Programming Language Concepts

COP 4020
Section: UFOL
Class Number: 24327
Academic Term: Spring 2023

Instructor:
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https://ufl.zoom.us/j/4755418272

Office Hours [OH]:
- **M 5:10 – 6 PM** [10th period] EST.
- **W 6:30 – 8 PM** EST.
- **F 10 – 11 AM** EST.
- OH will *begin Monday, January 16, 2023.*
- During the **first week of classes, Wednesday, January 11, 2023** from **6:30 – 7:30 PM** EST I will hold OH to get things kicked off.

Outside of OH, the **best way** to contact me is through our **MS Teams** chat. Everyone registered in our course will be added to the MS Teams chat after the drop/add period has ended. An announcement will be made in Canvas when Teams is available. From that point forward, announcements will be made in Teams. Please let me know if you have any questions.

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
Please contact the course staff through the course MS Teams chat. Within our Canvas course shell, you will find the complete OH schedule (Modules/General Course Info/Weekly OH Schedule) and contact information for each staff member.

Course Description
Introduces programming language principles, including language constructs, design goals, run-time structures, implementation techniques and exposure to a wide variety of programming paradigms. (M) 3 credit hours

Course Pre-Requisites / Co-Requisites
Prerequisite: COP 3530

Course Objectives
This course will discuss how programming languages are constructed and analyze the methodology used to create existing languages. Topics included are lexical analysis, scanning, programmatic semantics, code generation, and types of programming language. Due to the nature and complexity of this field of study, the course will be time consuming and requires serious dedication on the part of each student. Be careful not to fall behind, success in this course requires consistent effort and practice.

Student Learning Outcomes (SLOs)
During this course, you will see the process for designing and implementing your own programming language. After the course, you will be able to:
- implement the Compiler and Visitor design patterns,
- implement solutions for a customer created project specification,
- implement and execute end-to-end a modular solution to a semester-long project,
- update/enhance/extend existing software and system functionality,
- use a debugger to analyze the code you implement,

- build your own testing suite, and
- unit test solutions you implement.

Materials and Supply Fees
There are no materials or supply fees for this course beyond the textbook. See the *Required Textbook* section below for purchasing details.

Professional Component (ABET):
See the table provided in the *Relation to Program Outcomes* section that follows. Note this course is not tracked as part of the accreditation process at this time.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.	
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	High
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	Medium
4. An ability to communicate effectively with a range of audiences	
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course. Note this course is not tracked as part of the accreditation process at this time.

Required Textbooks and Software
- https://craftinginterpreters.com/
- See the setup instructions provided under Canvas → Modules/Project/

Recommended Materials
- Programming Language Pragmatics, 4th Edition, Michael L. Scott, 2016, Morgan Kaufmann, ISBN 10 | 13: 0124104096 | 978-0124104099.
- Concepts of Programming Languages, 12th Edition, Robert W. Sebesta, 2018, Pearson, ISBN 10 | 13: 0134997182 | 978-0134997186.

Course Schedule

Here is a general schedule for the semester. Please refer to the Canvas → Modules/Week #/ for final details about each topic, exact dates, and the specific schedule we implement this semester.

Dates	Week	Topics
2023 / 01 / 08 – 01 / 14	1	Introduction, OOP
2023 / 01 / 15 – 01 / 21	2	Regular Expressions, Testing
2023 / 01 / 22 – 01 / 28	3	Lexical Analysis, Streams
2023 / 01 / 29 – 02 / 04	4	*peek* and *match*, "The Lexer"
2023 / 02 / 05 – 02 / 11	5	Context Free Grammars, Parsing
2023 / 02 / 12 – 02 / 18	6	"The Parser [Expressions]"
2023 / 02 / 19 – 02 / 25	7	"The Parser [Complete]"
2023 / 02 / 26 – 03 / 04	8	Visitor Pattern, Semantic Analysis
2023 / 03 / 05 – 03 / 11	9	"The Interpreter"
2023 / 03 / 12 – 03 / 18	–	Spring Break
2023 / 03 / 19 – 03 / 25	10	"The Interpreter"
2023 / 03 / 26 – 04 / 01	11	"The Analyzer"
2023 / 04 / 02 – 04 / 08	12	Naming, Scoping, Binding
2023 / 04 / 09 – 04 / 15	13	"The Analyzer"
2023 / 04 / 16 – 04 / 22	14	"The Generator"
2023 / 04 / 23 – 04 / 29	15	Memory Management
2023 / 04 / 30 – 04 / 06	16	Final Project Evaluation

Attendance Policy, Class Expectations, and Makeup Policy

Notice: portions of interactive course activities [such as OH] may be audio visually recorded for students in the course to reference after the given activity. Students who choose to participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during any discussion and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during an activity, you will need to keep your mute button activated. A textual "chat" feature is also available. "Chats" sent through the public channel may be recorded. If you wish to send a personal message to the instructor, do so through Teams [preferred] or email. Please note, when multiple students are attending OH, the OH session is a public setting, private chats may or may not always be answerable until other students have left the OH. If your instructor is sharing their screen, even private chats sent through Zoom will be public whenever screen sharing is enabled. OH are provided throughout the week to accommodate individual time for any private discussions that cannot be handled during a non-private session. During OH recording can always be turned off to accommodate any private discussions. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

COVID-19 RESPONSE

These COVID-19 guidelines help create an effective learning environment and enhance everyone's safety during any In-Person [*face*-to-*face*] interactions:

- UF recommends that members of our campus community and visitors wear masks in indoor, public settings and on transportation [UF guidelines and information: https://coronavirus.ufl.edu/university-updates/june-15-the-campus-brief.html].
- Reusable, disposable, N95, and KN95 masks are available for purchase at the UF Bookstore. Disposable and reusable masks are available for purchase at all Gator Dining locations. Additionally, masks are available for purchase from 50 vending machines across campus.
- If you are, or are concerned you might be, experiencing COVID-19 symptoms, click here for CDC guidance: https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.

- If you are exposed to, or are experiencing, COVID-19 symptoms, follow these UF Health instructions: https://coronavirus.ufhealth.org/campus-testing/.
- Remember, the Student Health Care Center (SHCC – https://shcc.ufl.edu/) is free resource available to all UF students.

MAKEUP/LATE WORK

Makeups or extensions for graded class activities are provided **given appropriate documentation is presented** in a timely fashion. Excused absences must be consistent with UF policies in the undergraduate catalog (https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/) and meet UF requirements regarding excused absences. There are very few events which would impede your participation in a graded activity warranting an exception, that you would not be aware of well before [at least a few hours] the start of the activity.

Instructor notifications provided by the Care Are of the Dean of Students office (DSO) are sometimes not sufficient to excuse a course absence. Specifically, the instructor notification letter form provided by the DSO must directly state that an "absence has been excused" and provide the excused dates. If the letter does not state this, then the student must provide the instructor directly with supplemental documentation that meets UF's rules for an excused absence. Otherwise, the absence is not excused, and accommodations cannot be provided.

In place of makeups or extensions on project assignments, you are allowed to drop multiple project milestones (see schedule below for details).

Late work policy: course staff will download your work sometime after the assigned due date and time. Most likely this will be the following morning. Note, this might be at 12:00 AM, after an 11:59 PM due date. Or it might be at 9 AM the morning following the 11:59 PM due date. To help you out, all work submitted before the download will be viewed as "on-time". Be careful and make sure the work you wanted graded is what you have submitted before the deadline! You are allowed unlimited submissions. Submitting early and often will benefit you. No work submitted after the download will be accepted for grading.

Evaluation of Grades

Activity		Due Date		Comments	Total Grade Percentage
Homework	HW1 – Supplements Lexing	2023 / 01 / 28		5% each	**10%**
	HW2 – Supplements Parsing	2023 / 02 / 11			
Participation	Syllabus/Course Quiz 1 pt	2023 / 01 / 21		10 pts full credit $\begin{bmatrix}12\ pts\ possible \\ 2\ pts\ dropped\end{bmatrix}$	**10%**
	Project Group Signup 1 pt	2023 / 01 / 24			
	Last Test Submission $\begin{bmatrix}6\ pts\ total \\ 1\ pt\ each\end{bmatrix}$	P1: Lexer	2023 / 02 / 01		
		P2a: Parser [Expressions]	2023 / 02 / 15		
		P2b: Parser [Complete]	2023 / 02 / 22		
		P3: Interpreter	2023 / 03 / 22		
		P4: Analyzer	2023 / 04 / 05		
		P5: Generator	2023 / 04 / 19		
	Challenge Exercises	*various* dates during the semester			
Project	P1: Lexer	2023 / 02 / 04		7.5% each for the highest 4 scores [2 *drops*]	**30%**
	P2a: Parser [Expressions]	2023 / 02 / 18			
	P2b: Parser [Complete]	2023 / 02 / 25			
	P3: Interpreter	2023 / 03 / 25			

P4: Analyzer	2023 / 04 / 08				
P5: Generator	2023 / 04 / 22				
Final Evaluation [(re)-*submit all parts*]	2023 / 05 / 02	Lexer	6%		50%
		Parser	11%		
		Interpreter	11%		
		Analyzer	11%		
		Generator	6%		
		End-to-End	5%		
				Total	**100%**

Project Assignments

We will have a semester project split into 6 graded milestones (**5 Parts** w/ **Part 2** being *split* into **2a** and **2b**) building to the final submission evaluation. Your two lowest project milestone scores [Part 1 through Part 5, including distinctly Part 2a and Part 2b] will automatically be dropped. However, the following parts of the project will require the previous part's completion. The final project evaluation will evaluate the complete project [incorporating both the complete interpreter and compiler].

To pass the course, you are required to have a private GitHub for your project, submit a zip of your .git and add our PM(s) as members of your Github [see Canvas Canvas → Modules/Project/ for details].

Unless stated otherwise, all work is due by 11:59 PM EST on the date given.

You may submit any project as many times as you need, however *no late submissions will be accepted for grading*. Dropping two project milestones provides you with flexibility should undocumented, and thus unexcused, exceptions arise. Refer to the section MAKEUP/LATE WORK above for more details.

Completing the project does not require that you work in a group. Optionally, you are allowed to work in a group of size two. Group signup opens Saturday, January 14, 2023 at 12:01 PM EST [after drop/add] and is completed through a Canvas Quiz. Prior to Monday, January 23, 2023 at 11:59 PM EST, groups are self-managed [you select to work *individually*, pick your project *partner*, or choose to be *randomly* assigned into a group by completing the Group Signup Quiz in Canvas]. After Monday, January 23, 2023 at 11:59 PM EST, I will *randomly* assign anyone not within a group into a group. Random assignments might lead to you being in a group of two or by yourself [a group of one]. Group signup (for both individual and partnered work) will begin after drop/add has ended. Signing up to define your group structure (again for working *individually*, with a *partner*, or to be *randomly* assigned one of the two) will be your first participation activity (see below).

When working in a group, it is each student's responsibility to manage their individual effort. If you find your group is not working effectively, you are allowed a one-time shift to working individually. This request must be made after Sunday, February 19, 2023 at 11:59 PM EST and before Monday, March 27, 2023 at 11:59 PM EST.

The penalties for submitting code that does not compile or does not execute are:
- 90 point / 90% max on the assignment if we can fix / hack your submission in 2 minutes or less.
- 75 point / 75% max on the assignment if we can fix / hack your submission in 15 minutes or less.
- 0 to 50 point / 0 to 50% max on assignments that cannot be fixed within 15 minutes.
- submitting to test submissions greatly reduces compilation and execution errors.

Homework

Homework activities will be *completed* **individually**. They will be assigned and submitted through Canvas. There will be two homework assignments, supplementing your work on the project.

Participation

Your participation in the course is worth **10%** of your grade and will be evaluated by your completion of *participation activities*. Spread across multiple activities, 12 participation points are possible. Each participation point is worth 1% of your grade. Therefore, to earn full participation credit, you are only required to earn 10 of the 12 possible points. The 2 additional participation points are provided so that you have flexibility in choosing which activities will show your participation.

To earn participation points for submitted code, **your code must compile** and **not crash** when executed.

Examples of participation activities are:
- Completing the Syllabus/Course Quiz.
- Completing the Group Signup Quiz, to work with a *partner*, *individually*, or *randomly* assigned individual or group work on the project. See the *Project Assignments* section above. [1 participation point is available.]
- Making a reasonable attempt and submission to the project milestone test submissions:
  - reasonable evaluated by **>50**% on the *last* test evaluation provided for each milestone,
  - HW, Modified [Typed] Parser, and Final Project Evaluation test submissions are *not* included,
  - in total, these comprise **6** participation activities [and 6 possible points], one for each milestone
- Solving Challenge Exercises, each exercise is **1** participation activity/point. For example,
  - answering questions about recent lecture material.
  - examining an aspect of our project and identifying how/where the system could be extended.

Grading Policy
The range used to calculate your final letter grade in our course will be no harsher than this grading scale provided in the following table. Your final point total will be calculated using the percentages given in the *Evaluation of Grades* section. The percent you earn on each activity will be multiplied by the grade points associated with that activity.

Grade Points	Letter Grade	Highest	Lowest
4.00	A	100+	92.00
3.67	A–	91.99	89.00
3.33	B+	88.99	86.00
3.00	B	85.99	82.00
2.67	B–	81.99	79.00
2.33	C+	78.99	76.00
2.00	C	75.99	72.00
1.67	C–	71.99	69.00
1.33	D+	68.99	66.00
1.00	D	65.99	62.00
0.67	D–	61.99	59.00
0.00	E	58.99	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

Re-Grade Requests
All grading/re-grading issues **must** be resolved within **1 week** of the graded work being returned. You must return exams/projects/quizzes to the person grading the activity in question, along with a **printed (not handwritten) attachment** stating the reasons for the re-grade. Do not write anything on the exam itself or detach (un-staple) the pages from each other. If you do so, your exam/project/quiz will not be re-graded. Note, when requesting a re-grade, the whole exam/project/quiz is subject to the re-grade, not just the portion you specify. We will be happy to discuss the solution and answer any questions, however no change will be made after the allotted week has passed.

Disclaimer

This document is subject to change at the discretion of the instructor, based on unforeseen circumstances [such as pandemics, hurricanes, sub-freezing temperatures… this is Florida after all, rifts in the fabric of time, and so on] occurring during the semester. Any such change would be introduced in order to better accommodate *you* due to the circumstances being experienced.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/ (352.392.8565, https://disability.ufl.edu/). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Once registered, the DRC provides documentation to instructors. Students should contact instructors to ensure documentation has been received as well as to discuss accommodation specifics so that everything can be setup. Students with disabilities should follow this procedure as early as possible in the semester, delaying may affect the ability to schedule the accommodation. All exams, quizzes, and so on administered through the DRC office must follow the course exam structure, being completed on the same date and time as the course exam.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons),

including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

In accordance with the ethics and standards of the University of Florida and Computer Science professionals, breaches of the Student Code of Conduct are taken *very seriously*. All violations will not only be prosecuted through the University Honor Court, but the course recommendation to the Honor Court will be that first offenses be penalized by a course grade of E (a failing grade without possibility of withdrawal) and second offenses be penalized by suspension from the University.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact

umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance** (https://titleix.ufl.edu/) located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*: * https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: * http://www.distance.ufl.edu/student-complaint-process.