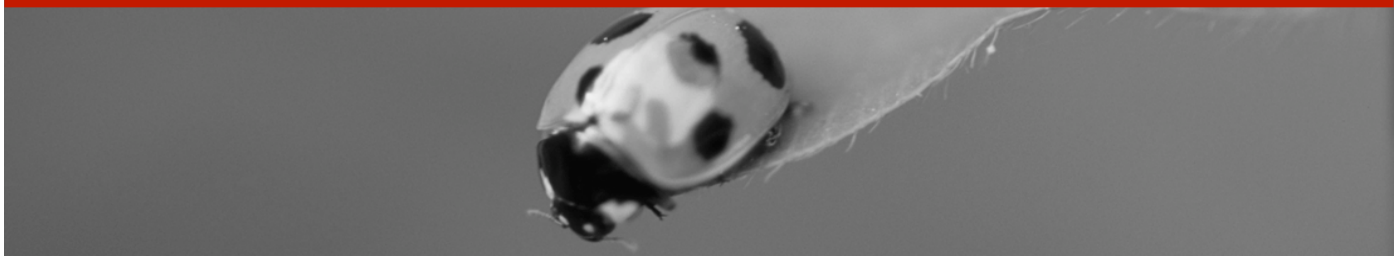
Fall 2021 CS592 Software Reliability and AI



Course Websites

- Lecture notes and publicly available info: https://bitbucket.org/lintan/592-21
- D2L Brightspace (https://purdue.brightspace.com/) for assignment/lab submissions and password protected content

Instructor

Prof. Lin Tan, lintan [at] purdue.edu, https://www.cs.purdue.edu/homes/lintan/

Office Hours: lecture time, to be announced, or by appointment. **B*e sure to add [CS592] to your email subject line.***

Lecture Time

TBD

Textbook

No required textbook. Lecture notes/slides will be provided.

Optional Textbook: Paul Ammann and Jeff Offutt. Introduction to Software Testing. Edition 2. Cambridge University Press, 2016.

Rationale:

Software needs to be reliable and secure; otherwise, they cause casualty, financial losses, and many other damages. Software bugs significantly hurt software reliability and security. This course discusses a broad range of techniques to reduce the negative impact of software bugs to improve software reliability and security.

On the one hand, machine learning software is widely used in domains including aircraft collision avoidance systems, Alzheimer's disease diagnosis, and autonomous driving cars. Despite the requirement for high reliability, machine learning software is difficult to test and debug. This course will discuss how to use software testing techniques to improve the reliability and security of deep learning software.

On the other hand, machine learning and natural language processing techniques have unique advantages in completing and automating challenging software development tasks. This course will also discuss techniques that use machine learning and natural language processing techniques to extract specifications, generate test cases, detect software bugs, and fix software bugs.

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Main Topics:

- Fundamental Software Reliability and Security Concepts
- AI for software and software for AI
- Application of Machine Learning and Natural Language Processing
- Software Text Analytics
- Testing Deep Learning Software Systems
- Software Bug Detection, Prediction, and Diagnosis
- Software Bug Tolerance and Recovery
- Security Vulnerabilities

Recommended Background

(Operating Systems and Systems Programming) or equivalent; or permission of the instructor

Grading *(Grades may be curved or adjusted at the instructor's discretion)*

- Research Project: 30%
  - I- Project Topic Selection 4%
  - I- Project Proposal, Literature Survey & Presentation 6%
  - I- Project Final Paper & Demo 20%
- Final Exam: 26% (The final exam may be a mix of (online) written and oral exam)
- Paper Critiques and Assignments: 16%
- Paper Presentation(s): 18%
- In-Class Discussion: 10%

You must pass the final exam (>= 60) to pass the course.

Final grades will be computed as follows:

*Normal = 0.30*Projects + 0.26*Final + 0.18*Critiques + 0.16*Presentation + 0.10*Discussion*

IF (Final < 60)

FinalGrade = min{Normal, Final}

ELSE

FinalGrade = Normal

The conversion that I use will be no worse than the following:

A+	97 - 100% of points
A	94 - 96% of points
A-	90 - 93% of points
B+	87 - 89% of points
B	84 - 86% of points
B-	80 - 83% of points
C+	77 - 79% of points
C	74 - 76% of points
C-	70 - 73% of points

D+ 67 - 69% of points
D 64 - 66% of points
D- 60 - 63% of points

Example Papers (this list is likely to change, and enrolled students can suggest papers!):

- *Problems and Opportunities in Training Deep Learning Software Systems: An Analysis of Variance. (ASE'20)*
- *Predicting Node Failure in Cloud Service Systems (FSE'18)*
- *Translating code comments to procedure specifications (ISSTA'18)*
- *DeepXplore: Automated Whitebox Testing of Deep Learning Systems (SOSP'17)*
- *Automatically Learning Semantic Features for Defect Prediction (ICSE'16)*
- *An Analysis of Patch Plausibility and Correctness for Generate-And-Validate Patch Generation Systems (ISSTA'15)*
- *Do Not Blame Users for Misconfigurations (SOSP'13)*
- *Bugs as Deviant Behavior: A General Approach to Inferring Errors in Systems Code. (SOSP'01)*
- *Fundamental Concepts of Dependability (2000)*

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Policies

By registering for this class, students agree to the following class policies:

- *Independent work*: All work turned in on critiques, assignments, and individual presentations will be that of the individual student. Discussions are allowed only for group presentations and group projects. Violations would result in zero credit to all students concerned. Check the Academic Integrity section for more.
- *Lateness*: students are responsible to submit their paper critiques and reports on time. No late submission will be taken without a well justified reason (for example, documented medical or family emergency).
- *Make-up Critiques*: If you miss submitting the critique for one paper, you can submit a critique for a paper from the "Additional Reading" list of the same topic. You can do this for **up to two papers**. The papers must have not been presented by the time of the makeup critique submission. All makeup critiques must be submitted by the last critique submission deadline.
- See the rest of the syllabus for COVID19-related special consideration

Paper Critiques

Students are required to read and submit paper critiques (**1 page per paper and 1 pdf file per week**) for the selected papers we discuss (in bold in the schedule) each week. You are expected to read both papers for each week, but only need to write a critique for the paper in bold and sometimes answer questions

about any of the papers (to be submitted with the critiques). The critiques including answers to questions for each week are due by **1:00 PM Monday** in **pdf format**. Papers can be downloaded from the schedule page. You may be required to answer specific questions regarding these papers.

The purpose of critiques is to help you gain more from reading papers. The critique must have the following content:

- Brief summary of the paper (about 2-3 sentences):

- Key contributions of this paper (what are different from previous work):

- Shortcomings of this paper (at least one that is not mentioned in the paper)

- Future work that the paper inspired you to think of (at least one that is not mentioned in the paper) -

- Ideas that you can borrow from this work to apply to your own or others' work

- At least one question that you want to discuss in class

The critique may contain the following content:

- Assumptions in the paper that you disagree with and how you think different assumptions would affect the outcome

- Comparisons between the paper and another paper or approach for the same problem

- Relationship between the problem being attacked in this paper and another problem

- How the paper relates to other papers or approaches

Paper Presentations

Each student is required to give one paper presentation (in a team of two). The student must upload his/her pdf (preferred for better compatibility) or power-point **slides** to D2L Brightspace **by 1:00 PM Monday** the week the presentation is scheduled so other students can view the slides and watch the videos in advance.

Schedule and Important dates

Here is a link to the Purdue Academic Calendar: https://www.purdue.edu/registrar/calendars/2020-21-Academic-Calendar.html

The schedule and important dates will be posted to D2L Brightspace.

Exams

The final exam may be a written exam, an oral exam, or a mix of both. Details will be released later.

Academic Guidance in the Event a Student is Quarantined/Isolated: If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be

reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur.

Attendance Policy during COVID-19 Students should stay home and contact the Protect Purdue Health Center (496-INFO) if they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, but the student still needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to take an exam. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible (a week in advance minimally). For unanticipated or emergency conflict, when such advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Classroom Guidance Regarding Protect Purdue The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, wearing a mask in classrooms and campus building, at all times (e.g., no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining proper social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their instructor. Students also have the option of reporting the behavior

to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

Course Evaluation

During the last two weeks of the course, you will be provided with an opportunity to evaluate this course and your instructor. Purdue uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site. You will have up to two weeks to complete this evaluation. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Academic Integrity

Academic integrity i one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Regarding the use of course materials

Course materials, such as notes, slides, projects, and exam questions, are "considered to be 'derivative works' of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials." As such, they cannot be sold or bartered without your express written permission. See the policy with regard to commercial note taking in classes (see part J of the Purdue student miscellaneous conduct regulations).

Course materials are not allowed to be shared outside of the class without instructor's written consent.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on our course Brightspace table of contents, under University Policies.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

Mental Health Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email. You are expected to read your @purdue.edu email on a frequent basis.