CSCI 512: TESTING AND ANALYSIS OF SOFTWARE SYSTEMS

COURSE INFORMATION
The information in this section will vary by semester.

CLASS LOCATION AND TIME
Location: KAP 113
Time: MW 10-11:50

INSTRUCTOR
Name: William G.J. Halfond
Office: SAL 330
Office Hours: Monday and Thursday 4-5pm
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TEACHING ASSISTANT
Name: TBD
Office: TBD
Office Hours: TBD
Email: TBD

COURSE DESCRIPTION
This course covers automated testing and analysis of large-scale modern software systems; topics include test coverage criteria, test case generation, fault localization, and regression testing.

MOTIVATION
The development and usage of modern software systems, such as web and mobile applications has increased dramatically. For example, 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. These come at a significant cost. The National Institute of Standards and Technology estimates that software errors cost the US economy over 60 billion dollars annually. Of that, over a third was found to have been preventable if existing techniques for software testing and analysis had been applied. Although software testing and analysis has been an active area of research for several decades, many of these developed techniques are not directly applicable to modern software systems. Researchers and practitioners have worked to develop new and 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 modern applications.
**OBJECTIVES**

This course will introduce students to the topic of testing and analysis of large-scale modern software systems, such as mobile and web applications. Throughout the course, students will learn common testing processes, terminology, and concepts. 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 research-based techniques for finding errors and exposing security vulnerabilities.

**TOPICS TO BE COVERED IN THIS COURSE:**

1. General testing methodologies in the context of software engineering
2. Automated techniques for interacting with software systems
3. Black-box and white-box testing techniques and coverage criteria
4. Static analysis and formal verification of software systems
5. Fault localization using automated testing techniques
6. Regression testing after changes to the software system
7. Current research projects in the above areas

**READINGS AND REFERENCE MATERIALS**

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.

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

ASSIGNMENTS, PROJECTS, AND EXAMS
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.

- In-class activities - 45% (9 @ 5%)
- Research paper presentation - 10%
- Semester project - 25%
- Final 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. Please see Appendix A for two sample ICAs.

RESEARCH PAPER PRESENTATION
Students will work individually to present a testing and analysis research paper to the class. The paper will be selected from a list of papers selected by the instructor. Please see Appendix B for a list of readings from previous years. 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. Size of the group will be proportional to the scope of the project. The focus of the class project will be to develop new and innovative techniques for testing and analyzing web applications, as guided by the instructor. Please see Appendix C for a
sample list of projects from previous years. 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. The grade for the project will be broken down as follows:

- Project proposal, due Week 8: 15%
- Project checks/milestones, Week 11 and Week 14: 10% (2 @ 5%)
- Final project deliverable, Week 15: 75%

Final project deliverables will receive scores based on the effectiveness of the developed technique, creativity of the technique design, and completion of all deliverables as described in the project proposal.

**FINAL EXAM**
There will be a single cumulative exam for the class. This will cover the concepts and terminology presented in the class lectures and the research papers presented in class.

**LATE WORK POLICY**
Late work will not be accepted without prior approval of the instructor.

**SEMESTER SCHEDULE**
Below is a week by week breakdown of the class’ semester schedule. Reading for each class are denoted by bracketed numbers (e.g. [1]) and, if applicable, the chapters or sections. For weeks with research paper presentations, students are responsible for reading the assigned research paper presentations. These are denoted on the schedule using “RP-X” and correspond to the list of sample research papers in Appendix B.

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<thead>
<tr>
<th>Week</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Readings</th>
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<tr>
<td>1</td>
<td>Administrative tasks/Overview</td>
<td>Web Application Basics</td>
<td>N/A</td>
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<td>2</td>
<td>Testing Overview</td>
<td>Web Application Testing</td>
<td>[1] Chapters 1-4</td>
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<td>7</td>
<td>ICA 5: Formal Specifications</td>
<td>Formal Verification</td>
<td>[1] Chapters 7 and 8</td>
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<td>Week</td>
<td>Due Date</td>
<td>Topic 1</td>
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<td>11</td>
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<td>ICA 9: Fault Localization</td>
<td>Mobile Web Applications</td>
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<td>12</td>
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<td>Research Papers</td>
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**Final**  
For the date and time of the final for this class, consult the USC Schedule of Classes at [www.usc.edu/soc](http://www.usc.edu/soc).

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**ACADEMIC CONDUCT**

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, Behavior Violating University Standards [https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions](https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions). Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, [http://policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity [http://equity.usc.edu](http://equity.usc.edu) or to the Department of Public Safety [http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us](http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us). This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men [http://www.usc.edu/student-affairs/cwm/](http://www.usc.edu/student-affairs/cwm/) provides 24/7 confidential support, and the sexual assault resource center webpage [http://sarc.usc.edu](http://sarc.usc.edu) describes reporting options and other resources.

**SUPPORT SYSTEMS**

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the
American Language Institute [http://dornsife.usc.edu/ali](http://dornsife.usc.edu/ali), which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs [http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, [USC Emergency Information](http://emergency.usc.edu) will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.