

Spring 2018 CQI Report Software Curriculum

November 21, 2018

Committee: Omar Badreddin, Claudia Casas, Yoonsik Cheon, Ann Gates, and Salamah Salamah.

The Software cluster consists of four classes: CS 3195 Junior Professional Orientation, CS 3331 Advanced Object-Oriented Programming, CS 4310 Software Engineering I, and CS 4311 Software Engineering II.

The committee met on November 13, 2018 and reviewed the assessments of the learning outcomes provided by the course instructors. The stated course outcomes of all four courses were met, most satisfactory, except for one outcome that was not assessed. The committee also confirmed that the stated course outcomes align very well with the IEEE/ACM CS Curricula 2013, covering most of topics listed in SDF/Development Method and SE. The recommendations below are those made by the instructors and the committee members.

Revision of Course Outcomes (Need Faculty Approval)

The committee approved the following changes to the course outcomes of CS 3331 and CS 4311.

CS 4311:

2d. Relate general strategies for creating a design of a system.

⇒ **2c. Apply** general strategies for creating a design of a system.

2c. Relate general strategies to identify and implement appropriate software architecture styles (including distributed and cloud) for the system under development.

⇒ **2d. Apply** general strategies to identify and implement appropriate software architecture styles (including distributed and cloud) for the system under development.

CS 3331:

2e. Use frameworks and library classes and methods in problem solutions.

⇒ 2e. Use frameworks and library classes and methods, **such as collections, GUI, multithreading, and networking**, in problem solutions.

CS 3195 Junior Professional Orientation

This course provides an overview to the Computer Science profession with an emphasis on ethics and the local and global impact of computing on individuals, organizations, and society. In Spring 2018, it was taught by Claudia Casas using the textbook, *A Gift of Fire: Social, Legal, and Ethical Issues for Computing Technology* (Sara Basse, 4th edition, Pearson, 2012). The committee recommends to:

- Continue making an appropriate adjustment/arrangement for a half-semester course (e.g., speakers and mockup interviews).
- State explicitly whether each course outcome was met or not. A summary in an easily-checkable form, e.g., table, will also help.
- If any, describe briefly how the concerns/recommendations from the last CQI were addressed.

CS 3331 Advanced Object-Oriented Programming

This course provides an in-depth exposure to the object-oriented programming paradigm. In Spring 2018, it was taught by Yoonsik Cheon, and the course textbooks included Xiaoping Jia, *Object-Oriented Software Development Using Java*, second edition, Addison Wesley, 2003, Martina Seidl, et al., *UML@Classroom: An Introduction to Object-Oriented Modeling*, Springer, 2015 (ebook), and Cay S. Horstmann, *Core Java SE 9 for the Impatient*, 2nd edition, Addison-Wesley, 2017 (ebook). The committee recommends to:

- Monitor the outcome that was met marginally (3e unit testing).
- Continue incorporating best practices and educational technologies, such as application-driven approach, pair/group programming, incremental assignments, and the quiz app).
- Provide help in identifying a qualified TA who is knowledgeable on the course subject, e.g., someone who took this class and/or CS 4310/4311. Due to the nature of this course (low-level design and coding), adequate TA support is essential for its success. The course TA should be able to give good and effective feedback on students' design and coding work, be knowledgeable on OO design and programming, and be familiar with development environments (Eclipse/IntelliJ IDEA, Git, JUnit).
- Ask for continued support for an undergraduate teaching assistant (IA). The IA was very helpful, especially with a large size.

CS 4310 Software Engineering I

This course is the first semester of a two-semester capstone project in which students work with a customer to capture and specify requirements for a real-world application. In Spring 2018, it was taught by Ann Gates and the class worked with a team from the Army Research Laboratory. The course textbook was Hull, E., Jackson, K., and Dick, J. *Requirements Engineering*, 3rd edition, Springer. The committee recommends to:

- Continue incorporating technologies like iClicker to facilitate and improve student learning.
- Introduce Software Engineering Code of Ethics earlier in the course, considering its increased importance in CS curricula.
- Assess more rigorously Outcome 2f (importance of professional society).
- Consider offering 1 or 2-credit course on non-functional requirements, or a unified, lab-type (technical elective) course to address concerns of all three courses, i.e., requirement, design and coding.

CS 4311 Software Engineering II

This is the second semester of a two-semester capstone project in which students design and implement a real-world application specified in CS 4310. In Spring 2018, it was taught by Salamah Salamah, and the course textbook were S. Pfleeger and J. Atlee's *Software Engineering: Principles and Practice* (4th edition, Prentice Hall, 2009) and R. Wirfs-Brock, et al.'s *Designing Object-Oriented Software* (Prentice Hall, 1990). The committee recommends to:

- Develop a way to measure the outcome 2j (analysis of nonfunctional properties) that wasn't assessed.

- Monitor the outcomes that were met “marginally” with average scores 70-74%, i.e., outcomes 2b (detailed design) and 2c (architectural styles). This might be a concern, as it repeats (see the 2016 CQI report).
- Discuss with department faculty (especially those teaching the Fundamental courses) ways to improve students’ skills in formulating and writing assertions in the first-order logic. Students continue to score low on writing pre and post conditions as part of detailed design (2b).

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Course Outcomes Analysis
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This document describes the learning outcomes obtained in CS 3195 in Spring 2018. The first part consists of the syllabus, interleaved with comments on student learning, and second part gives our overall recommendations and the third part some more information about the Ethics outcomes.

Part 1: Syllabus and Detailed Outcomes Analysis

Course Description

This class will provide an overview to the Computer Science profession with an emphasis on ethics and the local and global impact of computing on individuals, organizations, and society.

Prerequisites by Topic

Junior standing required for this course.

CS2302 required unless approved by instructor.

Textbook

Baase, Sara (2012). *A Gift of Fire: Social, Legal, and Ethical Issues for Computing Technology (4th Edition)*

Class Objectives

1. To attain an ability to analyze the local and global impact of computing on individuals, organizations, and society
2. To analyze current issues in professional ethics related to computing
3. To reflect on your professional development and personal goals with respect to employment opportunities and career paths
4. To be able to prepare a professional portfolio
5. To learn interview techniques
6. To understand the importance of continuing education with an emphasis on graduate school
7. To hone writing and presentation skills

Level 1: Knowledge and Comprehension

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level. Upon successful completion of this course, students will be able to:

- a. **Describe techniques for face-to-face and telephone interviews.**
- b. **Recognize possible post-baccalaureate paths, including graduate study, entrepreneurship, and employment in government, academia, and the private sector.**
- c. **Describe the role of ethics in society and software engineering.**
- d. **Describe the need and venues for continuing professional development.**

Level 2: Application and Analysis

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details. Upon successful completion of this course, students will be able to:

- a. **Set short-term and long-term goals based on one's strengths, weaknesses, and experiences.**
- b. **Prepare for and participate in a mockup interview.**
- c. **Evaluate the impact of computer science solutions on individuals, organizations, and society.**
- d. **Prepare a portfolio that includes a cover letter, resume, samples of software development experiences, oral communication, and written communication samples**

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CO	Outcome Description	Engagement	Quizzes (Ch1-6)	Assignments (1-4)	Final	Ethics Report
1a	Describe techniques for face-to-face and telephone interviews	E:95				
1b	Recognize possible post-baccalaureate paths, including graduate study, entrepreneurship, and employment in government, academia, and the private sector.			E:95		
1c	Describe the role of ethics in society and software engineering					ER: 92
1d	Describe the need and venues for continuing professional development.	E: 95				
2a	Set short-term and long-term goals based on one's strengths, weaknesses, and experiences.			A1: 91		
2b	Prepare for and participate in a mockup interview.			A3: 92 A2: 92		
2c	Evaluate the impact of computer science solutions on individuals, organizations, and society.		Q1-6: 89		F:91	
2d	Prepare a portfolio that includes a cover letter, resume, samples of software development experiences, oral communication, and written communication samples			A4: 91		

Outcomes Summary Table (Average Grade Included)

1a. Class presentation was provided by Career services on interview preparation, tips, and interview techniques. A group activity during class involved answering common interview questions among classmates which included personal and professional strengths and weaknesses. Part of the activity also required students to network and

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compile contact information from their future professional peers. Phone interviews were overviewed including the advantages and disadvantages comparing to in person interviews.

1b. Different career paths were overviewed by guest speakers and instructor:

Federal Government Career Path Presentation
FBI

PhD Panel Presentation
Computer Science Department
Dr. Ann Gates, Chair, Dr. Natalia Villanueva, Professor, and Dr. Vladik Kreinovich, Professor.

Overview of M.S. in Software Engineering and the graduate fast track
Dr. Salamah Salamah, UTEP Professor

Interview Techniques presentation from Career Center
UTEP Career Center Presentation

Companies Comparison Report: Students submit a group class comparison report of 3 companies (large companies, small companies, and government companies). Assignment requires comparing positions, location, and salary ranges. Group discussion during class complemented this assignment. The students discussed and compared livability factors in cities based on their comparison findings.

The Entrepreneurs Academy (EA) modules were promoted, however, due to time limitations, the modules were not required.

1c. A two-page ethics individual report is assigned involving various topics in relation to computing and their impact in society. Please see Appendix B for a list of Ethics Report Topics provided and Appendix D for grading rubric.

Class presentation provided an overview of ethics and group debates were held around different ethics scenarios. Students discussed scenarios in groups and defended their points of view in front of the class. The debates and discussion were documented by each group and counted towards their class participation grade.

Assessment of level 1 included a participation grade which is 10% of their final grade, the quizzes grade which is 15% of their quizzes grade, and a final exam which is 20% of their final grade.

The participation grade is aimed to engage the students actively during class and is 10% of their total grade. Class participation included student attendance and class activities such as: class networking activity, resume review through the UTEP career center, elevator speech class practice, ethics mini-scenarios and group debates, class discussion on ethics book topics, SMART goals class assignment and participation during speakers presentations. All activities were provided using ARG cooperative learning techniques in order to ensure attendance and participation from everyone.

1d. Every presentation in relation to career and educational paths included a section on the importance of continued professional growth. The student class assignments and professional portfolio project was an important factor for students to identify potential areas where they can engage in additional professional development based on their career paths.

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2a. Assignment: Explained and used the S.M.A.R.T. guide to analyze and set long term and short term goals (Please see Appendix C). Senior students worked on future goals and plans after graduation. Junior and sophomore students worked on future goals and plans to improve professional development before graduation.

2b. Class presentation: Career services provided a class presentation on interview preparation, tips, and interview techniques prior to mockup interview activity.

Activity: UTEP faculty and staff, and local computing professionals volunteered their time to provide mockup interviews for the JPO students. Students received feedback on-site that evaluated interviewee punctuality, appearance, communication skills, knowledge of company, and provided an overall professional evaluation. The rubric used the mockup interview used: Excellent, Very Good, Good, Average, or Needs significant improvement (Please see Appendix D).

2c. Quizzes: The book “A Gift of Fire” Social, Legal, and Ethical Issues for Computing Technology”, 4th Edition by Sara Baase is assigned as part of the class content. Chapters 1-6 are assigned as homework reading material and selected topics are discussed at class due to time limitations (7 weeks / 2 hours per week). The book serves as a complement for class content in relation to class objectives #1: To attain an ability to analyze the local and global impact of computing on individuals, organizations, and society and #2: To analyze current issues in professional ethics related to computing. The quiz was available once per week from noon until midnight outside of class time. A bank of previously created questions is randomly assigned to prevent dishonesty. The quiz is open book since the purpose is to ensure book content is read and understood, not for memorization. A set time limit of 15 minutes encourages the students to read ahead of time to avoid delays in submitting answers.

Final Exam: A final exam includes a list of questions that were provided previously during the quizzes. The final exam covers chapters 1-6 and it is a closed book blackboard exam provided on-site. The student are given a study guide 2 weeks prior to the exam to allow time to prepare. Also, a final exam review is provided during class to overview the topics and the answers in groups. The lowest quiz is removed at the end of the semester for everyone in case someone to prevent for student emergencies since no quiz make ups are allowed.

The book content covers different topics related to social, legal, and ethical issues and the impact of computer science solutions under different social environments. Topics covered through the book include: Changes and advancements in technology and the social impact, privacy and legal implications, freedom of speech and the challenges with technology advancements, intellectual property with legislation challenges, hacking and identity theft, technology impact on employment, and error and risks related to computing development. By the end of the semester, the students have adequate understanding of the impact of their CS major and technology advancements globally and individually. Please see Appendix A for sample questions.

Class presentation provided an overview of ethics and group debates were held around different ethics scenarios. Students discussed scenarios in groups and defended their points of view in front of the class. The debates and discussion were documented by each group and counted towards their class participation grade.

2d. Project: Online Professional Portfolio

Student assignment that involves the development of an online professional portfolio.

Portfolio Content that must be included:

- elevator speech
- Downloadable Resume

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- Experience/Projects
 - Work Experience Samples: Sample Class Projects, Web Sites, , Code, Technical Support, Job Evaluations, etc
 - Other Experience not in resume already: Community Services, Organizations, Volunteer work
 - Education Content in more detail (info not on resume): Diplomas, Training/Certifications, Award Letters, Workshops, Lectures, Honors
 - Writing & Communication Experience: Letters, Training materials, proposals, articles, presentations, data, reports
 - Computer Experience samples: Graphics, Presentations, Documents

Activity: The portfolio is reviewed and graded by the instructor. The student can use this project as part of their mockup interview.

Assessment of level 2 involves homework assignments and an ethics report which are related to individual professional preparation. Assignments include: resume assignment and review, companies' research and comparison, SMART goals, mockup interview, and EA modules (optional). Homework assignments were 50% of the total grade, and the ethics report was 15% of their total grade.

Part 2: Analysis and Recommendations by Instructors:

Spring 2018

The course was adapted for 7 weeks, meeting once per week for two hours. This change allowed the students to have additional time for their course work during the last months of the semester. Due to the fast pace of the course, long-term assignments such as the online portfolio and ethics reports need to be provided during the first two weeks of the course to make sure students have clear expectations and enough time to submit all require work. The students responded well to the fast pace of the course and they definitely benefited from the extra time once the course is over.

Recommendations: Speakers and mockup interviews need to be arranged before semester starts to make sure a timeline is ready for the students since day 1.

Spring 2017

This course will be provided on a Maymester this coming summer 2018. The class will be adapted to be taught Monday – Thursday for two weeks / 2 hours per day.

Recommendations: Provide the course in a 7-week intense format. This will allow the course to be taught twice per semester if needed. Also, it will provide the student with extra time for the last months of the semester.

Spring 2016

Student Numbers: The total number of students was 47. Many of the class activities were adapted for a bigger class size and classroom layout (auditorium style). A smaller class size is recommended 20-30. A smaller group will allow for better class interaction and more individual interaction with instructor. If the number of registered students for this class is greater than 40, I recommend to split the group in two classes to allow more time for class group activities.

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Classroom style: This class uses ARG collaborative techniques. All of the group activities work more efficiently with a classroom style that allows for group interactions.

Student Level: The students in class were categorized and registered for the JPO class as juniors based on their number of credits. However, the students were not junior level in reality. A very big number of them had not taken data structures yet, some of them were taking the introductory CS courses. This class is recommended for students whose graduation is one to two years away. I would recommend that the class registration is filtered by the data structures pre-requisite. In this case, students will actually be taking more advanced courses or technical electives that include projects that can be part of their professional portfolios.

Fill in the blank Quiz questions: In the past semesters, I had included fill in the blank quiz questions. However, blackboard is not effective in grading this types of questions automatically. Students would get correct answers graded incorrectly due to space issues or grammar issues. Starting this semester Spring 2016, I removed all fill-in the blank questions and used only multiple choice and true and false questions.

Spring 2014

A weekly quiz was provided to ensure book content was read and understood. The book served as a compliment for class content in relation to class objectives #1: To attain an ability to analyze the local and global impact of computing on individuals, organizations, and society and #2: To analyze current issues in professional ethics related to computing. However, book content was not necessarily covered during class time due time limitations. The reason some students who did not perform well on the quizzes was due to lack of planning for reading content, specially seniors taking software engineering and database management courses at the same time. These group of students seem to have conflicts with time once the group projects in the SE and DB classes were assigned. To help with this situation, I recommend to cover the book content in the first 8 weeks of the semester when student's project deadlines are not tight.

Spring 2013

This class is recommended for students whose graduation date is one to two years away, not based on their junior/senior classification which is based on the number of credits taken. Based on the student feedback during final individual interviews, graduating senior students felt they were not able to take full advantage of the information provided during class given their near graduation date, especially in relation to graduate school preparation, and summer and funding opportunities.

A good number of students felt attendance for this 1 credit course was not important. To deal with this issue, all relevant assignment information and submissions took place during the first 5 minutes of class. This strategy increased attendance, allowed for identification of absences, and increase in punctuality.

The interview evaluation reviews were higher than the resume evaluation reviews. Feedback received from the volunteer interviewers aligns with these results. All of them agreed that the students have a great potential, but many resumes did not reflect their experience or technical background.

The total registered students were 64. Many of the class activities were adapted for a bigger class size and classroom layout. A smaller class size is recommended 20-30. A smaller group will allow for more class interaction and more individual interaction with instructor.

APENDIX A
Sample Quiz Questions

Question Title	Chapter 1 True/False
Question	Ethics is the study of what it means to "do the right thing"
Answer	<input checked="" type="checkbox"/> True <input type="checkbox"/> False
Correct Feedback	The answer is True Book Reference: 1.4 Ethics
Incorrect Feedback	The answer is True Book Reference: 1.4 Ethics
Question Title	Chapter 1 True/False
Question	The Children's Online Privacy Protection Act (COPPA) is a privacy law intended to allow all children to create their own profiles on internet sites.
Answer	<input type="checkbox"/> True <input checked="" type="checkbox"/> False
Correct Feedback	The correct answer is false Book reference 1.4.2 A variety of ethical views
Incorrect Feedback	The correct answer is false Book reference 1.4.2 A variety of ethical views
Question Title	Chapter 2 - True/False
Question	In the context of privacy issues, personal information includes any information relating to, or traceable to, an individual person.
Answer	<input checked="" type="checkbox"/> True <input type="checkbox"/> False
Correct Feedback	The answer is True. Section 2.1.3
Incorrect Feedback	The correct answer is True Section 2.1.3
Question Title	Chapter 2 - Multiple Choice
Question	If a business follows an "opt-in" policy for handling personal data, information about a customer A. may not be released under any conditions
Answer	<input checked="" type="checkbox"/> B. may not be released unless the customer gives permission

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C.
 may be released unless the customer requests that the information be kept private
 D.
 may be released for any legitimate business purpose

Correct Feedback The correct answer is "may not be released unless the customer gives permission"
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Incorrect Feedback The correct answer is "may not be released unless the customer gives permission"
 Pg. 59

Question Title Chapter 3 - Fill-in the blank

Question When a government action or law causes people to avoid legal speech and publication out of fear of prosecution, the action or law is said to have a "_____ effect" on First Amendment Rights.

Evaluation Method

Answer

Exact Match chilling

Correct Feedback Correct answer is "chilling"
 Book ref. Pg. #138

Incorrect Feedback Correct answer is "chilling"
 Book ref. Pg. #138

Question Title Chapter 3 - Multiple Choice

Question The freedom of speech guidelines that are used in court to help determine if a censorship law is constitutional include all of the following EXCEPT

- A. Solve speech problems by least restrictive means
- B. Do not reduce adults to reading only what is fit for children
- C. Laws must not chill expression of legal speech
- D. Follows community standards

Answer



Correct Feedback Correct answer is:
 Follows community standards
 Book Ref. Pag #142

Incorrect Feedback Correct answer is:
 Follows community standards
 Book Ref. Pag #142

Question Title Chapter 4 - True/False

Question Napster was not responsible for copyright infringement because it did not keep copies of songs on its computers.

Answer True

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 False

Correct Feedback The correct answer is: False
Book Ref. Pg. #192-193

Incorrect Feedback The correct answer is: False
Book Ref. Pg. #192-193

Question Title Chapter 4 - Multiple Choice

Question Which of the following is not an exclusive right (subject to some exceptions) granted by copyright law?

- A. Copy the work
- B. Distribute the work

Answer 

- C. Profit from the work
- D. Create "derivative works"

Correct Feedback The correct answer is:
Profit from the work
Book Ref. Pg. 181

Incorrect Feedback The correct answer is:
Profit from the work
Book Ref. Pg. 181

Question Title Chapter 5 - True/False

Question Prosecutors dropped charges against the person responsible for releasing the ILOVEYOU virus in 2000 because the Philippines had no law against releasing a virus at that time.


Answer  True
False

Correct Feedback the correct answer is true.
Book Ref. Pg #258-259

Incorrect Feedback the correct answer is true.
Book Ref. Pg #258-259

Question Title Chapter 5 - Multiple Choice

Question In the early days (1960's to the early 1970's), a "hacker" was:
An incompetent programmer who wrote programs that did not work properly
A busy programmer who reused code to save time

Answer 
A creative programmer who wrote very elegant or clever programs
A new programmer who wrote simple programs

Correct Feedback The correct answer is:

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A creative programmer who wrote very elegant or clever programs
book Ref. Pg # 231

The correct answer is:

Incorrect Feedback A creative programmer who wrote very elegant or clever programs
book Ref. Pg # 231

Question Title Chapter 6 - Multiple Choice

Question Which of the following reflects the impact that computing technology has on employment?

- A.
Elimination of jobs but creation of others
- B.
High demand for engineering jobs

Answer C.
Telecommuting is another option among companies



- D.
All of the above

Question Title Chapter 6 - True/False

Question The Electronic Communication Privacy Act (ECPA) does not restrict corporations from reading employees email on company systems.

Answer  True
False

Correct The answer is "True"

Feedback Book Ref Pg. #300

Incorrect The answer is "True"

Feedback Book Ref Pg. #300

Question Title Chapter 8 - Multiple Choice

Question Which of these are factors related to computer system errors?

- A.
Insufficient testing
- B.
Insufficient Planning

Answer C.
Data Entry Errors



- D.
All of the above

Correct Feedback Correct answer: all of the above
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Correct answer: all of the above

Incorrect Feedback

Pg. #376

Question Title Chapter 8 - True/False

Question

One of the reasons for the delay in the Denver baggage system was insufficient time for development and testing.

Answer

True
 False

Correct Feedback

correct answer: true
pg. #372
correct answer: true

Incorrect Feedback

pg. #372

APENDIX B
Ethics Report Topics

1. Recently, Facebook lost a court case for \$500 million to video maker ZeniMax in relation to the Oculus Rift product that Facebook purchased. This case also involved intellectual property claims. This report should include an overview of the case. Discuss the ethical and social implications involved and the main reasons for the court's final decision.
2. It is fairly easy to install stealth software on someone's cell phone to track all of their communications. Discuss the ethical/social implications involved. Include at least one case where this type of software could cause problems OR one case where this type of software could be a benefit.
3. What are some skills, traditions, and/or social conventions that have been or might soon be lost because of computer, phone, and internet technology? Include at least one that you think will be a real loss and include at least one that you think is not a problem. Give reasons.
4. Talk about the advantages and disadvantages of the use of cloud computing within a corporation. What ethical issues have arisen due to the use of cloud computing?
5. What are the ethical/social implications with children using the internet? Include at least one that you think will be major problem, and include at least one that you think will be a benefit. Give reasons.
6. Nowadays, it is common practice for corporations to use monitoring devices to track employees' productivity and activities. Provide an ethical perspective supporting this practice if you are the employer. OR Provide an ethical perspective against this practice if you are the employee.
7. What are some of the ethical/social implications of robotic surgery? Include at least one that you think will be major problem, and include at least one that you think will be a benefit. Give reasons.
8. Discuss at least two areas where internet technology is impacting copyright and the ethical and social implications.

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9. Discuss the advantages and disadvantages of telecommuting .What ethical or social issues have arisen due to telecommuting?
10. Discuss at least two ethical or social concerns that exist due to the development of mobile applications. What is being done to resolve the issues? Provide current situations to compliment your discussion.
11. Describe what are the pros and cons of outsourcing and the ethical and social implications.
12. Discuss how computing has impacted employment. Include at least one job that has disappeared, and include at least one job that did not exist ten years ago. What ethical or social impact occurred due to the loss or creation of these jobs?

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APPENDIX C

Setting Goals Using the SMART Method

Short Term Goal #2: (3 months- 12 months)

Goal (Specific: Make a specific description of your goal):

Measurable: (How can you measure progress and completion of your goal?)

Attainable: (What actions can be made to make this goal happen?)

Relevant: How does this goal align with you career path?

Timely: When do you plan to complete this goal?

Short Term Goal #3: (3 months- 12 months)

Goal (Specific: Make a specific description of your goal):

Measurable: (How can you measure progress and completion of your goal?)

Attainable: (What actions can be made to make this goal happen?)

Relevant: How does this goal align with you career path?

Timely: When do you plan to complete this goal?

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APPENDIX D

Ethics Report Rubric

Submitted by deadline	Yes	No	_____	(-20 pts)
2-3 Pages in length	Yes	No	_____	(-10 pts)
Followed format instructions	Yes	No	_____	(-10 pts)

Ethics Report Rubric

Criteria	20 pts	18 pts	16 pts	14 pts
Content	Paper addresses all aspects of the assignment	Paper addresses the assignment, some sections could have more support	Paper does not address completely the assignment	Paper does not address the assignment
Clarity & Organization	Well Organized, logical transitions and clearly articulated.	Clearly articulated Transitions often connect ideas	Mainly organized Does not connect ideas easily	Lacks organization No transitions or clarity to connect ideas
Grammar	Very good level grammar: proficient	Good level of grammar: demonstrates proficiency	Usually demonstrates proficiency	Inconsistently demonstrates proficiency
Ethics	Fully addresses social, ethical issues of the topic	Addresses social, ethical issues of the topic but could have more supporting data	Mentions or gives some consideration to social, legal & ethical issues	Does not address social, legal & ethical issues appropriately
Citations/References (APA Style)	Use citations correctly within content and included references.	Included references, but incorrect use of some citations	Included references; incorrect format of citations/ no citations included	No citations or references were used

Comments:

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APPENDIX E

Research and compare 4 companies: You must include a large corporation, small size company, and a government agency/government contractor. You must use the template included in this document. *Please delete the samples included.* **Deadline: Monday, February 7 at 10:00 AM. Please submit via blackboard.**

COMPANY NAME	JOB TITLE (MINIMUM OF 2 PER COMPANY)	KNOWLEDGE & SKILLS REQUIRED	JOB LOCATION	SALARY RANGE
Oracle	MySQL DBA / Database Administrator / Oracle DBA Database Analyst	<ul style="list-style-type: none"> • DBMS design • Database Development • Mysql Certification • Shell Programming • Linux and Unix Environments 	Boca Raton, FL	\$65,000 - \$75,000
Oracle	Database Architect/Analyst	<ul style="list-style-type: none"> • At least 3 years experience in database architect/analyst roles on custom development software projects • At least 3 years experience in designing/architecting/modeling databases • At least 3 years experience in creating and perfecting stored procedures, triggers, indexes, functions, and other database constraints available in Microsoft SQL Server and in Oracle 11g • At least 3 years experience in Object Oriented (OO) to Relational DBMS translations • At least 3 years experience in database replication and synchronization in disconnected/reconnected environments 	Washington, D.C.	\$75,000 - \$100,000
What additional benefits does this companies offer? Training, health insurance, stock options, telecommuting				

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APPENDIX F

Interview Rubric Sample

Interviewer: _____ Date: _____

Please check as appropriate:

Participant Names					
	5 Excellent	4 Very Good	3 Good	2 Average	1 Need significant improvement
Punctuality					
Appearance					
Communication skills					
Knowledge of your company					
Professional Qualities					
Resume Evaluation					
Portfolio Evaluation					
Comments/ Strengths /weakness/					

Course Outcomes Analysis: CS 3331, Spring 2018

Number: CS 3331

Title: Advanced Object-Oriented Programming

Instructor: Yoonsik Cheon

Description

An in-depth exposure to the object-oriented programming paradigm, which builds upon programming experience gained in lower-level computer science classes. Emphasis on programming in an object-oriented language with which students are already familiar, and on requirements, testing, code reading, and comprehension.

Textbooks

- Xiaoping Jia, *Object-Oriented Software Development Using Java*, second edition, Addison Wesley, 2002.
- Martina Seidl, et al., *UML@Classroom: An Introduction to Object-Oriented Modeling*, Springer, 2015.*
- Cay S. Horstmann, *Core Java SE 9 for the Impatient*, 2nd edition, Addison-Wesley, 2017.*

*E-book through UTEP library

Grade Distribution

The class started with about 70+ students enrolled, and several students dropped before the course withdrawal date. The table below summarizes the distribution of final letter grades that the remaining 69 students earned.

Grade	Pass			Fail	
	A	B	C	D	F
No. of students (69)	29	18	14	2	6
Percent (%)	42%	26%	20%	3%	9%
Total	88% (61/69)			12% (8/69)	

Out of six students who received an F, five didn't take the final exam.

Learning Outcomes

Assessment was done with exams and homework assignments. There were frequent, on-line quizzes upon reading assignments, but they weren't used for the assessment

For each outcome I measured the average score obtained by students on the exam/homework questions mapped to the outcome, and the nominal acceptance value was 70%. Most outcomes had multiple questions mapped to them, and for these outcomes I picked a few most relevant, representative, or recent questions.

Level 1: Knowledge and Comprehension

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level. Upon successful completion of this course, students will be able to:

- 1a. Explain the differences between an object-oriented approach and a procedural approach.

Satisfactory (Exam 1 question 1a, 100%)

Level 2: Application and Analysis

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details. Upon successful completion of this course, students will be able to:

- 2a. Formulate use-case diagrams and scenarios to support understanding of user requirements.
Satisfactory (88%; HW1b q1 88%)
- 2b. Use object-oriented design notations, including UML class diagrams and state machine diagrams (optionally sequence diagrams) to model problem solutions.
Satisfactory (83%; Exam 1 q7b 73%, HW1b q2-q3 88%)
- 2c. Use basic object-oriented design patterns to structure solutions to software design problems.
Satisfactory (88%; Final q6 83%, HW 4 92%)
- 2d. Translate design features, such as classes and their relations, to implementations.
Satisfactory (78%; Exam 1 q4 76%, Exam 1 q8 80%)
- 2e. Use frameworks and library classes and methods in problem solutions.
Satisfactory (89%; Final q5 87%, Final q7 90%)

Level 3: Synthesis and Evaluation

Level 3 outcomes are those in which the student can apply the material in new situations. This is the highest level of mastery. Upon successful completion of this course, students will be able to:

- 3a. Design and implement software employing the principles of modularity, encapsulation, information hiding, abstraction, and polymorphism.
Satisfactory (81%; HW2 73%, HW4 92%, HW5 79%)
- 3b. Design, implement, and use classes and methods that follow conventions and styles, and make appropriate use of advanced features such as inheritance, exception handling, and generics.
Satisfactory (86%; HW4 92%, HW5 79%)
- 3c. Evaluate existing classes and software for the purposes of extension through inheritance.
Satisfactory (79%; Exam 1 q9 74%, Final q6 83%)
- 3d. Create API documents for classes, fields and methods.
Satisfactory (81%; HW2 73%, HW4 92%, HW5 79%)
- 3e. Design and implement test suites for automated unit testing.
Satisfactory (74%; Exam 1 q6 76%, HW3 72%)
- 3f. Re-factor existing source code to improve its design or efficiency.
Satisfactory (80%; Exam 1 q8 80%)

In summary, all course outcomes were met satisfactory.

Observations

- 1. There is an outcome that is met weakly, 3e (unit testing; 74%). This is one of the two outcomes that were not measured during the last assessment. The other outcome, 3d (API documentation),

was also measured and met satisfactory at this time. For each programming assignment, it was required to write Javadoc API documents.

2. The outcome 2b (UML) was revised to make the sequence diagram optional and focus more on the state machine diagram; the revision was approved by the faculty. This outcome was met satisfactory.
3. Due to the large class, we couldn't afford in-class demos of programming assignments through which students learn from the work of their classmates. A large class also made it challenging to have effective in-class activities such as exercises and group work. It reduces the amount of interaction with students and individual feedback as well.
4. Due to the nature of this course (low-level design and coding), adequate TA support is essential for its success. The course TA should be able to give good and effective feedback on students' design and coding work, be knowledgeable on OO design and programming, and be familiar with development environments (Eclipse/IntelliJ IDEA, Git, Junit).
5. The undergraduate instructional assistant was very helpful with a large class size. I noticed that many students prefer to see the IA for programming-related questions.
6. I adopted elements of the so-called *application-driven approach* in which new concepts are introduced in the context of specific applications, i.e., programming assignments. It seemed to work well for CS 3331.
7. All programming assignments were allowed to be done in pairs. They were developed incrementally from HW1 to HW4 by adding new features, e.g., GUI, multithreading and networking.
8. A mobile app was used to deliver and grade all quizzes (15 of them).

Recommendations

1. Monitor the outcome that was met marginally (3e unit testing).
2. Revise the outcome 2e to include a few representative frameworks and library classes, e.g., Use frameworks and library classes and methods, such as collections, GUI, multithreading, and networking, in problem solutions.
3. Continue incorporating best practices and educational technologies, such as application-driven approach, pair/group programming, incremental assignments, and the quiz app).
4. Provide help in identifying a qualified TA who is knowledgeable on the course subject, e.g., someone who took this class and/or CS 4310/4311.
5. Ask for continued support for an undergraduate teaching assistant (IA).

CQI Assessment Report
CS 4310
Spring 2018

Department and Course Number: CS 4310 (23575)

Course Title: Software Engineering I: Requirements Engineering

Course Instructor: Dr. Ann Q. Gates

Teaching Assistant: Eric Camacho

Course Overview: Software Engineering I: Requirements Engineering (CS4310) is the first semester of a two-semester capstone course in which students work with a customer to capture and specify requirements for a real-world application. The spring 2018 project required the class to work with a team from the Army Research Laboratory led by Dr. Jaime Acosta. The real-world application is called the Network Traffic Proxy System, which allows security network analysts to intercept, examine, and modify network traffic packets.

On top of preparing students to become proficient in applying software requirements engineering methods and techniques, the students also learn how to work in cooperative teams and lead and manage a project. The students are assigned to teams of 5 with each team member playing a different software engineering role. The teams are formed based on the members' personalities, their role preferences, their experience, and their grade point averages. They learn team building and developing using PIGSFACE (P = Positive interdependence, I = Individual Accountability, G = Group Processing, S = Social Skills, and FACE = Face to Face Promotive Interaction). Each team member takes turns to lead a major deliverable to practice their leadership skill.

Major deliverables in this class include interview questions and memo, interview report, feasibility report, prototype, software requirements specification and models. Each team performs group processing after delivering the interview report, feasibility report, prototype, and software requirements specification. The purpose of group processing is to reflect on how the team performed, what worked, and what did not worked. Teams also get feedback on their work, deliverables, and team performance from the guidance team on a regular basis. At the end of the semester, the teams present their work to the customers and the members of the guidance team.

Textbook: Hull, E., Jackson, K., and Dick, J. Requirements Engineering 3/E. Springer, ISBN 978-1-84996-405-0 (<http://www.springer.com/computer/swe/book/978-1-84996-404-3>).

Course Goals: To prepare students to become proficient in applying software requirements engineering methods and techniques, working cooperative teams, and managing projects.

CS 4310 Course Outcomes:

Level 1: Knowledge and Comprehension

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level. Upon successful completion of this course, students will be able to:

- a. Define basic software engineering concepts and principles (abstraction, anticipation of change, modularity, stepwise refinement, and separation of concerns).
- b. Define quality attributes such as availability, correctness, efficiency, interoperability, maintainability, portability, reliability, security, modifiability, availability, testability, and usability.
- c. State the main features of process improvement models, e.g., CMM, ISO, PSP, QPI, Plan-Do-Check.

Level 2: Application and Analysis

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details. Upon successful completion of this course, students will be able to:

- a. Determine which life cycle model to use by analyzing different scenarios.
- b. Apply techniques for eliciting requirements.
- c. Analyze requirements to determine if they meet the attributes of well-written requirements.
- d. Identify risks in software development and project management.
- e. Analyze the course project and determine the local and global impact on computing on individuals, organizations, and society, including consideration of professional software engineering code of ethics.
- f. Relate the importance of professional societies.
- g. Engage in self-directed study to learn new techniques and tools for software requirements definition.

Level 3: Synthesis and Evaluation

Level 3 outcomes are those in which the student can apply the material in new situations. This is the highest level of mastery. Upon successful completion of this course, students will be able to:

- a. Construct a feasibility report that demonstrates ability to engage in self-directed study.
- b. Conduct verification and validation using techniques such as inspections and walkthroughs.
- c. Construct a prototype, which adheres to basic HCI principles, to validate the user interface.
- d. Construct a software requirements specification.
- e. Analyze and model aspects of a problem by applying various modeling techniques.
- f. Demonstrate an ability to assemble and orally present technical work and compose technical documents that are grammatically correct and technically sound.
- g. Apply effective techniques for project management, collaboration, and problem-solving within groups.

Summary of the Assessment of the Course Outcomes

The course assessment was based on the two exams, a final, assignment, and a project. The course project, which centered on the development of a Network Traffic Based Software Generation system, included the creation of an interview report, feasibility study, prototype interface, software requirements specification document, and a traceability report. There were a number of in-class exercises. Exams, team documents, and exercises are available upon request.

	T1	T2	Final	Project	Assignment	Outcome
1a. Define basic software engineering concepts and principles	Q9a (Total: 2; Mean: 1.51); Q9b (Total: 2; Mean: 0.84)		Q12a (total: 2; Mean: 1.25); Q12b (Total: 2; Mean: 1.41)	SRS (Total: 100; Mean: 83.92) Final Presentaton	SE Principle Safe Home Exercise (Total: 100; Mean: 83.47) Use Case Exercise 1 (Total: 100; Mean: 77.77); Use Case Exercise 2 (Total: 100; Mean: 79.21); Class Diagram Exercise (Total: 100; Mean: 84.79); State Exercise (Total: 100; Mean: 76.37); DFD Exercise (In-class assignment)	Good/ Acceptable
1b. Define quality attributes.			Q6 (Total: 2; Mean: 0.89); Q7 (Total: 3; Mean: 1.80)		QAS Exercise (Total: 100; Mean: 83.65)	Acceptable
1c. State the main features of process improvement models.			Q4 (Total: 3; Mean: 2.69)			Good
2a. Determine which life cycle model.	Q4 (Total: 6; Mean: 2.89)	Q3a (Total: 3; Mean: 2.14); Q3b (Total: 3; Mean: 2.35)	Q9a (Total: 3; Mean: 2.32); Q9b (Total: 3; Mean: 2.75)			Acceptable
2b. Apply techniques for eliciting requirements	Q6 (Total: 10; Mean: 7.12); Q7a (Total: 2; Mean: 1.91); Q7b (Total: 4;		Q8i (Total: 1.50; Mean: 1.40); Q8ii (Total: 1.50; Mean: 1.37)	Interview Memo and Questions (Total: 100; Mean: 89.36); Interview Report (Total: 100; Mean: 82.73)		Good

	Mean: 3.51)					
2c. Analyze requirements attributes of well-written requirements.		Q2a (Total: 3; Mean: 2.89); Q2b (Total: 3; Mean: 2.82); Q2c (Total: 3; Mean: 2.65)	Q3a (Total: 2; Mean: 1.61); Q3b (Total: 2; Mean: 1.79)	SRS (Total: 100; Mean: 83.92)	Software Requirements Specification Exercise (Total: 100; Mean: 79.89)	Good
2d. Identify risks in software development and project management.				Q5 (Total: 4; Mean: 3.19)		Good
2e. Determine local and global impact on computing, including code of ethics.					Social, Ethical, and Economic Impact Analysis Assignment (Total: 100; Mean: 90.91); Ethics Report (Total: 100; Mean: 69.49)	Acceptable
2f. Relate the importance of professional societies.						Assessed through quiz and class discussion
2g. Engage in self-directed study to learn new techniques and tools.				Interview Memo and Questions (Total: 100; Mean: 89.36); Interview Report (Total: 100; Mean: 82.73); FR (Total: 100; Mean: 86.48); SRS (Total: 100; Mean: 83.82); Prototype (Total: 100; Mean: 85.50); Traceability Report (Total:		Good

				100; Mean: 84.55)		
3a. Construct a feasibility report.	Q8 (Total: 6; Mean: 5.65)			FR(Total: 100; Mean: 86.48)		Good
3b . Conduct V&V using techniques such as inspections and walkthroughs.	Q10 (Total: 9; Mean: 6.67)		Q1a (Total: 2; Mean: 0.63); Q1b (Total: 2; Mean: 1.04); Q1c (Total: 2; Mean: 1.30); Q10 (Total: 3; Mean: 1.92)	Traceability Report (Total: 100; Mean: 84.55)	In-class Exercise Questions in the final presentation	Good/ Acceptable
3c. Construct a prototype.		Q7 (Total: 3; Mean: 1.51); Q8 (Total: 4; Mean: 3.63)		Prototype (Total: 100; Mean: 85.5)		Good
3d. Construct a software requirements specification.				SRS(Total: 100; Mean: 83.82)		Good/ Acceptable
3e. Analyze and model aspects of various modeling techniques	Q3 (Total: 4; Mean: 3.42); MQ1 (Total: 20; Mean: 15.46); MQ2 (Total: 20; Mean: 15.60)	Q5 (Total: 3; Mean: 1.86); Q6 (Total: 3; Mean: 1.68); MQ1a (Total: 10; Mean: 8.63); MQ1b (Total: 15; Mean: 12.44); MQ2 (Total: 30; Mean: 26.54)	Q2a (Total: 2; Mean: 1.17); PII Q1 (Total: 20; Mean: 16.22); PII Q2 (Total: 10; Mean: 8.63); PII Q3a (Total: 15; Mean: 13.63); PII Q3b (Total: 5; Mean: 3);	FR(Total: 100; Mean: 86.48); SRS(Total: 100; Mean: 83.82)	Use Case Exercise 1 (Total: 100; Mean: 77.77); Use Case Exercise 2 (Total: 100; Mean: 79.21); State Exercise (Total: 100; Mean: 76.37); DFD Exercise (In-class assignment)	Good
3f. Demonstrate an ability to assemble and orally present technical work and compose technical				Final Individual Presentation (Total: 100; Mean: 87.39); Final Group Presentation		Good

documents-grammatically correct tech sound.				(Total: 100; Mean: 88.27); Interview Memo and Questions (Total: 100; Mean: 89.36); Interview Report (Total: 100; Mean: 82.73); FR(Total: 100; Mean: 86.48); SRS(Total: 100; Mean: 83.82); Prototype (Total: 100; Mean: 85.50); Traceability Report (Total: 100; Mean: 84.55)		
3g. Apply effective techniques for project management, collaboration and problem-solving within groups.	Q2 (Total: 5; Mean: 4.11); Q5 (Total: 4; Mean: 2.37)	Q1 (Total: 4; Mean: 2.40); Q9a (Total: 7; Mean: 6.46); Q9b (Total: 3; Mean: 2.56)	Q3-2 (Total: 2; Mean: 1.49); Q11 (Total: 6; Mean: 4.93)	Interview Memo and Questions (Total: 100; Mean: 89.36); Interview Report (Total: 100; Mean: 82.73); FR(Total: 100; Mean: 86.48); SRS(Total: 100; Mean: 83.82); Prototype (Total: 100; Mean: 85.50); Traceability Report (Total: 100; Mean: 84.55)	IR Group Processing; FR Group Processing; Final Presentation Feedback	Good

Grade Distribution

57 students were enrolled in this course with the following distribution:

Grade	A	B	C	D	F
	20/57	22/57	14/57	1/57	0/57
Percent	35%	39%	25%	2%	0%

Summary

Overall the outcomes were met, although Outcome 2f was not assessed through exam, homework, or in-class assignments (see next section). It is desirable to include more discussion and in-class exercises to capture improvement in students' performance, especially in the area of modeling.

Recommendations

The recommendations from the 2016 report and how they were addressed follow:

- Measure Outcome 2f (importance of professional society), which was not assessed in spring 2016. Response: This report only includes those measurements from exams, homework, and in-class assignments. It does not include the in-class quizzes that were done using i-clicker.
- Pay attention to outcomes that were met marginally, e.g., 1a (basic software engineering concepts and principles), by experimenting with different ways of presenting and teaching them. Change: The course added more readings and quizzes to address the marginal outcomes. The course adopted iclicker technology that allowed us to ask a question and, depending on the results, the instructor engages the class in discussion to enhance learning and understanding.
- Consider introducing software engineering concepts and principles into the CS curriculum earlier. Response: Done
- Consider offering 1 or 2-credit course on non-functional requirements. Response: The department focused on the development of problem-solving courses over the last year and a half; thus, this is still on the to-do list.

The 2018 recommendations include:

- Introduce Software Engineering Code of Ethics earlier in the course, and add more questions on the exams.
- Include a discussion and self-reflection exercise on professional societies (Outcome 2f). This could be accomplished through an essay assigned in the class after the lecture, or include it in the Social Impacts exercise.
- Expose students to the practice of assessing risk of software and software development in the fundamental classes.
- If there is funding available to support a faculty member, create a one-credit hour course focused on non-functional requirements (carry-over from previous report).

CQI Assessment Report
CS 4311
Spring 2018

Department and Course Number: CS 4311 (27422)

Course Title: Software Engineering II: Design and Implementation

Course Instructor: Dr. Salamah Salamah

Teaching Assistant: Eric Camacho

Course Catalog Description: This course is the second semester of a two-semester capstone project in which students work to design, implement, and test a real-world application.

Course Overview: Software Engineering II: Design and Implementation (CS4311) is the second of a two-semester capstone course in which students work to design, implement, and test a real-world application. The students continue to work in their teams, which are formed during the first capstone course (CS4310).

The teams of students in the 4311 use the Software Requirement Specification (SRS) document developed in the previous semester to design a solution for the problem in multiple phases. Design-related deliverables for the project are as follows:

- Classes, Responsibilities, and Collaborations (CRC),
- Class Contracts,
- Subsystem design, and
- Detailed design

In addition, the students implement the design and go through client acceptance testing of system at the end of the semester. Other deliverables of the course include Software Configuration Management (SCM) plan, and a Test Plan. At the end of the semester, the teams present their work to the client and the members of the guidance team

Textbook(s):

Shari Lawrence Pfleeger, Joanne Atlee, Software Engineering: Theory and Practice, 4th Edition, Prentice Hall, 2009.

Wirfs-Brock, R. Wilkerson, and L. Wiener, Designing Object-Oriented Software, Prentice Hall, 1990.

Course Goals: To prepare students to become proficient in applying software design, implementation, and testing principles and techniques, working cooperative teams, and managing projects.

CS 4311 Course Outcomes:

Level 1: Knowledge and Comprehension

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level. Upon successful completion of this course, students will be able to:

- a) Articulate design principles, including cohesion and coupling, encapsulation, and information hiding.
- b) Describe software design concerns related to maintenance.
- c) Describe different software architectural styles, such as blackboard, event systems, layered system, and pipe and filters

Level 2: Application and Analysis

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details. Upon successful completion of this course, students will be able to:

- a) Apply different diagramming techniques for an architectural design.
- b) Apply different notations for producing a detailed design of a system.
- c) Apply general strategies for creating a design of a system.
- d) Apply general strategies to identify and implement appropriate software architecture styles (including distributed and cloud) for the system under development.
- e) Distinguish between the different levels of cohesion and coupling.
- f) Use software development and maintenance tools, such as software documents creation and editing tools, GUI generators, comprehension and analysis tools, supporting activities tools (configuration management tools), verification and validation tools, and security vulnerability analysis tools.
- g) Describe differences between unit, integration, system, and acceptance testing.
- h) Apply black testing techniques to develop test cases for a variety of test coverages.
- i) Apply white-box testing techniques to develop test cases for a variety of test coverages.
- j) Apply static and dynamic techniques to analyze non-functional properties, including common security vulnerabilities such as password weakness, over/underflows, and race conditions.
- k) Engage in self-directed study to learn new techniques and tools for software design, implementation, and/or testing.

Level 3: Synthesis and Evaluation

Level 3 outcomes are those in which the students can apply the material in new situations. This is the highest level of mastery. Upon successful completion of this course, students will be able to

- a) Conduct a technical review of software design, implementation, and V&V.
- b) Create and implement a software configuration management plan.
- c) Create an architectural design and a detailed design for a software system.
- d) Construct software from a detailed design.
- e) Develop a test plan for a software system.
- f) Demonstrate an ability to orally present a software design and implementation.
- g) Compose software design-related documents that are grammatically correct and technically sound.
- h) Apply effective techniques for collaboration and problem-solving within a team.

Summary of the Assessment of the Course Outcomes

The course assessment was based on two midterms, a comprehensive final exam, and a team project. In completing the course project (real-world project for the Army Research Lab), the student teams created a software configuration management document, a complete design in multiple stages, partial

implementation of the developed design, and a test plan for testing the developed functionality. The students also presented components of their semester project as a team in the later stages of the semester. Exams, team documents, and exercises are available upon request.

As shown above, CS4311 has 22 stated learning outcomes: Level 1 1a-1c, Level 2 2a-2k and Level 3 3a-3h. For each outcome we measured the average score obtained by students for the exam questions and project assignments mapped to the outcome, and the nominal acceptance value was 70% (even though a D is a passing grade for this course): “not met” for 69% or below, “marginal” for 70-74%, “acceptable” for 75-80%, “good” for 81-90%, and “excellent” for 91-100%. The table below shows the evaluation.

CO	Outcome Description	Exam 1	Exam 2	Final	Project	Result
1a	Articulate design principles, including cohesion and coupling, encapsulation, and information hiding.	10a (70%) 10b (72) 11a (88) 11b (80)				Acceptable (78)
1b	Describe software design concerns related to maintenance	8 (77) 9 (89)		1 (83)		Good (83)
1c	Describe different software architectural styles, such as blackboard, event systems, layered system, and pipe and filters				Subsystems (Contracts) (84)	Good (84)
2a	Apply different diagramming techniques for an architectural design			7d (81)	Subsystems (Collaboration Graphs) (88)	Good (85)
2b	Apply different textual and diagramming techniques for producing a detailed design of a system.			5 (73)	Protocols (75)	Marginal (74)
2c	Apply general strategies for creating a design of a system.				SDD (86)	Good (86)
2d	Apply general strategies to identify and implement appropriate software architecture styles (including distributed and cloud) for the system under development.	12a (80) 12b (70) 12c (55)			SDD (86)	Marginal (73)
2e	Distinguish between the different levels of cohesion and coupling.	10a (70) 10b (64) 11a (95) 11b (64)		1a (80) 1b (77) 1c (85) 1d (80)		Acceptable (77)

2f	Use software development and maintenance tools, such as software documents creation and editing tools, GUI generators, comprehension and analysis tools, supporting activities tools (configuration management tools), verification and validation tools, and security vulnerability analysis tools.				SCM (88) Implementation (84)	Good (86)
2g	Describe differences between unit, integration, system, and acceptance testing.			2 (82)	Test Plan (87)	Good (85)
2h	Apply black testing techniques to develop test cases for a variety of test coverages.		2a (80) 2b (76) 4b (80) 4c (81) 5a (72) 5b (82) 5c (80) 6a (84) 6b (81)		Test Plan (87)	Acceptable (80)
2i	Apply white-box testing techniques to develop test cases for a variety of test coverages.		7a (86) 7b (72) 7c (87)		Test Plan (87)	Good (83)
2j	Apply static and dynamic techniques to analyze non-functional properties, including common security vulnerabilities such as password weakness, over/underflows, and race conditions					Not Assessed

2k	Engage in self-directed study to learn new techniques and tools for software design, implementation, and/or testing				Project Work ¹ (85)	Good (85)
3a	Conduct a technical review of software design, implementation, and V&V.				Project reports ² (87)	Good (87)
3b	Create and implement a software configuration management plan.				SCM Plan (88)	Good (88)
3c	Create an architectural design and detailed design for a large system				SDD (86)	Good (86)
3d	Construct software from a software design.				Implementation (84)	Good (84)
3e	Develop a test plan for a software system				Test plan (87)	Good (87)
3f	Demonstrate an ability to orally present a software design and implementation.				Semester Presentations (85)	Good(85)
3g	Compose software design-related documents that are grammatically correct and technically sound.				SDD (86)	Good (86)
3h	Apply effective techniques for collaboration and problem-solving within groups				Project work (85)	Good (85)

¹ Project work refers to all the project assignments including various project reports (see below) plus Prototype Demos and Final Project Presentation.

² Project reports include Software Configuration Management (SCM) Plan, Classes-Responsibilities-Collaborations (CRC), Subsystems, Protocols, Test Plan, and Software Design Document (SDD).

Grade Distribution

48 students were enrolled in this course with the following distribution:

Grade	A	B	C	D	F
	11/48	27/48	9/48	1/48	0/48
Percent	23%	56%	19%	2%	0%

Summary

Based on the recommendations from the last cycle, the number of outcomes for CS 4311 were increased from 21 to 22, and the changes were approved by the Software CQI Committee and faculty.

All students passed the course with a grade of D or higher. A significant number of students (79%) passed the course by receiving either an A (23%) or B (56%); only one student passed by receiving a D grade. Outcome 2j was not assessed during this cycle. All other course outcomes were met, with only two out of 22 received *marginal* score.

Recommendations

- (1) Develop a code review exercise and exam question(s) to assess outcome 2j.
- (2) Monitor those outcomes that were met “marginally” with average scores 70-74%, i.e., outcomes 2b and 2c.
- (3) Refine outcomes 2c and 2d
- (4) Break outcome 2b into two different outcomes. Currently the outcome combines the assessment of textual and diagramming techniques for software design. Students continue to score low on textual notations in the form of protocols (methods pre and post conditions).
- (5) Discuss with department faculty the need to enhance students’ preparedness in the area of logic (propositional and 1st order logic) in the fundamental CS sequence.