

CSC447 Concepts of Programming Languages

Syllabus

Stefan Mitsch

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OVERVIEW

In this course, we build our understanding of programming language concepts from the bottom up, starting with the most basic building blocks of programs (expressions and statements) up to high-level concepts (structs, objects), with a focus on functional programming as a language paradigm. All these concepts shape our way of thinking about programming languages as tools to solve problems through decomposition into more manageable pieces. The course discusses functional programming as an alternative way of thinking in expressing function contracts to establish trust in auto-generated and AI-generated code. To build an auxiliary understanding of the non-functional properties (e.g., security, performance, maintainability) of programs, along the way we also study programming languages in terms of their interaction with the underlying execution platform and hardware, especially how the resulting programs interact with memory.

Programming paradigms and language concepts discussed: functional programming; comparison of object-oriented languages; type systems for functional and object-oriented languages; runtime systems for functional and object-oriented languages. A variety of programming languages will be used to illustrate concepts, e.g., C, C++, Scheme, Scala, JavaScript, Ruby, Rust.

The course follows the schedule below in Table 1, and is also listed on the web page with links to worksheets and assignments here: <https://facweb.cdm.depaul.edu/smitsch/courses/csc447/schedule.html>

INSTRUCTOR INFORMATION

- **Instructor** Stefan Mitsch
- **Loop Office** CDM 840, CDM Building, 243 S. Wabash Avenue
- **Email** smitsch@depaul.edu

- **Instructor's Homepage**
<https://facweb.cdm.depaul.edu/smitsch>
- **Course's Homepage**
<https://facweb.cdm.depaul.edu/smitsch/courses/csc447/>
(for lectures slides, assignments, reading schedules, examples, learning outcomes)
- **LMS Homepage**
<https://d2l.depaul.edu>
(for grades, quizzes, homework submission, video recordings, discussion, and announcements)
- **Office Hours**
🕒 TUE/THU 1:30PM–3:00PM (in-person or Zoom)
📅 Please schedule an appointment on OneDePaul

PREREQUISITES

If you are not sure that you have satisfied the prerequisites, speak to the instructor before the second lecture.

PREREQUISITE COURSES

- **Data Structures II** (CSC403)
- **Computer Systems I** (CSC406)

PREREQUISITE SKILLS

- You *must* have programmed with Java and C before this course.
- Integrated Development Environment (IDE) support is unavailable for many tools, so you should be familiar with use of the command line:
 - Command Prompt or Powershell on Windows
 - a shell on Linux / OS X such as `bash` or `zsh`

There are two required textbooks:

- *Concepts in Programming Languages* by Mitchell.
Published by Cambridge University Press.
<https://doi.org/10.1017/CB09780511804175>
The first few chapters are partly available in a [preview](#).
- *Programming in Scala: A Comprehensive Step-by-step Guide* by Odersky, Spoon, and Venner, 5th edition. Published by Artima Press.
<https://www.artima.com>.

This is available in paperback and/or as a PDF ebook (for purchase). If you wish to buy the PDF ebook or you want to buy the paperback and PDF ebook combo, visit the Artima Press website (see link above).

The first edition is available for free online, but covers an old version of Scala with different syntax: <https://www.artima.com/pins1ed/>

The DePaul University Library (<https://library.depaul.edu>) provides access to authoritative information sources, such as scholarly articles, journals, and books, primary sources, and research databases. Research help is available daily in-person and via chat, email, phone, or text. You may also make an appointment (in-person, phone, or Zoom) with a librarian to discuss your research projects.

COURSE SCHEDULE

Table 1: Course Schedule (CPL: Concepts in Programming Languages; PS: [Programming in Scala 5th ed.](#)); worksheets and assignments are linked at [Course Website](#)

Week	Date	Topic	Reading	Worksheets after: complete quiz in D2L	Assignments submit on D2L
1	THU APR 3	Overview Scala Introduction Scala Classes Scala Pragmatics Contracts	CPL Ch 1 PS Chs 1,2,4	Scala	Assgnmt. 1 due APR 11
2	THU APR 10	Statements and Expressions Strict and Nonstrict Evaluation Formal Semantics Pattern Matching	CPL Ch 4 PS Ch 3,5,13	Java and C	Assgnmt. 2 due APR 18
3	THU APR 17	Functional Programming with Lists Methods and Functions	CPL Ch 3 PS Ch 7,14	Functional Programming	Assgnmt. 3 due APR 25
4	THU APR 24	Folds Static/Dynamic Types	CPL Ch 6 PS Ch 9,24	-	Assgnmt. 4 due MAY 2
5	THU MAY 1	Undefined Behavior & Safety Option Types Midterm Exam (5:45pm-7:15pm)	CPL Ch 6	-	-
6	THU MAY 8	Loops and Recursion Tail Recursion Algebraic Data Types L-Values & Argument Passing	CPL Ch 7 PS Chs 19	Algebraic Data Types Argument Passing	Assgnmt. 5 due MAY 16
7	THU MAY 15	Scope and Lifetime Nested Classes Closures	CPL Ch 7 PS Ch 8	Runtime Storage Closures	Assgnmt. 6 due MAY 23
8	THU MAY 22	Dynamic Dispatch and Inheritance Delegation-based OOP	CPL Ch 10,13 PS Ch 10,11,20	OOP	Assgnmt. 7 due MAY 30
9	THU MAY 29	Parametric Polymorphism Subtyping	PS Ch 17,18	Subtyping	Assgnmt. 8 due JUN 6
10	THU JUN 5	Surprising Design Decisions Exam Review	-	JavaScript	-
11	THU JUN 12	Final Exam (5:45pm-8:00pm)			

ASSESSMENT

The course grade will be based on:

Item	Weight
Worksheets (10 total)	5%
Quizzes (6 total)	15%
Homework assignments (8 total)	30%
Midterm Exam	20%
Final Exam	30%

The grade boundaries used for the class are:

Letter Grade	Percentage $\geq$
F	0%
D	60%
D+	68%
C-	70%
C	72%
C+	78%
B-	80%
B	82%
B+	88%
A-	90%
A	92%

- Worksheets provide guided instruction through simple problems, and should be completed before homework assignments and quizzes. Worksheet completion is self-reported, but may be audited by asking for a demonstration of the completed source code / work.
- Homework assignments must compile. Homework submissions with source code that does not compile with the build/test system will receive 0 points. Homework assignments must be programmed in Scala 3 (new syntax), submissions in Scala 2 will receive 0 points.
- The exams are multiple choice.
- The final exam is comprehensive, i.e., requires knowledge of the material covered in the entire course.
- To provide the same testing environment for in-class and Online Learning students, the instructor will not answer questions during the exams.

WEEKLY CHECKLIST

- Attend lecture (see D2L for recordings)
- Reading from textbooks (see Table 1 Course Schedule)
- Worksheet (see Table 1 Course Schedule)
- Worksheet confirmation quiz (this is just a checkbox in D2L)
- Homework submission (in D2L)
- Quiz (in D2L)

POLICIES I

CHANGES TO SYLLABUS

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class or posted under Announcements in D2L.

ATTENDANCE

1. Students are expected to attend class or watch the online recording within 48 hours of the live class.
2. The midterm exam and final exam dates are posted on the schedule on the [course homepage](#). You must attend the midterm and final exams. A medical note, submitted to the Dean of Students Office (see Policies II below), will be required for an absence. Business trips or vacations are not valid reasons for missing the exam. Please register for the exam as soon as possible.
3. **Lecture slides are a supplement to lectures only.** The slides are not intended to be read in lieu of listening to the lecture.

HOMEWORK ASSIGNMENTS

1. Students must keep backup copies of all submitted homework.
2. Homework assignments will be distributed via the [course website](#) and submitted via D2L.
3. Students must only submit source code.

4. Submitted source code must compile correctly with the build/test system (or be parsed without error in the case of non-compiled languages). Homework submissions with source code that does not compile with the build/test system will receive 0 points. Homework assignments must be programmed in Scala 3 (new syntax), submissions in Scala 2 will receive 0 points.
5. Students must verify that homework has been submitted correctly. NOTE: the D2L interface requires confirmation of the homework submission after the file has been uploaded.
6. Homework submissions are usually due an hour before class each week. See D2L for details. **Late submissions will not be accepted.**
7. Homework submissions must be submitted online via D2L. **Email submissions will not be accepted at all.**
8. Submitted work must be worked on individually. You must not use or look at anyone else's solution, and you must clearly acknowledge any code that you obtain from other sources (such as books, magazines, the Internet, or AI-supported coding tools). If you are in any doubt, contact the instructor well before the submission date for advice. You may use as much code as you like (without acknowledgment) from the examples discussed in class. **Plagiarism will result in penalties up to and including failing the course.**

EXPECTATIONS

1. Several languages and tools will be used. Students are expected to learn these languages and tools without the level of guidance that would be available for 100 and 200 level classes.
2. The course requires that students actively engage the material on your own. Students should not only read the notes and example programs, but also do self-tests, modify code, and run it. As always, figure out what you can definitely code, code it, try it, and then consider extending the boundaries.
3. Students must keep up with the assigned textbook reading.
4. Students are strongly encouraged to ask questions and offer comments relevant to the day's topic.
5. All electronic interactions are an extension of the classroom and should be treated as such. While disagreement can be part of the discourse, online communication should remain respectful and appropriate rather than demeaning and/or unprofessional.

6. Classroom use of a laptop or tablet must normally be restricted to class-related tasks such as note taking, checking references, testing code examples, etc.

POLICIES II

RETRO-ACTIVE WITHDRAWAL

CDM understands certain extenuating circumstances can hinder one's ability for academic success and completion of course work. Please see <https://www.cdm.depaul.edu/Current%20Students/Pages/Enrollment-Policies.aspx> for additional information.

ABSENCE NOTIFICATIONS

In order to petition for an excused absence, students who miss class due to illness or significant personal circumstances should contact the professor. The professor reserves the sole right whether to offer an excused absence and/or academic accommodations for an excused absence.

ACADEMIC INTEGRITY AND PLAGIARISM

All students are expected to abide by the University's Academic Integrity Policy which prohibits cheating and other misconduct in student coursework. Publicly sharing or posting online any prior or current materials from this course (including exam questions or answers), is considered to be providing unauthorized assistance prohibited by the policy. Both students who share/post and students who access or use such materials are considered to be cheating under the Policy and will be subject to sanctions for violations of Academic Integrity.

More information can be found at <https://academicintegrity.depaul.edu/>. If you have any questions be sure to consult with your professor.

ACADEMIC POLICIES

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the University Academic Calendar. Information on enrollment, withdrawal, grading and incompletes can be found at: <https://cdm.depaul.edu/enrollment>

INCOMPLETE GRADES

An incomplete grade is defined in the Student Handbook as follows (note that the policy in the undergraduate student handbook applies to both undergraduate and gradu-

ate students): A temporary grade indicating that the student has a satisfactory record in work completed, but for unusual or unforeseeable circumstances not encountered by other students in the class and acceptable to the instructor is prevented from completing the course requirements by the end of the term. Please see <https://www.cdm.depaul.edu/Current%20Students/Pages/Grading-Policies.aspx> for additional information.

STUDENTS WITH DISABILITIES

Students seeking disability-related accommodations are required to register with DePaul's Center for Students with Disabilities (CSD) enabling you to access accommodations and support services to assist your success. The CSD loop campus location can be reached at:

- Lewis Center 1420, 25 East Jackson Blvd.
- Phone number: 312 362 8002
- Fax: 312 362 6544
- TTY: 773 325 7296

Students can also email the office at csd@depaul.edu Students who are registered with the Center for Students with Disabilities are also invited to contact me privately to discuss how I may assist in facilitating the accommodations you will use in this course. This is best done early in the term (preferably within the first week of class). Our conversation will remain confidential to the extent possible.

UNIVERSITY COUNSELING & PSYCHOLOGICAL SERVICES

[University Counseling & Psychological Services](#) (UCAPS) helps remove barriers to learning and support academic success by providing free, goal-focused, collaborative, short-term, confidential, individual, and group counseling services for DePaul's students. UCAPS has a diverse multi-disciplinary staff that includes licensed mental health professionals in psychology, counseling, and social work. Students¹ can talk to a therapist or schedule a brief screening and consultation appointment in the following ways:

- To speak directly to a therapist 24 hours a day, 7 days a week, students should call 773-325-CARE (2273) and Press "1" when prompted.

¹Services are provided based on student eligibility. For full eligibility details please visit go.depaul.edu/ucaps.

- To schedule a brief screening and consultation (BSC) appointment, students should call 773-325-CARE (2273) during regular business hours and Press "2" when prompted.
- Students can visit go.depaul.edu/ucaps and click the 'Schedule a Consultation' button to use online scheduling for a Brief Screening & Consultation (BSC) appointment. Online scheduling is available Monday through Friday from 8:00 am to 4:30 pm. All BSCs scheduled online are for phone appointments. To schedule an in-person or telehealth BSC, please call 773-325-CARE (2273) and Press "2" when prompted.

DEAN OF STUDENTS' OFFICE

The Dean of Students' Office (DOS) helps students navigate the college experience, particularly during difficulty situations such as personal, financial, medical, and/or family crises. For a list of support services and advocacy information, please visit <https://studentaffairs.depaul.edu/dos/>.

ONLINE COURSE EVALUATIONS

Evaluations are a way for students to provide valuable feedback regarding their instructor and the course. Detailed feedback will enable the instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. The evaluations are anonymous; the instructor and administration do not track who entered what responses. A program is used to check if the student completed the evaluations, but the evaluation is completely separate from the student's identity. Since 100% participation is our goal, students are sent periodic reminders over three weeks. Students do not receive reminders once they complete the evaluation. Students complete the evaluation online in CampusConnect.