

## **SYLLABUS: CEN 6070 SOFTWARE TESTING AND VERIFICATION**

Summer 2012 Pre-Recorded EDGE Offering

**Description:** Software Testing and Verification is a survey course on concepts, principles, and techniques related to software testing and formal program verification. Students will become acquainted with both the strengths and limitations of various functional and structural testing methods, as well as techniques for proving the functional correctness of sequential programs. Topics include: black-box and white-box test case design strategies, incremental integration testing techniques, inspections and reviews, axiomatic verification techniques, predicate transforms, and function-based verification. Students will have the opportunity to practice the techniques presented in lectures via optional exercises.

### **Prerequisites:**

- (1) Successful completion of an upper division undergraduate or graduate-level software engineering survey course (such as CEN 3031/5035), or permission from the instructor. (Students who have been employed as software professionals automatically meet this requirement.)
- (2) Familiarity with programming using a high-level language (C, C++, Java, etc.), and
- (3) Basic knowledge of algorithms, data structures, object-oriented design principles, and discrete math.
- (4) Students who have earned credit for CEN 4072 may NOT take CEN 6070 for credit.

A self-assessment *pre-test* is available at the course website to assist students in determining their preparedness for the course vis-a-vis coverage of a small subset of prerequisite knowledge.

**Instructor:** Steve Thebaut, CSE314-A, E-mail: [smt AT cise DOT ufl DOT edu](mailto:smt@cise.ufl.edu). Additional contact info is available on the course website.

**Course Logistics:** All 40 lectures are pre-recorded from the spring 2012 offering of the course and available for viewing at any time during the summer via UF's "e-Learning in Sakai" system at <http://lss.at.ufl.edu> (You will need your GatorLink account and password to access this site.) Note that the summer term is compressed compared to the fall/spring terms, and the two exam dates (see below) are firm. **Plan to view about 4 lectures per week, on average.**

**Course Web Site:** Available via the Sakai system at <http://lss.at.ufl.edu>  
You may also access the website directly at: [www.cise.ufl.edu/class/cen6070/su12.html](http://www.cise.ufl.edu/class/cen6070/su12.html)

**Course Materials:** Lecture notes are available on the course web site in PowerPoint format (see additional info below under "Instructor Tips and Advice"). A collection of required readings may be purchased as a packet from *Target Copy*, 1412 W. University Avenue, (352) 376-3826. (Note that copies of the packet are on reserve at Marston Science Library, and that references for the individual readings are posted on the course website under "Reading List.") An *optional* textbook, Pezze and Young's *Software Testing and Analysis*, Wiley, 2008, is recommended only for students who wish to have additional software testing and analysis reference material at their disposal.

**Outline of Course Topics:** The following topical areas will be covered in the order listed.

|   |                                     |
|---|-------------------------------------|
| Intro to V&V Techniques and Principles  | Formal Program Specification        |
| Requirements and Specifications         | Axiomatic Verification              |
| Black-Box Test Case Design Strategies   | Weak Correctness                    |
| Partition Testing                       | Rules of Inference                  |
| Combinatorial Approaches                | Strong Correctness                  |
| Other Strategies                        | Predicate Transforms                |
| White-Box Test Case Design Strategies   | Proving Strong Correctness          |
| Logic Coverage                          | Computing Weakest Pre-conditions    |
| Dataflow Coverage                       | Functional Verification             |
| Path Conditions and Symbolic Evaluation | Complete and Sufficient Correctness |
| Other Strategies                        | Axiom of Replacement                |
| Integration and Higher Level Testing    | Correctness Conditions              |
| Testing Object-Oriented Software        | Iteration Recursion Lemma           |
| Reviews and Inspections                 | Revisiting Loop Invariants          |
| Testing Tools                           | Cleanroom Software Engineering      |

**Examinations and Grades:** Course grades will be based *SOLELY* on two equally weighted 90-minute exams (see exam schedule below). A histogram of numeric scores will be provided with solution notes for each exam. Course letter grades will be determined at the end of the semester.

**Exam schedule:**

Exam 1: **Wednesday, June 20.** Covers class material through lecture 21. Coverage: "Intro to V&V Techniques" through "Testing Tools" + associated readings.

Exam 2: **Wednesday, August 1.** Covers remaining class material through lecture 40. Coverage: "Formal Program Specification" through "Cleanroom Software Engineering" + associated readings.

All students residing in Gainesville are required to take the exams at the same time and on-campus location (to be posted on the course website) on the dates specified above. Students NOT residing in Gainesville must take the exams within a 2-day window after these dates (e.g., Thursday or Friday), and should make arrangements with their EDGE-approved proctors to do so well in advance. (Proctors will be instructed to schedule a SINGLE EXAM TIME for all students at each off-campus site or location.)

**Make-Up Exam Policy:** Students are expected to make every effort to be available at scheduled exam times. Do not schedule elective activities (family gatherings, business or interview trips, etc.) that conflict with scheduled exams. If missing an exam is unavoidable (e.g., due to sickness, accident, or other reasons beyond your control), contact the instructor as far in advance as possible. Make-up exams, when permitted, may be administered orally.

Note that depending on the circumstances, it may NOT be possible to administer a permitted make-up exam before the end of the term. In such cases, a course grade of "I" (incomplete) may be assigned.

**Problem Sets:** There are 7 non-graded problem sets covering the areas:

- |   |                             |
|---|-----------------------------|
| (1) Black-box Testing                       | (5) Axiomatic Verification  |
| (2) Logic Coverage                          | (6) Predicate Transforms    |
| (3) Dataflow Coverage                       | (7) Functional Verification |
| (4) Path Conditions and Symbolic Evaluation |                             |

Some problems may be non-trivial and/or require the *creative application* of techniques presented in lectures. You are strongly encouraged to work on the problem sets, either alone or in groups, **BEFORE** consulting the posted solution notes. Problem set introductions, discussions, hints, and solution reviews will be provided in the lectures. Note that exams assume a *thorough* understanding of the problem sets and their solutions.

**Tips and Advice:** Most of the lecture notes available on the course website under "Lecture Notes" are provided in two versions. Links in the column labeled "Student Notes" open abbreviated versions of the full lecture notes, which are available via links in the column labeled "Lecture Notes". The former are intended for printing in "handout" format and may be used for note-taking while viewing the taped lectures. The full lecture notes are intended for on-line review and study *after* viewing the taped lectures. Remember that the summer term is compressed compared to the fall/spring terms; **plan to view about 4 taped lectures per week, on average.**

Although problem set solution notes are posted on the course website, students are strongly encouraged to at least attempt all problems before viewing solutions.

**Computer Facilities:** Access to e-mail and the WWW is required.

**Academic Integrity:** All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

You will be asked to sign the following statement on both exams in this course:

*On my honor, I have neither given nor received unauthorized aid on this exam and I pledge not to divulge information regarding its contents to those who have not yet taken it.*

**UF Counseling Services:** Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- University Counseling Center, 301 Peabody Hall, 392-1575: personal and career counseling.
- SHCC Mental Health, Student Health Care Center, 392-1171: personal and counseling.
- Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161: sexual assault counseling.
- Career Resource Center, Reitz Union, 392-1601: career development assistance and counseling.

**Software Use:** All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

**Instructor Bio:** Steve Thebaut received the BA in Mathematics from Duke University in 1977, and the MS and PhD in Computer Science from Purdue University in 1979 and 1983, respectively. He is currently Associate Chair of the CISE Department. Dr. Thebaut's research interests include software requirements engineering, testing and verification, and software engineering technology transfer. He has received funding from the National Science Foundation, IBM, the Florida Department of Education, the Florida High Technology and Industry Council, the Sino-Software Research Center at HKUST, the Software Engineering Research Center, and the Software Engineering Institute (SEI) at Carnegie Mellon University, where he was an invited lecturer in the SEI production of "Software Project Management," a nationally distributed video-based continuing education course. He has been a course developer and consultant for IBM's IS&PG Technical Education program, and has served on the program committee of the Conference on Software Engineering Education. He was Associate Editor of the International Journal of Computer and Software Engineering from 1990-1996.