

# COM S 413x: Foundations and Applications of Program Analysis

Iowa State University

Spring 2019

**Lectures:** M W F 12:10-1:00pm Carver 0294

**Instructor:** Wei Le (weile@iastate.edu: please preface all email subjects with “413x: ”)

**Office Hours:** F 3:00pm-5:00pm Atanasoff 210

**Lecture notes and homework assignments:** Course website

**Homework submissions and grades:** Canvas

## 1 Course Description

Algorithms and tools for automatically reasoning about code and program executions to predict software behavior. Theory and foundations related to control flow analysis, dataflow analysis, abstract interpretation and symbolic execution. Applications of program analysis to improve software security, performance and testing. Concepts, algorithms, tools, benchmarks, methodologies for solving problems using program analysis and for preparing research in program analysis —from Iowa State University course catalog.

## 2 Course Objectives

After successfully completing this course, students of COM S 413x are expected to:

1. learn terminologies needed to read program analysis literature,
2. know classical program analysis algorithms,
3. be able to use program analysis tools to address challenges in software engineering, and
4. be able to implement and modify program analysis tools for software engineering problems.
5. be able to work with an open source development environment and tools such as github and docker

## 3 Prerequisites

Minimum of C- in COM S 342: Principles of Programming Languages

## 4 Textbooks and Resources

The course does not have a required text book. We will use lecture notes and papers to teach and learn, though the following books are considered classical to learn program analysis:

- *Principles of Program Analysis* by Chris Hankin, Flemming Nielson, and Hanne Riis Nielson, published by Springer, ISBN 9783662038116: a theoretical, static analysis book.
- *Advanced Compiler Design and Implementation* by Steven Muchnick, published by Morgan Kaufmann, ISBN 9781558603202: it is a compiler book that covers the topics of control flow analysis, dataflow analysis, alias analysis, and the applications of program analysis in compiler optimizations.

You are also welcomed to check out the program analysis courses taught by other instructors:

- Alex Aiken, Stanford, CS 357 Techniques for Program Analysis and Verification
- Monica Lam, Stanford, CS243 Program Analysis and Optimization
- Jonathan Aldrich, CMU, 15-819 O Program Analysis
- Jens Palsberg, UCLA, CS232 Static Program Analysis
- Mayur Naik, Georgia Tech, CS6340 Software Analysis and Testing
- Stephen Chong, Harvard, CS252r Advanced Topics in Programming Languages
- Mooly Sagiv, Tel Aviv University, Program Analysis
- Evan Chang, University of Colorado Boulder, CSCI7135 Program Analysis: Theory and Practice

## 5 Tentative Topics

1. finding bugs
2. automatic test input generation
3. debugging
4. specification inference
5. analyzing software changes and versions
6. big code analysis
7. advanced topics: automatic program repair, and certify and explain AI software

## 6 Course Work and Evaluation

- Survey (10%):
- Homework assignments (60%)
- Project (30%)

Note that we do not grade late submissions. Please submit your homework on time. Undergraduate and graduate students will have different requirements for survey and projects.

## 7 Academic Integrity

Regarding programming assignments, you are expected to write, debug and submit your own code. You should not copy the code from your classmates or from the Internet. You should not share your code, or edit and debug other people's code. You may discuss the approaches and algorithms with your classmates.

Iowa State University's policy on academic dishonesty: Suspected academic misconduct will be reported to the dean of students office <http://www.dso.iastate.edu/ja/academic/misconduct.html>

## **8 Accommodations for Disabilities**

We would like to hear from you if you have a disability that may require some modification of seating, testing, or other class requirements. If so, please request that the Disability Resources staff send a Student Academic Accommodation Notification form verifying your disability and specifying the accommodation you will need. Then bring the Accommodation Notification form along and talk to the instructor as soon as possible so appropriate arrangements may be made.