



Elective-4 (Software Testing and Analysis – 2)

Course Logistics

(subject to change with notice)

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Administrative Information

- Instructor: Dr. Sobeih
 - **E-mail:** dr_sobeih@yahoo.com
 - Office: 3716 Computer Engineering Department
Architecture Bldg., 7th Floor
 - Office hours: *by appointment only*; please let me know in advance to set up a date and time
- TA-1: Check the course info
- TA-2: same as TA-1 if there is only one TA. Check the course info
- Newsgroup: swtesting2@yahoogroups.com
- **URL:** <https://groups.yahoo.com/group/swtesting2/>
 - If your membership request was not approved in 72 hours, send an e-mail to TA-1, and TA-1 will send you an invitation to join.

Course Prerequisites

- I assume that you already know:
 - C/C++ and Java
 - Note: The examples and the exercises in the textbook are all in Java. Make sure you're comfortable with them!
 - Based on previous offerings of this course, the programming language has (almost) never been the problem
 - Data structures and algorithms
 - Object-oriented programming
 - Software engineering
 - Basic discrete math, logic and graph theory
 - **Material covered in “Software Testing and Analysis - 1” course that I taught in the previous semester**
- I also assume that you can follow simple instructions ...

Course Intended Learning Objectives (ILOs)

- State essential facts, concepts and principles related to logic coverage criteria and syntax-based coverage criteria.
- Design, execute and evaluate test sets satisfying certain coverage criteria on several types of software artifacts: source code, specifications, finite state machines (FSMs), and BNF grammars.
- Identify different techniques used for running a regression test.
- Identify, select and apply appropriate methods for implementing a test oracle for the software under test (SUT).
- Integrate effective *testing* strategies into the overall software *development* process.
- Apply software testing techniques on a large-scale software project.
- Profile software and enhance its performance.

Required Textbook

- “Introduction to Software Testing” by Paul Ammann and Jeff Offutt, Cambridge University Press, 1st edition, 2008, ISBN-13: 978-0521880381
 - URL: <http://cs.gmu.edu/~offutt/softwaretest/>
 - on reserve in the CUFÉ library; its code is **MIC38**
 - Student solution manual and support software also available on the textbook website
 - Slides are also available online
<http://cs.gmu.edu/~offutt/softwaretest/powerpoint/>
 - Errata list is also important
 - Resources keep being updated; so make sure you check out the latest update (especially before taking an exam)

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- Note: My slides will not be available. You do not need them!

Required Textbook (cont'd)

- **MIC38** : “Introduction to Software Testing” by Paul Ammann and Jeff Offutt, Cambridge University Press, 1st edition, 2008, ISBN-13: 978-0521880381
- Material that was covered in “Software Testing & Analysis - 1”
 - Chapter 1
 - Chapter 2 (except Sections 2.5 and 2.7)
 - Chapter 4
 - Section 6.5.2
- Material that will be covered in “Software Testing & Analysis - 2”
 - Chapter 3 (except Section 3.6)
 - Sections 5.1 and 5.5
 - Sections 6.1 and 6.5
 - Profiling (not in textbook)

Self-Learning Policy



- My courses usually contain a (small?) part of self-learning
- I will give you some reading assignments from the textbook ...
 - You must have access to the textbook
 - **We may ask you to bring your textbook to class**
- I may also give you reading assignments to look them up on the Internet ...
- All reading assignments are included in the course
 - i.e. may be on the exams!

Tentative Schedule (subject to change with notice)

Week	Section	Topic
1-2	3.1; 3.2	Overview of Logic Coverage
3	3.4	Logic Coverage of Specifications
4-5	3.3	Logic Coverage of Source Code
6	3.5	Logic Coverage of Finite State Machines
7	6.1; 6.5	Regression Testing; Test Oracles
TBD	---	Mid-term Exam (exact date TBD by college / department)
9-10	5.1; 5.5	Syntax-based testing and BNF grammars
11	not in textbook	Profiling and performance enhancement of software
12 and/or 13	---	Project Demo and Discussion (exact date TBD)
14	---	Make-up; Office Hours; Revision

Discussion Sections

- Before each discussion section, I will notify you what you will do in the section
- Students should come to the discussion section having already thought about the solutions to the problems; otherwise you will not gain much from the section.
 - **Always bring your problem sets to the section**
- Each section is 90 minutes long. If you finish early, the TAs will stay in class (or in office) during the remaining time to see if any students have any questions about the course and/or the projects.
- Make use of any available time to discuss your projects with the TAs

Assessment

- **15% Mid-term exam** Date: TBD
- **15% Project**
- **70% Final exam** Date: TBD

Note: All exams are cumulative (i.e. cover all of the material until the moment of the exam), closed-book, closed-notes, and open-mind

Bonus: I may give you a merit-based bonus (depending on your performance). The TAs cannot give a bonus!

However, I may ask the TAs about which student(s) they want to give a bonus, and why. I reserve the right to decline.

Grading

- College grading policy for undergraduate students
 - Excellent (85%)
 - Very good (75%)
 - Good (65%)
 - Pass (50%)
 - Fail ($< 50\%$)

- I cannot change the cutoff points ...

Grading Policy

- Grading the mid-term and final exams is “absolute”
 - if you get the right answer, you get the score
- Grading the project and its deliverables is “relative”
 - you are evaluated compared to your peers
 - the highest possible grade is “A”
 - the lowest possible grade is “Z” (i.e. zero), if you did not do anything or in the case of violating the academic integrity
- Members of the **same** group may get **different** grades, depending on the quantity and quality of the work each member did. (We do not like doing that, but sometimes we have to.)
- If a team member is not participating adequately in the group work, he/she may be asked to leave the team and either work alone or join a team specifically made out of the non-participating members in all other teams

Project

- Goal and Scope:
 - Apply the software testing concepts and techniques that you study in class on a large-scale software project
 - You will have to write a report and make a presentation and demo on your project
- You must have access to the source code
- Software must be an integral and important part of the software under test (SUT)
 - e.g. do not choose a project that is 80% hardware!

Project (cont'd)

- Most important grading criterion is the “depth” of your work:
 - test design and generation: *have a reasonable set of test cases that satisfies the coverage criteria explained in class* **IN THIS SEMESTER**
 - You may use *at most* 3 criteria from the previous semester
 - test automation and execution: *execute the tests on the software under test (SUT)*
 - test evaluation: *measure and collect some coverage data; any failures observed?* (you will have to write a test oracle)
 - debugging: *faults found? faults fixed?*
 - regression testing: *done after the software has changed*
- Other important grading criteria:
 - breadth of your work: coverage criteria considered? coverage levels achieved?
 - quantity and quality of the faults that you have found and fixed (do not manually inject a fault 😊)

Project (cont'd)

- Yes, you are allowed to use any *legally-obtained* tools from the Internet:
 - this includes, but is not limited to: test generation, test automation, test execution, test evaluation, coverage analysis tool, debugger, profiler, etc.
- You may start with testing the hotspots --- code that is used most frequently and/or a significant proportion of program execution time is spent in it
 - hint: use a profiler

Where to search for software testing tools

- An incomplete list (in no particular order) ...
- <http://people.engr.ncsu.edu/txie/softtestingedu.html>
- <http://www.cs.cmu.edu/~aldrich/courses/654/tools/>
- <http://www.cs.purdue.edu/homes/apm/foundationsBook/TestProcessTechniquesTools.pdf>
- <http://www.testingfaqs.org/>
- <http://opensource-testing.org/>
- <http://www.aptest.com/resources.html>
- <http://www.whyprogramsfail.com/resources.php>
- <http://srl.cs.berkeley.edu/~ksen/doku.php?id=projects>
- <http://sourceforge.net/>
- ... and many other links ...
- or just use your favorite search engine: google, yahoo, etc.
- Advice: Make sure that the “tool” compiles and runs!

Project (cont'd)

- You may:
 - implement your own tool
 - (+) great experience in and of itself
 - (+) if done well, may look impressive on a CV
 - (-) may be time-consuming
 - (-) could be error-prone; your results are “as good as” the tool you built
 - generate tests randomly
 - (+) easy and fast
 - (-) may suffer from low coverage levels
 - generate tests manually
 - (+) good for educational purposes
 - (-) may be very tedious



Project Schedule and Deliverables

Due Date	Deliverable
3 rd week	Group formation: by e-mail; no hardcopy needed
5 th week	Project proposal: Report (softcopy)
5 th week	Project proposal: Report (hardcopy)
TBD (usu. 12 th and/or 13 th week)	Final Submissions: Report (softcopy); Presentation and demo (softcopy)
TBD (usu. 12 th and/or 13 th week)	Final Submissions: Report (hardcopy) and CD

Unless stated otherwise:

- 1) Softcopies are due at 11:59:59 pm, by e-mail
- 2) Hardcopies are due on the following day at the class meeting time, **NOT** in my mailbox.
- 3) The CD must contain EVERYTHING: report, presentation, demo, code, test scripts, etc.

“Group Formation” Checklist

Submit the same e-mail to the TAs and to me:

a plain text e-mail, no attachments, indicating the following information for each group member:

- a) Full name (as it appears on the class list), section number, and bench number
- b) E-mail address

TA-2 will:

- check that each team is 3 – 5 students. (We recommend 4)
- assign each group a unique name (in English) from the month or day names; e.g. January, February, March, ..., Sunday, Monday, Tuesday, ...

(No two groups will have the same name)

Within one week: TA-2 will upload a file indicating the group name of each student.

“Project Proposal” Checklist

Includes the following (≤ 4 pages excluding appendices):

- 1) SUT; description and use, software URL, why you chose this software, “size” of the software, etc.
- 2) languages, tools, IDEs, any other relevant information (judgment call)
- 3) A work plan for the rest of the semester
- 4) References (and appendices if any). **We may or may not read the appendices. Do NOT print them!**

**Submit the same e-mail to the TAs and to me: SOFTCOPY
ATTACHMENT as ONE PDF ONLY**

i.e. only one e-mail having only one PDF attachment submitted to all of the class personnel: Dr. and TAs

Submit: HARDCOPY of the project proposal to TA-2.

TA-2 will check that no two groups have the same project:

- Proposals will be approved on a FCFS basis

Within one week: TA-2 will provide you with feedback

The “Final Submissions” Checklist

Submit the same e-mail to the TAs and to me: 3 attachments

- Report (**≤ 20 pages excluding appendices**): SOFTCOPY ATTACHMENT as ONE PDF ONLY
 - **We may or may not read the appendices! Do not print them!**
 - In your report, please describe the contents of the CD very clearly; e.g.:
 - test scripts are in a folder called “Scripts\Test”
- Presentation and Demo: SOFTCOPY ATTACHMENT as ONE POWERPOINT and ONE PDF

We will let you know to whom you should submit:

- Report **HARDCOPY**.
- CD (remember: CD must include EVERYTHING). Write the semester, the course code and title, and your group name on the CD itself.

TA-2 (and/or TA-1) will take part in grading your projects, and we will post the term work score of each student one week before the final exam

Important Note

The very last page of your report must indicate what each team member did:

- Be very clear and specific
- Put in a table

Team Member	Activities
Name and e-mail address	An itemized list of activities 1. 2. 3.

- Provide hyperlinks to previous sections
- Do **NOT** include “writing the report” or “documentation” in the list of activities!

Project Demo and Discussion

- We will meet with each group for 10-15 minutes in the office (TA-2 will send you the schedule ...)
 - Each group member will have to present his/her own work
 - You need to tell us what's so strong about your project work. Essentially, why do you think we should give you an "A"?
 - Bring a **laptop** because we will ask you to make a demo
 - If you don't have a laptop, borrow one from your colleagues or we can meet at the computer lab (subject to availability)
- **Meanwhile**, other groups will be presenting their project work in class or in the computer lab (again, subject to availability) to other students and the TAs
- Checklist for each student during that day:
 - 1) participate in his/her group demo and discussions
 - 2) present his/her work to other students and the TAs (think of it as an opportunity for you to learn from each other)

General Formatting Requirements

- 1) No need for a cover page; just include the semester, the course code and title, and your **group name** in the header
- 2) Must have project title, group members' names and e-mail addresses at the top center of the first page (as in research papers)
- 3) All hard-copy submissions should be double-sided (if possible)
- 4) Either staple your papers firmly or use a firm paper-size (spiral) binder. No removable paper clips or binder clips.
- 5) Page numbers in the footer please (just in case the staples fall out)
- 6) Make use of bookmarks, hyperlinks and cross-references. Yes, they should survive the Word to PDF conversion

Note: Never send us compressed, Word, Excel, or EXE files!

Submissions Policy

- Hardcopy (double-sided if possible)
- In any submission (or just any correspondence with us) via e-mail, your e-mail subject line must be:
 - [Elective-4] [Your group name]
- **The file name of any softcopy must have your group name;**
e.g. Elective-4-YourGroupName-Report.pdf
Elective-4-YourGroupName-Presentation.pdf
- Late submissions (after due date; e-mail softcopy and leave hardcopy at the mailbox ASAP):
 - Points will be taken off for late or incomplete submissions (e.g. softcopy, but no hardcopy)
- Your submission should be your own team work
 - Copying from other teams or from the Internet will simply get zero

Academic Integrity

- Simply stated, any work that has your name on it should be your individual and original work
 - Yes, this applies to any work, even a 1% assignment!
- Violations of academic integrity (e.g. cheating, plagiarism, etc.) are **not** tolerated, and will be punished to the maximum extent possible as permitted by the college/department policy
- If you violate the academic integrity, you will (at least):
 - 1) Get zero on whatever you violated the academic integrity!
 - 2) Not get any bonus in this course!

I have the right, and the duty, to notify the administration
- Check the college/department policy for more details ...

Exams Policy

- Anything said/done in class is included in exams
- Bring your original, valid university card (or photo ID)
- Bring everything you may need; you will not borrow anything from your colleagues (imagine you're taking the exam alone!)
- **No mobile phones, laptops or programmable calculators** are allowed in exams
 - We will let you know if standard, non-programmable calculators are allowed
- Follow any other rules announced in the exam room
- Continuing to talk during an exam, despite being warned, will be considered cheating
- If you cheat or make a disruptive behavior during an exam:
 - this behavior will be penalized to the maximum extent possible according to the college/department policy
 - I have the right, and the duty, to notify the administration

Make-up Exams Policy

- Make-up mid-term exams are offered only under truly exceptional circumstances that are documented and verifiable
 - Check the college/departments policy for acceptable “excuses”
 - You have to bring an official document from the Students Affairs office
 - To ensure fairness: The make-up exam is also cumulative; i.e. may, and most likely will, cover more material than the original exam!
- If you miss the final exam, you have to check the college/departments policy on what you can/have to do ...

Exam Regrade Policy

- Regrade requests and appeals must be computer-typed hardcopy (no oral, no handwritten, no softcopy, no e-mails), signed and dated
- Submit your regrade request to the TA who graded your exam, within 1 week from the date you got your exam paper. No extensions!
- Suggested structure of the request: Please be very specific
 - 1) Course name, your name and e-mail address
 - 2) Question number: e.g., Mid-term exam, Question 1-a
 - 3) Specific request: e.g., Get two more points
 - 4) Rationale: why you think you deserve these two more points ...
 - 5) Attach your exam paper
- Wait for the TA's response. If the TA's response does not satisfy you, you have the right to appeal to me within 10 days. Again, no extensions!
- You must give your appeal to me by hand; do not put it in my mailbox
- Suggested structure of the appeal: Please be very specific
 - 1-5) Five items above
 - 6) TA's response
 - 7) Your rebuttal to the TA's response
- I will respond to you as soon as I can. No promises.
- I trust the TA's judgment; you'd better have a very strong appeal
- I will actually "regrade" your exam paper; i.e. **yes, you may lose points!**

Your today's to-do list

- 0) Decide: Take it or leave it?
- 1) Join the newsgroup; you are responsible for any announcements made, files uploaded, etc.
- 2) Go to the newsgroup website:
 - Download the “Course Logistics” slides from the “Files” area. Read them very carefully and prepare any questions you may have for next time ...
- 3) Go the CUFE library for the textbook [**MIC38**]
- 4) Start working on your project: group formation, SUT choice, ...
- 5) Relax! I hope you'll enjoy the course 😊



How to join a Yahoo! group? (in case you don't already know!)

- Login to your Yahoo! account. (Create an account for free at www.yahoo.com if you don't have one already)
- Go to the newsgroup website (see the Administrative Information slide above)
- Click on the “Join This Group!” button on the right
- Step 1) Fill in your contact information. *Write your full name (as it appears on the college roster) in the “Comment from user:”*
- Step 2) Message Delivery. Choose “Individual Email”
- Step 3) Message Preference. Choose “Fully Featured”
- After filling out everything, click on “Join”
- Wait for confirmation ...
- ***Check your spam / junk folder. Messages may go there!!***

Note: The TAs and I will only use this newsgroup for the e-mails sent to all students.

Notes to the TAs

- Approve the students' requests to join the newsgroup.
- Include yourself in proctoring the mid-term exam.
 - Right after the mid-term exam, let me know the names of students who were absent on the exam, if any.
- Do not change the date or time of the sections.
- Finish the sections promptly on time. Never go over time!
- Use the newsgroup to send announcements to students. Do not send them announcements on any other newsgroup or social networking website.
- Do not send files as attachments. Instead, upload them to the Files area of the newsgroup. Make sure that you notify all group members right after a file has been uploaded / updated.
- Never upload compressed, Word, PowerPoint or EXE files

Notes to the TAs (cont'd)

- For students' scores: each TA must maintain ***two identical*** files (Excel and PDF) on the newsgroup under "Files > Grades"
 - Use the official sheet with the students' full names **in Arabic**. You can get it from the secretary. It would be better if it contains only the students choosing this course (not all students).
 - Project scores must be available on the newsgroup within **3** days
 - The scores of anything else (mid-term exam, etc.) must be available on the newsgroup within **7** days.
 - Do not leave the cell of any score empty. If the student were absent, put the number 0 instead.
 - In the header of each column, specify:
 - the type ("mid-term", "project")
 - the date. This helps us in dealing with students who were absent with excuses.
 - In the row of each student, indicate his/her project group name

Notes to the TAs (cont'd)

- For the course file: Please include the following:
 - all files on the newsgroup: course logistics, problem sets, term work, etc.
 - three samples of students' work for each: mid-term exam, project deliverable (report and CD), etc.
 - Start working on the course file early. I will keep checking it regularly.
- Course files are now made online. I will send you the URL.

Final Note

- Anything mentioned in these slides is subject to change with notice ...