CS106B: Programming Abstractions in C++
Course Information and Syllabus
Stanford University - Autumn 2019

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Course Website
Main site: https://cs106b.stanford.edu/
Q&A forum: https://piazza.com/stanford/fall2019/cs106b/home (self-register)

Course Overview
Students coming to CS106B are expected to have substantial prior experience with programming constructs such as loops, functions/methods, arrays, console and file I/O, standard data types (integer, string, and floating point), and classes. In other words, students coming to CS106B are expected to know how to write code. In this course, we transform you from someone who knows how to write some code into someone who can wield the power of the computer in a more expansive, versatile, and fluent way. This course adds powerful new tools to your skillset: managing complexity through abstraction, using recursion to crack big, tough problems by breaking them into smaller solvable problems, and applying analytical tools to evaluate the efficiency of different software design choices.

Units
Undergraduates must take the course for 5 units. Graduate and professional students may opt for 3-5 units. Course requirements and grading are the same regardless of number of units.

Who Should I Email/Contact?
- Miscellaneous basic policy questions such as “When is the midterm?” or “How many late days do I get?”: Re-read this course information document and the course website. Any additional questions post publicly on Piazza so other students can respond and/or benefit from staff response. (unless confidential)
- Help with assignments or course topics: Piazza or email SL.
- Assignment special circumstances/requests for additional late days: email our Head TA (first use all your existing late days, then only once they are exhausted email the TA).
- Anything very sensitive or confidential: email TA or Cynthia Lee.

Prerequisites
Substantial prior programming experience can take the form of strong performance in Stanford’s CS106A or a rigorous high school AP CS A course or equivalent. Students coming from AP CS Principles are encouraged to start with CS106A or CS106AX before moving on to CS106B. No extracurricular coding experience is necessary or expected, though students may be successful in 106B with that background and without having prior formal coursework. This course is taught in C++, but no prior exposure to C++ is expected. Languages such as
Java, Python, and JavaScript are all acceptable preparation for 106B. Students whose prior experience is in non-object-oriented languages (e.g., Matlab, Perl, C) may find that CS106A is a better starting point. Extensive further advice on choosing between CS106A, CS106AX, CS106B, CS106X, and selected other CS courses, is available from the CS106 course placement document: https://cs106b.stanford.edu/handouts/course-placement.pdf

**Instructor Office Hours**

I’m happy to talk to any student any time in office hours. Some uses of office hours include:

- Career or academic advising such as about research and other opportunities at Stanford and beyond, concerns about performance in the class, suggestions for how the class could be improved, etc.
- Homework help can be accessed through the nightly Section Leader “LAIR” office hours, and is also welcome in instructor and TA office hours. I generally handle homework questions in an open format where all students present are welcome to listen to each others’ questions and answers (since often students are encountering similar issues). So you are also welcome to come to office hours just to work and listen.
- If you come with a private matter, we will excuse ourselves from the group briefly and go to an adjacent quiet office.
- You don’t need a “reason” to come to office hours—I do like to meet as many of you as possible, so stopping by to introduce yourself is most welcome! I just ask that you plan on an introduction of no more than 5 minutes if other students are waiting.

**Topics**

The following is our *approximate* course topics schedule for the quarter (see website for more detail). The terms on this list might not entirely make sense to you until we begin to cover them, but I list them here so that those who might be candidates for skipping CS106B entirely, or for whom other classes might more directly address their educational goals, can make that determination:

- Week 1: Welcome to C++
- Week 2: Basic ADTs: Vector, Grid, Stack, Queue, Map, Set, Lexicon.
- Week 3-4: Recursion, advanced recursion, backtracking recursion
- Week 5: “Big O” mathematical performance analysis; Classes in C++
- Week 6: Pointers and dynamic memory allocation (new/delete); Linked lists
- Weeks 7-8: Basic ADTs revisited: how do we implement them behind the scenes? Linked lists, trees, Binary Search Trees, tries, hashing
- Week 9: Graphs, graph search algorithms
- Week 10: Special topics, quarter wrap-up

**Textbook**


The book was written by a Stanford CS professor targeted directly for this course. Also, exams in this course will be open-book, so it will be advantageous to own the book for use as a reference during exams. We will have copies of the book available at the front of the room during exams if you are unable to purchase/bring your own copy.
Class Environment

CS106B is fast-paced and challenging, by design. Students may notice a significant step up in complexity of the programming assignments and amount of individual design and planning required. These challenges exist because we want to effect the greatest possible increase in your skills and performance as a programmer in the short 10 weeks that we have together. To make that happen for everyone, I strive to create an inclusive and equitable classroom. I further depend on you to help each other obtain excellence rather than mistaking Stanford or this class for a zero-sum game. Please do your part by seeking to promote the success of others, and by treating each other in ways that respect and celebrate the diversity of talent that is drawn to our exciting field of computer science.

Here are a few specific things you should know about my policies on creating an inclusive and equitable class:

- **Preparation:** Perhaps more than many other subjects, students come to computer science with greatly varying previous exposure to programming and computer science. I want to assure students whose first real experience with programming was in CS106A that you are well prepared to succeed in CS106B, and in the major and in a career. The same was true of many of the students who are now your section leaders!

- **Classroom environment:** For some reason, it seems unusually common in computer science classes that 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 who are not familiar with those terms and worry that this indicates that they are less prepared to do well in the class (note: this is rarely the case—knowing jargon outside the scope of the course is not a good predictor of success/failure). If you find yourself wanting to make such a question or comment in lecture, I encourage you to consider whether office hours would be a better venue for exploring that topic with me. I LOVE discussing things that are tangentially related to our class in office hours.

- **Name and pronouns:** I want you to be you in our class. You are always welcome to write your preferred name on all class assignments and exams. If you have a name and/or pronoun that doesn’t match what our class roster gets from the registrar’s office, please let me know and I will ensure we use that in our class.

- **Feedback:** Please do not hesitate to reach out to me, anonymously if you prefer, if any aspect of our course or class community can be improved.

Class Expenses

All students should retain receipts for books and other course-related expenses, as these may be qualified educational expenses for tax purposes. If you are an undergraduate receiving financial aid, you may be eligible for additional financial aid for required books and course materials if these expenses exceed the aid amount in your award letter. For more information, review your award letter or visit the Student Budget website: [https://financialaid.stanford.edu/undergrad/budget/index.html](https://financialaid.stanford.edu/undergrad/budget/index.html).

Office of Accessible Education Accommodations

If you have an OAE letter, please present it to me and/or the Head TA (by email) at your earliest convenience, so I can ensure that the course materials and staff support comply with your needs. I am always willing to do what it takes to support you, but I ask that if you have exam scheduling needs that you get your letter to us no later than 7 days prior to the exam, because I must respect our room scheduling staff person’s time to make those arrangements.
Grades
Your overall course grade will be determined by the following percentage breakdown:

- 5%  section participation
- 20%  midterm exam
- 30%  final exam
- 45%  homework assignments

Grades will be assigned no stricter than the usual scale of 90% = A- or better, 80% = B- or better, etc. A more generous curve may be adopted at the instructor’s discretion, depending on exam difficulty or other factors. The grade of A+ is rare and given at instructor discretion.

Section Participation
You must sign up for a weekly 50-minute section, held on various times/places on Wed-Fri. The section signup process will begin at the end of the first week of the quarter on the section leading website (http://cs198.stanford.edu). After the signup period, a matching process is undertaken by the course staff, and your section assignments will be e-mailed out to you. Sections begin the second week of classes. Note that we don't look at Axess section enrollment when assigning sections. If you miss the section signup period, there will be a second round chance for you to enroll in a section, but you will be limited to sections that are not full; if this happens to you, just wait and watch the section leading website (http://cs198.stanford.edu) for the second round to open.

Your section leader (“SL”) will grade your homework and provide individual guidance to you throughout the quarter. In section, your SL discuss sample problems in more detail than we can in lecture. Part of your course grade comes from participating in your section and interactive grading sessions.

Lecture Participation
There will be frequent opportunities for participation during lecture: solving problems, responding with mobile app, and group discussion. Lecture attendance is not required, but everyone present on a given day is expected to sit in groups of about three students and contribute to their group’s discussions. This class operates more like a conversation than other college classes you may be used to. Discussion questions with mobile app votes are used to help me gauge class understanding in real time (rather than waiting until the midterm) and tailor the class to your needs.

Exams
There are no discretionary alternate exams. Family vacations, internships, job interviews, etc., are not allowable reasons to miss an exam. Please note that University policy prohibits students from enrolling in courses with conflicting final exams, so we do not give alternates for conflicting final exams (only conflicting midterm exams, because those are scheduled out of class time). If you must miss a midterm exam due to an unavoidable academic schedule conflict (an exam in another class at the same time), you must request an exception immediately via a web form (link to be emailed in week 1). After you fill out the form, you will be notified whether your request will be granted or not.

106B exams are open-book (the official course textbook), but closed-notes/handouts except one page of notes. I know textbooks are expensive and that some students choose not to purchase one, so a few copies will be available for loan during the exam. A reference page will be included in the exam itself, containing commonly needed information (for example, documentation on the Stanford C++ library classes). The purpose of my open-book, closed-notes policy is to reduce the need for rote memorization of anything (this is a problem-solving course, not a memorization course), but still standardize the playing field in terms of precisely what information students have with them.
Homework Assignments

Homework consists of programming assignments done on an individual or pair basis. Programs will be graded on both functionality and style. Rather than a direct point-based scoring system, a check-plus, check, check-minus grading system is used. Dividing the grades into these general categories means that your section leader can spend more of the interactive grading (“IG”) time talking about what you need to learn from the assignment without being bogged down in accounting for minor point deductions. For each assignment, you must make an appointment for an IG session with your section leader. Your section leader will explain in section how to schedule these sessions and go over the grading process and standards in more detail.

From past experience, most grades will be ✓ or ✓+. The meanings of the grades are as follows, with approximate letter grade equivalents:

- 0  Zero: No credit. Typically this is only given if you do not submit any work on the assignment. (F grade)
- ––  Minus-Minus: Has extremely serious issues; shows almost no understanding. (D or F grade)
- –  Minus: Has serious issues and does not demonstrate significant understanding. (C or D grade)
- ✓–  Check-Minus: Has problems serious enough to fall short of the expectations/requirements for the assignment. (B- grade)
- ✓  Check: Meets the requirements for the assignment, with a few small problems or areas of improvement. (B or B+ grade)
- ✓+  Check-Plus: Satisfies all the requirements for the assignment, showing very solid functionality as well as good style. It reflects a job well done, so this is generally the score to aim for. (A- or A grade)
- +, ++  Plus, Plus-Plus: Excellent; significantly exceeds our expectations for the assignment. To receive these grades, a program often reflects additional work beyond the requirements and/or solves the problem in a particularly elegant way. A mark of + or ++ will be given out only on rare occasions and should not be considered a standard goal for each assignment you submit. It is more of a way of congratulating the rare submission that goes above and beyond. (A+ grade)

An assignment’s style score may be capped at a given maximum if its functionality score is particularly low.

Working in Pairs

Some of the assignments must be completed on an individual basis, but the majority of them allow you to optionally work in a pair with a partner. Working in pairs can improve student learning by giving you someone to talk to when you are stuck, or by letting you see a different way of approaching the same problem.

If you choose to work with a partner, you must pair with another student who is currently taking the course and in your section. If you have a friend you want to work with, request the same section or request a section swap if necessary. Students working in a pair must be taking the course for the same grading basis. That is, a student taking the course Credit / No Credit may not pair with one taking it for a letter grade. Students auditing or sitting in on the course may not work in a pair with a student who is taking the course. No person who is not enrolled in the course may be part of any pair.

If you submit as a pair, each of you are expected to make a significant contribution toward solving that assignment. You should not claim to be part of a pair submission if you did not contribute significantly to help solve that program. Regardless of pairs, every student is still responsible for learning all course material. Of course, all exams are completed individually.

Many details about working in pairs are answered in a FAQ linked to from the class web site assignments page. Please read that pair FAQ page and make sure that you follow its guidelines.
Assignment Submission and Lateness
Submit your assignments electronically through a link provided on the course web site. Each student begins the course with 3 "late days" for use on homework assignments. Late days are intended to be used for emergencies that would typically warrant official exceptions granted by the university and/or the instructor: disability, illness, accidents, family emergencies, and the like. Please use care in deciding when to use your late days, because students who have consumed late days for reasons other than dire emergency will not be granted additional late days, even in cases of dire emergency.

To use a late day, simply turn in the assignment as usual (do not email anyone).

A late day allows you to submit a program up to one lecture day later without penalty. For example, if a program is due on Monday at 1pm, using one late day allows you to submit by Wednesday at 1pm without penalty. If a program is due on Friday at 1pm, using a late day allows you to submit it on Monday at 1pm without penalty. You may use up to 2 late days on any given assignment; you may not use all 3 on the same program. Any fraction of a late day counts as one day. For example, if a program is due on Monday at 1pm, turning in the assignment at 5pm will consume an entire late day. If you turn in an assignment late and do not have any more late days, you will lose one bucket grade per lecture day. In no case may any assignment be turned in more than 2 lecture days late. This is to allow timely grading.

No late days allowed on the last assignment.

Drop-In and Online Homework Help
The department operates a student drop-in CS106 help service in the food court area on the ground floor of Tressider Union (by Decadence, Subway, Starbucks, etc.). Section leaders will be available to help students with homework problems. Please refer to the https://cs198.stanford.edu website for the most current schedule information.

Students are also invited to post questions (but no source code) to the Piazza web discussion board for our class.

SCPD
Our class is being recorded for SCPD this quarter. SCPD is a distance learning program for working professionals. Of course, on campus students are also welcome to use the videos as a resource. A link to the videos will be posted on the lectures schedule page of the course website. SCPD students have a few special policy arrangements that apply only to them, as follows:

- **Section:** SCPD students are placed in a special SCPD section that takes place by video. Like other students, SCPD students should go to the cs198.stanford.edu website to register for a section during the section enrollment period that begins at the end of Week 1, but **at the cs198 website be sure to select the link for SCPD section sign-up.** Because weekly attendance at section and in-person participation in IGs is not possible, SCPD students are exempt from the 5% of the course grade for section participation (grade on remaining portion will be projected onto that 5%).

- **Exams:** SCPD students are required to have a designated proctor arrangement that has been vetted with the SCPD office. You should try to take exams with your proctor during the same time (in Pacific Time) as our actual exam if possible. Understanding that some SCPD students may be located in different time zones, special handling instructions for this circumstance will be emailed to you (watch for it by the end of the first week of class).

- **Homework partners:** As explained above, some assignments allow partner work. The same rules apply to SCPD students as all other students, that is, SCPD students may choose to work with a partner from the same section. Because all SCPD students are enrolled in an SCPD section, in practice this means your partner must be another SCPD student. To identify a partner, you may use the Piazza partner finding tool.

- **Office hours:** There will be weekly Google hangouts-based office hours TBA (for SCPD students only).