

CS 324 Programming Languages Design and Implementation

Spring 2025

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Office hours: *Tuesday, 11:00-noon;*

Wednesday, 2:00-3:30;

Thursday, 3:30-4:30; and by appointment

Email Address: LKing@holycross.edu

Meeting times: 12:30 p.m. - 1:45 p.m. TR

Text: Concepts of Programming Languages, 10th, 11th, or 12th Ed., by Robert W. Sebesta

Initial Course Information: You may have the notion this course is about the different languages used to program a computer, and that you will learn to program in a variety of new languages. That point of view comes from the common abbreviation of the course name: *programming languages*. This course, however, is about the *design* and *implementation* of programming languages in general. You will learn about the styles and features of programming languages that encourage and discourage the writing of good software, and you will learn how these features are implemented. As a side effect, you will also learn about specific languages. Big questions we will answer are: *How do we formally describe language syntax? How do we create translators for languages? How do we describe semantics? What features must be included? Usually included? Interesting to include? How are programs as processes implemented in memory?*

Catalog Description: Principles for designing and implementing programming languages are presented as well as styles and features that encourage and discourage the writing of good software. Specific topics include language syntax and semantics, comparison of language features and their implementation, methods of processing a program, establishing the run-time environment of the program and the major programming language paradigms (the imperative/procedural, functional/applicative, declarative/logic and object-oriented paradigms).

Honor Code: Unless otherwise explicitly stated by the instructor, it is expected that the work you turn in is your own. Do not discuss or in any other way transmit answers to homework problems/assignments with anyone. You may use only your text, your notes and your professor to complete any work in this class. If there is any doubt about whether a general question can be posed to a peer or another professor, err on the conservative side and ask your own instructor instead. [See the "Academic Honesty" section of the Holy Cross Catalog, <http://catalog.holycross.edu/requirements-policies/academic-policies/#academicintegritytext>] as well as the Math and C.S. Departmental Statement on Academic Integrity available at <http://mathcs.holycross.edu/~little/AcademicIntegrity.html>]. On **programming lab assignments**, you may discuss ideas with your peers and will turn in a discussion log.

Grade Calculation Breakdown:

15% Bibliography, Associated Programs, Presentation, etc.

12% Written Homework

You may **not** consult outside sources or chat with anyone about homework assignments.

You may use the course textbook, handouts from your instructor, and office hours.

3% Programming Lab Assignments

Scheme, Prolog and an interpreter are among the likely assignments. You may chat with fellow students about your labs. You **MUST** include a discussion log if you do so. See examples of acceptable discussion logs below.

10% Scheme Quiz

30% Midterm Exam

30% Final Exam

Late Policy: Late assignments will be penalized. When you know in advance you will have to miss a scheduled class, it is better to make up any work before the actual class session. All work (homework, labs, etc.) is always due at the *start of class* on the date specified. Work submitted within 24 hours of the time when they were due will be

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penalized 10%. Penalties continue to accumulate in this way each 24-hour period.¹ [The late penalty is determined when the work is "physically transferred" to the instructor. Do not leave work in the box outside my office.] Once work is returned to the class, no late work will be accepted.

Discussion Logs: For each lab assignment, you must keep a log detailing every collaboration you had with someone else and every source you consulted when completing the lab. Each log entry must include: the date, the source, the length of time spent talking or reading, and a summary of discussion or material read. You don't need to include the course textbook, or the instructor, since it is assumed you will consult these sources. Here is an example from a different course and assignment—you should use a similar format:

Discussion Log

Assignment: Project 5 (battleship game)

Name: Jane Smith

- 11/8 15 min http://en.wikipedia.org/wiki/Battleship_game Read the wikipedia page to understand how to play the battleship game.
- 11/8 10 min <http://www.cplusplus.com/forum/beginner/42045/>
<http://www.cplusplus.com/doc/tutorial/classes/>
Looked at some example code for using 2-D arrays, but none of the code seemed useful. The classes tutorial reminded me how to declare a derived class.
- 11/9 5 min G. Hopper
Talked with my classmate Grace about how to implement the top scores feature. She walked me through the lab 10 code until I understood it, and pointed me at last week's lecture notes for the rest.
- 11/11 30 min <http://www.cplusplus.com/forum/general/986/>
My bubble-sort code still doesn't work, so I borrowed about 30 lines of bubble-sort code from this page. Several of the examples didn't make sense to me, but one of the examples seemed okay so I used that. I had to adapt it to use in my project (the example was sorting alphabetically by name, and I needed to sort by numeric score), but this seemed quicker than trying to fix my own broken code and I am running out of time.
- 11/12 5 min B. Gates, A. Turing
Asked my classmate Bill what the "array index out of bounds" error I keep getting means. He didn't know, but Alan did (he took this class last year). He said it probably has to do with accessing off the end of an array or maybe using a pointer that is NULL. He told me to use jdb to find the error in my code, and I did.

Even if you did not discuss anything with anybody and never consulted any other sources, you must still submit a discussion log that says just that, like so:

Discussion Log

Assignment: Scheme Introductory Lab

Name: Jane Smith

I finished this lab entirely by myself without consulting outside help at all. I did not talk with anyone about this lab (except, of course, the instructor), and I did not look at any web sites or books (except, of course, the course textbook).

¹ Detailed Explanation: The penalty imposed each day is 10% of the original point value of the project. Thus, the maximum possible score for an assignment will be reduced by 10% for each day or portion of a day that the assignment is turned in late. If the project is up to 24 hours late, 10% will be subtracted from your score, hence the maximum possible score for an assignment turned late is 90% of the original point value. If the project 24 or more hours late, up to 48 hours, 20% of the original point value will be subtracted from your score, and the maximum possible score for an assignment turned in up to 48 hours late is 80% of the original point value, and so on.

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Tentative Schedule and Topics to be covered:

Important Note: Nearly every chapter will have a homework assignment. I have not included any assignments in the schedule below. The assignment webpage will list lab, homework, and project dates (<https://mathcs.holycross.edu/~csci324/>).

<u>Week</u>	<u>Date</u>	<u>Chapters</u>	<u>Subject Material/Project Topics</u>
T R	1/21 1/23	1, 2	The need for programming languages, Evaluation Criteria, Categories, Evolution of Languages
T R	1/28 1/30	15	Functional Programming LISP/Scheme
T R	2/4 2/6 (via ZOOM)	3	Syntax of programming languages, Formal Methods Recognizers, Generators: Regular and Context Free Grammars Attribute Grammars
T R	2/11 2/13	4	Semantics of programming languages Parsing, Recursive Descent, LL, LR
T R	2/18 2/20	5	Design and Implementation of Variables, memory cells Scope (Static/Dynamic) and Lifetime
T R	2/25 2/27		Scheme Quiz (Swords 219) No Class, SIGCSE
M-F	3/3 - 3/7		No Classes -- Spring Break
T R	3/11 3/13	6 7	Typing, Structured Data Types Expressions and Assignment
M	3/17		Midterm Exam (Swords 359) -- late afternoon/evening
T R	3/18 3/20	8 9	Statements/Control Structures Subprograms, Parameter passing, Referencing Environments
T R	3/25 3/27	9 10	Functions, Overloaded and Generic Subprograms Calls and Returns; Static Memory Structure
T R	4/1 4/3		<i>Ch. 10 continued</i> Dynamic memory structure
T R	4/8 4/10		Activation stack <i>continued</i>
T R	4/15 4/17	16	Support for Logic programming, Prolog No Class -- EASTER BREAK
T R	4/22 4/24		Start Class Presentations Class Presentations
T R	4/29 5/1		Class Presentations Class Presentations; Review; Last day of class

Final Exam (cumulative): TBD by Registrar: May 10th-15th, 2025; time TBD

College Policies and Statements

Academic Integrity. All education is a cooperative enterprise between faculty and students. This cooperation requires trust and mutual respect, which are only possible in an environment governed by the principles of academic integrity. As an institution devoted to teaching, learning, and intellectual inquiry, Holy Cross expects all members of the College community to abide by the highest standards of academic integrity. Any violation of academic integrity undermines the student-faculty relationship, thereby wounding the whole community. Students in this class are required to read the full text of the College's Academic Integrity Policy and to abide by its standards. Each student is responsible for knowing what constitutes violating the policy. The policy can be accessed at this link:

<http://catalog.holycross.edu/requirements-policies/academic-policies/#academicintegritytext>

Attendance and Excused Absence Policy. Students are expected to attend class regularly and to fulfill all obligations of the course as outlined on this syllabus and discussed during class. A few years ago, all the information in the College Catalog that addresses attendance, excused absences, requests for reasonable accommodations and the like was collected. That information is in the College Catalog and can be accessed at:

<https://catalog.holycross.edu/requirements-policies/academic-policies/#coursepoliciestext>

Accessibility Resources and Requests for Reasonable Academic

Accommodations. (<https://catalog.holycross.edu/requirements-policies/academic-policies/#coursepoliciestext>) The College of the Holy Cross is committed "to providing students with disabilities equal access to the educational opportunities and programs available at Holy Cross in accordance with the Americans with Disabilities Act of 1990 as amended, Section 504 of the Rehabilitation Act of 1973, and Massachusetts laws." All academic accommodations for students need to be approved through the Office of Accessibility Services (<https://www.holycross.edu/health-wellness-and-access/office-student-accessibility-services>). In its effort to be sure that every student is aware of the process to request accommodations, the Office of Accessibility Services suggests including a statement in the course syllabus.

Any student who feels the need for accommodation based on the impact of a disability should contact the Office of Accessibility Services to discuss support services available. Once the office receives documentation supporting the request for accommodation, the student would meet privately with Accessibility Services to discuss reasonable and appropriate accommodations. The office can be reached by calling 508-793-3693.

If you are already registered with Accessibility Services, please be sure to get your accommodation letters and deliver them to your instructors in a timely fashion. Instructors need at least 4-5 days advance notice to be able to facilitate the process of receiving testing accommodations.

PLEASE NOTE that, consistent with applicable federal and state law, this course may be video/audio recorded as an accommodation only with permission from the Office of Accessibility Services. Students are not permitted to record the contents of this class under any other circumstances.

Cumulative Final Exams. Exams that are not cumulative may be held the last day of classes. However, as the Dean's Office reminds us each semester, all cumulative final exams should be administered during the final exam period, not on the final day of classes.

Personal technologies (laptops, pads, smartphones) are not allowed in this class.

*****Exception: lay-flat devices on which to take electronic notes.**

Why the ban? Several professors at a different college banned electronics (laptops, pads, smartphones) in their computer science lectures. They were inspired not only by their own experiences, but also by the below articles. So in adopting this policy, I considered the following findings, listed for your consideration as well:

- **Technology ban improves grades and also students are fine with it**
 - <https://www.insidehighered.com/news/2018/05/11/ohio-state-professors-technology-ban-finds-positive-reaction-and-results>
(Not only were there quantitative improvements the class atmosphere improved.)
- **Even students not using electronics seem harmed if others do:**
 - <https://www.insidehighered.com/news/2018/07/27/class-cellphone-and-laptop-use-lowers-exam-scores-new-study-shows>
(Study shows that splitting attention between lecture and cellphone or laptop use hinders long-term retention, and those in class suffer from others' use of devices.)
 - <https://www.sciencedirect.com/science/article/pii/S0360131512002254>
(The results demonstrate that multitasking on a laptop poses a significant distraction to both users and fellow students and can be detrimental to comprehension of lecture content.)
- **Humans simply cannot multitask**
 - <https://www.npr.org/templates/story/story.php?storyId=95256794>
(Humans are not good at doing several tasks at once.)
 - <https://hbr.org/2010/12/you-cant-multi-task-so-stop-tr>
(Multitasking does not exist, at least not as we think about it. We instead switch tasks.)
- **Multitasking may actually damage your brain**
 - <https://www.entrepreneur.com/article/288829>
(Research conducted at Stanford University found that multitasking is less productive than doing a single thing at a time. Multitasking is bad for you, but new studies show that it kills your performance and may even damage your brain.)