

# CSCI 599: Testing and Analysis of Software Systems

## Motivation

The use of web applications is extensive: over 70% of Americans access web applications on a daily basis and companies do over 124 billion dollars in annual sales via their web applications. However, significant errors and security vulnerabilities continue to appear in web applications and have, in fact, increased over the past decade. Although software verification and validation has been an active area of research for several decades, many of the developed techniques are not directly applicable to modern web applications. Researchers and practitioners have worked to develop web application-specific techniques. These include web crawling, usage-derived models, formal specifications, reverse engineering techniques, and static analyses. Used effectively, these new techniques offer the hope of improved testing and analysis for web applications.

## Objectives

This course will introduce students to the topic of testing and analysis of large-scale software systems, such as mobile and web applications. In the first half of the course, students will gain practical hands-on experience with the most popular tools and techniques in the field while learning about the testing and analysis theories that underpin these techniques. In the second half, students will focus on new cutting edge research based techniques for finding errors and exposing security vulnerabilities. Throughout the course, students will learn basic software testing and analysis concepts as they relate to web applications.

### Topics:

1. General testing methodologies in the context of software engineering
2. Structure and development of J2EE web applications
3. Web application crawling
4. Black-box and white-box testing techniques for web applications
5. Static analysis and formal verification of web applications
6. Fault localization
7. Current research topics

## Recommended Preparation

1. CS 571 or instructor permission
2. Java programming skills
3. Linux system administration

## Required Course Materials

1. Laptop - for in class assignments

## Schedule

| Week | Day 1                         | Day 2                          |
|------|-------------------------------|--------------------------------|
| 1    | Administrative tasks/Overview | Web Application Basics         |
| 2    | Testing Overview              | Web Application Testing        |
| 3    | ICA 1: Test Measurement       | Black-box Testing Techniques   |
| 4    | ICA 2: Web Crawling           | White-box Testing Techniques   |
| 5    | ICA 3: Black-box Testing      | Usage-based Testing Techniques |
| 6    | ICA 4: White-box testing      | Basic Program Analysis         |
| 7    | ICA 5: Formal Specifications  | Formal Verification            |
| 8    | ICA 6: Usage-based Testing    | Regression Testing             |
| 9    | ICA 7: Formal Verification    | Fault Localization             |
| 10   | ICA 8: Regression Testing     | Security in Web Applications   |
| 11   | ICA 9: Fault Localization     | Mobile Web Applications        |
| 12   | Research Papers               | Research Papers                |
| 13   | Research Papers               | Research Papers                |
| 14   | Research Papers               | Research Papers                |
| 15   | Research Papers               | Exam                           |

## Grading

The grades for the students will be based on completion of the nine in-class activities, presentation of a research paper, semester project, and an exam. The breakdown for each of these categories is listed below. A more detailed explanation of the grading for each category is also provided.

- Class assignments - 45%
- Topic presentation - 10%
- Semester project - 25%
- Exam – 20%

### ***In-Class Activities***

Students will carry out a series of in-class activities (ICA) that demonstrate their mastery of various testing and analysis concepts and tools. Prior to each ICA, students will be provided with an overview of the tools and techniques they must demonstrate in class. During the class period allocated for the ICA, the students will carry out a series of activities to demonstrate their mastery and proficiency with the topics. Students will be graded based on their ability to complete the requirements of the ICA, the speed with which they can carry out the ICA, and the quality of the ICA deliverables.

## **Topic Presentation**

Students will work either individually or in small groups to present a web application testing and analysis research paper to the class. The paper will be selected from a list of papers selected by the instructor. The presentations will be graded on clarity, completeness, and presentation style.

## **Semester Project**

Students will work either individually or in small groups to carry out a class project. The focus of the class project will be to develop new or innovate techniques for testing and analyzing web applications. Students will leverage tools, concepts, and techniques presented in the class to develop this technique. Students may also suggest project ideas related to their personal interests or research activities. The grade for the project will be based on the successful completion of the agreed upon project objectives.

## **Exam**

There will be a single cumulative exam for the class. This will cover the concepts and terminology presented in the class lectures.

## **Readings**

At this time, most background material for testing and analysis of web applications has not yet been formalized in a textbook. Therefore, most of the readings will be based on research papers and articles that will be provided to the class as PDF based handouts via Blackboard or via the USC Library's online journal access. The following books provide useful background information about the techniques studied in class. However, they do not discuss the application or adaptation of these techniques to web applications.

1. Introduction to Software Testing. By Paul Ammann and Jeff Offut.
2. Software Testing and Analysis. By Mauro Pezze and Michal Young.

## **Late Work Policy**

Late work will not be accepted without prior approval of the instructor.

## **Statement on Academic Integrity**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://scampus.usc.edu/university-student-conduct-code/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://scampus.usc.edu/1300-academic-integrity-review/>.

## **Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday.

## **Emergency Preparedness/Course Continuity in a Crisis**

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

### **IT Help**

Software for programming assignments will be made available in ITS labs and user rooms. For questions and support, use the following contact information.

Name: USC ITS Customer Support

Hourse of Service: 24/7

Phone: 213-740-5555

e-mail: [consult@usc.edu](mailto:consult@usc.edu)

Website: <http://www.usc.edu/its/csc>

### **Course Information**

The information in this section will vary by semester.

#### ***Class***

Class Day and Time: TBD

Class Location: TBD

Course Website: <http://blackboard.usc.edu>

#### ***Instructor***

Name: TBD

Office Location: TBD

Office Phone: TBD

Office Hours: TBD

Email: TBD

#### ***Teaching Assistants***

Name: TBD

Office Location: TBD

Office Hours: TBD

Email: TBD