# CSE 6324: Advanced Topics in Software Engineering

Fall 2023

## Instructor Information

### Instructor(s)

Christoph Csallner

### Office Number

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### Faculty Profile

Christoph Csallner (<https://www.uta.edu/academics/faculty/profile?username=csallner>)

### Office Hours

Tuesday and Thursday, 8:45am – 9:15 am in UTA’s Microsoft Teams. Email me to set up additional meeting times as needed.

## Course Information

### Section Information

CSE 6324-001

### Time and Place of Class Meetings

Tuesday and Thursday, 12:30 pm – 1:50 pm.

Most of the classes and tests are designed to be taken online synchronously at the scheduled time using a combination of UTA’s Microsoft Teams (for classes and in-class interaction) and UTA’s Canvas (for tests).

Five or more class meetings will be in-person (location is TBD). The in-person meeting dates will be announced beforehand in class and via announcement on Canvas.

### Description of Course Content

This course is a hands-on introduction to automatic program analysis. We will explore how to create a software tool that can automatically analyze other software programs. Such program analysis may have various goals, e.g., to automatically find bugs in code or to infer some other properties of the analyzed program. The course has a team project. This edition of the course will focus on analyzing software in the “smart contracts” ecosystem (e.g., automatically analyzing Ethereum smart contracts).

### Student Learning Outcomes

* Students will be able to perform basic program analysis tasks on both bytecode and (procedural or object-oriented) source code. Students will be able to perform these tasks via modern automated tools. In addition, students will understand the program analysis concepts deeply enough to perform these steps manually (e.g., on paper during a quiz). These program analysis tasks include the following.
  + Convert source code to bytecode
  + Convert a given piece of code into a control-flow graph
  + Perform a dataflow analysis (e.g., static backward slicing) on a piece of code
  + Symbolically execute a given piece of code, both via static symbolic and dynamic symbolic execution
* Students will be able to create, explain, and provide constructive feedback on automated program analysis tools. To reach these outcomes, students will
  + Review the literature and explain existing program analyses
  + Specify, design, implement, and test a program analysis tool
  + Present deliverables
  + Review deliverables of other teams

### Required Textbooks and Other Course Materials

We mainly use selected papers from the literature. All papers are freely available to registered UTA students.

Recommended (but not required):

Mauro Pezze and Michal Young: Software Testing and Analysis: Process, Principles and

Techniques. Wiley, 2007. Request your free soft-copy from the authors here: <https://ix.cs.uoregon.edu/~michal/book/free.php>

Students: Additional materials for this course may range in cost depending on the project and or topic you choose to work on.

### Descriptions of major assignments and examinations

Following is the tentative outline. I will announce concrete dates in class.

* Paper presentations: Throughout the course.
* Quizzes: Throughout the course.
* Project: Throughout the course.

### Technology Requirements

This course will use UTA’s Canvas system, e.g., for announcements, class materials, and quizzes. Paper presentations and project deliverables will also be submitted and graded via Canvas.

Class and office hours will be held on UTA’s Microsoft Teams. Log into Microsoft Teams with your UTA student login credentials. This class should just appear when you click the "Teams" button (in the column on the left) the moment you log into Teams.

For team presentations you will need microphone and speakers on the device you are using for Microsoft Teams.

The following are optional but recommended.

* Install and use the Microsoft Teams app (the web-based version misses certain features).
* Use a Windows or Mac laptop that has a built-in webcam. This will make it easier for you to present.
* Use a microphone that is built into a head-set or ear-phones.
* Log into the same Microsoft Teams meeting (i.e., this class) from several devices at the same time. For example, I will log into the class's Teams meeting on my PC (large screen but no webcam) and on my laptop (webcam).
* There is also a Microsoft Teams app for iOS and Android.

### Other Requirements

* Student team meetings in addition to regular class meetings, as scheduled by the team members.
* Undergraduate algorithms and data structures.
* Undergraduate discrete mathematics (set, relation, function, graph) and first-order logic.
* Fluency in a mainstream programming language, such as Python, C, C++, C#, or Java.

### Do Not Share Class Recordings with Anyone Not Enrolled in this Class

The following notice is copy-paste from UT System’s Online Learning Student Privacy & Related Issues FAQ (<https://www.uta.edu/administration/provost/units/faculty-affairs>). FERPA is the Family Educational Rights and Privacy Act.

*“Class sessions may be recorded by the instructor for use by students enrolled in this class. Recordings that contain personally identifiable information or other information subject to FERPA shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant students. Class recordings are reserved only for the use of students enrolled in the class and only for educational purposes. Course recordings should not be shared outside of the class in any form without express permission.”*

## Grading Information

### Grading

* Grade Components
  + 20% Quizzes
    - Goal: Learn program analysis techniques and principles. This will provide the basis for your project.
    - Quizzes will be announced in class one week in advance. Each quiz will take place in the first 20 minutes of class.
    - Quizzes are closed-book, but you can use a one-page cheat sheet that you have written yourself.
  + 20% Research paper presentation
    - Goal: Learn a specific program analysis technique that is similar to or otherwise related to the program analysis you will implement in your project.
    - Each student will pick one or two papers and present these papers in class.
    - Including questions and answers, a paper presentation should cover one class (a class is 80 minutes). Your fellow students are encouraged to ask questions during your presentation, so the presentation itself should take about one hour. The remaining 20 minutes should be reserved for questions and answers.
    - You may pick papers from the reading list, consult the instructor, or propose papers on your own.
  + 10% Class participation, such as asking and answering questions
  + 50% Project
    - Goal: Create, explain, and provide constructive feedback on program analysis tools.
    - This is a team project. You should distribute project work fairly among yourselves, but I leave the detailed project management to you.
    - To make collaboration as easy as possible, I very strongly encourage you to use a free open-source project hosting service such as **GitHub**.
    - After each project iteration, each team will present some aspects of their project, both in writing and by oral presentation.
    - 20% Project specifications, designs, code, tests, reports, etc. (written)
    - 10% Project reviews (written)
      * After each iteration, you will formally review the deliverables of another team.
      * Each review should be probing but always constructive and helpful.
      * To facilitate this review, you will submit your written project deliverables to both Canvas and your review team, by the due date of the respective deliverables.
    - 20% Project presentations (oral)
      * Over the course of the semester I expect that each team member presents a similar amount of material in project presentations.
    - For each project-related deliverable, written or oral, each team will receive a team score. The sum of these team scores will determine 50% of your project-related grade.
    - **In addition to the team scores, for the entire project each team member will receive an overall individual score.** The individual score is derived from peer evaluations, your feedback to other teams during presentations, and your handling of questions. This individual score will determine the other 50% of your project-related grade
* Grade Distribution
  + A from 90%
  + B from 75%
  + C from 60%
  + D from 50%
  + F else.
* Deadline for Written Project Deliverables
  + Mondays at 9am.
  + The concrete dates will be announced in class.
* Format
  + All written deliverables (project deliverables, etc.) should be in plain text, HTML, or PDF, unless I announce otherwise.
* Late Policy
  + Late submissions will be accepted until we discuss results.
  + For being late up to one day the penalty is 10%, for up to two days it is 20%, etc.

### Make-up Exams

The university catalog lists under student responsibilities the following kinds of absences.

* University authorized absences
* Absence for military service
* Observance of religious holy days

See the university catalog for details (<http://catalog.uta.edu/academicregulations/studentresponsibility/#attendancetext>).

### Expectations for Out-of-Class Study

Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 9 hours per week of their own time in course-related activities, including work on project deliverables, reading required materials, completing assignments, preparing for in-class quizzes, etc.

### Grade Grievances

Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog

(<https://catalog.uta.edu/academicregulations/grades/#graduatetext>).

## Course Schedule

1. Overview and motivation
2. Project inception
3. Ideas for student class projects
4. Fagan inspection, reviews, and walkthrough
5. Refresher on set, relation, graph, and function
6. Bytecode and virtual machine
7. Control-flow graph
8. Dataflow analysis and slicing
9. Symbolic execution
10. Dynamic symbolic execution
11. Student research paper presentations throughout the semester
12. Student team project presentations throughout the semester

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course

## Institutional Information

UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the [Institutional Information](https://resources.uta.edu/provost/course-related-info/institutional-policies.php) page (https://resources.uta.edu/provost/course-related-info/institutional-policies.php) which includes the following policies among others:

* Drop Policy
* Disability Accommodations
* Title IX Policy
* Academic Integrity
* Student Feedback Survey
* Final Exam Schedule

## Additional Information

### Face Covering Policy

*Face coverings are not mandatory; all students and instructional staff are welcome to wear face coverings while they are on campus or in the classroom.*

### Attendance

Attending class sessions is a critical predictor and indicator of student success. The University of Texas at Arlington does not recognize a single attendance policy but encourages facultyto establish class-specific policies on attendance. As the instructor of this section, I have established the following attendance policy. Since this is a 6000-level course, I do not plan to take attendance directly. But (active) online attendance contributes indirectly to the final grade. Specifically, final grade components include in-class quizzes, class participation such as asking and answering questions during class, and in-class project presentations.

The U.S. Department of Education requires that UT Arlington have a mechanism in place to verify Federal Student Aid recipients’ attendance in courses. UT Arlington instructors are expected to report the last date of attendance when submitting students’ final course grades; specifically, when a student earns a course grade of F, instructors must report the last date a student attended their class. For on-campus classes, last date of attendance can be based on attendance rosters or on academic engagements—a test, participation in a class project or presentation, or Canvas-based activity. Online or distance education courses require regular and substantive online interaction and participation. Students must participate in online course activities in Canvas to demonstrate attendance; logging into an online class is not sufficient by itself to demonstrate attendance. The last date of attendance is reported to the U.S. Department of Education for federal financial aid recipients.

### The English Writing Center (411LIBR)

The Writing Center offers **FREE** tutoring in 15-, 30-, 45-, and 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Register and make appointments online at the [Writing Center](https://uta.mywconline.com/) (https://uta.mywconline.com). Classroom visits, workshops, and specialized services for graduate students and faculty are also available. Please see [Writing Center: OWL](http://www.uta.edu/owl) (http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library’s 2nd floor [Academic Plaza](http://library.uta.edu/academic-plaza) (http://library.uta.edu/academic-plaza) offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the [library’s hours](https://library.uta.edu/hours) (https://library.uta.edu/hours) of operation.

### Librarian to Contact

Each academic unit has access to [Librarians by Academic Subject](http://www.uta.edu/library/help/subject-librarians.php) (http://www.uta.edu/library/help/subject-librarians.php) that can assist students with research projects, tutorials on plagiarism and citation references as well as support with databases and course reserves.

## Emergency Phone Numbers

In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381