Syllabus: CS 222 Programming Languages – Fall 2020

Class Time: MWF 10:30-11:20am in Taylor 210
Website: http://csweb.wooster.edu/hguarnera/cs220/
Piazza: http://piazza.com/wooster/fall2020/cs220
Professor: Heather Guarnera (hguarnera@wooster.edu)
Office: Taylor 303
Office Hours: MW 11:30am – 12:30pm, F 12:30-1:30pm (or by appointment)

Textbook Materials:

- Programming Languages Through Translation: A Tutorial Approach, Jerud Mead. *PDF available on course website.*
- Haskell: A Tutorial Introduction, Jerud Mead. *PDF available on course website.*

Course Description: CS 222 is one of the "breadth" courses in the CS curriculum. All CS majors must take either CS 220 Theory of Computation or CS 222 Programming Languages. Both courses expose the underlying theory of computing, the design of programming languages, and issues in the translation and execution of programs. We will study the historical development of programming languages and the decisions involved in the design and implementation of programming language features. Selected features of several existing languages are examined in the context of these issues. Topics include:

- *Functional programming:* write basic algorithms in Haskell; compare and contrast the functional approach and the object-oriented approach; define and use iterators; use functions as arguments
- *Object-oriented programming*: design and implement a class; inheritance via interfaces and abstract classes; define and use iterators; exception handling
- *Basic type systems*: static and dynamic type systems; typing rules; generic types, subtyping, and overloading
- *Language translation and execution*: components of a compiler; distinguish syntax and parsing from semantics and evaluation
- *Syntax analysis*: formal grammars to specify syntax; relationship of grammar to parser design; ambiguity, associativity, precedence
- *Basic automata computability*: finite state machines; DFAs and NFAs; regular expressions and regular grammars; context-free grammars
- *Graphs and trees*: trees as a data structure; tree traversals; depth-first search
- *Algorithm design and software development*: design, implement, test, and debug algorithms; apply consistent documentation and program style standards

Prerequisites: Introductory CS courses (CS 100/102, CS 110, and CS 120).

Format: The application of theory in practice is a central idea of this course. In that spirit, the course will take an active learning approach in which typically there is a shortish presentation of some concepts followed by an application. You will do a fair bit of problem solving and coding in this class, individually and in small groups.

CS 222 is a blend that explores issues in language design and specification through the development of translators for a few simple languages. You will learn a good deal of Java and to understand what it means to say there are different programming language paradigms, you will program in the functional language Haskell. Beyond that, this course addresses three expected characteristics of computer science graduates:

- Applying Theory: The design and implementation of a translator is an excellent example of the practical application of theory. We'll see that understanding the underlying theory makes it possible to understand critical aspects of programming languages and leads to elegant approaches to their implementation.
- Project Experience: The programming projects in this course are distinguished by their intellectual as well as their implementation complexity. Unlike programs you have done for most of your courses, you will find that these projects have a high ratio of thinking/planning time to coding time. You will regret a strategy of code first, think later. As suggested above, once you understand the theory, the implementation becomes more obvious and natural. And, these projects will give you a firm background in Java.

- Understanding Systems: This course will give you a unique "longitudinal" system perspective – the extent to which language design decisions impact future design and implementations choices. As an example, there are events that occur at the time we design a translator (choice of algorithms, data structures, and strategies), at the time it is used to translate code (code is parsed, checked, optimized, and new code is generated), and at the time the translated code is executed (activation records are created/destroyed, closures are built and executed, and so on). Grasping the distinction between these various times and the ways in which activities occurring at one time impact activities at another time is powerful and allows you to see design in a whole new way.

Grading: Your final grade will be calculated as follows.

10%	*Professionalism*. Includes being prompt, prepared, engaged, taking responsibility, being positive, and treating others with respect. As a participant in a community of learners, I expect each of you to assume an active role in the class. This requires being prepared by completing readings and any other assignments before each class. You should strive for consistently helpful participation in class and small group discussions. Helpful participation does not mean talking all the time or giving the "right" answers, but rather a willingness to raise questions and give attention to the comments of others and the overall trends and themes of the discussion.
35%	*Labs*. The texts we are using include labs that you will begin in class and, most likely, will complete outside of class. You will receive other assignments, some coding and some written work, that will also count as labs.
20%	*Projects.* In a few stages, you'll work on the implementation of an interpreter for a small language called PDef.
15%	*Exam*.
20%	*Final project & presentation.* Working alone or with one other person, you will write a short chapter suitable for use in this course on some aspect of program language design or implementation that is of interest to you. This project will be completed in several stages.

This class uses the standard grading scale:

A	A-	B+	B	B-	C+	C	C-	D	F
93%	90%	87%	83%	80%	77%	73%	70%	60%	below

Note that the main purpose of lab assignments is to give students opportunities to practice what they learn. I hope that you understand the value of this work, and do not regard it solely as a grading source. With this in mind, the instructor will choose to grade only a subset of labs. The remaining subset could be graded partially or based on whether the work was submitted.

Pass/Fail option. The College is temporarily broadening the policies on electing a pass-fail grading structure

- Students may elect a Pass-Fail grading option for any course (including those in a major/minor)
- Special note on transcript noting unique policy changes specific to Fall Semester 2020 regarding pass-fail counting toward the major.
- Students may elect as many courses as they wish on a Pass-Fail grading structure. Courses elected as Pass-Fail for Fall Semester 2020 will not count toward the maximum number of Pass-Fail courses that a student may take at Wooster.

The deadline for electing a Pass-Fail grading option is Friday, December 18 @ 12:00PM.

Course Drop. The College is temporarily extending the deadline for dropping a course. For Fall Semester 2020: Students may drop any course by Tuesday, November 24 @ 4:00PM. The minimum enrollment of 3.0 credits remains in effect. Requests to drop enrollment below 3.0 credits will require additional documentation via Other academic petitions.

Attendance: We work best as a learning community when everyone participates. As such, it is expected that you will attend class (in-person or remotely) at scheduled times and in accordance with health and safety protocols. Each student will be assigned a group: A, B, or C.

- Group A: attend in-person on Wednesdays and virtually on Mondays & Fridays
- Group B: attend in-person on Fridays and virtually on Mondays & Wednesdays
- Group C: attend virtually on Mondays, Wednesdays, & Fridays

If you are unable to attend class in-person on a specific day, then you are welcome to join remotely. If you are unable to join remotely, I encourage you to check the course website and get notes from a classmate to catch up on missed materials. I will communicate to you in a timely manner any changes to this schedule.

Technology: Our class works best when we use our devices to further our learning. I encourage you to only use technology during class time to enable, rather than to distract from, our learning and community building. There are a variety of tools that will be used, including

- *Microsoft Teams* – for class meetings, video conferencing, discussions, general chat, office hours, and questions
- *Git and GitHub* – version control environment that supports software development and collaboration

Recording of Classes: On occasion, I plan to record class discussions for educational purposes only so that students who miss class can access them at a later time. Recordings will be available only to course participants on password-protected websites. No one should distribute recordings, screenshots, or other course material beyond class without express permission of all involved in the recording. I will inform those participating in person and/or remotely, and offer options for participation to protect student privacy, such as:

- Participating remotely with video camera turned off
- Participating in the chat (which is not recorded)

Communication: Communication is the key to success. Contact me as soon as possible if you are struggling with material or if a conflict arises. The best way to contact me outside of class is by Piazza or by coming to my office hours. It is so often the case that when one student has a question, several others have the same or similar question. We use Piazza so that the entire class can collectively benefit from questions, and so that your classmates can see that they are not alone in their struggle. You have the option to ask questions on Piazza anonymously. I encourage you to share your understanding with your classmates by answering questions on Piazza as well. If you have a private concern, such as a question about your grade, we can discuss it in a private setting.

You should allow 24 hours response time for any communication. I usually respond faster than that, but you should not count on it. Please keep this in mind when contacting me late at night or over the weekend.

Token System: Sometimes the unexpected happens. The token system is to help prepare for that by allowing for student-driven flexibility in assignment due dates. Each student starts the semester with 5 tokens. You can *spend* tokens with the following actions: **1** token to turn in a lab/project 24 hours late, **2** tokens for 48 hours late, **n** tokens for bonus points on your exam/final project. You cannot spend more than 2 tokens on an assignment.

- Not applicable to any stage of the writing assignment.
- Tokens are non-transferrable.
- Tokens can only be applied by request, as this process is not automatic.
- Do not use the token system when you have a documented illness, school or athletic event, family emergency, technology limitation, or COVID-19 related situation. Instead, contact me for other accommodations that are available in these cases.

Late Policy: I will do my best to grade and return assignments to you as soon as I can. Late submissions make timely grading much more difficult. As such, late assignments are not accepted without a valid token or documented problem (i.e., illness, school or athletic event, family emergency, COVID-19 related situation).

Accommodations: Your success in this class is important to me. We all need accommodations to learn effectively. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. We can work together to develop strategies to meet both your needs and the requirements of the course, and to identify specific resources that may assist you.

Names and Pronouns. All people have the right to be addressed and referred to in accordance with their personal identity. We include pronoun introductions to avoid gender-based assumptions and to ensure that the correct pronoun is used when referring to you. I will do my best to address and refer to all students by the names and pronouns shared in class, regardless of what is listed on the roster, and I support classmates doing so as well.

In this class, we will have the chance to indicate the name that you would like to be called and, if we choose, to identify pronouns with which we would like to be addressed. The name and pronoun(s) that you use may change and, if they do, please let us know you would like us to change how we address you. If you are interested in changing your chosen name and pronoun(s) in the College of Wooster system, you can find additional information here.

Academic Honesty: You are expected to know and abide by the rules of the institution as described in The Scot's Key and the Handbook of Selected College Policies. Dishonesty in any of your academic work is a serious breach of the Code of Academic Integrity and is grounds for an F in this course. Such violations include turning in another person's work as your own, copying from any source without proper citation, and violating expectations for a group project.

Conflicts with Academic Responsibilities: When conflicts arise between academic commitments and complementary programs (including athletic, cultural, educational, and volunteer activities), students, faculty, staff, and administrators all share the responsibility of minimizing and resolving them. The College expects students to give the highest priority to their academic responsibilities. As a student you have the responsibility to inform me of potential conflicts as soon as you are aware of them, and to discuss and work with me to identify alternative ways to fulfill your academic commitments without sacrificing the academic integrity and rigor of the course.

Title IX. The College of Wooster is committed to fostering a campus community based on respect and nonviolence. To this end, we recognize that all Wooster community members are responsible for ensuring that our community is free from discrimination, gender bias, sexual harassment, and sexual assault. In accordance with Title IX, Wooster is legally obligated to investigate incidents of sexual harassment and sexual assault that occur on our campus. Faculty who become aware of an incident of sexual violence, including harassment, rape, sexual assault, relationship violence, or stalking, are required by law to notify Wooster's Title IX Coordinator. The purpose of this disclosure is to ensure that students are made aware of their reporting options and resources for support. For more information about your rights and reporting options at Wooster, including confidential and anonymous reporting options, please visit here.

Additional Resources. Please view the course website for additional links and resources, including information on Moodle, the Learning Center, Library Support, health and safety guidelines, Title IX, and discriminatory or bias-related harassment reporting. Once finished, for one extra point towards your participation, share on Piazza your favorite picture of the animal specified at the end of those resources/links on the course website. Create a new thread called "Read the syllabus" if necessary, or use an existing thread if someone already posted.

We're All Human. This has been a tough few months for all of us for many reasons. Let's all practice empathy, kindness, and understanding - towards each other and ourselves. The situation due to COVID-19, including the learning environment, is as new to me as it is to you. I have done my best to structure the course according to best practices and my own expertise, and to make the course policies fair, equitable, and humane. There is still a lot of uncertainty ahead, so we may need to make adjustments as the semester progresses. Please bear with me. Any changes will be communicated to you in a timely manner.