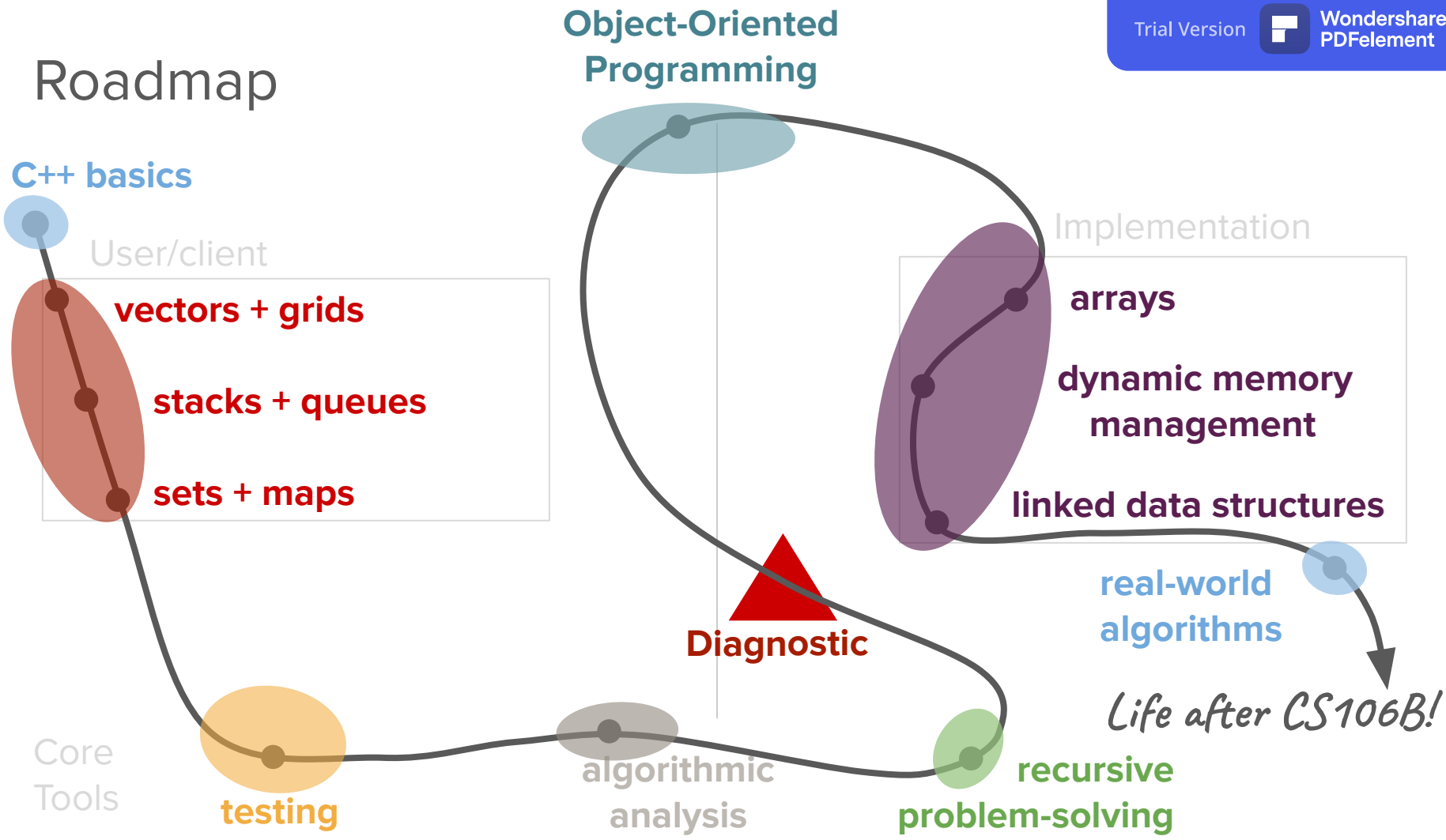
- Complete the C++ survey.

- Fill out your section time preferences by Tuesday at 5pm PDT.
  - Make sure to check what time you've been assigned on Wednesday morning.

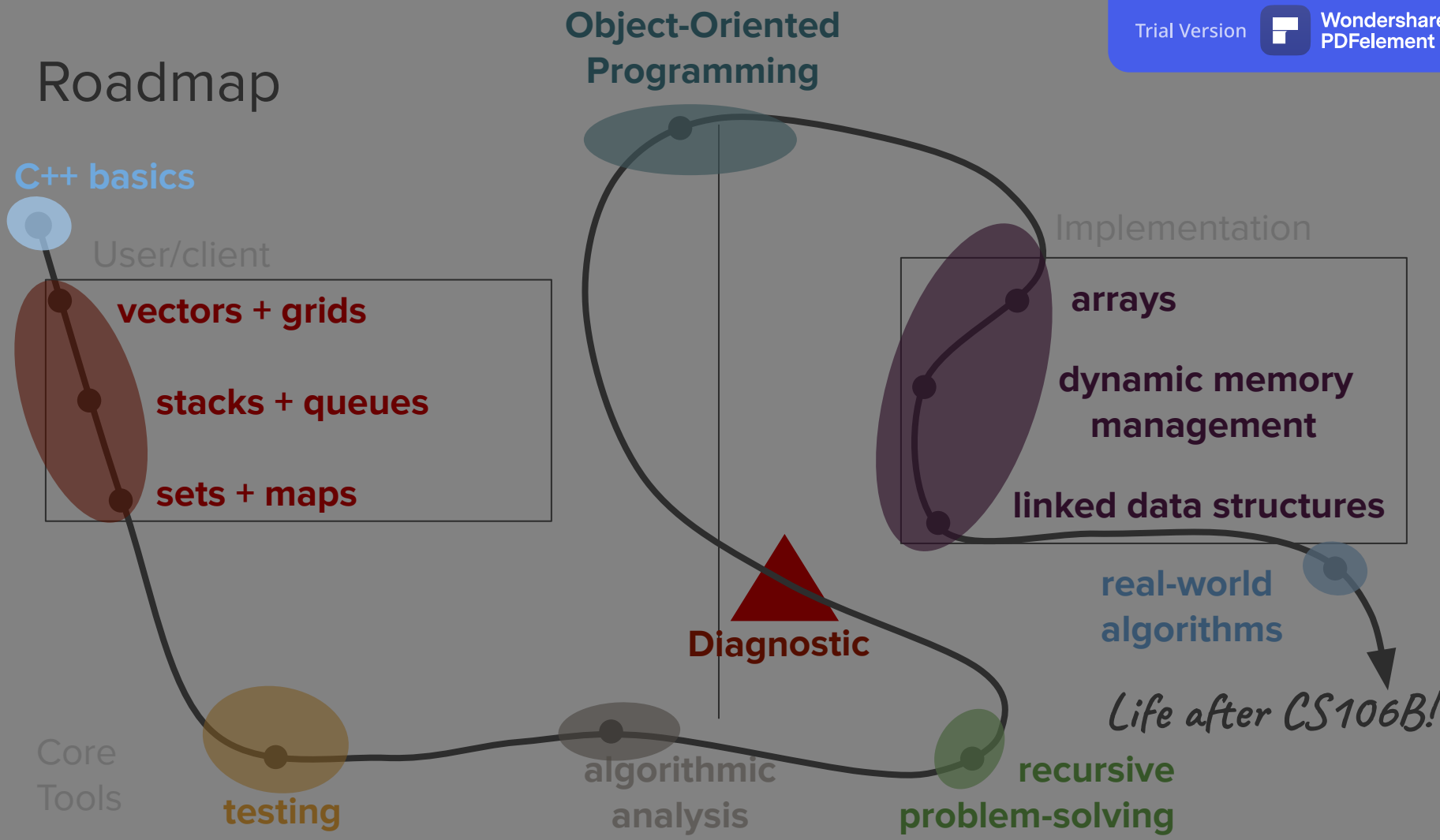
- Finish Assignment 0 by Wednesday.
  - If you're running into issues with Qt Creator, come to the Qt Installation Help Session tomorrow (Tuesday) at 7pm PDT.

- Assignment 1 will be released tomorrow!

Roadmap



Roadmap



Roadmap