

# CSC 591/791-009 Fundamental Program Analysis

Fall 2016  
Course Syllabus  
3 credits

**Instructor:** Kathryn Stolee, PhD  
**Office:** 3268 Engineering Building II (EBII)  
**Phone:** 919-515-3305  
**Instructor E-mail:** [ktstolee@ncsu.edu](mailto:ktstolee@ncsu.edu)

**Lectures:**  
**Office Hours:**

**Textbook:** none (research papers and other resources will be made available online)

**Prerequisites:** graduate, or senior standing undergraduate with permission

## Summary:

Have you ever wanted to discover which lines of code are causing your test case to fail, without needing to trace through the code? Or wanted to search for code based on what it does instead of how it's written? Or have you ever wanted to find out if the code you're writing has been written already, somewhere else in the project? Solutions to all these questions can be achieved with a mastery of program analysis fundamentals.

This course focuses on static and dynamic program analysis and the tools and techniques that make it possible. It explores state-of-the-art research and tools in program analysis and how they can be applied to solve some of today's most complex software problems. Students have the opportunity to do original research in program analysis and push the state-of-the-art.

## Learning outcomes:

- Understand fundamental concepts and tools in program analysis, including static and dynamic analysis, dataflow analysis, fault localization, and symbolic execution
- Identify limitations of current program analysis techniques

## Course Topics:

- Static and Dynamic Program Analyses:

- Abstractions and program representation
- Control flow and dataflow analysis
- Symbolic execution
- Program slicing
- Applications/Tools:
  - SMT solvers
  - Fault localization
  - Program repair
  - Semantic code search
  - Clone detection
  - Specification Mining

## Course Structure:

This course will involve lectures, outside reading, small group discussions, in-class exercises, tool demonstrations, and student presentations.

## Late Policy:

No late assignments will be accepted. Early assignments are always welcome!

## Grading:

( $\infty$ , 98] A+, (98, 92] A, (92, 90] A-,  
 (90, 88] B+, (88, 82] B, (82, 80] B-,  
 (80, 78] C+, (78, 72] C, (72, 70] C-,  
 (70, 68] D+, (68, 62] D, (62, 60] D-, (60, 0] F

### 591 Students:

Midterm: 30%  
 Homework: 20%  
 Participation: 10%  
 Tool Review and Presentation: 10%  
 Final Project: 30%

### 791 Students:

Midterm: 20%  
 Homework: 20%  
 Participation: 10%  
 Tool Review and Presentation: 10%  
 Final Project: 40%

There will be no final exam, but a final project will be delivered during dead week.

## Project:

Students will conduct a project that consists of reproducing a study, creating a new tool, extending an existing tool, adapting an existing tool to a new domain, or similar. The final deliverable will be a paper in 2-column ACM format. Students will make their tools and/or evaluation artifacts available on GitHub.

## Tool Review and Presentation:

Students will explore and demonstrate a research tool to the class. The focus of these presentations will be on *what it does*, illustrated through examples. These tools will be related to the topic covered in class and may include:

- Findbugs, <http://findbugs.sourceforge.net/>
- PMD <https://pmd.github.io/>
- Emma <http://emma.sourceforge.net/>
- Klee, <https://klee.github.io/>
- Daikon, <http://plse.cs.washington.edu/daikon/>
- CodeHint, <http://jgalenson.github.io/codehint/>
- Perfume, <http://people.cs.umass.edu/~ohmann/perfume/>
- Z3, <https://github.com/Z3Prover/z3>
- Hampi, <https://people.csail.mit.edu/akiezun/hampi/>
- CodeHunt, <http://www.codehunt.com/>

## Attendance:

Attendance is not mandatory, but participation is a component of the grade. If you don't show up, you can't actively participate in discussions. That said, I will not keep track of each and every absence.

An unexcused absence from the midterm will result in a grade of F on the midterm. If you have a conflict, tell me at least one week in advance of the midterm date.

## Statement for students with disabilities:

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with

disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG 02.20.01).

## N.C. State University Policies, Regulations, and Rules (PRR):

Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include: <http://policies.ncsu.edu/policy/pol-04-25-05> (Equal Opportunity and Non-Discrimination Policy Statement), <http://oied.ncsu.edu/oied/policies.php> (Office for Institutional Equity and Diversity), <http://policies.ncsu.edu/policy/pol-11-35-01> (Code of Student Conduct), and <http://policies.ncsu.edu/regulation/reg-02-50-03> (Grades and Grade Point Average).