COM S 413/513 and CPR E 513: Foundations and Applications of Program Analysis

Iowa State University

Fall 2022

Lectures: T/Th 9:30am-10:45pm, LAGOMAR 1445

Instructor: Wei Le (weile@iastate.edu: please preface all email subjects with "413/513: ")
Office Hours:
  T 1:30pm-2:30pm
  Atansoff 210, https://iastate.webex.com/meet/weile (both in person and online)

TA: Ahmed, Shibbir (shibbir@iastate.edu)

Office Hours:
  Fri 10-11:00am
  Pearson 0112, https://iastate.webex.com/meet/shibbir (both in person and online)

Lecture notes and homework assignments: https://github.com/wei-le/programanalysiscourse
Homework submissions and grades: Canvas

1   Course Description

Algorithms and tools for automatically reasoning about code and program executions. Theory and foundations related to control flow analysis, dataflow analysis, abstract interpretation, and symbolic execution. Applications of program analysis to bug detection, test input generation, debugging, program repair, specification inference and trustworthy AI engineering. 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 accompishing this course, students will

1. understand basic concepts and terminologies in program analysis,

2. know and implement program analysis algorithms,

3. learn the frontier of program analysis research,

4. gain experience with open source environment and tools, and

5. improve problem solving skills to address software engineering challenges.

One additional objective for 513 students:

1. get more research experience in program analysis and software engineering

3 Prerequisites

COM S 327 or CPR E 288; 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. The following is a list of additional materials for your reference:

- *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.

- Monica Lam, Stanford, CS243 Program Analysis and Optimization

- Jonathan Aldrich, CMU, 15-819 O Program Analysis

- Jens Palsberg, UCLA, CS232 Static Program Analysis

- Stephen Chong, Harvard, CS252r Advanced Topics in Programming Languages

- Mooly Sagiv, Tel Aviv University, Program Analysis

5 Tentative Schedule

Week	Topic	Homework Assignment (due date)
1	bug detection	
2	control flow analysis	
3	dataflow analysis	HW1
4	abstract intepretation	Survey
5	fuzzing	Project idea
6	symoblic execution	HW2
7	midterm project and catchup	Project proosal
8	debugging & repair	
9	dependencies & slicing	HW3
10	software changes and versions	
11	specification inference	HW4
12-13	AI for code	HW5
14	analyzing and testing deep learning models	
15	final project presentation	final project

6 Course Work and Evaluation

- Survey (20%)

- Homework assignments (50%): 5 projects, each project 10%

- Final Project (30%)

Please submit your homework on time, as we do not grade late submissions. Undergraduate and graduate students will have different requirements for survey and projects. The details will be provided in class.

7 Academic Integrity

For the 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. For the written assignments, you should not share or copy solutions. You may discuss the approaches and algorithms with your classmates. You can also ask questions in office hours.

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.

9 Free Expression

Iowa State University supports and upholds the First Amendment protection of freedom of speech and the principle of academic freedom in order to foster a learning environment where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.