

# Performant Programming

CEN 4XXX

**Class Periods:** MWF P5

**Location:** NSC 215

**Academic Term:** Fall 2024

## **Instructor:**

Jeremiah Blanchard

[jib@eng.ufl.edu](mailto:jib@eng.ufl.edu)

352-294-6643

Office Hours: Tues, Thurs P6

## **Course Description**

Focuses on utilizing language bindings to pair interpreted scripting language(s) (e.g., Python) with compiled languages (e.g., C, C++, and/or Rust) with the goal of reserving the flexibility of scripting but incorporating high-performance features of compiled languages (such as threading, process manipulation, and computational libraries in machine code) to build software that is extensible, robust, and performant. Topics to be covered include language binding mechanisms, data type conversion between language and virtual machine / native types, multiprocessing via bindings, and inter-process / inter-thread communication. (3)

## **Course Pre-Requisites / Co-Requisites**

COP3530 - Data Structures & Algorithms

## **Course Objectives**

By the end of the semester, successful students should be able to...

- Convert virtual machine types into native types, and vice-versa
- Identify potential performance bottlenecks within a software system
- Build high-performance modules in low-level languages and bind them to scripting engines
- Design an application using modern optimization-focus conceptual programming models
- Develop and deploy performant software using a mix of flexible and performant sources

## **Materials and Supply Fees**

None

## **Required Textbooks and Software**

No textbook required. All materials are provided for free and/or by the instructor. Resources include Python language standard and standard library API ([python.org](http://python.org)), C++ language standard and standard library API ([cppreference.com](http://cppreference.com)), Rust language standard and standard library API ([rust-lang.org/std](http://rust-lang.org/std)), and instructor provided lecture slides, videos, and sample code snippets.

## **Professional Component (ABET):**

This course serves criteria (b) of ABET Professional Component, namely: "one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study". This course constitutes one-semester of engineering-specific coursework.

## **Relation to Program Outcomes (ABET):**

The table below is an example. Please consult with your department's ABET coordinator when filling this out.

Outcome	Coverage
1.Ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.	High
2.Ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	Medium
3.Ability to develop & conduct appropriate experimentation, analyze & interpret data, & use engineering judgment to draw conclusions.	

4.Ability to communicate effectively with a range of audiences	
5.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.	Low
6.Ability to recognize ongoing need for additional knowledge & locate, evaluate, integrate, & apply this knowledge appropriately.	
7.Ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	Medium

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

### Required Textbooks and Software

There are no require materials for this course. All materials will be provided by the instructor. The College of Engineering requires students to have a mobile computing device (laptop).

### Course Schedule

Week 1:	Scripting & Systems Languages / Syllabus Quiz
Week 2:	Leveraging Flexibility of Scripting Languages / Ex0: Software Setup
Week 3:	Development Tools / Ex1: Language Fundamentals
Week 4:	Libraries in Systems Languages / Project Pitch
Week 5:	Language Bindings / Team Formation
Week 6:	Cython Dialect / Ex2: Data Type Conversions
Week 7:	Rust Language: Types and Borrowing / Peer Evaluation 1
Week 8:	Rust Language: Data Structures / Design Prototype / Peer Evaluation 2
Week 9:	Presentation Days / Progress Presentation / Presentation Reviews (3)
Week 10:	Web Assembly / Ex3: TUI and Object-Oriented Data Conversion
Week 11:	Mixed-Language Concurrency / Peer Evaluation 3
Week 12:	User Interfaces & Interaction / Ex4: GUI & Multi-Threading / Peer Evaluation 4
Week 13:	Performant Data Science / Peer Evaluation 5
Week 14:	Production Release Builds / Production Release / Peer Evaluation 6
Week 15:	Presentation Days / Post-Mortem Presentations

### Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is mandatory. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

### Evaluation of Grades

Assignment	Points	Percent
<b>Milestones</b>		
Pitch	50	5%
Progress Presentation	90	9%
Post-Mortem Presentation	150	15%
Design Prototype	100	10%
Production Release	200	20%
<b>Classroom Activities</b>		
Syllabus Quiz	20	2%
Presentation Reviews (6)	5 x 6	3%
Peer Evaluations (6)	10 x 6	6%
Exercises (4-drop-1)	100 x 3	30%
<b>TOTAL</b>	<b>1000</b>	<b>100%</b>

### Grading Policy

Percent	Grade	Grade Points
93.0 - 100.0	A	4.00
90.0 - 92.9	A-	3.67
87.0 - 89.9	B+	3.33
83.0 - 86.9	B	3.00
80.0 - 82.9	B-	2.67
77.0 - 79.9	C+	2.33
73.0 - 76.9	C	2.00
70.0 - 72.9	C-	1.67
67.0 - 69.9	D+	1.33
63.0 - 66.9	D	1.00
60.0 - 62.9	D-	0.67
0.0 - 59.9	E	0.00

Percentages will be rounded to the nearest whole percentage for the purposes of assigning letter grades. More information on UF grading policy may be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Exercises***

Exercises are shorter assignments, spaced each three weeks, intended to provide students with practice in the topics covered in the course outside of the project itself. These are individual assignments with specifications available on Canvas.

### ***Peer Evaluations***

All students are required to submit confidential peer evaluations regularly for members of their project groups. Peer evaluations are used by instructors to identify issues with equal participation, team dynamics, and potential dysfunctions. Peer evaluations are graded for participation only.

### ***Presentations***

Teams will present their work at the midpoint and end of the term. Presentations are expected to be professional in nature and target a technical audience. Presentations will include information and current project state as well as planned additions and/or changes in future iterations. Additional details are provided on Canvas.

### ***Presentation Reviews***

Students will submit reviews of other teams' presentations. The purpose of these reviews is to provide practice in technical reviewing of communication and to provide feedback for other students in the course. Presentation reviews are graded for participation.

### ***Project Pitch***

All students will pitch a project concept for development. Pitches should include its goals, the target audience for the project, overview of performant and binding-related components, and practical concerns. Additional details are provided on Canvas.

### ***Project Milestones***

Teams will submit two major milestones for the project – a design prototype (with major architectural components completed) and a production release (which should be the completed, polished version of the project). The milestones represent the cumulative work of all members of the team. Additional details are provided on Canvas.

### ***Student Teams***

Most software requires many disparate skillsets. Few students will have all these skills; instead, student should form groups with the goal of create well-rounded teams.

All students will be responsible for completing peer reviews that, on their honor, are correct and accurate. Students will also be required to utilize GitHub or another source control system that may be used to task review and consideration. Students are also required to track features and issues using a professional tool (e.g., Trello and/or GitHub issues).

Based on peer reviews, instructors will intervene to correct behavior as necessary to maintain well-functioning teams. All team members are expected to contribute to the project on equal terms; as such, grade adjustments may be made if it is determined by faculty that student(s) are not acting productively as part of the team.

Finally, students are expected to be available during regular business hours (EDT) to contribute to the team's efforts, meetings, and necessary communications. Teams are expected to meet **synchronously**, at a minimum, on a weekly basis, but more frequent meetings are recommended for the health of the projects. Meetings are not required to be formal, but to build community, communication channels, and rapport; for example, some students may choose to engage in a short formal meeting each week but meet informally for co-working on other days.

### ***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/>. 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.

### ***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 Honor 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. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- HWCOE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto: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 support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Connections 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:** <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.