CALIFORNIA STATE UNIVERSITY
FULLERTON

# CPSC 323-06: Compilers and Languages

**College of Engineering and Computer Science, Department of Computer Science**

## CATALOG DESCRIPTION

Basic concepts of programming languages and principles of translation. Topics include history of programming languages, various programming paradigms, language design issues and criteria, design of compilers for modern programming languages.

## COURSE DESCRIPTION

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| **Course Name** | Compilers & Languages | **Course Number** | CPSC 323 - 06 |
| **Final Examination** | 05/15/2024, Wednesday<br>7:00 PM to 8:50 PM | **Course Location** | Hum 511- Lecture Room |
| **Course Term** | Spring 2024<br>01/20/2024 - 05/10/2024 | **Class Timings** | Wednesday<br>7:00 PM – 9:45 PM |

## PREREQUISITES

CPSC 131, Computer Science or Computer Engineering major or minor; or Computer Science or Computer Engineering graduate standing or CPSC 301 passing score on Examination in Programming Proficiency; declared major/minor in CPSC, CPEN, or CPEI; if not met, you may be dropped by the department. If you have any concerns about the prerequisites, please contact the department immediately.

## INSTRUCTOR INFORMATION:

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| **Instructor Name** | Mr. Param Venkat Vivek Kesireddy |
| **Email Address** | pkesireddy@fullerton.edu |
| **Office Hours** | By Zoom On Wednesday: 11:00 AM – 12:00 PM or by appointment |
| **Zoom Link** | https://fullerton.zoom.us/j/83749703896?pwd=N0lUVWJ5SFpna1N2eEVnUXM4M2lDQT09 |

| | |
|---|---|
| **Meeting ID** | 837 4970 3896 |
| **Passcode** | 106061 |

If you have any problem with this course, please do not hesitate to contact me as soon as possible. I want the entire class to do well and for that I am willing to help as much as possible and as much as I can.

**Office hours availability:** During the final week the office hours will be held by appointment only.

## HOLIDAYS

April 1, 2024 - April 5, 2024 Spring Recess, No Classes.

## RESPONSE TIME

Except for weekends and holidays, the instructor usually responds to email questions and online assignments within **48 hours**.

## COURSE COMMUNICATION

All course announcements and individual email are sent through Canvas, which only uses CSUF email accounts. Therefore, you MUST check your CSUF email on a regular basis (several times a week) for the duration of the course.

## LEARNING GOALS

1. Understand how compilers translate human-readable language into a machine-executable language.
2. Identify the technical and social challenges of building a large software system such as a compiler.
3. Understand how to write a compiler on your own.

## LEARNING OBJECTIVES

1. Reproduce and describe the major phases of a modern compiler.
2. Develop and analyze formal descriptions of computer languages.
3. Apply finite automata theory to build recognizers for regular languages.
4. Apply pushdown automata theory to build recognizers (parsers) for context-free languages.
5. Describe the algorithms and data structures that enable automated translation.
6. Evaluate the role of static analysis in automated program translation.
7. Apply tree traversals to convert a syntax tree to low-level code.
8. Understand the limitations placed by an architecture or execution environment on the generation of machine code.
9. Describe common optimizations and evaluate the tradeoffs associated with good optimization.

## TECHNICAL PROFICIENCY

Students are expected to be intimately familiar with their development platform of choice and be able to write and debug code in any of the programming languages like Python/C/C++/Java/ JavaScript/C# at a

level of proficiency that corresponds to the prerequisites of the course. Specifically, students are expected to -

1. Have basic computer competency which includes the ability to use -
    a. a personal computer to locate, create, move, copy, delete, name, rename, and save files and folders on hard drives and on secondary storage devices such as floppy disks.
    b. a software program namely Python, C, C++, Java, JavaScript, C# that runs on a PC or Macintosh computer for their programming assignments.
    c. an electronic mail system to receive, create, edit, print, save, and send an email message with and without an attached file.
    d. an Internet browser to upload their assignments on Canvas.
2. Have ongoing reliable access to a computer with Internet connectivity for regular course assignments.
3. Maintain and access three times weekly a student email account.
4. Apply his/her educational technology skills to complete expected competencies.
5. Utilize other software applications as course requirements dictate.
6. Utilize Canvas to access course materials and complete assignments.

**Student Technical support:** (657) 278-8888

**IMPORTANT DATES**

CSUF's Academic Calendar is posted online at http://apps.fullerton.edu/AcademicCalendar/. The Academic Calendar contains all the campus closures and holidays one should be aware of. CSUF's Admissions Calendar contains all the major dates with respect to adding, dropping, and withdrawing from classes and is posted online at http://www.fullerton.edu/admissions/Resources/Calendars.asp.

**There will be one midterm exam and one final exam.**

**Tentative:**

| **Exam** | Week |
|---|---|
| **Mid Term:** | Week 7 |
| **Final Exam:** | Week 16 |

**ATTENDANCE POLICY**

**Administrative drops:** Any student who misses the first-class meeting may be dropped from the class, unless they contact the instructor or Computer Science department within 24 hours.

**Attendance:** Attending lectures is mandatory. You are expected to attend all lectures in person. Students are responsible for all course material and announcements regardless of whether they are present or absent. A student must be physically present to take exams. You are responsible for missed work if you are absent.

## TEXTBOOKS

Concepts of Programming Languages by Robert W. Sebesta

Introduction to Compiler Construction by Thomas W. Parsons

## ASSIGNMENT DESCRIPTION

**Projects:** There will be two Project assignments, duration of each is about 2-3 weeks. Groups need to submit their own files for each project. One may work in groups of up to three on projects. Each project will involve designing, implementing, and analyzing a substantial program. Projects will be on writing a lexicon analyzer, a syntax analyzer, or on writing a code generator.

**Assignments:** Suggested homework assignments will be given periodically and will count towards the final grade. They will be useful for understanding the course material. It is strongly recommended that you try them out on your own.

### In Class Hands-on:

Following the lecture, you may/ will be given a related problem/sum or an exercise that is not graded (depending on the time constraint) but is only for practice, and you can complete it right away and ask questions if you have any.

### Collaboration:

In exams, collaboration is not allowed. For projects, groups of up to three are permitted. While students can work together to understand and brainstorm solutions, each group must create and submit unique work. Technical support is acceptable, but detailed solutions, source code, and project reports must be developed individually. Any submissions with identical content will be suspected of plagiarism.

## ALTERNATIVE PROCEDURE FOR SUBMITTING WORK

In case of technical difficulties with submissions, the instructor will communicate with students directly through CSUF email, and assignments can be sent through email to the professor or the Department of Computer Science. In case email does not work, students should call the department coordinator at 657-278-3700 for further directions.

## GRADING POLICY

**Exams:** One midterm and one final exam will be given; closed book; no external source of information or collaboration is allowed. If you miss a midterm exam and you do not have a documented exceptional circumstance, you will receive 0 for the exam grade. If you miss a midterm exam and you have a documented exceptional circumstance, then the final exam will increase its weight toward the final grade.

**Assignments**: 15 % all together will count towards the final grade.

**Projects:** There will be two projects spaced at least three weeks apart. Every project score is weighted equally, regardless of the number of points available on each project. Late submissions will be accepted, however there will be deductions. There will be a 20% deduction for the first day you are late, and 1% deduction each additional day you are late. For example, if you are late by one week, the total deduction will be 20 % (first day) + 6 % (6 additional days) = 26 %; if the project is maximum 10 points, you can receive up to 7.4 points. A zero score will be given to:

- Email submissions originating from emails other than the CSUF-supplied email account.
- Input/output that is falsified.
- Submissions that are plagiarized or otherwise violate the collaboration guidelines.

**Extra Credit Policy:** There is NO Extra credit for this course.

## GRADING STANDARDS AND CRITERIA

Grades will be based on following:

- **Assignment's 15%**
    1. Assignment 1 – 5%
    2. Assignment 2 – 5%
    3. Assignment 3 - 5%
- **Projects 30%**
    1. Project 1- 15%
    2. Project 2- 15%
- **Examinations 50%**
    1. Mid Term - 20%
    2. Final Exam – 30%
- **Class Participation 5%**

If you miss a midterm with a valid excuse, the final will have increased weight. Missing the final exam will be dealt with according to the university regulations.

| GRADING SCALE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Grade** | **Percentage** | | **Grade** | **Percentage** | | **Grade** | **Percentage** |
| **A** | **95-100%** | | **B-** | **80-83%** | | **D** | **60-69%** |
| **A-** | **90-94%** | | **C+** | **77-79%** | | **F** | **below 59%** |
| **B+** | **87-89%** | | **C** | **74-76%** | | | |
| **B** | **84-86%** | | **C-** | **70-73%** | | | |

Keep all assignments and exams returned so that any discrepancies can be easily and fairly straightened out.

## POLICY ON RETENTION OF STUDENT WORK

Work is submitted through the Canvas and shall be retained on the course website for a reasonable time after the semester is completed.

## UNIVERSITY INFORMATION:

## CANVAS

Each registered student is enrolled in Canvas.

Problems? Contact the student help desk at (657) 278-8888 or email StudentITHelpDesk@fullerton.edu.

## ADA ACCOMMODATIONS FOR STUDENTS WITH SPECIAL NEEDS

Please inform the instructor during the first week of classes about any disability or special needs that one may have that may require specific arrangements related to attending class sessions, carrying out class assignments, or writing papers or quizzes, tests, or examinations.

Any student who, because of a disability, may require special arrangements to meet course requirements must contact the instructor and the Office of Disability Support Services as soon as possible to make the necessary arrangements. Students are encouraged to contact the Office of Disability Support Services within the first week of the semester to best ensure that the appropriate accommodation is implemented in a timely manner. The Office of Disability Support Services' website is http://www.fullerton.edu/DSS/ . They can be reached by phone at (657) 278-3112 or email dsservices@fullerton.edu . Their office is in University Hall, room 101. The instructor may request verification of need from the Dean of Students Office.

## ACADEMIC DISHONESTY POLICY

By submitting work for evaluation, the student acknowledges that he/she has adhered to the spirit of the university's academic honesty policy and that his/her submission is an original work done by the student unless otherwise directed to work in groups. It is the student responsibility to be aware of and follow the spirit of CSU Fullerton's academic honesty policy found at http://www.fullerton.edu/senate/publications_policies_resolutions/ups/UPS%20300/UPS%20300.021.pdf . Academic dishonesty includes such things as cheating, inventing false information or citations, plagiarism, and helping someone else commit an act of academic dishonesty. It usually involves an attempt by a student to show a possession of a level of knowledge or skill, which he/she in fact does not possess.

Cheating is defined as the act of obtaining or attempting to obtain credit for work by the use of any dishonest, deceptive, fraudulent or unauthorized means. Examples of cheating include but are not limited to using notes or aids or help of other students on tests and examinations in the ways other than those

expressly permitted by the instructor, plagiarism as defined below, tampering with grading procedure, and collaborating with others on any assignment where such collaboration is expressly forbidden by the instructor. Plagiarism is defined as the act of taking the specific substance of another and offering it as one's own without giving credit to the source (e.g., copying another person's program). When sources are used, acknowledgment of the original author or source must be made following standard scholarly practice. You are not allowed any material from any website that provides solutions to the assignments given in class for a fee or free of charge.Failure to follow the spirit of the academic honesty policy will result in a severely negative evaluation of the work in question. Each offense will be reported to the Department Chair and to the Dean of Students office, Student Conduct. A first offense will result in a zero score on the offending assignment. A subsequent offense will result in an F in the course.

## LIBRARY SUPPORT

The Pollak Library has many services to offer students. Please check the website for any assistance.

## UNIVERSITY LEARNING CENTER

The goal of the University Learning Center is to provide all CSUF students with academic support in an inviting and contemporary environment. The staff of the University Learning Center is carefully selected and trained to assist students with their academic assignments, general study skills, and computer user needs. The services that the ULC provides to the CSUF students include an open computer lab, tutoring, workshops, online tutoring, and collaborative learning. More information can be found on the University Learning Center website**.**

## WRITING CENTER

The Writing Center offers all registered CSUF students the opportunity to receive writing assistance. In half hour-long tutorials, the students who come to the Writing Center will work with a tutor to create and/or improve specific assignments and, more importantly, to improve their overall writing skills. Students can expect to engage in conversation about their assigned topics, the point or thesis of their writing, ways to organize and develop ideas, or how to improve sentence structure and mechanics to convey the intended meaning of the essay. More information can be found on their webpage.

## EMERGENCY PROCEDURES

Each student is expected to read and understand the guidelines published at http://prepare.fullerton.edu/campuspreparedness/ . Should an emergency occur, follow the instructions given by faculty, staff, and public safety officials, or contact the University Police.

## RECORDING & TRANSCRIPTION OF CLASS CONTENT

Recording class content is governed by UPS 330.230. The instructor permits class content to be recorded or transcribed by students when mandated to do so by the Americans with Disabilities Act or by other federal or state laws. Any recording of class content is for private use and should not be made publicly accessible without the written consent of the instructor and students in the class.

## COURSE RULES & CLASSROOM MANAGEMENT

Unless an agreement or accommodation is reached between the student and the instructor, these rules must be followed.

1. Attendance of **75%** at all regularly scheduled lectures and discussion sections is mandatory.
2. Eating and drinking is allowed unless it doesn't affect the class.
3. The student is responsible for being aware of any course announcements including changes to due dates and requirements.
4. Third party work (code, artwork, etc.) may not be used in student work without prior instructor consent. Failure to gain and document instructor consent will be construed as willful academic dishonesty.
5. When a third party's work is incorporated into student work after gaining instructor consent, failure to wholly document the work's origin, copyright and license will be construed as willful academic dishonesty.
6. Photographs are not permitted unless the instructor gives permission.

**WEEKLY SCHEDULE – TENTATIVE**

| Week & Day | Material | Chapters & References |
|---|---|---|
| 1 (1/24) | Class Schedule & Information presentation, Syllabus & Introduction. | Introduction, Ch 1 |
| 2 (1/31) | Lexical analysis (tokens; lexemes; finite-state automata DFA; NFA; regular expressions; finite-state machines) | Ch 1, Ch 2 |
| 3 (2/7) | Lexical analysis (pumping lemma; application to lexical analysis) | Ch 2 |
| 4 (2/14) | Syntax analysis (grammars; top-down parsers) | Ch 3 |
| 5 (2/21) | Syntax analysis (top-down parsing) | Ch 3 |
| 6 (2/28) | Syntax analysis (bottom-up parsing) | Ch 4 |
| ***7 (3/6)*** | ***Review and Mid Term*** | ***Exam: Ch 1- 4 (first half), programming assignments*** |
| 8 (3/13) | Syntax analysis (LR parsers) | Ch 4 |
| 9 (3/20) | Syntax analysis (LR parser) | Ch 4 |
| 10 (3/27) | Intermediate Code Generation | Ch 5 |
| | Spring Recess | |
| 11 (4/10) | Code Optimization | Ch 6 |
| 12 (4/17) | Code Optimization & Object Code Generation | Ch 6, Ch 7 |
| 13 (4/24) | Object Code Generation | Ch 7 |
| 14 (5/1) | Symbol Table, Lex & Yacc | Ch 8 |
| 15 (5/8) | Other topics & Review for final exam | Ch 4-8, programming assignments |
| ***16 (5/15)*** | ***Final Exam*** | ***Exam*** |