|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Term** | **Class No.** | **Section** | **Units** | **Days & Times** | **Room** | **Mode** |
| Spring 2020 | 499/599 | 001 | 3 | Tu 5:30PM-8:00PM | SICCS 102 | NAUFlex |

**Enrollment Requirements**

Pre-requisites: CS 249

**Course Website**

<http://bblearn.nau.edu>

**Instructor(s)**

Dr. Alex Groce

Email: alex.groce@nau.edu

Office Hours: Tuesday/Thursday 8:35AM-9:35AM

**TA:**

Lucina de la Rosa

Email: [dld297@nau.edu](mailto:dld297@nau.edu)

Office Hours: TBA

**Catalog Text (not actually, it’s not in the catalog)**

This course covers testing of embedded systems, and embedded software in particular. More generally, it covers testing and analysis of low-level, systems-oriented software in C and C++. Letter grade only. Co-covened with CS 599.

**Course Purpose**

This course is about how to test low-level software in C and C++, that interacts with systems/hardware aspects of computing, in particular. Testing is emphasized, but we’ll discuss static analysis as well, since it is an integral part of modern “testing”. The DeepState C/C++ test framework will be our primary focus as far as practical tools go.

**Grading System**

A weighted sum of assessment components is used to determine your final grade in the course:

* **Tests: 4 tests worth 20% each; the last will be a Final that is comprehensive plus covering the last part of the material**
* **Project: the implementation component of the course will be based on a comprehensive project submitted towards the end of the class, worth 15% of your grade**
* **Participation: 5%**

Graduate students taking 599 will be required to also take an additional test on advanced materials and include a research aspect to their final project (basing part of their work on a software testing publication from the last five years).

Grades will be assigned using the weighted sum described above using this scale:

**A** ≥ 90%, **B** ≥ 80%, **C** ≥ 70%, **D** ≥ 60%, **F** < 60%.

There is no “curve”. Each student’s grade is based on their own outcomes assessments and not affected by the grades of other students. Extra credit opportunities may present themselves throughout the semester and will be announced during class meetings. Mistakes in grading to happen, and students are encouraged to discuss such concerns with the instructor during office hours.

**The Project**

Near the end of the term you will submit a testing portfolio, in the form of a zipfile containing complete source code and scripts to run static analysis and automated testing on a C or C++ language project of your choosing. This may be a fork of an open source program or your own (substantial, meaningful!) code. The effort will be described in a 3 page (5 page for graduate students) pdf writeup, explaining what you did to test the code, and what bugs you found. The emphasis will be on demonstrating your understanding of the basic ideas of the course. You are required to use the DeepState tool, but other than this restriction you are free to explore various approaches to C/C++ test generation. Graduate students should include a discussion of a recent research result (within the last five years) in the field in their writeup (citing the relevant paper(s)), and apply a research method in their effort, beyond those discussed in class.

**Readings and Materials**

Readings are primarily from a blog that is in-progress, to form the basis of an eventual text on software testing and analysis. You can check out some of the posts already: https://howtotestit.wordpress.com/

**Class Outline and Tentative Schedule**

The course topics and a tentative schedule serve as an outline for the class:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Dates** | **Topics** | **Reading** | **Assignments & Tests** |
| **Module 1** | 1/11 -TBD | Introduction to Embedded Systems Testing and Overview of Course | Blog posts (specifics will be posted in bblearn) |  |
| **Module 2** | TBD | Basic embedded and low-level testing concepts: undefined behavior, sanitizers, fuzzing | “ | Test #1 |
| **Module 3** | TBD | DeepState basics  TOOL: https://github.com/trailofbits/deepstate | “ |  |
| **Module 4** | TBD | Hardware simulation, hardware testing | “ |  |
| **Module 5** | TBD | Code coverage | “ | Test #2 |
| **Module 6** | TBD | Mutation testing  TOOL: https://github.com/agroce/universalmutator | “ |  |
| **Module 7** | TBD | Test generation methods | “ | Test #3 |
| **Module 8** | TBD | Advanced topics | “ | Project, Test #4, Grad student test |

Please check BBLearn frequently for updates. **Classes will be available for online attendance through bblearn, using BB Collaborate Ultra. Please find BB Collaborate Ultra in BBLearn! These sessions will also be recorded and accessible via BB Collaborate Ultra.**

**Course Policies**

The following policies will apply to this course:

* Students who have not completed the prerequisite(s) for this course, or who do not participate in the first week of class may be administratively dropped from the course.
* The makeup and late work policies are as follows:
  + Homework: No make-ups or late submissions allowed.
  + Exams: Make-up exams will be given only in the case of a documented emergency supported by appropriate documentation **and** with approval from the instructor. Make-up exams may be considerably different than the original exam. Make-up exams must be taken within 3 business days of the original exam except in unusual circumstances.
* Cheating and plagiarism are strictly prohibited. All academic integrity violations are treated seriously. All work you submit for grading must be your own. You are encouraged to discuss the intellectual aspects of assignments with other class participants. However, each student is responsible for formulating solutions independently and in their own words. Academic integrity violations may result in penalties including, but not limited to, a zero on the assignment, a failing grade in the class, or expulsion from NAU.
* Grades will be entered in BBLearn but your final grade will be calculated in Excel using the grading system described above and then entered in LOUIE. Your final course grade will **not** necessarily appear in BBLearn. Please check LOUIE for your final grade.
* The Academic Success Centers offer free tutoring and academic support to improve your study skills and review course material in a number of engineering and math courses. You can schedule an appointment by visiting [nau.edu/asc](http://nau.edu/asc), calling the Academic Success Center at 928-523-7391 or swinging by Dubois Center room 140.
* Email to the instructor and teaching assistants must be respectful and professional. Specifically, all emails should:
  + Contain a salutation, (for example, “Dear Alex/Dear Dr. Groce/Hey Al if we are on particularly friendly terms”)
  + Contain a closing, (for example, “Best, Jane Doe”)
  + Use complete sentences and correct grammar including correct usage of lowercase and uppercase letters. Composing emails on a mobile device is **not** an excuse for poor writing.
  + The body of your message should also be respectful and explain the full context of the query.
  + The subject should be prefixed with “CS 345” so that the message can be easily identified. The subject should also use lower case and upper case correctly.
  + Although email will typically be answered quickly, you should allow up to three (3) business days for a response; but if it takes more than 3 days, ping me again – it may have been lost in the shuffle, sent to spam, etc..

**Syllabus Policy Statements:**

The information contained in this syllabus, other than this course’s grade and attendance policies, may be subject to change with reasonable advance notice.

Access to the Syllabus Policy Statements can be found at: <https://nau.edu/university-policy-library/wp-content/uploads/sites/26/Syllabus-Policy-Statements.docx>

** Syllabus**

**Requirements**

# Appendix A: Syllabus Policy Statements

# COVID-19 Requirements and Information

**The following statements in red set forth in this document’s first section are specific to NAU’s response to the COVID-19 situation. The requirements outlined below are mandatory until further notice.** They are based upon current public health conditions and guidance and may change as circumstances warrant or new information becomes available. Additional information about the University’s response to COVID-19 is available from the **Jacks are Back!** web page located at [https://nau.edu/jacks-are-back/lumberjack-responsibilities](https://nau.edu/jacks-are-back/lumberjack-responsibilities/).

**FACE COVERING AND PHYSICAL DISTANCING REQUIREMENTS**

Appropriate face masks or other suitable face coverings must be worn by all individuals when present in classrooms, laboratories, studios, and other dedicated educational spaces. To maximize the benefits of physical distancing as an important strategy to help reduce community transmission of the SARS-CoV-2 virus, instructors may implement mandatory student seating arrangements or specific seat assignments. Instructors may remove students who do not cooperate with these requirements from the instructional space in the absence of an approved accommodation arranged through Disability Resources. Failing to comply with these requirements may constitute a violation of the university’s *Disruptive Behavior in an Instructional Setting* policy available at <https://nau.edu/university-policy-library/disruptive-behavior>.

**USE NAUFLEX TO HELP MAINTAIN PHYSICAL DISTANCING**

NAUFlex (available at <https://nau.edu/nauflex/student>) is designed to help all students actively participate in their coursework during the required day and time of a course when they are not physically present in the classroom. This course design model allows students to be fully engaged with faculty and peers and receive the high-quality educational experience for which NAU is known.

**CLASS SESSION RECORDINGS FOR STUDENTS AND FACULTY USE ONLY**

Certain class sessions may be audio or video recorded to help reinforce live instruction during the COVID-19 pandemic. These recordings are for the sole use of the instructor and students enrolled in the course. Recordings will be stored in approved, accessible repositories. By enrolling, students agree to have their image and classroom statements recorded for this purpose, to respect the privacy of their fellow students, and university-owned intellectual property (including, but not limited to, all course materials) by not sharing recordings from their courses. Questions regarding restrictions on the use of classroom audio or video recordings may be addressed to the appropriate academic unit administrator.

# Syllabus Policy Statements

## ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people’s ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU’s online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

## COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224 – *Academic Credit*), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

## DISRUPTIVE BEHAVIOR

Membership in NAU’s academic community entails a special obligation to maintain class environments that are conductive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of “W”. For additional information, see NAU’s *Disruptive Behavior in an Instructional Setting* policy at [<https://nau.edu/university-policy-library/disruptive-behavior>](https://nau.edu/university-policy-library/disruptive-behavior).

## NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU’s *Safe Working and Learning Environment* (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at [equityandaccess@nau.edu](mailto:equityandaccess@nau.edu), or via the EAO website at <https://nau.edu/equity-and-access>.

## TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a “Title IX Coordinator” to monitor the institution’s compliance with this important civil rights law. NAU’s Title IX Coordinator is Elyce C. Morris. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3515, by fax at 928-523-0640, or by email at [elyce.morris@nau.edu](mailto:elyce.morris@nau.edu). In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <https://in.nau.edu/title-ix>.

## ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or [dr@nau.edu](mailto:dr@nau.edu) (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU’s Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at [jamie.axelrod@nau.edu](mailto:jamie.axelrod@nau.edu).

## RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

## MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University’s Research Integrity Officer, Dr. David Faguy, who can be reached at [david.faguy@nau.edu](mailto:david.faguy@nau.edu) or 928-523-6117. More information about misconduct in research is available at [https://nau.edu/university-policy-library/misconduct-in-research](https://nau.edu/university-policy-library/misconduct-in-research/).

## SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

*Last revised August 3, 2020*