Institutional Effectiveness Report
2021-2022

Contents

Program: Computer Science BS

College and Department: College of Engineering – Computer Science

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Mission: "Our mission is to be widely recognized for enabling students to have global impact through innovative and quality programs, through research that emphasizes collaborative partnerships, and by enabling the success of a diverse student, faculty, and alumni community."

This mission is consistent with the University's mission to "provide leadership and outstanding programs in engineering, the sciences, and related areas that benefit the people of Tennessee and the nation" and with the University's commitment to the life-long success of students and to enrich the lives of people and communities in the Upper Cumberland region of Tennessee.

It is also consistent with Flight Plan, the University's strategic plan, and it's focus on improving student experience, transforming technology, and creating distinctive programs.

1   Program Goals:

PG 1.   Professionalism: Our graduates will exhibit the clear communication, responsible teamwork, commitment to quality, personal self-organization, professional attitude, and ethics needed to engage in successful careers in industry, academia, and public service.

PG 2.   Leadership: Our graduates will exhibit technical, personal, ethical, and professional leadership in their businesses, professions, and communities

*PG 3.   Technical Proficiency***:** Our graduates will exhibit the technical proficiency and problem-solving skills required to positively impact organizations, people, and processes at the local and global levels

PG 4.   Life-long Learning: Our graduates will exhibit an ability to be self-motivated, life-long learners who adapt to new technologies, tools, and methodologies to maintain the ability to respond to the challenges of a changing environment.

2   Student Learning Outcomes

SLO 1.   Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

SLO 2.   Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

SLO 3.   Communicate effectively in a variety of professional contexts.

SLO 4.   Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

SLO 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

SLO 6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

3   Assessment Methods

In 2021-2022 we performed the following assessments:

- *Faculty Course Reflections (all courses):* Each faculty member is asked to complete a course reflection at the end of each semester. The reflection allows a faculty member to summarize the results of the course, map the appropriate objectives and outcomes to the course and identify successes from the semesters, opportunities for improvement, puzzles (i.e., questions to be resolved), suggested changes, issues with facilities, technology issues, and other reflections.
- *Direct Assessment of Student Work (direct):* Several courses are assessed every semester. These assessments directly examine student work based on traits (performance criteria) created specifically for each student outcome. The measurement rubric used for direct assessment uses a four-level rubric: Excelling, Practicing, Apprentice, and Novice (E/P/A/N).
- *Pre-Post Surveys (Pre-Post):* Pre-post surveys are conducted for courses in which a direct assessment is scheduled. The pre-post survey is administered twice: once at the beginning of a semester and again at the end of a semester.
- *Senior Student Exit Surveys (Exit):* We have developed our own internally specified student exit survey conducted each semester and administered to graduating seniors. Several questions are asked that are related to specific course outcomes. This indirect assessment is conducted as a supplement to the direct assessments that examine student work. In this case, the students self-assess their perception of learning.
- *California Critical Thinking Skills Test (CCTST)*: The CCTST is a nationally normed test that measures problem solving and decision making through formation of reasoned judgements. We use the CCTST as a supplement to the direct and indirect assessments we conduct for Student Outcome 1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

4   Results

A. Faculty Course Reflections

Faculty are responsible for reflecting about their courses upon the completion of a given semester. The template used for this reflection is provided below. Faculty course reflections are provided in the appendix. The reflections are used to determine whether operational changes or other modifications are needed in future semesters. The major recommendations that resulted from the reflections are the following:

- CSC 1300 was modified for Fall 2022 to account for the varied experiences of students
- CSC 2310 was modified to remove Java and move to Python

Course Reflection Template

Course Name:
Semester/Year:
Course Instructor:

Summary of Student Performance:
- Grade distribution:

Grade	A	B	C	D	F
Number of students	0	0	0	0	0

Related Program Educational Objectives (Check all that apply):

☐ Professionalism: Our graduates will exhibit the clear communication, responsible teamwork, commitment to quality, professional attitude, and ethics needed to engage in successful careers in industry, academia, and public service.

☐ Leadership: Our graduates will provide technical leadership in their business, profession, and community.

☐ Economic Impact: Our graduates will enhance the economic well-being of the Upper Cumberland, the state of Tennessee, and the Nation through their technical expertise and leadership.

☐ Life-long Learning: Our graduates will adapt to new technologies, tools and methodologies to maintain their ability to respond to the challenges of a changing environment.

Related Student Outcomes (Check all that apply):

☐ Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

☐ Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

☐ Communicate effectively in a variety of professional contexts.

☐ Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

☐ Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

☐ Apply computer science theory and software development fundamentals to produce computing-based solutions.

Reflections:

What went particularly well in the course this semester?
- Place response here

What did not go so well this semester?
- Place response here

What still puzzles you about the course and how it was taught or in regard to what the students learned?
- Place response here

What changes do you suggest for future offerings of the course?
- Place response here

Were the facilities (room size, configuration, etc.) appropriate for the course? Explain.
- Place response here

How did the instructional technologies help or hinder the course? Would you make changes to or select different technologies?
- Place response here

Other reflections?
- Place response here

B. Direct Assessment of Student Work

We performed direct assessment of student work in at least one course per outcome on the schedule shown above. These assessments occur in courses that are either at the mid-point or end of the program. Each of the following subsections (numbered 1 – 9) provides a list of performance criteria that were assessed, a description of the learning activities used to measure learning, performance data showing levels of achievement by the students, and recommendations made by the faculty based on the data.

1) Outcome 1: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

CSC 4610 Software Engineering I – Fall 2021

Performance Criteria (Traits):

1. **Students can identify and define the computing requirements appropriate to its solution. (Bloom's taxonomy level: Analysis)**
2. **Students can analyze and weigh trade-offs related to computing problems. (Bloom's taxonomy level: Analysis).**

Overall Assessment Results

Values: *<number of students>* (*<percentage of total>*)

Trait 1. Students can identify and define the computing requirements appropriate to its solution.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm: Analysis – Q1	**51 (78%)**	**9 (14%)**	**1 (2%)**	**4 (6%)**
Midterm: Analysis – Q2a-d	**9 (14%)**	**13 (20%)**	**18 (28%)**	**25 (38%)**
Project Charter Documents	**33 (51%)**	**16 (25%)**	**11 (17%)**	**5 (8%)**

Trait 2. Students can analyze and weigh trade-offs related to computing problems.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm: Analysis – Q3a-d	**23 (35%)**	**17 (27%)**	**6 (9%)**	**19 (29%)**
Midterm: Short Answer – Q3	**38 (58%)**	**7 (11%)**	**18 (28%)**	**2 (3%)**

Traits

1. **Students can identify and define the computing requirements appropriate to its solution. (Bloom's taxonomy level: Comprehension)**
   - Exam question on stakeholders: *Analysis - Question 1* – this question assesses the students' ability to analyze the context of a project and to identify the relevant stakeholders for that project. The placement of a stakeholder in an interest-influence matrix exercises the students' knowledge of potential collaborators, an activity especially relevant for requirements analysis and later project management.

Summary: Overall, students were able to identify relevant stakeholders, and while most understood their importance to a project, a small number had difficulty in distinguishing between the various quadrants.

- Scale: Excelling (>=87.5%), Practicing (>=75%, <87.5%), Apprentice (>=62.5%, <75%), Novice (<62.5%)

Assessment	Excelling	Practicing	Apprentice	Novice
Analysis – Q1	**51 (78%)**	**9 (14%)**	**1 (2%)**	**4 (6%)**

Analysis – Q1 Text:

Consider the *Interest Influence* matrix shown below. The Chief Information Officer (CIO) for the ABC Company is a hands-on leader that generates and sponsors a large number of projects at ABC. The Chief Financial Officer (CFO), on the other-hand often defers to the CIO unless a given project runs over-budget. Software developers for a project are often assigned to projects at ABC; however, they all came to ABC due to the mission of the organization and have for the most part bought into the direction of the work. Likewise, end-users are often pre-ordering ABC's offerings. Finally, while ABC is a well-known organization, the local community (outside of those that are also end-users) will only follow ABC's progress through the local newspapers or media.

Level of Influence	High Influence	Keep Satisfied	Manage Closely
	Low Influence	Monitor	Keep Informed
		Low Interest	High Interest

Level of Interest
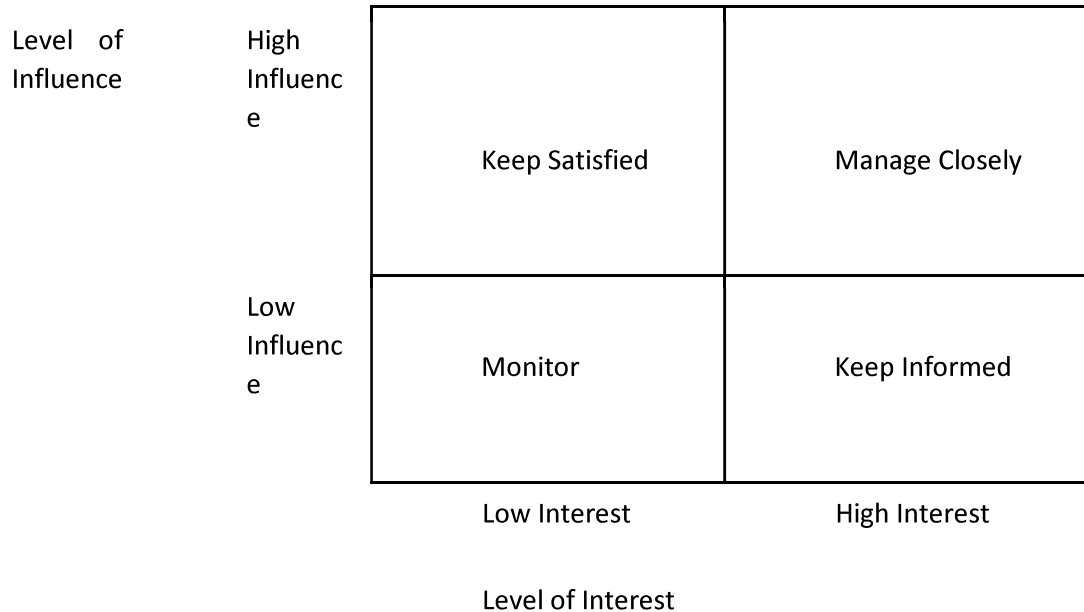
Identify the stakeholders described above, place them in the matrix, and then provide a description below of why each stakeholder belongs in the quadrant in which you've placed them.

- Exam question on user stories: ***Analysis – Question 2a-d*** – these questions assess whether a student can adequately understand and analyze a *user story* to determine if it is deficient. In

addition, the student is asked to provide an alternate solution when the story is indeed deficient. In the context of identifying and defining requirements, user stories are the primary idiom used in software development team and is an expression of requirements with respect to target users, the desired function, and related rationale.

Summary: Students struggle to create well-defined stories, and identify the true deficiencies in poorly written user stories.

- Scale: Excelling (>=85%), Practicing (>=70%, <85%), Apprentice (>=55%, <70%), Novice (<55%)

Assessment	Excelling	Practicing	Apprentice	Novice
Analysis – Q2a-d	**9 (14%)**	**13 (20%)**	**18 (28%)**	**25 (38%)**

Analysis – Q2a-d Text:

For each of the following user stories, explain why the story is deficient. Write one plausible alternate story, if one exists.

a. "As an online portal e-commerce customer, I want *a shopping cart*, so I can buy products."
b. "As a software development manager, I want the *developers to follow our processes* so that we can be an efficient organization"
c. "As an executive, I want to *generate **reports** that are easy to export* so that we can interchange our reports with any of the thousands financial systems in production in the industry as well as future systems."
d. "As a student user of iLearn, I want to be able to *generate an audio study guide using the **planned** podcast feature* of iLearn, so that I can listen to lectures online while I am in my car."

Project Charter Documents:

Students were placed on **teams** to work directly with corporate and community project sponsors to develop project charters. In these charters, teams were required to define user stories, size those stories using relative weighting, and to prioritize those user stories.

Summary: In the case of the "excelling" version, students' used the prescribed user story format of "*as a <user>, I want <capability>, so that <rationale>".* In addition, these same teams also identified story points and priorities (using MoSCoW). The "apprentice" listed their stories but were missing some context, weightings, or priorities.

Assessment	Excelling	Practicing	Apprentice	Novice
Project Charter Document (User Stories)	**33 (51%)**	**16 (25%)**	**11 (17%)**	**5 (8%)**

2. **Students can analyze and weigh trade-offs related to computing problems. (Bloom's taxonomy level: Analysis)**

- Burn-up chart question on exam: *Analysis – Q3a-d* – these questions assess students' ability to analyze the amount of effort needed for a project.
  Summary: Most students were able to identify iteration lengths, but many students missed on the concept of an MVP and did not realize when they were able to complete a release.
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Analysis – Q3a-d Text:

The following picture represents the data collected so far for a fictitious project. Use this chart to answer the questions listed below and on the next page. Assume the project team has just completed Iteration 3. The team has settled into a velocity of about 18 story points per iteration.
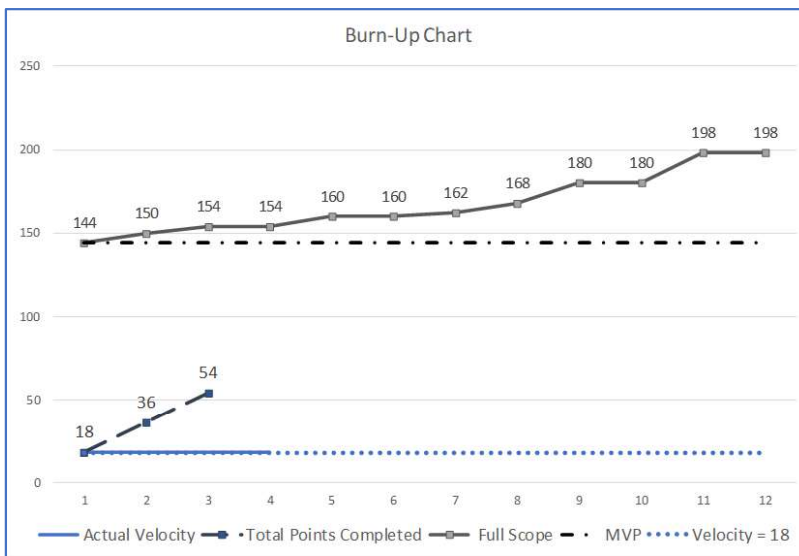
a. A manager has requested an estimate of when the team can expect to deliver the MVP. When will that be? Show your work on the graph and your answer below.

b. How many iterations will it take to deliver the full scope of the project? Show/explain how you came up with your answer.

c. The customer has found that they are only able to support six (6) iterations of effort. How many story points can the team deliver in that period? Show/explain how you came up with your answer.

d. Given the scenario in the previous questions, what must happen in order to effectively deliver the "new" MVP?

Assessment	Excelling	Practicing	Apprentice	Novice
Analysis - Q3a-d	**23 (35%)**	**17 (27%)**	**6 (9%)**	**19 (29%)**

- Business Rule Variation Question on exam: *Short Answer - Question 3* – this question exercises the students' ability to identify variations (i.e., alternatives) to potential features in a requested software system.

Summary: Majority of students understood the INVEST principle of developing good user stories. However, many students overanalyzed the problem, taking them down an incorrect path.

- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Short Answer – Q3 Text:

Consider the following user story for a travel or airline site: "**As a user, I want to receive a notification of a cancelled reservation so that I can have a confirmation of the cancellation**". Consider the pattern of the "Business Rule Variation" and the idea of "*notification of a cancelled reservation*". Write **three** (3) variations of this user story that considers different forms of notification. [Hint: The Business Rule Variation rule states that stories may seem fairly simple but that they perhaps can be broken into several stories.]

Assessment	Excelling	Practicing	Apprentice	Novice
Short Answer – Q3	**38 (58%)**	**7 (11%)**	**18 (28%)**	**2 (3%)**

Recommendation:

- Even though this has been noted each of the last two years, we still need to provide more examples and exercises for writing good user stories in CSC 4610 (i.e., get them more experiences earlier, before starting on their customer project).

Optional (but highly suggested) Improvements

- While we provided more feedback early on, need to consider perhaps workshopping with them (which is difficult because only had one instructor for 65 students) when they build their user stories and project charters for their customer.

2) *Outcome 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.*

CSC 2310 Object-Oriented Programming and Design – Fall 2021

Performance Criteria: Outcome 2 was assessed using the following criteria:

1. The student can design a computing-based solution given a set of requirements
2. The student can implement a computing-based solution given a set of requirements
3. The student can evaluate/test a computing-based solution given a set of requirements

We assessed these criteria using a significant design and implementation project. The assignment description is attached.

Performance Criterion 1: The student can design a computing-based solution given a set of requirements

We assessed this criterion using *Concept Initiate 2*, which was an activity that required the students to translate user requirements expressed with use case diagrams into class diagrams representing three levels of concerns, namely data (via class definitions), aggregates (via refinements of the class definitions), and relations (i.e., the relationships between different classes). The rubric used to assess the work of the students is shown below for the *data* component of this assessment.

Data	Excelling 7 points	Practicing 5 points	Apprentice 3 points	Novice 1 point	Criterion Score
Class Definition 1 - Catalog Info	Class definition captures all attributes, including correct specification of types	Missing some attributes or problems with types	Missing most attributes or major problems with types	No submission or major problems	/ 7
Class Definition 2 - Course Instance Info	Class definition captures all attributes, including correct specification of types	Missing some attributes or problems with types	Missing most attributes or major problems with types	No submission or major problems	/ 7

The tables shown below provide the results of the direct assessments of the student submissions. Overall, the assessments show that students are meeting are performance expectations of 70% achieving Excelling/Practicing levels.

Class Definition 1 - Catalog Info		Class Definition 2 - Course Instance Info	
Excelling	76 %	Excelling	85 %
Practicing	14 %	Practicing	14 %
Apprentice	5 %	Apprentice	0 %
Novice	5 %	Novice	1 %

The second component of the design assessment was focused on the students' ability to capture aggregations of classes as forming the larger modules and subsystems of the solution. The rubric is below:

Aggregates	Excelling 4 points	Practicing 3 points	Apprentice 2 points	Novice 0 points	Criterion Score
Catalog Aggregate	Aggregation captured between collection and catalog class; attributes differentiate between subjects	Missing some attributes or problems with types	Missing most attributes or major problems with types	No submission or major problems	/ 4
Course Instance Aggregate	Aggregation captured between collection and catalog class; attributes differentiate between subjects	Missing some attributes or problems with types	Missing most attributes or major problems with types	No submission or major problems	/ 4

The performance of the students in this area of design was lower than in the first component but still well within expected results. In particular, roughly 75% of the students were in the Excelling and Practicing range.

Catalog Aggregate		Course Instance Aggregate	
Excelling	41 %	Excelling	41 %
Practicing	34 %	Practicing	36 %
Apprentice	17 %	Apprentice	12 %
Novice	8 %	Novice	12 %

The third part of the design assessment included having students capture relationships between different classes. These relations communicate whether students understand collaborations between different classes in a system.

Relations	Excelling 5 points	Practicing 3 points	Apprentice 2 points	Novice 0 points	Criterion Score
Relations	Model captures all relationships between classes, including aggregations and relations as necessary	Missing some relationships	Missing most relationships	No submission or major problems	/ 5

Fewer submissions placed in the Excelling range even though the overall number in the Excelling and Practicing range was still around 75%.

Relations		
Excelling	11 %	
Practicing	63 %	
Apprentice	23 %	
Novice	3 %	

Performance Criterion 2: The student can implement a computing-based solution given a set of requirements

We assessed the criterion using Iteration 2. In particular, we assessed whether students were able to adequately implement a specific capability: *exception handling*. The assessment looked at two different exception handling routines within the larger project, as shown in the rubric found below.

Exceptions	Level 4 7 points	Level 3 5 points	Level 2 3 points	Level 1 0 points	Criterion Score
CourseNotFound	Created as separate class; contains all methods required	Missing some methods or some problem with throwing exception	Major issues with exceptions	No exception implemented	/ 7
CatalogNotFound	Created as separate class; contains all methods required	Missing some methods or some problem with throwing exception	Major issues with exceptions	No exception implemented	/ 7

The ability of students to implement these particular features was well above expectations as most students were able to complete this work at Excelling Level (i.e., Level 4).

CourseNotFound			CatalogNotFound		
Level 4	86 %		Level 4	85 %	
Level 3	6 %		Level 3	6 %	
Level 2	1 %		Level 2	0 %	
Level 1	7 %		Level 1	9 %	

Performance Criterion 3: The student can evaluate/test a computing-ased solution given a set of requirements

Performance Criterion 3 was assessed using the Iteration 1 assignment. A significant part of the assignment was for students to implement and test *Happy path* and *Error path* behaviors. In particular, students were assessed on their ability to implement and test specific kinds of behaviors. The rubrics are shown below for the Happy Path (i.e., expected program behaviors).

Happy Path Test Cases	Level 4 13 points	Level 3 11 points	Level 2 8 points	Level 1 0 points	Criterion Score
Course Class	All expected tests pass	Some happy path tests fail	Most tests fail	No submission or compilation fails	/ 13
CourseCatalog Class	All expected tests pass	Some happy path tests fail	Most tests fail	No submission or compilation fails	/ 13

On the *Happy Path* side of the assessment, approximately 75% of the students were at Excelling/Practicing. This is expected since the implementation and tests are based on the standard behaviors of the implemented system.

Course Class		CourseCatalog Class	
Level 4	71 %	Level 4	62 %
Level 3	7 %	Level 3	10 %
Level 2	5 %	Level 2	6 %
Level 1	17 %	Level 1	22 %

The *Error Path* implementation and testing assesses the students' ability to handle unexpected inputs and behaviors. The assessment is somewhat awkward since there are only 3 levels of achievement. In the assessment, if a system fails on the tests, a Level 2 (0) was awarded, indicating that the submission did not check for errant behaviors.

Error Path	Level 4 2 points	Level 3 1 point	Level 2 0 points	Criterion Score
Course Class	Expected error path tests pass	Some error path tests pass	No submission or compilation fails	/ 2
CourseCatalog Class	Expected error path tests pass	Some error path tests pass	No submission or compilation fails	/ 2

The results showed that students did not adequately test for errant behavior. The observation and conclusion to make is that the students' ability to evaluate anomalous behaviors is still developing and that instruction should be adjusted to help students better understand how to test such situations.

Course Class		CourseCatalog Class	
Level 4	20 %	Level 4	11 %
Level 3	1 %	Level 3	5 %
Level 2	79 %	Level 2	84 %

Observations:

The assessments in this report indicate that students are able to create designs that match requirements of a system description. The assessments we performed on the implementations demonstrated that at the end of the semester they were able to create solutions that handled exceptional behaviors. The assessment of testing and evaluation was bimodal: the handling of expected behaviors through test was in the higher range, while the testing of unexpected behavior was well below the desired range. The times when these assessments were performed may have affected performance. In particular, the assessment of Criterion 3 happened earlier than Criterion 2 and may have impacted the students' focus on handling exceptional behaviors.

Recommendations:

We are in the middle of a plan to introduce more software engineering content in the CSC 2310 course in order to address the concerns of this and other related program outcomes. In particular, we have had a number of faculty that are displeased with the programming capabilities of our students later in the program. This assessment does provide some evidence of the concerns but also evidence of improvement.

A number of changes to this course have already been implemented and the recommendation is that we stay the course with these changes and continue to study the data.

3) *Outcome 3: Communicate effectively in a variety of professional contexts.*

CSC 4610 Software Engineering I and CSC 4620 Software Engineering II – Fall 2021, Spring 2022

Performance Criteria (Traits):

1. **Students can communicate project status. (Bloom's taxonomy level: Synthesis)**
2. **Students can describe an overview of a project. (Bloom's taxonomy level: Comprehension)**

Overall Assessment Results

Values: *<number of students>* (*<percentage of total>*)

Trait 1. Students can communicate project status.				
Assessment	Excelling	Practicing	Apprentice	Novice
Iteration reports	**44 (68%)**	**21 (32%)**	**0 (0%)**	**0 (0%)**
Team Iteration 1 Showcase (video)	**60 (92%)**	**5 (8%)**	**0 (0%)**	**0 (0%)**

Trait 2. Students can describe an overview of a project.				
Assessment	Excelling	Practicing	Apprentice	Novice
Project poster (written)	**56 (90%)**	**6 (10%)**	**0 (0%)**	**0 (0%)**
Project final demo (senior expo)	**50 (80%)**	**12 (20%)**	**0 (0%)**	**0 (0%)**

Traits

1. **Students can communicate project status. (Bloom's taxonomy level: Synthesis)**

- Iteration Report: Student **teams** submit an Iteration 1 report **at the end of the first semester** that includes an initial burn-up chart, summary of completed stories, and code committed to git repository. This assignment assesses the students' ability to present written material to a customer.
  Summary: Overall, students did very well on their Iteration 1 report; some need to work on the overall professionalism of their reports (e.g., missing cover page, project name, team member names, etc.), but the content was as expected.
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Iteration Reports	**44 (68%)**	**21 (32%)**	**0 (0%)**	**0 (0%)**

- Team Iteration 1 Showcase: Student **teams** create a video demonstrating their application after Iteration 1 **at the end of the first semester**. This assignment assesses the students' ability to orally and visually present material in a professional manner.
  Summary: Overall, students appear to be well-versed in video editing and presentation skills, but do need to use a better microphone in some cases; some could also use better coordination of the presentation.
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Team Iteration 1 Showcase (video)	**60 (92%)**	**5 (8%)**	**0 (0%)**	**0 (0%)**

2. **Students can describe an overview of a project. (Bloom's taxonomy level: Comprehension)**
- Project Poster: Student **teams** present a poster of their completed project **at the end of the second semester**. This assignment assesses the students' ability to present visual and written material to a customer.

  Summary: The students did an excellent job of creating professional posters for the Senior Expo. Some could have been better "sales pitches", but all of them were of high quality and demonstrated what they had accomplished.

- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Project Poster	**56 (90%)**	**6 (10%)**	**0 (0%)**	**0 (0%)**

- Project Final Showcase: Student **teams** demoed their product to customers and the general community at the Senior Expo **at the end of the second semester**. This assignment assesses the students' ability to orally and visually present material in a professional manner.
  <u>Summary</u>: **The students were very professional in their demos and received high praise not only from their customers but also the general public that attended the event. One group had some issues, but that was primarily due to their wifi connectivity.**
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Project final demo (senior expo)	**50 (80%)**	**12 (20%)**	**0 (0%)**	**0 (0%)**

Recommendation:

- Work with the students more on their posters – make them more of a sales pitch.
- Great to be back in person, but some issues with the venue: very hot; poor wi-fi.

Optional (but highly suggested) Improvements

- Consider having students dress at least business casual (most were dressed nicely, but was not required).

4) *Outcome 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.*

CSC 3040 Professionalism, Communication and Research in Computing – Fall 2021

Performance Criteria (Traits):

1. Students can recognize responsibilities as a computing professional.
   (*Bloom's taxonomy level: Knowledge*)
2. Students can recognize, identify, and describe *ethical* concepts related to computing.
   (*Bloom's taxonomy level: Comprehension*)
3. Students can recognize, identify, and describe *legal* concepts related to computing.
   (*Bloom's taxonomy level: Comprehension*)
4. Students can analyze the challenges associated with *ethical* concepts in the context of computing. (Bloom's taxonomy level: Analysis)
5. Students can analyze the challenges associated with *legal* concepts in the context of computing.
   (*Bloom's taxonomy level: Analysis*)
6. Students can apply *ethical* concepts to assess computing practice.
   (*Bloom's taxonomy level: Application*)
7. Students can apply *legal* concepts to assess computing practice.
   (*Bloom's taxonomy level: Application*)

Overall Assessment Results:

Values: <*number of students*> (<*percentage of total*>)

Trait 1. Students can recognize responsibilities as a computing professional.				
Assessment	Excelling	Practicing	Apprentice	Novice
Final exam-selected questions	45 (58%)	11 (15%)	15 (23%)	3 (4%)

Trait 2. Students can recognize, identify, and describe ethical concepts related to computing.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	149 (51%)	129 (44%)	17 (6%)	1 (0.3%)
Final exam-selected questions	93 (63%)	26 (18%)	17 (11%)	12 (8%)

Trait 3. Students can recognize, identify, and describe legal concepts related to computing.				

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	345 (94.5%)	9 (2.5%)	7 (1.9%)	9 (2.5%)
Final exam- selected questions	82 (37%)	55 (25%)	34 (15%)	51 (23%)

Trait 4. Students can analyze the challenges associated with ethical concepts in the context of computing.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	68 (93%)	1 (1%)	0 (0%)	5 (7%)
Final exam - selected question	43 (58%)	11 (15%)	17 (23%)	3 (4%)

Trait 5. Students can analyze the challenges associated with legal concepts in the context of computing.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	62 (85%)	9 (12%)	0 (0%)	3 (4%)
Final exam - selected questions	38 (51%)	19 (26%)	15 (20%)	2 (3%)

Trait 6. Students can apply ethical concepts to assess computing practice.				
Assessment	Excelling	Practicing	Apprentice	Novice
Final exam - selected questions	131 (59%)	35 (16%)	31 (14%)	25 (11%)
Essay	58 (77%)	11 (15%)	4 (5%)	2 (3%)

Trait 7. Students can apply legal concepts to assess computing practice.				
Assessment	Excelling	Practicing	Apprentice	Novice

Midterm exam - selected questions	78 (53%)	48 (33%)	10 (7%)	12 (8%)
Final exam - selected questions	25 (34%)	19 (26%)	8 (11%)	22 (30%)

Trait 1

Students can recognize responsibilities as a computing professional. (*Bloom's taxonomy level: Knowledge*)

Final exam – selected question:

- Exam questions to recognize responsibilities as a computing professional.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – Q12	45 (58%)	11 (15%)	15 (23%)	3 (4%)

Text of selected question from final exam:

- Q12. Discuss how the field of software engineering tries to ensure software quality?

Trait 2

Students can recognize, identify, and describe ethical concepts related to computing. (*Bloom's taxonomy level: Comprehension*)

Midterm exam - selected questions:

- Exam questions to recognize, identify, and describe basic ethical concepts.

- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	149 (51%)	129 (44%)	17 (6%)	1 (0.3%)

Text of selected questions from midterm exam:

- Q2: Which of the following can be used to describe Social Contract Theory? Select all that apply.

    a. Associated with individuals' rights and societal duties.
    b. The consequences of an action matter more than the intentions of an action.
    c. Not treating people as a means to an end.

d. Act only from moral laws that can be universal moral laws.

e. Attempts to resolve the issue of "moral luck".

f. Rational people will follow the "rules" on the condition that other people will follow them too.

g. An action is right to the extent that it increases total happiness.

h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

- Q3: Which of the following can be used to describe Act Utilitarianism? Select all that apply.

  a. Associated with individuals' rights and societal duties.

  b. The consequences of an action matter more than the intentions of an action.

  c. Not treating people as a means to an end.

  d. Act only from moral laws that can be universal moral laws.

  e. Attempts to resolve the issue of "moral luck".

  f. Rational people will follow the "rules" on the condition that other people will follow them too.

  g. An action is right to the extent that it increases total happiness.

  h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

- Q4: Which of the following can be used to describe Kantianism? Select all that apply.

  a. Associated with individuals' rights and societal duties.

  b. The consequences of an action matter more than the intentions of an action.

  c. Not treating people as a means to an end.

  d. Act only from moral laws that can be universal moral laws.

  e. Attempts to resolve the issue of "moral luck".

  f. Rational people will follow the "rules" on the condition that other people will follow them too.

  g. An action is right to the extent that it increases total happiness.

  h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

- Q5 Which of the following can be used to describe Rule Utilitarianism? Select all that apply.

  a. Associated with individuals' rights and societal duties.

  b. The consequences of an action matter more than the intentions of an action.

  c. Not treating people as a means to an end.

  d. Act only from moral laws that can be universal moral laws.

  e. Attempts to resolve the issue of "moral luck".

  f. Rational people will follow the "rules" on the condition that other people will follow them too.

  g. An action is right to the extent that it increases total happiness.

  h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

Final exam – selected questions:

- Exam questions to recognize, identify, and describe basic ethical concepts.

- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice

| Final exam – selected questions | 93 (63%) | 26 (18%) | 17 (11%) | 12 (8%) |

Text of selected questions from final exam:

- Q1: Privacy can have both a harmful and beneficial consequences. Describe a harm of privacy and a benefit of privacy
- Q2: Why do businesses and governments often use utilitarian thinking to determine the proper course of action?

Trait 3

Students can recognize, identify, and describe legal concepts related to computing. (*Bloom's taxonomy level: Comprehension*)

Midterm exam - selected questions:

- Exam questions to recognize, identify, and describe basic legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	345 (94.5%)	9 (2.5%)	7 (1.9%)	9 (2.5%)

Text of selected questions from midterm exam:

- Q25: Which of the following can be used to describe Patent?

  a. The circumstances under which it is legal to reproduce protected works.
  b. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
  c. How the US government provides authors with certain rights to original works that they have written.
  d. A confidential piece of intellectual property that provides a company with a competitive advantage.
  e. A word, symbol, picture, sound, or color used by a business to identify goods.
  f. Contains information about an incident or action reported to a government agency for the purpose of informing the public.

- Q26: Which of the following can be used to describe Copyright?

  a. The circumstances under which it is legal to reproduce protected works.
  b. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
  c. How the US government provides authors with certain rights to original works that they have written.
  d. A confidential piece of intellectual property that provides a company with a competitive advantage.
  e. A word, symbol, picture, sound, or color used by a business to identify goods.

     f.   Contains information about an incident or action reported to a government agency for the purpose of informing the public.

- Q27: Which of the following can be used to describe Trade Secret?

    a.   The circumstances under which it is legal to reproduce protected works.
    b.   A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
    c.   How the US government provides authors with certain rights to original works that they have written.
    d.   A confidential piece of intellectual property that provides a company with a competitive advantage.
    e.   A word, symbol, picture, sound, or color used by a business to identify goods.
    f.   Contains information about an incident or action reported to a government agency for the purpose of informing the public.

- Q28: Which of the following can be used to describe Trademark?

    a.   The circumstances under which it is legal to reproduce protected works.
    b.   A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
    c.   How the US government provides authors with certain rights to original works that they have written.
    d.   A confidential piece of intellectual property that provides a company with a competitive advantage.
    e.   A word, symbol, picture, sound, or color used by a business to identify goods.
    f.   Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q34: How is intellectual property (IP) different from physical property?

Final exam – selected questions:

- Exam questions to recognize, identify, and describe basic legal concepts.

- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	82 (37%)	55 (25%)	34 (15%)	51 (23%)

Text of selected questions from final exam:

- Q3: What is the purpose of the Freedom of Information Act, and describe an exemption to this law?

- Q4: Select the correct term from the following list that matches with the sentences below. Write the letter in the blank that matches.

A – FISA

B – DMCA
C – HIPPA
D – GDPR
E – COPPA
F – FERPA
G – USA PATRIOT Act
H – CALEA
I – GNU
J – HITECH
K – NCIC

_____Limits the exchange of information among health care providers.

_____A set of rules governing the collection of information from citizens of the European Union and requires that companies disclose the information they are seeking to collect and why they are collecting it.

_____Required doctors and hospitals to move medical records from paper to electronic by 2015 for the purpose of improving quality of medical care.

_____Also known as the Digital Telephony Act, this law required that networking equipment used by phone companies be designed or modified so that law enforcement agencies can trace calls, listen in on telephone calls, and intercept email messages.

_____This legislature amended many existing laws and provided federal law enforcement and intelligence officials with greater authority to monitor communications.

- Q5: What is the purpose of FERPA?

Trait 4

Students can analyze the challenges associated with ethical concepts in the context of computing. (Bloom's taxonomy level: Analysis)

Midterm exam - selected question:

- Exam question to analyze challenges associated with pros/cons of ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	68 (93%)	1 (1%)	0 (0%)	5 (7%)

Text of selected question from midterm exam:

- Q36: Describe at least one way that computers make it harder to protect intellectual property.

Final exam – selected question:

- Exam question to analyze challenges associated with pros/cons of ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected question	43 (58%)	11 (15%)	17 (23%)	3 (4%)

Text of selected question from final exam:

- Q6: Describe two ethical concerns related to telework.

Trait 5

Students can analyze the challenges associated with legal concepts in the context of computing. (Bloom's taxonomy level: Analysis)

Midterm exam - selected question:

- Exam question to analyze challenges associated with pros/cons of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	62 (85%)	9 (12%)	0 (0%)	3 (4%)

Text of selected questions from midterm exam:

- Q33: Describe two things about the Internet that makes its censorship challenging.

Final exam – selected question:

- Exam questions to analyze challenges associated with pros/cons of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected question	38 (51%)	19 (26%)	15 (20%)	2 (3%)

Text of selected question from final exam:

- Q7: Under what circumstances is whistleblowing justifiable?

Trait 6

Students can apply ethical concepts to assess computing practice. (*Bloom's taxonomy level: Application*)

Final exam – selected questions:

- Exam questions to think through the application of ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	131 (59%)	35 (16%)	31 (14%)	25 (11%)

Text of selected questions from final exam:

- Q8: Explain how you could (or could not) ethically justify a denial of service attack.
- Q9: You are a software engineer at Alice's House of Software. Your manager, Bob, tells you that the software project you are developing needs to be released tomorrow, but you have not finished testing. Using two of the ethical frameworks above, describe how you should respond to Bob's demand and why?
  Framework 1: _____
  Argument:
  Framework 2: _____
  Argument:

Ethics essay:

- Essay requiring students to explain and defend an ethical claim related to networked communications.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Ethics essay	58 (77%)	11 (15%)	4 (5%)	2 (3%)

Text of ethics essay assignment:

Write an essay about an ethical issue pertaining to a topic discussed in Chapter 3 Networked Communications. Find one or more current (2019 to 2022) news article(s) that contain(s) information about an ethical dilemma pertaining to a networked communication (email, social network, search engines, internet, internet of things devices, data mining, online privacy, internet-based research, identity theft, internet addiction, cyberbullying, online predators, etc.) Make sure the news article is valid (nothing off reddit, TikTok, etc.). Then, explain and defend if the action taken in the dilemma was right or wrong based on the Kantianism ethical theory.

Trait 7

Students can apply legal concepts to assess computing practice. (*Bloom's taxonomy level: Application*)

Midterm exam – selected questions:

- Exam questions to think through the application of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam – selected questions	78 (53%)	48 (33%)	10 (7%)	12 (8%)

Text of selected questions from midterm exam:
- Q23: Which of the following are factors used in determining fair use? Select all that apply.
  a. Purpose and character of use
  b. Nature of work being copied
  c. How much work is being used
  d. Effect on the market of the original work
  e. Amount of profit made from the new work
  f. The platform on which the new work is distributed

- Q35: Name four factors used to determine fair use.

Final exam – selected questions:
- Exam questions to think through the application of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	25 (34%)	19 (26%)	8 (11%)	22 (30%)

Text of selected question from final exam:

- Q10: What are the implications of the Stored Communications Act for all those who let an Internet service provider handle their e-mail.

Recommendation:

- **Students know the definitions of the various legal terms, but don't fully understand how to apply them; students need to be exposed to more scenarios and discussions regarding their appropriate application.**

Optional Improvements:

- Although essay grades were pretty good, students complained about not having enough direction and were most frustrated with completing the essays in the class. One suggestion is to include a lecture on tips to writing an essay including building an outline and strategies to stay on topic.

- Students need to be exposed to more professionalism topics such as emotional intelligence, diversity, inclusion, equity, and leadership skills.

5) *Outcome 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.*

CSC 3570-001 "IT Security" – Fall 2021

Performance Criteria (Traits):

1. **Students can recognize identify and describe ethical and legal concepts related to computing and associated challenges (*Bloom's taxonomy level: Comprehension and Analysis*)**

Assessment Results

Trait 1. Students can recognize identify and describe ethical and legal concepts related to computing and associated challenges				
Assessment	Excelling	Practicing	Apprentice	Novice
Final exam, question 3	18 (46.1%)	12 (30.8%)	8 (20.5%)	1 (2.6%)

Final exam, Question 3:

- Students were asked to make an informed judgment based on legal and ethical concepts about what violations the imaginary healthcare company made in case of an imaginary cybersecurity incident that happened to the imaginary company. Students were asked to list the violations the imaginary healthcare company has made and briefly explain how they would prevent each of the violations. The assessment results for this question show 46.1% of the students excelling.

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – question 3	18 (46.1%)	12 (30.8%)	8 (20.5%)	1 (2.6%)

- Text of the question 3 from the final exam:

"Imagine that you are asked to help with investigating a cyber incident that happened with one healthcare company. You have discovered the following:

1) Electronic Health Records (EHRs) for some patients were stored for about 1 year. Then they were erased in order to free up the disk space.
2) EHRs were stored in a plaintext format in the database with a weak password "root".
3) When the cyber incident happened, several EHRs of patients were leaked to some unknown entities. Further investigation is required on that.
4) The company did not notify the law enforcement trying to hide the cyber incident and quickly fix it. The company's top management thought that notifying the law enforcement would damage the company's reputation in a healthcare market, resulting in losing the customers.
5) After the cyber incident, the company decided to harden their IT infrastructure, use the strong password for the EHR database, encrypt the EHRs in the database, and revise the firewall rules for the corporate Intranet.

Make an informed judgment based on legal and ethical principles about what the company did wrong and identify the violations. List the violations the company has made and briefly (no more than 3 sentences per violation) explain how you would prevent each of these violations. *Hint: in the USA, the Health Insurance Portability and Accountability Act (HIPAA) defines the requirements for safeguarding and retaining health records."*

Recommendation: None.
Optional (but highly suggested) Improvements – None.

6) *Outcome 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.*

CSC 3040 Professionalism, Communication and Research in Computing – Fall 2021

Performance Criteria (Traits):

1. Students can recognize responsibilities as a computing professional.
   (*Bloom's taxonomy level: Knowledge*)
2. Students can recognize, identify, and describe *ethical* concepts related to computing.
   (*Bloom's taxonomy level: Comprehension*)
3. Students can recognize, identify, and describe *legal* concepts related to computing.
   (*Bloom's taxonomy level: Comprehension*)
4. Students can analyze the challenges associated with *ethical* concepts in the context of computing. (Bloom's taxonomy level: Analysis)
5. Students can analyze the challenges associated with *legal* concepts in the context of computing.
   (*Bloom's taxonomy level: Analysis*)
6. Students can apply *ethical* concepts to assess computing practice.
   (*Bloom's taxonomy level: Application*)
7. Students can apply *legal* concepts to assess computing practice.
   (*Bloom's taxonomy level: Application*)

Overall Assessment Results:

Values: <*number of students*> (<*percentage of total*>)

Trait 1. Students can recognize responsibilities as a computing professional.				
Assessment	Excelling	Practicing	Apprentice	Novice
Final exam-selected question	17 (24%)	25 (36%)	4 (6%)	14 (20%)
Essay	38 (66%)	14 (24%)	2 (3%)	4 (7%)

Trait 2. Students can recognize, identify, and describe ethical concepts related to computing.				
Assessment	Excelling	Practicing	Apprentice	Novice

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	91 (41%)	57 (25%)	69 (31%)	7 (3%)
Final exam- selected questions	58 (48%)	9 (8%)	23 (19%)	30 (25%)

Trait 3. Students can recognize, identify, and describe legal concepts related to computing.

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	208 (93%)	0 (0%)	0 (0%)	16 (7%)
Final exam- selected questions	66 (55%)	20 (17%)	17 (14%)	17 (14%)

Trait 4. Students can analyze the challenges associated with ethical concepts in the context of computing.

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	43 (77%)	7 (13%)	3 (5%)	3 (5%)
Final exam - selected question	34 (57%)	1 (2%)	7 (12%)	18 (30%)

Trait 5. Students can analyze the challenges associated with legal concepts in the context of computing.

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	18 (32%)	25 (45%)	11 (20%)	2 (4%)
Final exam - selected questions	9 (15%)	37 (62%)	5 (8%)	9 (15%)

Trait 6. Students can apply ethical concepts to assess computing practice.

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam - selected questions	79 (44%)	32 (18%)	24 (13%)	45 (25%)
Essay	47 (89%)	3 (5%)	2 (3%)	1 (2%)

Trait 7. Students can apply legal concepts to assess computing practice.				
Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	70 (63%)	17 (15%)	4 (4%)	21 (19%)
Final exam - selected questions	24 (40%)	18 (30%)	6 (10%)	12 (20%)

Trait 1

Students can recognize responsibilities as a computing professional. (*Bloom's taxonomy level: Knowledge*)

- Final exam – selected question:
- Exam questions to recognize responsibilities as a computing professional.
- Scale: Excelling ($\geq$90%), Practicing ($\geq$80%, <90%), Apprentice ($\geq$60%, <80%), Novice (<60%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected question	17 (24%)	25 (36%)	4 (6%)	14 (20%)
Essay				

Text of selected question from final exam:
- Q10. Discuss how the field of software engineering tries to ensure software quality?
- Professionalism essay:
- Essay requiring students to write an essay pertaining to workplace inclusion, diversity and/or equity.
- Scale: Excelling ($\geq$90%), Practicing ($\geq$80%, <90%), Apprentice ($\geq$60%, <80%), Novice (<60%)

Assessment	Excelling	Practicing	Apprentice	Novice
Ethics essay	38 (66%)	14 (24%)	2 (3%)	4 (7%)

Text of ethics essay assignment:

Write an 800-1200-word essay pertaining to workplace inclusion, diversity and/or equity. The essay can focus on any of the following:

• Creating/ensuring an inclusive workplace
• Hiring & supporting a diverse workforce

• Ensuring equity in the workplace
• Harms of discrimination in the workplace
• Imposter syndrome in the workplace
• How men can be allies for women in the workplace
• Lack of equity for [women, disabled workers, minorities, etc.]
• Other (ask me if you are not sure)

The essay must have citations in IEEE format and be supported by 3 to 5 relevant peer-reviewed articles published between 2020 – 2022.

Trait 2

Students can recognize, identify, and describe ethical concepts related to computing. (*Bloom's taxonomy level: Comprehension*)

Midterm exam - selected questions:
• Exam questions to recognize, identify, and describe basic ethical concepts.
• Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	91 (41%)	57 (25%)	69 (31%)	7 (3%)

Text of selected questions from midterm exam:

Q2: Which of the following can be used to describe Social Contract Theory? Select all that apply.

a. Associated with individuals' rights and societal duties.
b. The consequences of an action matter more than the intentions of an action.
c. Not treating people as a means to an end.
d. Act only from moral laws that can be universal moral laws.
e. Attempts to resolve the issue of "moral luck".
f. Rational people will follow the "rules" on the condition that other people will follow them too.
g. An action is right to the extent that it increases total happiness.
h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

Q3: Which of the following can be used to describe Act Utilitarianism? Select all that apply.

a. Associated with individuals' rights and societal duties.
b. The consequences of an action matter more than the intentions of an action.
c. Not treating people as a means to an end.
d. Act only from moral laws that can be universal moral laws.
e. Attempts to resolve the issue of "moral luck".

f. Rational people will follow the "rules" on the condition that other people will follow them too.

g. An action is right to the extent that it increases total happiness.

h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

Q4: Which of the following can be used to describe Kantianism? Select all that apply.

a. Associated with individuals' rights and societal duties.

b. The consequences of an action matter more than the intentions of an action.

c. Not treating people as a means to an end.

d. Act only from moral laws that can be universal moral laws.

e. Attempts to resolve the issue of "moral luck".

f. Rational people will follow the "rules" on the condition that other people will follow them too.

g. An action is right to the extent that it increases total happiness.

h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

Q5 Which of the following can be used to describe Rule Utilitarianism? Select all that apply.

a. Associated with individuals' rights and societal duties.

b. The consequences of an action matter more than the intentions of an action.

c. Not treating people as a means to an end.

d. Act only from moral laws that can be universal moral laws.

e. Attempts to resolve the issue of "moral luck".

f. Rational people will follow the "rules" on the condition that other people will follow them too.

g. An action is right to the extent that it increases total happiness.

h. We ought to adopt moral rules that lead to the greatest increase in total happiness.

Final exam – selected questions:
- Exam questions to recognize, identify, and describe basic ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	58 (48%)	9 (8%)	23 (19%)	30 (25%)

Text of selected questions from final exam:

- Q1: Why do businesses and governments often use utilitarian thinking to determine the proper course of action?

- Q2: Privacy can have both a harmful and beneficial consequences. Describe two harms of privacy and two benefits of privacy.

Trait 3

Students can recognize, identify, and describe legal concepts related to computing. (*Bloom's taxonomy level: Comprehension*)

Midterm exam - selected questions:

- Exam questions to recognize, identify, and describe basic legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected questions	208 (93%)	0 (0%)	0 (0%)	16 (7%)

Text of selected questions from midterm exam:

Q23: Which of the following can be used to describe Patent?

   a. The circumstances under which it is legal to reproduce protected works.
   b. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
   c. How the US government provides authors with certain rights to original works that they have written.
   d. A confidential piece of intellectual property that provides a company with a competitive advantage.
   e. A word, symbol, picture, sound, or color used by a business to identify goods.
   f. Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q24: Which of the following can be used to describe Copyright?

   a. The circumstances under which it is legal to reproduce protected works.
   b. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
   c. How the US government provides authors with certain rights to original works that they have written.
   d. A confidential piece of intellectual property that provides a company with a competitive advantage.
   e. A word, symbol, picture, sound, or color used by a business to identify goods.
   f. Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q25: Which of the following can be used to describe Trade Secret?

   a. The circumstances under which it is legal to reproduce protected works.
   b. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
   c. How the US government provides authors with certain rights to original works that they have written.
   d. A confidential piece of intellectual property that provides a company with a competitive advantage.
   e. A word, symbol, picture, sound, or color used by a business to identify goods.
   f. Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q26: Which of the following can be used to describe Trademark?

    a.   The circumstances under which it is legal to reproduce protected works.

    b.   A way the US government provides an inventor with an exclusive right to a piece of intellectual property.

    c.   How the US government provides authors with certain rights to original works that they have written.

    d.   A confidential piece of intellectual property that provides a company with a competitive advantage.

    e.   A word, symbol, picture, sound, or color used by a business to identify goods.

    f.   Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q35: How is intellectual property (IP) different from physical property?

Final exam – selected questions:

- Exam questions to recognize, identify, and describe basic legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	66 (55%)	20 (17%)	17 (14%)	17 (14%)

Text of selected questions from final exam:

Q3: What is the purpose of the Freedom of Information Act, and describe an exemption to this law?

Q22: Match the government legislature with the correct description.

1. Employee Polygraph Protection Act (EPPA)
2. Children's Online Privacy Protection Act (COPPA)
3. Telecommunications Act
4. Electronic Communications Privacy Act (ECPA)
5. Communications Assistance for Law Enforcement Act (CALEA)
6. Clarifying Lawful Overseas Use of Data Act (CLOUD Act)
7. Privacy Act of 1974
8. Computer Matching and Privacy Protection Act
9. USA PATRIOT Act
10. General Data Protection Regulation (GDPR)
11. Health Insurance Portability and Accountability Act (HIPPA)
12. Family Educational Rights and Privacy Act (FERPA)
13. Right to Financial Privacy Act (RFPA)
14. Fair Credit Reporting Act (FCRA)
15. Fair and Accurate Credit Transactions Act (FACTA)
16. Fair Debt Collection Practices Act (FDCPA)
17. Driver's Privacy Protection Act (DPPA)

18. Information Technology Management Reform Act
19. Computer Fraud and Abuse Act (CFAA)
20. E-Government Act

_____ Protect the privacy of personal information assembled by State Department of Motor Vehicles (DMVs) by prohibiting the release or use by any state DMV of PI about an individual obtained by the department.

_____ A U.S. federal statute that modernized the flow of healthcare information, stipulating how personally identifiable information maintained by the healthcare and healthcare insurance industries should be protected from fraud and theft.

_____ Prohibits most private employers from using lie-detector tests in most situations.

_____ Authorizes the Federal Communications Commission (FCC) to impose restrictions on telecommunications carriers regarding the access, use, and disclosure of customer information.

_____ United States statute with the purpose of improving the management and promotion of electronic government services and processes by establishing a Federal Chief Information Officer of the United States within the Office of Management and Budget and by establishing a framework of measures that require using internet-based information technology to improve citizen access to government information and services.

_____ Primarily amends the Stored Communications Act (SCA) of 1986 to allow federal law enforcement (like the FBI) to force U.S.-based technology companies (like Microsoft) via warrant or subpoena to provide requested data stored on servers regardless of whether the data are stored in the U.S. or on foreign soil.

_____ A US wiretapping law that requires phone companies to design or be able to modify networking equipment so that law enforcement agencies can trace calls, listen in on telephone calls, and intercept email messages.

_____ Was enacted following the September 11 attacks and the 2001 anthrax attacks with the stated goal of dramatically tightening U.S. national security, especially foreign terrorism.

_____ A consumer protection amendment, establishing legal protection from abusive debt collection practices.

_____ Establishes a Code of Fair Information Practice that governs the collection, maintenance, use, and dissemination of personally identifiable information about individuals that is maintained in systems of records by federal agencies.

_____ A law that governs the access to educational information and records by publicly funded educational institutions, and foreign governments.

_____ An amendment to the Fair Credit Reporting Act and allows consumers to request and obtain a free credit report once every 12 months from each of the three nationwide consumer credit reporting companies (Equifax, Experian, and TransUnion) via AnnualCreditReport.com.

_____ Allows police to attach two kinds of surveillance devices to a suspect's phone line. If the suspect makes a phone call, a pen register displays the number being dialed. If the suspect gets a phone call, a trap-and-trace device displays the caller's phone number.

_____ Establishes specific procedures that federal government authorities must follow in order to obtain information from a financial institution about a customer's financial records.

_____ Requires Federal agencies to enter into written agreements with other agencies or non-Federal entities before disclosing records for use in computer matching programs.

_____ The purpose is to improve the way the federal government acquires, uses, and disposes information technology (IT). Information technology with respect to an executive agency is defined in this act as any equipment or system that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency.

_____ This Act's primary aim is to enhance individual's control and rights over their personal data and to simplify the regulatory environment for international business.

_____ Enacted to promote the accuracy, fairness, and privacy of consumer information contained in the files of consumer reporting agencies. It was intended to shield consumers from the willful and/or negligent inclusion of erroneous data in their credit reports.

_____ Designed to reduce the amount of information gathered from children using the Internet.

_____ US cybersecurity bill that was enacted as an amendment to existing computer fraud law which had been included in the Comprehensive Crime Control Act of 1984

Trait 4

Students can analyze the challenges associated with ethical concepts in the context of computing. (Bloom's taxonomy level: Analysis)

Midterm exam - selected question:

- Exam question to analyze challenges associated with pros/cons of ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	43 (77%)	7 (13%)	3 (5%)	3 (5%)

Text of selected question from midterm exam:

Q37: Describe at least one way that computers make it harder to protect intellectual property.

Final exam – selected question:

- Exam question to analyze challenges associated with pros/cons of ethical concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected question	34 (57%)	1 (2%)	7 (12%)	18 (30%)

Text of selected question from final exam:

Q4: Describe two ethical concerns related to telework.

Trait 5

Students can analyze the challenges associated with legal concepts in the context of computing. (Bloom's taxonomy level: Analysis)

Midterm exam - selected question:

- Exam question to analyze challenges associated with pros/cons of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam - selected question	18 (32%)	25 (45%)	11 (20%)	2 (4%)

Text of selected questions from midterm exam:

Q34: Describe two things about the Internet that makes its censorship challenging.

Final exam – selected question:

- Exam questions to analyze challenges associated with pros/cons of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected question	9 (15%)	37 (62%)	5 (8%)	9 (15%)

Text of selected question from final exam:

Q9: Under what circumstances is whistleblowing justifiable?

Trait 6

Students can apply ethical concepts to assess computing practice. (*Bloom's taxonomy level: Application*)

Final exam – selected questions:

- Exam questions to think through the application of ethical concepts.

- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	79 (44%)	32 (18%)	24 (13%)	45 (25%)

Text of selected questions from final exam:

> Q5: Explain how you could (or could not) ethically justify a denial of service attack.
>
> Q6: You are a software engineer at April's House of Software. Your manager, Bingo, tells you that the software project you are developing needs to be released tomorrow, but you have not finished testing. Use the Rule Utilitarianism ethical framework to argue how you should respond to Bingo's demand and why.
>
> Q7: You are a software engineer at April's House of Software. Your manager, Bingo, tells you that the software project you are developing needs to be released tomorrow, but you have not finished testing. Use the Virtue Ethics ethical framework to argue how you should respond to Bingo's demand and why.

Ethics essay:

- Essay requiring students to explain and defend an ethical claim related to networked communications.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Ethics essay	47 (89%)	3 (5%)	2 (3%)	1 (2%)

Text of ethics essay assignment:

Write an essay about an ethical issue pertaining to a topic discussed in Chapter 3 Networked Communications. Find one or more current (2019 to 2022) news article(s) that contain(s) information about an ethical dilemma pertaining to a networked communication (email, social network, search engines, internet, internet of things devices, data mining, online privacy, internet-based research, identity theft, internet addiction, cyberbullying, online predators, etc.) Make sure the news article is valid (nothing off reddit, TikTok, etc.). Then, explain and defend if the action taken in the dilemma was right or wrong based on the Kantianism ethical theory.

Trait 7

Students can apply legal concepts to assess computing practice. (*Bloom's taxonomy level: Application*)

Midterm exam – selected questions:

- Exam questions to think through the application of legal concepts.

- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Midterm exam – selected questions	70 (63%)	17 (15%)	4 (4%)	21 (19%)

Text of selected questions from midterm exam:

Q22: Which of the following can be used to describe Fair Use?

1. The circumstances under which it is legal to reproduce protected works.
2. A way the US government provides an inventor with an exclusive right to a piece of intellectual property.
3. How the US government provides authors with certain rights to original works that they have written.
4. A confidential piece of intellectual property that provides a company with a competitive advantage.
5. A word, symbol, picture, sound, or color used by a business to identify goods.
6. Contains information about an incident or action reported to a government agency for the purpose of informing the public.

Q36: Name four factors used to determine fair use.

Final exam – selected questions:

- Exam questions to think through the application of legal concepts.
- Scale: Excelling (≥90%), Practicing (≥80%, <90%), Apprentice (≥70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Final exam – selected questions	24 (40%)	18 (30%)	6 (10%)	12 (20%)

Text of selected question from final exam:

Q8: What are the implications of the Stored Communications Act for all those who let an Internet service provider handle their e-mail.

Recommendation:

An observation is that students tend to forget to use an ethical framework to defend their opinions unless they are explicitly told to do so in the text of the question. In future semesters, we need to stress the importance of defending opinions with an ethical framework based on logic, reason, and facts.

Students know the definitions of the various legal terms, but don't fully understand how to apply them to the field of computing; students need to be exposed to more scenarios and discussions regarding their appropriate application.

7) *Outcome 5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.*

CSC 4610 Software Engineering I and CSC 4620 Software Engineering II – Fall 2021, Spring 2022

Performance Criteria (Traits):

1. **Students can create and manage a plan. (Bloom's taxonomy level: Synthesis)**
2. **Students can track and manage a plan. (Bloom's taxonomy level: Synthesis)**
3. **Students can produce deliverables. (Bloom's taxonomy level: Application)**

Overall Assessment Results

Values: *<number of students>* (*<percentage of total>*)

Trait 1. Students can create and manage a plan.				
Assessment	Excelling	Practicing	Apprentice	Novice
Project Charter	**27 (42%)**	**31 (48%)**	**6 (9%)**	**0 (0%)**

Trait 2. Students can track and manage a plan.				
Assessment	Excelling	Practicing	Apprentice	Novice
Student Progress	**45 (73%)**	**17 (27%)**	**0 (0%)**	**0 (0%)**
Iteration Reports	**44 (71%)**	**14 (23%)**	**4 (6%)**	**0 (0%)**

Trait 3. Students can produce deliverables.				
Assessment	Excelling	Practicing	Apprentice	Novice
Project Showcase Demo (final video)	**62 (100%)**	**0 (0%)**	**0 (0%)**	**0 (0%)**

Traits

1. **Students can create and manage a plan. (Bloom's taxonomy level: Synthesis)**
   - Project Charter: Student **teams** create a Project Charter **in the first semester**. This assignment assesses the students' ability to organize and work together as a team.
     Summary: Overall, students are able to identify what needs to be done, and organize tasks with individuals; some need to work on including more detail and identifying sub-tasks.

   - Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Project Charter	**27 (42%)**	**31 (48%)**	**6 (9%)**	**0 (0%)**

2. **Students can track and manage a plan. (Bloom's taxonomy level: Synthesis)**

- Student Progress: Student **teams** use gitlab to document the progress of their project. The continual tracking of accomplishments towards a final product assesses the students' ability to keep track of and manage a project plan.
  Summary: Teams did a much better job this semester with providing detailed reports. Sometimes individual reports would reflect more about the team than their individual efforts. Overall, students managed their CM repositories well. Did not always stay on top of their Kanban boards, but in the end were up-to-date.
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Student Progress	**45 (73%)**	**17 (27%)**	**0 (0%)**	**0 (0%)**

- Iteration Reports: Student **teams** submit a report **at the end of each Iteration** that includes an initial burn-up chart, summary of completed stories, and code committed to git repository. This assignment assesses the students' ability to present written material to a customer.
  Summary: Overall, student reports were professional and reflective of work accomplished. Marked improvement over the semester (and from the previous semester).
- Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Iteration Reports	**44 (71%)**	**14 (23%)**	**4 (6%)**	**0 (0%)**

3. **Students can produce deliverables. (Bloom's taxonomy level: Application)**
   - Project Showcase: Student teams **demo** (and video) the final version of their product **at the end of the second semester**. This assignment assesses the students' ability to orally and visually present material in a professional manner.
     Summary: Overall, students presented solid demos to the customer at the Senior Expo, and final videos were of good quality. All teams delivered their MVP.
   - Scale: Excelling (>=90%), Practicing (>=80%, <90%), Apprentice (>=70%, <80%), Novice (<70%)

Assessment	Excelling	Practicing	Apprentice	Novice
Project Showcase Demo (final video)	**62 (100%)**	**0 (0%)**	**0 (0%)**	**0 (0%)**

Recommendation:
- **Find a better way to distinguish individual work and participation towards the team's product.**

Optional (but highly suggested) Improvements
- **None.**

8) *Outcome 6: Apply computer science theory and software development fundamentals to produce computing-based solutions*

CSC 2310 Spring 20222

Performance Criteria

1. Students can apply computer science theory and software development fundamentals to *design* computing-based solutions. (*Bloom's taxonomy level: Apply*)
2. Students can apply computer science theory and software development fundamentals to *implement* computing-based solutions. (*Bloom's taxonomy level: Apply*)

Trait 1. Students can apply computer science theory and software development fundamentals to *design* computing-based solutions. (*Bloom's taxonomy level: Apply*)

Examples:
- Concept Initiate 1 – Use Case Diagrams (See attached project description)
- Concept Intiaite 2 – Class Diagrams

The rubric used to assess student work for Concept Initiate 1 assessment is shown below. The assessment included two aspects of design: correctness of the models and completeness of the models. These particular models represented use case diagrams as a translation of user stories or requirements.

Content	Excelling 10 points	Practicing 7 points	Apprentice 4 points	Novice 1 point	Criterion Score
Correctness	Model uses all the correct notational conventions and the use cases are partitioned	All of the use cases are present but there is no partitioning of the model, some of the notation is used incorrectly	The use cases are not built correct, some notational issues	Model missing or incorrect in all aspects of its construction	/ 10
Completeness	Includes all use cases as well as some of their own cases	Uses the reference use cases only or may be missing appendices	Missing some use cases; only includes a few cases and misses some of the reference cases	Model missing or not relevant to the problem of the project	/ 10

The table shown below records the percentages of achievement for the exercise. Overall, students were in the Excelling or Practicing levels of achievement for both correctness and completeness.

Correctness

Excelling	79 %	████████████████░░░░
Practicing	15 %	███░░░░░░░░░░░░░░░░░░
Apprentice	5 %	█░░░░░░░░░░░░░░░░░░░░
Novice	0 %	░░░░░░░░░░░░░░░░░░░░

Completeness

Excelling	95 %	███████████████████░
Practicing	3 %	█░░░░░░░░░░░░░░░░░░░░
Apprentice	3 %	█░░░░░░░░░░░░░░░░░░░░
Novice	0 %	░░░░░░░░░░░░░░░░░░░░

The second assessment involved three components, each shown in the following rubrics. The exercise was to develop class diagram designs using the use case diagrams as the source material. The first component assessed their ability to properly capture information about object classes in their designs.

Data	Excelling 6 points	Practicing 4 points	Apprentice 1 point	Novice 0 points	Criterion Score
Class Definitions	Class definitions capture attributes, including correct specification of types	Missing some classes, attributes, or methods, or there problems with types	Missing most classes, attributes, or methods, or there are major problems with types	No submission or major problems	/ 6

The following tables shows the student achievement levels for this component of the assessment. 100% of the students were at the Excelling or Practicing level.

Class Definitions

Excelling	82 %	████████████████░░░░
Practicing	18 %	███░░░░░░░░░░░░░░░░░░
Apprentice	0 %	░░░░░░░░░░░░░░░░░░░░
Novice	0 %	░░░░░░░░░░░░░░░░░░░░

The second part of the design assessment covered relationships between different design elements. The rubric is below.

Relations	Excelling 6 points	Practicing 4 points	Apprentice 1 point	Novice 0 points	Criterion Score
High-level relationships	Captures basic relationships between classes	missing some high-level relationships	missing most high-level relationships	No submission or major problems	/ 6
Relationship refinements	Correctly refines relationships according to semantic definitions of aggregation, composition, and inheritance	some refinements used	relationships refined incorrectly, including using the wrong symbols	No submission or major problems	/ 6
Multiplicities	Correctly captures use of multiplicities	some minor multiplicity problems	multiplicities missing entirely or mostly incorrect	No submission or major problems	/ 6

The student assessment statistics are shown below. Again, 100% of the students were able to achieve either Excelling or Practicing for this assessment. This indicated that students were able to both identify relevant classes and the high-level relationships between them in their designs.
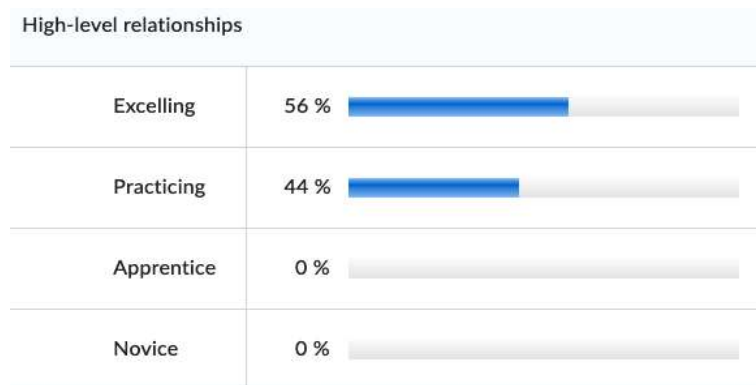
The assessment of the refinements and multiplicities were still relatively high achieving, as shown in the following table. Roughly 18-21% of the students produced diagrams that needed work with respect to use of refined relationships and multiplicities in their designs.

Relationship refinements

Level	Percent	
Excelling	36 %	
Practicing	46 %	
Apprentice	18 %	
Novice	0 %	

Multiplicities

Level	Percent	
Excelling	67 %	
Practicing	13 %	
Apprentice	18 %	
Novice	3 %	
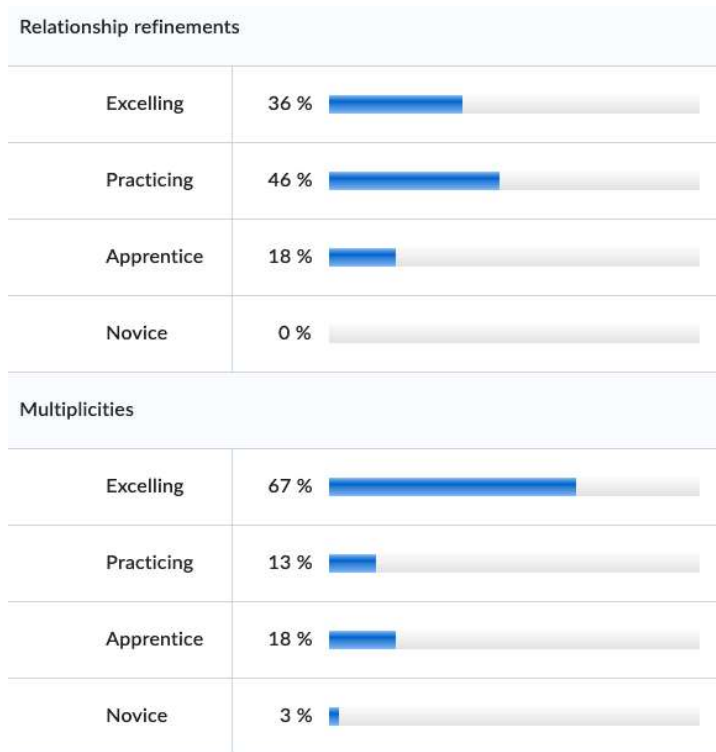
The final part of the assessment checked to see if students were able to properly match the user stories from Concept Phase 1 with the design. The students were consistent in their achievement of this trait, with 100% achieving Excelling and Practicing.

Requirements	Excelling 6 points	Practicing 4 points	Apprentice 1 point	Novice 0 points	Criterion Score
Match with user stories	Design matches requirements posed by the user stories	Model missing some requirements	Model does not address most requirements	No submission or major problems	/ 6
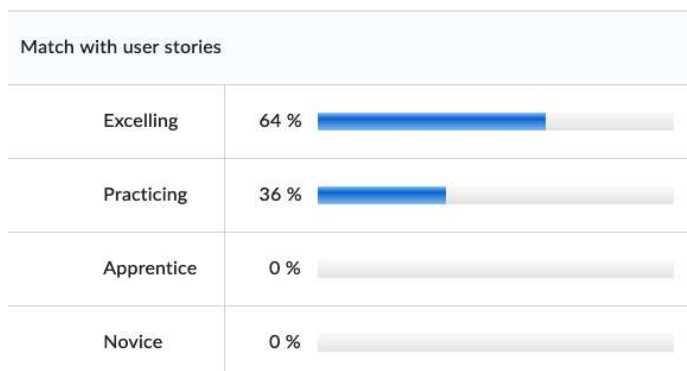
Match with user stories

Level	Percent	
Excelling	64 %	
Practicing	36 %	
Apprentice	0 %	
Novice	0 %	

Trait 2. Students can apply computer science theory and software development fundamentals to *implement* computing-based solutions. (*Bloom's taxonomy level: Apply*)

Examples:
- Iteration 1 – Creation of first set of services
- Iteration 2 – Creation of second set of services

The rubric used to assess Iteration 1 included the following criteria:
- Services created – Did the submission create all of the required services set forth in the assignment sheet?
- Service signatures correct – Did the submission use the predefined signatures set forth in the design of the system?
- Test created for each service – Did the submission include its own set of tests?
- Project build with mvn clean; mvn compile – Was the submission buildable and compilable using the mvn command as specified?
- Services deploy without modification – Was the submission deployable without modification?
- Services produce an output – Was an output genreated when called?
- Returned service data format is correct – Was the data format correct?
- Services pass tests – Did the services pass test cases created by the instructor?

The following pages provide the achievement levels for each element of the rubric. In the reports, Level 4, 3, 2, and 1 correspond to Excelling, Practicing, Apprentice, and Novice, respectively.

A significant number of students did not achieve the Excelling/Practicing levels for this particular assignment. At the most rudimentary level, services with the proper signatures were submitted, as shown in the first two tables.

Services created			Service signatures correct		
Level 4	73 %		Level 4	73 %	
Level 3	3 %		Level 3	3 %	
Level 2	10 %		Level 2	0 %	
Level 1	15 %		Level 1	25 %	

Students' ability to create and submit tests were bi-modal, as shown below.

Test created for each service		
Level 4	48 %	
Level 3	3 %	
Level 2	3 %	
Level 1	48 %	

Compilation and build with deployment is a sign of whether students were able to at least get something running. Again, the pattern shows a bi-model level of performance.

Project build with mvn clean; mvn compile			Services deploy without modification		
Level 4	53 %		Level 4	48 %	
Level 3	10 %		Level 3	0 %	
Level 2	13 %		Level 2	3 %	
Level 1	25 %		Level 1	50 %	

The real proof is in the output as to whether students were able to achieve the desired outcomes for this assignment. Again, a bi-model level of performance was observed. Finally, testing showed that many students were unable to complete this assignment satisfactorily.

Services produce an output when called			Returned service data format is correct		
Level 4	40 %		Level 4	35 %	
Level 3	3 %		Level 3	5 %	
Level 2	5 %		Level 2	5 %	
Level 1	53 %		Level 1	55 %	

Services pass tests		
Level 4	10 %	
Level 3	18 %	
Level 2	13 %	
Level 1	60 %	

In the second iteration of the assessment for Trait 2, student performance increased significantly. The same rubric was applied to the assessment, as follows:

- Services created – Did the submission create all of the required services set forth in the assignment sheet?
- Service signatures correct – Did the submission use the predefined signatures set forth in the design of the system?
- Test created for each service – Did the submission include its own set of tests?
- Project build with mvn clean; mvn compile – Was the submission buildable and compilable using the mvn command as specified?
- Services deploy without modification – Was the submission deployable without modification?

- Services produce an output – Was an output genreated when called?
- Returned service data format is correct – Was the data format correct?
- Services pass tests – Did the services pass test cases created by the instructor?

The first three tables provide a view of the basic requirements for the submission. Services were created with correct signatures, and for the most part, tests were created.

Services created	
Level 4	83 %
Level 3	0 %
Level 2	8 %
Level 1	10 %

Service signatures correct	
Level 4	80 %
Level 3	8 %
Level 2	3 %
Level 1	10 %

Test created for each service	
Level 4	55 %
Level 3	13 %
Level 2	5 %
Level 1	28 %

As with the first iteration, the ability to compile, deploy and produce outputs is important. Mostly, the shift in better performance here was due to the core repository used by students to begin the last iteration.

Project build with mvn clean; mvn compile			Services deploy without modification		
Level 4	80 %		Level 4	80 %	
Level 3	3 %		Level 3	5 %	
Level 2	5 %		Level 2	0 %	
Level 1	13 %		Level 1	15 %	

The last three tables are the best assessment of student performance for this assignment. The ability to produce correct outputs according to the provided tests shows that at the core, students were able to implement the solution with properly formatted outputs, but that the satisfaction of the tests was still mixed, with 60% of the students falling below Excelling and Practicing.

Services produce an output when called			Returned service data format is correct		
Level 4	58 %		Level 4	48 %	
Level 3	20 %		Level 3	20 %	
Level 2	3 %		Level 2	10 %	
Level 1	20 %		Level 1	23 %	

Services pass tests		
Level 4	18 %	
Level 3	23 %	
Level 2	40 %	
Level 1	20 %	

Recommendation

We have long suspected that the quality of students' software development skills has been waning. This assessment provides credence to that suspicion. The final outcomes of Trait 2 – Iteration 2 showed improvement internally, with roughly 25-30% of the students falling below the Excelling/Practicing range, in the Services output/format assessments, and 60% below when applying the tests.

A number of changes to this course have already been implemented and the recommendation is that we stay the course with these changes and continue to study the data.

9) *Outcome 6. Apply computer science theory and software development fundamentals to produce computing-based solutions*

CSC 4575 Spring 2022

Performance Criteria (Traits):

1. **Students can apply computer science theory and software development fundamentals to <u>design</u> computing-based solutions (*Bloom's taxonomy level: application, analysis and synthesis*)**
2. **Students can apply computer science theory and software development fundamentals to <u>implement</u> computing-based solutions (*Bloom's taxonomy level: application, analysis and synthesis*)**

Assessment Results

Trait 1. Students can apply computer science theory and software development fundamentals to <u>design</u> computing-based solutions				
Assessment	Excelling	Practicing	Apprentice	Novice
Final Exam, Question 15	16 (23.2%)	23 (33.3%)	20 (29%)	10 (14.5%)

Trait 2. Students can apply computer science theory and software development fundamentals to <u>implement</u> computing-based solutions				
Assessment	Excelling	Practicing	Apprentice	Novice
Programming Assignement 10	50 (72.5%)	12 (17.4%)	1 (1.4%)	6 (8.7%)

Trait 1
1. **Students can apply computer science theory and software development fundamentals to design computing-based solutions (*Bloom's taxonomy level: application, analysis and synthesis*)**
- Question 15 from the final exam assesses the students' ability to apply knowledge of computer science theory and cryptography to design a computing-based solution for identity management and protection from "51% attack" in permissionless blockchain platforms. The assessment results for this question show 23.2% of the students excelling.

Assessment	Excelling	Practicing	Apprentice	Novice
Final Exam, Question 15	16 (23.2%)	23 (33.3%)	20 (29%)	10 (14.5%)

Final Exam, Question 15: "Apply computer science theory and cryptography fundamentals to design a computing-based solution for identity management and protection from "51% attack" in permissionless blockchains. Select all the options that you would apply in your solution

(1) Require X.509 certificates, signed by a trusted Certificate Authority (CA), from all the network members
(2) Ask joining members to provide documents to prove their identity, such as driver's license or a passport, for verification by designated trusted members of the blockchain network
(3) Use protected communication channel for data exchange, relying on SSL/TLS and IPSec communication protocols
(4) Require self-signed X.509 certificates from all the network members
(5) Replicate the committed transaction to all the peers in the blockchan network
(6) Use cryptographically strong hash function in the block mining process
(7) Enforce Certificate Revocation List (CRL) that is maintained and updated on trusted nodes"

Trait 2
2. **Students can apply computer science theory and software development fundamentals to implement computing-based solutions (*Bloom's taxonomy level: application, analysis and synthesis*)**

Programming Assignment 10 assesses the students' ability to apply knowledge of permissionless blockchain platforms (using Bitcoin as an example) and their cybersecurity fundamental principles to implement (Trait 2) a unique bitcoin address generator in a Python language, using the Elliptic Curve Cryptography (ECC) and Base58 encoding schema. The assessment results for this assignment show 72.5% of the students excelling.

Assessment	Excelling	Practicing	Apprentice	Novice
Programming Assignement 10	50 (72.5%)	12 (17.4%)	1 (1.4%)	6 (8.7%)

Programming Assignment 10 Overview:
This exercise teaches students about methodology to generate unique bitcoin address, using Elliptic Curve Cryptography (ECC) and Base58 encoding scheme. Bitcoin address must not contain uppercase characters "O" and "I", lowercase character "l" and digit "0", in order to prevent confusion. Students need to implement (Trait 2) a unique bitcoin address generator in a Python language, using the provided skeleton source code.

Recommendation: None

Optional (but highly suggested)
Improvements: None

C. Pre-Post Surveys

We administer a Pre-Post survey in selected courses according to a set schedule determined by our assessment plan. The tables shown below provide a summary of the responses by students according to questions related to each respective outcome. The data in each table shows the number of responses (N), the mean of the pre test (pre mean), standard deviation of the pre test (pre std), and the corresponding responses in the post test (i.e., post N, post mean, and post std). A positive value in the change column indicates an improvement in student perceptions of learning in that area. The p-value indicates the significance of the result.

We have notably found that in some semesters that the response rate of students exhibited a mismatch between respondents in the pre-post administrations. We consider those data points to be invalid and have highlighted them as such. The remaining data shows that in most cases there is a positive shift in the means between the pre and post surveys except for a few instances. This indicates that students believe there is a perception of learning during a given semester. We are especially interested in the results of the capstone courses (i.e., the culminating experience). In each of these cases, there is a positive shift in the mean.

OUTCOME 1 – Fall 2021

Q1 - How well can you analyze a complex problem? (Analyzing a problem means determining the elements or essential features of that problem.)								
	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
1300-001	15	2.60	0.63	17	2.41	0.62	0.19	0.40
1300-002	18	2.61	0.92	23	2.13	0.92	0.48	0.10
1300-003	9	2.44	0.53	8	2.25	0.71	0.19	0.53
1300-ALL	42	2.57	0.74	48	2.25	0.79	0.32	0.05
Capstone	14	2.14	0.86	12	1.92	0.67	0.23	0.47

Q2 - How well can you identify and define the computing requirements appropriate for a solution a complex problem?								
	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
1300-001	15	2.87	0.74	17	2.76	0.75	0.10	0.70
1300-002	18	2.94	1.16	23	2.65	0.98	0.29	0.39
1300-003	9	2.67	0.87	8	2.63	1.30	0.04	0.94
1300-ALL	42	2.86	0.95	48	2.69	0.95	0.17	0.40
Capstone	14	2.43	0.94	12	2.25	0.62	0.18	0.58

OUTCOME 2 – Fall 2021

Q1 - How well can you design a computer-based solution to meet a given set of computing requirements?								
	pre N	pre mean	pre std	post N	post mean	post std	change	p-value

2310-001	*9*	*3.00*	*1.32*	*21*	*3.29*	*1.19*	*-0.29*	*0.56*
2310-002	*2*	*2.50*	*0.71*	*15*	*2.87*	*1.13*	*-0.37*	*0.66*
2310-ALL	*11*	*2.91*	*1.22*	*36*	*3.11*	*1.17*	*-0.20*	*0.62*
3300--001	5	3.40	0.89	10	3.20	1.14	0.20	0.74
3300--002	8	2.88	0.83	11	1.91	0.70	0.97	0.01
3300--ALL	13	3.08	0.86	21	2.52	1.12	0.55	0.14

Q2 - How well can you implement a computer-based solution to meet a given set of computing requirements?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
2310-001	*9*	*3.22*	*1.20*	*21*	*3.24*	*1.18*	*-0.02*	*0.97*
2310-002	*2*	*2.50*	*0.71*	*15*	*2.73*	*1.03*	*-0.23*	*0.76*
2310-ALL	*11*	*3.09*	*1.14*	*36*	*3.03*	*1.13*	*0.06*	*0.87*
3300--001	5	3.00	1.22	10	2.70	1.34	0.30	0.68
3300--002	8	3.13	0.83	11	2.09	0.70	1.03	0.01
3300--ALL	13	3.08	0.95	21	2.38	1.07	0.70	0.06

Q3 - How well can you evaluate a computer-based solution to meet a given set of computing requirements?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
2310-001	*9*	*3.11*	*1.17*	*21*	*3.33*	*1.20*	*-0.22*	*0.64*
2310-002	*2*	*2.50*	*0.71*	*15*	*2.40*	*1.06*	*0.10*	*0.90*
2310-ALL	*11*	*3.00*	*1.10*	*36*	*2.94*	*1.22*	*0.06*	*0.89*
3300--001	5	2.80	1.30	10	3.10	1.37	-0.30	0.69
3300--002	8	3.00	0.76	11	2.18	0.87	0.82	0.05
3300--ALL	13	2.92	0.95	21	2.62	1.20	0.30	0.45

OUTCOME 4 – Fall 2021

Q8 - Given a real-world software development task, how well can you recognize your professional responsibilities (e.g., act consistently with the public good, ensure product meets highest professional standards possible, maintain integrity and independence in professional judgment, be fair to and supportive of your colleagues)?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	14	1.71	0.91	15	1.73	0.70	-0.02	0.95
3040-002	*1*	*2.00*	*N/A*	*5*	*1.60*	*0.55*	*0.40*	*N/A*
3040-ALL	15	1.73	0.88	20	1.70	0.66	0.03	0.90
3570-001	31	2.13	0.88	22	1.95	0.79	0.17	0.46
3570-002	11	2.36	0.92	14	1.71	0.61	0.65	0.05
3570-ALL	42	2.19	0.89	36	1.86	0.72	0.33	0.08

Q1 - How well can you make informed judgements in computing practices based on legal principles?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	14	2.36	0.93	15	2.07	0.88	0.29	0.40
3040-002	1	3.00	N/A	5	1.80	0.45	1.20	N/A
3040-ALL	15	2.40	0.91	20	2.00	0.79	0.40	0.18
3570-001	31	2.35	0.95	22	2.36	1.18	-0.01	0.98
3570-002	11	2.36	1.12	14	2.07	0.73	0.29	0.44
3570-ALL	42	2.36	0.98	36	2.25	1.02	0.11	0.64

Q2 - How well can you make informed judgements in computing practices based on ethical principles (i.e., rationally considering what is right to do regardless of the law)?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	14	2.36	0.93	15.00	2.07	0.88	0.29	0.40
3040-002	1	3.00	N/A	5	1.60	0.55	1.40	N/A
3040-ALL	15	2.00	0.76	20	1.65	0.49	0.35	0.11
3570-001	31	1.87	0.99	22	1.95	0.90	-0.08	0.75
3570-002	11	2.18	0.75	14	1.79	0.58	0.40	0.15
3570-ALL	42	1.95	0.94	36	1.89	0.78	0.06	0.75

Spring 2022 Survey Results

OUTCOME 3 – Spring 2022

Q1 - How well can you communicate in writing to a technical audience (e.g, fellow developers)?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	11	2.55	1.21	4	2.00	1.41	0.55	0.47
3040-002	7	2.86	0.90	5	2.00	1.00	0.86	0.15
3040-ALL	18	2.67	1.08	9	2.00	1.12	0.67	0.15
Capstone	14	2.29	0.73	12	2.00	0.85	0.29	0.37

Q2 - How well can you communicate orally to a technical audience?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	11	3.00	1.41	4	2.25	1.26	0.75	0.37
3040-002	7	3.00	0.58	5	2.40	0.55	0.60	0.10
3040-ALL	18	3.00	1.14	9	2.33	0.87	0.67	0.14
Capstone	14	2.79	0.89	12	2.17	0.72	0.62	0.07

Q3 - How well can you communicate in writing to a non-technical audience (e.g., a customer or user who is not also a developer)?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	11	2.55	1.04	4	2.50	1.73	0.05	0.95
3040-002	7	2.29	1.11	5	1.80	0.84	0.49	0.43
3040-ALL	18	2.44	1.04	9	2.11	1.27	0.33	0.47
Capstone	14	2.29	0.83	12	2.25	0.87	0.04	0.92

Q4 - How well can you communicate orally to a non-technical audience?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
3040-001	11	2.64	1.36	4	2.25	1.26	0.39	0.63
3040-002	7	2.43	0.53	5	1.80	0.84	0.63	0.14
3040-ALL	18	2.56	1.10	9	2.00	1.00	0.56	0.21
Capstone	14	2.64	1.01	12	2.33	0.89	0.31	0.42

OUTCOME 5 – Spring 2022; Results from CSC 3040 were omitted due to lack of validity of the data.

Q20 - How well can you function as a member or leader of a team to establish goals and plan tasks?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
Capstone	14	2.29	0.73	12	1.92	0.67	0.37	0.19

Q22 - How well can you function as a member or leader of a team to meet deadlines and produce deliverables?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
Capstone	14	2.31	0.75	12	1.92	0.67	0.39	0.18

Q24 - How well can you function as a member or leader of a team to manage risk?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
Capstone	14	2.71	0.83	12	2.08	0.79	0.63	0.06

OUTCOME 6 – Spring 2022

Q1 - How well can apply computer science theory to produce computing-based solutions?

	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
2310-001	3	3.33	0.58	8	2.50	0.93	0.83	0.19

4575-001	25	2.60	0.82	48	2.77	0.86	-0.17	0.41

Q2 - How well can apply software development fundamentals to produce computing-based solutions?								
	pre N	pre mean	pre std	post N	post mean	post std	change	p-value
2310-001	3	2.67	0.58	8	2.38	0.92	0.29	0.63
4575-001	25	2.76	0.88	48	2.73	1.01	0.03	0.90

D. Senior Student Exit Retrospective

The methodology used to conduct student exit surveys is through an in-person group session using a *retrospective* approach for soliciting feedback in the four program outcome areas. The questions fall into the following questions: *What went well? What did not go well/What can be improved? What questions do you have?*

These questions were then qualitative rated as +, -, Delta, or ? with a further refinement to determine whether potential issues were related to the following:

- Personnel – feedback was about specific personnel issues
- Methodology – feedback was based on a methodological approach
- Topical issue – feedback suggested new topic areas to explore
- Addressing – feedback is being addressed

The following two tables show responses from the Fall 2021 and Spring 2022 retrospective sessions, respectively. We note that for some of the feedback, the department has already been incorporating topics early into the program; these particular graduating students did not benefit from those curricular changes, including the introduction of Devops into the program, more use of git, and other similar topics. These are marked with an "a" in the far-right column. Feedback concerning personnel issues have been addressed in faculty evaluations. Finally, topical issues (those items marked with a "t") are being discussed by the faculty for possible future changes. Feedback mentioning specific faculty are modified by redacting the given faculty member's name.

Fall 2021 Responses	Rating	Addressing - a; Personnel - p; Methodology - m; Topical - t
Making more classes challenging but in a good way	Delta	m
Modern programming courses	Delta	t
Anything relating to Databases class(es) - was too unfocused.	Delta	t
DEVOPS as a required class, freshman level please	Delta	t
No but seriously Git should be included in education from the very beginning	Delta	a
More actual programming in later classes (less theory, more application)	Delta	t
git inclusion & things be more generalized to be more applicable	Delta	a
Requiring professional mentorship in the Capstone Projects	Delta	m
Teaching Agile. Was such a footnote in SE1.	Delta	m
not learning git	Delta	a

Web Development	Delta	a
introduce debuggers to students	Delta	a
introduction into more than 2/3 programming languages	Delta	t
Python outside of Machine Learning and 1200	Delta	a
Have more classes where obtaining a Certification is standard practice for passing the class, such as Security +	Delta	m
could there be a class on esoteric programming languages	Delta	t
advanced python class would be pretty cool	Delta	a
there is currently no content on APIs but we would benefit greatly from this	Delta	t
REDACTED (BLESS)	+	
Speaking to Professors	+	
Software Engineering class used a good format as far as success depending on student-ness	+	
Access to possible work places	+	
how to develop software	+	
Learning the basics of the field	+	
how to program in general	+	
working in a small team	+	
the reduction in my ego	+	
Opportunities to develop professional habits to form	+	
REDACTED, REDACTED, REDACTED, REDACTED, and REDACTED. (That is all. No others.)	+	
learning to teach yourself technical skills	+	
Gained a strong foundation in computer science	+	
Getting a job offer	+	
Agile methodologies	+	
teamwork and customer communication	+	
Group work in SE2 teaches team work well. Especially without a teacher to resolve it for us	+	
learning the basics for interviews and how to land a job offer	+	
application of data mining and machine learning topics to a research project	+	
Networking with other students	+	
Machine Learning (thanks REDACTED!)	+	
finally back in person	+	
Learn C++ with REDACTED	+	
Integrated conversations about industry standards¬†	+	
DISCRETE MATH!!! With REDACTED	+	
Capstone project provided an excellent opportunity to get used to working with a professional team	+	
Shouldn't REDACTED be paying attention to this since he is payed to be here?	+	
Being able to locate online resources	+	
Provided opportunities¬†	+	
demonstrating that for every course we approach we will need to teach ourselves new technologies to adapt to the task	+	
Learning a variety of relevant technologies	+	
Being able to google	+	
getting better at skimming documentation	+	
being able to learn a programming language with youtube tutorials and other sources	+	

this mostly only comes up in 4610-4620, group projects in other courses are much less	+	
Asking for feedback here is very good. We have more opinions than anyone at the university.	+	
Using compilers early in curriculum	+	
A good variety of courses to choose from	+	
Everything within the Data Science concentration	+	
CSC 3570 IT Security is a phenomenal class and should be student's first exposure to Cyber, not CSC 29-whatever	+	
why did i need humanities classes for a computer science degree	?	
Why are there so many different small things to do to graduate.	?	
why was one class dropped in the middle of my degree and had to be subistuted with a harder class?	?	
Why can we not consolidate grad tests and applications	?	
Why wasn't a class on taxes a required humanity class, instead of... "Art Appreciation"	?	
how will the department replace the CSC professors who left?	?	
Why was the ETS Exam not announced sooner if it's so important?	?	
What is an ets exam?	?	
Why was software engineering major droppped?	?	
why was software and systems security exceptionally difficult?	?	
Is the field test and ETS exam the same??????	?	
Why did I learn more about professionalism through co-op experience than through classes at Tech?	?	
what time should we arrive at the graduation ceremony?	?	
is the ets exam required?	?	
how did it end up to where i was missing 2 needed credit hours in order to graduate?	?	
Can the CS Exit exam be announced sooner so we can plan	?	
What is being done about instructors that do not attempt to help students? Nobody is perfect, but caring about our education would be a start.	?	
whomst tf is dr REDACTED?	?	
What is your definition of the real world?	?	
Doesn't Professionalism and Leadership overlap too much for them to be considered distinct categories here?	?	
why do we need architecture class?	?	
Will CSC4010 be offered more, given it is a class dedicated to other programing languages?	?	
When will Java stop being required?	?	
Will you answer all of the questions we have left for you here and send out your answers?	?	
What is being done about professors that are ineffective at teaching?	?	
Some professors are not focused on their classes	-	p
Need more professors who care about our learning	-	p
Hire more professors that are better at presenting material¬†	-	p
better professors, some are knowledgeable but just bad teachers	-	p
Team work	-	m
Dr. REDACTED OS class	-	t
Software Professors should be more involved if teams are struggling to work effectively	-	m

More modern curricula, such as continuous integration	-	t
CLEAR + EFFECTIVE communication by professors on expectations, requirements, etc,	-	p
course evaluation survey is too general to give good feedback	-	m
Implement courses that focus on using available frameworks	-	t
teammates keeping to their word of participation	-	m
Dr. REDACTED (who cares about his tenure)	-	p
Feedback from professors in SWE and sometimes in other courses	-	p
why was i not told of a senior exit exam until 2 days before the dead line to sign up?	-	m
TEAMWORK	-	m
Dr. REDACTED	-	p
Dr. REDACTED	-	p
Capstone projects.	-	m
More teaching of languages required for capstone projects	-	t
Too many gen eds	-	t
Losing REDACTED was sad	-	p
Would have been nice to work with companies outside of Tech in this class	-	m
There are a few instructors that simply do not put forth effort yet they still get paid off our tuition.	-	p
REDACTED - specifically constant last minute decisions, late grading, and poor use of our time (would make us come to class and only taught twice)	-	p
Having the opportunity to express professionalism doesn't mean people will take advantage of it¬†¬†	-	m
Dr. REDACTED	-	p
Some professors delay their grading until the last minute (see above)	-	p
REDACTED told us not to contact him at all, therefore we did not learn.	-	p
Conflicting definitions about what the real world is and how it applies to us now. For instance, while alot is required us in the real world we will also get the option to correct our work and respond to those critiques unlike a simple grade allows	-	m
REDACTED did not teach us	-	p
dr REDACTED	-	p
OOP is a bad class	-	m
maybe allowing students to choose what language they want to use (within reason) for programming assignments more often	-	m
You say things in the real world we will work but in the real world my unproductive team mates would get fired. That doesn't exist in classes and add unique difficulties¬†	-	m
architecture	-	t
Students who don't exhibit professionalism can still be passed through classes, and then are later made the responsibilities of other people who have by virtue of being on a team together	-	m
<- At least have that guy show us how to USE that debugger	-	t
Databases as a class.	-	t
I don't feel necessarily equipped for my concentration (cyber)¬†	-	t
Takes till senior year to lean most of the classes¬†	-	m
Teaching theory in a coherent way.	-	m
Less theory, more actual programming in later classes (application)	-	t
Opportunities are not results	-	m

Stop teaching new abstract concepts while forcing the student to at the same time independent study a new language	-	m
Maybe a 1 credit course on how to google lol	-	t
Introduction to more common practice in industry, testing and continuous integration..¬†	-	m
early introduction to engaging projects that students can contribute to 9like REUS)	-	m
Some disconnect between what is being taught in classes/ assigned as homework	-	m
more actual in practice exercises	-	m
Introduce ways to get in to research that aren't exclusively accosting professors for summer work.	-	m
in examples, where possible, allow for students to create something unique rather than everyone doing the same thing. forces creatively and for them to demonstrate more knowledge for application	-	m
When teachers don't teach, I was still able to learn a lot of material independently	-	p
starting with a compiled programming language and slowly encouraging the use of scripting languages	-	m
Ethics/Research/Communication in Comp Sci, or whatever the class is. Too unfocused.	-	m
Need take aways	-	m
Need more open projects, with equally open grading focused on effort, and what was explored over what the accomplishments were¬†	-	m
Takes till at least Junior year for anything vaguely industry relevant	-	m
Space to do self paced learning¬†	-	m
teaching strong study skills for CSC	-	m
Test that break away from fill in the blank are hard to write. But should be made the standard¬†	-	m
Networks	-	t

Text	Rating	Addressing - a; Personnel - p; Methodology - m; Topical - t
Teach a course around making an API	Delta	
PLEASE make a math oriented professor teach discrete math	Delta	a
NodeJS and web programming would be great	Delta	a
web design should be a requirement, along with networking opportunities	Delta	a
i wanna know more about web programming	Delta	a
Start Teaching Github / Repository system at a lower course level	Delta	a
We literally don't know how to do GUIs please	Delta	a
Control flow, things like github	Delta	a
more classes on web development would be cool	Delta	a
Add a Web Development Path (includes basic HTML/CSS/JS, backend, API's, frameworks, design)	Delta	a
Learning Git or some other VCS and using on more projects throughout all classes	Delta	a

We need a class centered around GitHub and how to use repositories.	Delta	a
NodeJS/web programming would be cool	Delta	a
More ops/devops courses/electives instead of being shoved in cybersec	Delta	a
More web dev classes	Delta	a
Python has more job listings than anything else rn	Delta	a
I ThinkÂ more experience building front ends would be very beneficialÂ	Delta	t
A stronger OOP/Data Structures Foundation	Delta	t
Could use more abstract languages	Delta	t
More concentration specific classes earlier in the curriculum.	Delta	m
Algorithms class should teach how to use the algorithms and not just what they are @Stephen Scott	Delta	t
Maybe a 1 credit hour class dedicated to common interview questions.	Delta	t
We need more low-level programming education. C++ is a terrible language, and I would like to see C taught instead.	Delta	t
More classes involving using Linux	Delta	t
More topics about preemptive software in security and using them in realistic labsÂ	Delta	t
Bring back the SE concentration and teach languages like React	Delta	t
TEACH DATA ORIENTED PROGRAMMING	Delta	t
Developing soft skills among our major	Delta	m
there should be a course where you're forced to use some kind of annoying but practical build tool like CMAKE and VCPKG	Delta	m
Cover topics like RMF and NIST security principles/stantards	Delta	t
cybersecurity classes that are more hands-on	Delta	m
web design should be required	Delta	t
A GUI fundamentals class?	Delta	m
MAKE. ETHICAL. HACKING. UNDERGRAD. LET. ME. HACK. THINGS. (With consent)	Delta	m
I wish I could have taken more CSC electives.	-	t
Using the other computer ranges for Labs in non-cyber classes	Delta	m
An emphasis on outside the box solutions when possible	Delta	m
I Love Docker	Delta	t
Take back computer forensics from the CoB	Delta	t
More technical, programmatic classes, less theory. Teach how to code, not how to read slides.	Delta	t
I wouldn't mind an advanced operating systems class...	Delta	t
An emphasis on individual contribution to the group would be fantastic. Uneven workload happens far too often.	Delta	m
open up tech's wifi so we can do configeration for network class	Delta	m
simulated environments to test skills and not just learn then fundamentally	Delta	m
Ethics was cool, but could probably be better	Delta	t
Focus on continuous improvement rather than once it works, move on	Delta	t
in labs/groupwork, there should be some way to enforce the code being done by multiple people rather than just one person who wants to do it all themselves. It leaves one person with all the experience and knowledge, and no one else with any
this was more aimed at labs	Delta	m

We need to have more assignments that we can work on as a group. The schools definition of Academic Misconduct hurts the development of teamwork.	Delta	m
Doing agile needs more practice before we're thrown into it	Delta	m
giving tips in the professionalism class about how to be organized and motivated to do tasks to prevent poor work/performanceÂ later on	Delta	m
I think more group assignments	Delta	m
Connections and Professionalism should be combined	Delta	m
Professionalism course needs one less ethics paper - the inferior post-it	Delta	m
Is it possible to introduce Agile or other methodologies earlier, so that it can be practiced more	Delta	m
I feel like we need to have a course/unit specifically on doing interviews due to how hostile they can be in the real world	Delta	t
Can we please learn more about how the industry works?Â I am genuinely terrified of the compsci work force.	Delta	t
More group projects, it helped well when dealing with communicating in teams.	Delta	m
Adding some introduction to code review would be helpful	Delta	t
More content on testing and debugging. people are going in the field without knowing how to use a debugger	Delta	t
Develop moreÂ working-in-a-group skills at lower levels.Â	Delta	m
Refactor 3040 to include more real-world interview / work / technical communication experience instead of writing essays and other assignments	Delta	m
more communication with companies	Delta	t
Potentially moving the time management section to a course later in the curriculum or having it covered in both freshmen year and later	Delta	m
A whole course on ethics of A.I. would be awesome	Delta	t
Professionalism (3040) needs to be similar to 4610 and 4620 with just a less-agile approach. Teach us to work with people and conduct ourselves accordingly.Â	Delta	t
Certification classes or opportunities are a great idea. Many entry level positions require one or two and they always provide an edge	Delta	t
Should enforce leadership with projects and assignments. Give more opportunity.	Delta	m
need real skills in hacking, ethically, such as deface a website	Delta	t
Changing roles in group capstone should be enforced.	Delta	m
more coursework focusing on this, maybe integrating it into the professionalism course?	Delta	m
Some people slip through the cracks when it comes to there programming skills so maybe more exam based programing	Delta	m
REDACTED taught a Programming Languages class that has helped me figure out how to pick up new languages. I truly think that if the curriculum was modified a little, it could be one of the most helpful classes that one could have,	Delta	t
There should be more individual programming assignments where we are allowed to use any programming language so we can experiment.	Delta	m
Classes like OS that have such large projects need more TA's. Very discouraging to start a new project before the last one was graded.	Delta	m
Encourage Googling/ Research First before asking questions	Delta	m

Maybe this could be a thing for the houses, but some way for personal projects to have meaning outside of personal interest. Sometimes it's hard to continue personal projects with coursework loads	Delta	m
Hear me out. Rust.	Delta	t
Long term free-form software engineering projects would help improve student's efficacy, and teach self-learning abilities	Delta	m
Next would be to make a universal schedule for freshmen and sophomores to see to get a better idea of how to graduate in 4 years. I have friends that were not informed about scheduling conflicts and cannot graduate on time just because they were not informed.	Delta	m
C# is... something	Delta	t
I loved OS class	+	
I like how many languages we get taught, I feel like it helped build out my resumeÂ	+	
I thought this curriculum has primarily taught me how to problem solve.	+	
Interview questions involving OOP have felt easyÂ to break down and answer	+	
The teaching of OOP type programs is well done	+	
Labs on the Cyberrange for Security related classes	+	
The programming assignments were generally good	+	
Learned a lot of programming skills and best practices	+	
Instructors were generally very good	+	
Gaining real world experience working on a project with customer in software engineering	+	
The skills learned have prepared me for any problem to be faced in the feild	+	
we learned how to go about solving problems in an efficient way	+	
I've learned quite a bit on how to code	+	
The material has gone well	+	
Developing skills in learning new languages and tools efficiently	+	
have to work for Clients for the real world helps technical proficiency	+	
I have learned how to code	+	
Learning C based languages was good.	+	
Learning the fundamentals of problem solving.	+	
We learned a large variety of topics.	+	
Exposure to widely used OOP languages	+	
I have learned how to work effectively within a team to implement features and resolve defects in the code	+	
Learning relevant algorithm solving problems to land coding interviews.	+	
Learning things that I will actually use in a job like Git and Agile.	+	
Learning all theses languages and technologies has improved my adaptability immensely	+	
Time managment skills	+	
Dr. Boshart and Dr. REDACTED	+	
REDACTED Poggers	+	
Employers have been impressed with our broad backgrounds in CS	+	
OS numero uno!	+	
The department is generally good at encouraging group work especially with SE I and II	+	
4620 has Strengthened my industry skills!	+	
Learning good communication skills while in group projects.	+	
REDACTED is Awesome	+	

April REDACTED is the only professor to actively try and engage with her classes. I've never had another CS professor care like her	+	
I have learned many new technologies and got to build a project from the gound up	+	
Exposure to group work settings is usually positive and occurs often enough to be beneficial	+	
Data Science program has massively improved	+	
REDACTED is GOAT	+	
April REDACTED	+	
REDACTED	+	
Solid ROI for CS degrees	+	
Learning different languages and how they work helps you understand coding more in a whole.	+	
Brummett teaching cloud	+	
REDACTED Goat	+	
Exposure to Agile has helped a lot in my interviews	+	
Only thing that went well was meeting new people lmao.	+	
My Interviewing skills have improved a lot	+	
discovering different avenues of careers through some classes	+	
the software engineering class was the only class where i felt like i was apart of a team, rather than just a few individualsÂ	+	
Software Engineering as a whole helps this	+	
software engineering has helped a lot in this regard	+	
REDACTED and REDACTED design their courses well	+	
Team working with group projects	+	
Understanding how to work in a team well	+	
If feels like SE2 is the only class to develop these skills	+	
team projects and learning industry practicesÂ	+	
Teach more classes like 3040 earlier ig	+	
A company I interned with last summer said they primarily hired TTU grads because of the quality and hard work they producedÂ	+	
SE I and II and 3040 help develop those skills	+	
I agree, CSC curriculum as taught me well on how to discuss topics in my field	+	
Certain classes are good at developing foundations rather than specific practices	+	
Software Engineering seems like the best class for lesson in professionalism, given that we are meeting and doing assignments for real people.Â	+	
Nist/Nice was fine (the first time, don't make me learn it 3 times)	+	
working with real world clients and in a team setting	+	
SE I and SE II really challenged us to organize our teams in the most efficient way possible to produce quality software on time	+	
My technical speaking skills have improved a lot.	+	
Agile and capstone	+	
I feelÂ professors have done a good job expressing doing projects outside of class	+	
SE1 and SE2 does help with leadership however there is always those who take change and those who let themÂ	+	
Learning how languages relate to each other helps my ability to adapt and ask questions about how I do something in a new language.	+	

REDACTED is the G>O>A>T	+	
My slils developed here have prepared me for anything	+	
The program has done well in making me teach myself at times which complies with this category.	+	
REDACTED made CS fun in a way that engaged us and encouraged personal exploration of the topics	+	
REDACTED provides resources to stay up-to-date at the end of the course	+	
Cryil has specifically made reading documentation a lab, I think this is a useful skill	+	
I feel confident in my ability to learn any skill I need	+	
REDACTED is the Goat, made me love this major with her top text bottom text memes.Â Made me into the memester I am today.	+	
Bring back REDACTED! he taught us good skills!	+	
Cyber professors give activities that get you interested in the tools that you use	+	
Learning the skills needed to complete our SE I / II project has given me confidence that I will be able to do it again in the real world	+	
I have learned some really good skills from many classes, 4620, 4100, 4200, 4310, 2310, and others	+	
Would it be possible to prepare students more for interviews	?	
Why don't we learn github in a course?	?	
Why does the program avoid going into topics like frontend development?	?	
Assembly. Like why? We take two semesters of it, and I go to multiple interviews in varying areas of CS, ranging from front website jobs, to manufacturing plants, to just normal software jobs and they all just chuckle and are like "That's useless". I swear, it feels like Assembly is like Latin, a dead language, and if you DID need to learn it for a job, you would just go learn it outside of this institution.	?	
I have no questions about the techincal proficiency	?	
why is the cybersecurity curriculum so unfocused	?	
Why don't we learn git control, and more modern day technologies?	?	
What certifications would be most beneficial for experience and qualifications in Cyber security?	?	
Why do we not have more classes on GUIs?	?	
#JusticeforREDACTED	?	
Why are courses not more focused towards the work environment earlier in the degree	?	
Kind of worried for the future of cybersecurity here at Tech, especially since Siraj is leaving.Â	?	
Why is the software concentration being focused? To the point where all concentrations have to have take its classes	?	
Do you want graduates to know a certain skill OR be able to pick up any skills?	?	
Why do we spend 2 semesters in Assembly when no employers want it. We could have learned more front in or done two semesters of SQL.	?	
By the overall nature of the curriculum, I feel that a decent work ethic is necessary to successfully complete all 4 years.	?	
Self-motivation should not be taught by the department. If you arent self motivated then you are not doing what you want and are passionate about.	?	
why is SE1/2 the only opportunity we have at working and managing a project?	?	

Why aren't certifications talked about more early on?	?	
Why we only introduced into real world work environment in the end of curriculum?	?	
why are no classes for security certs offered or hosted by the school?	?	
is it ethical to charge thousands of dollars in engineering fees for a major that doesn't use any costly resources? Just the internet and opensource software I'm salty	?	
I feel like we were just thrown in. While yes, we are expected to be on our own in the real world. But what the heck did I pay $85,000 for?	?	
When do we get a chance to talk about continued learning opportunities? I didn't know about the Security+ exam until last summerÂ	?	
I MISS DR. REDACTED	?	
REDACTED made me love x86 Assembly	?	
C# is very important .net 6 is the future	?	
The over-emphasis on being a "leader" is not useful when 99% of us will be the subordinates of a boss. Not everyone can be a leader.	?	
all my homies hate elizandro	-	p
Grading with some teachers takes too long. For example it may takes two months to getÂ grade back for a single assignment so i dont how im doing in that class	-	p
Lost a lot of very good professors recently	-	p
i too miss REDACTED	-	p
Make sure classes use up to date versions/libraires for code	-	m
I feel like I didn't get enough introduction into other programming paradigms.	-	t
The grading scale for some courses seems a bit extreme (only 2-3 tests for your entire grade) give more opportunities for grades	-	m
Package/Library Management	-	t
Consistency of languages. Meaning the languages used change based on class and can be confusing to keep up with. EX: We had Java for one class	-	t
Didn't learn some common tools such as Docker and had to teach myself git	-	t
most our skills are never appliedÂ	-	m
certain professors don't demonstrate the content they're teaching	-	p
How to teach the material might need to be changed.	-	m
we need more real life experience	-	m
Most classes seems to be a regurgitation of information that we aren't taught to use when it comes to higher level courses	-	p
Assembly doesn't seem useful in real life. At least right now when looking for jobs.Â	-	t
Please no Agile, we not business	-	t
The program doesn't feel like Computer Science. It feels like computer programming. I would like to see more raw theory courses.	-	t
How can I be better prepared for the real world? Rn i feel like a highschooler who learned some IT on his own	-	t
Making more activities that encourage students working together. The real world requires collaboration	-	m
Architecture is painÂ	-	t
Why only JFrame for GUIs?	-	t

sometimes it feels like projects and programs are so bizarre and unwieldy that i can't see the use in a job setting	-	m
I wish I could have taken certain classes for fun, but couldn't because they were part of a different concentration.	-	m
Sometimes the focus on groups is too much and ive met some individuals who are not very well individually skilled	-	m
Teach us new stuff, no more old head stuff	-	t
Would like more diverse programing assignments I can only do Hello World So many times	-	m
elizandro basically points and goes heres a vague explanation, understand,	-	p
not a huge fan of how many programs were throwaway stuff. I liked how they bnilt on each other	-	
why can't we ever be taught how to use real industry tools	-	
Not enough group projects to be a possible leader sometimes.	-	
This university made my mental health worse (shout out the therapists here, they stink)	-	
Scott was literally in class less than 10 times	-	p
There is not enough modern day technologies we learn for our course.	-	
Remove Operating Systems. Please	-	t
Have TAs that know what theyre doing	-	p
3040 sucks	-	t
Technical Interview Preperation	-	t
group work tends to not be graded properly. too many times i have been in teams with a lazy teammate and they still get same grade.	-	m
CSC 3040 was too general, and not really focused on CS	-	t
I don't feel like I've learned to apply these skills specifically to computer science or similar technical topics. Just general ethics and communications courses that really didn't do much more than cost money and take up time	-	m
Communication needs a class	-	m
Please teach me when employers are being buttheads about me being chatty in regards to modern day cybersecurity.	-	m
Sometimes learning these skills felt too general and weren't focused on computer science specifically	-	m
There's really only 1-2 classes on these skills, most of it is picked up in an internship	-	t
More opportunities to assume leadership would be nice, but it is more of a soft skill	-	m
Covid/online classes did not help this area, watching zoom recordings in pajamas does not develop these skills	-	m
professionalism feels more like a course on ethics	-	t
Ethics class felt like "just be a normal person", like don't Will Smith slap people in the workplace. Very little content that was specific to CS	-	t
SEII hard carry	-	t
I can't even remember anything from the professionalism class which seems like a problem	-	t
This program has NOT helped me be more organized. The dysfunction of many classes has made me more frantic and stressed than ever unorganized classes and no improvement of current skillset	-	m
getting help for things cause delay because the lack of communcation	-	m

3040 Focuses too much on research and not on in the workplace things. we could learn Agile there.	-	t
Ethics in Comp sci did not really focus on ethics in comp sci	-	t
A lot of students do just enough to get a C and move on. They have little to no passion for being a self-starter in learning Computer Science. It would be better for them to get an Associates and move on.	-	m
Only instance of this ever was SE with rotating scrum masters and wasn't even enforced	-	m
3040 interviews focus on behavioral questions and do not prepare you for technical questions	-	t
ideas that students have are not expand upon. projects and learning should not be restrictedÂ	-	m
We never left Foundation Hall	-	o
You have no idea what this field is like until internship or capstone	-	m
3040 was just connections in engineering again	-	t
Life long learning REQUIRES the ability to learn new skills NOT having actual skills themselves. SE does not produce graduates that are capable of new learning skills	-	m
A lot of the projects / assignments we did before SE had a lot of restrictions put in place by the teacher, which I don't think is good if we want to be adaptable	-	m
Classes like OS and Architecture kind of enforce learning/memorizing just to get out of the class alive. They don't encourage life-long learning.Â	-	m
More diverse programs working with a multitude of software development tools Along with starting students out with (IDE)s instead of Notepad++ it sucks nobody uses it	-	m
saying a CS field cant use google in the only field where the internet is the most useful resource available	-	m
learning how to google the problems is very important in this area	-	m
OS has me fighting for my life (REDACTED is not cool though)	-	m
OS specifically	-	t
This feels more like self-taught with some professors without them teaching us how to properly breakdown the concepts	-	p
Please, Architecture is killing me in that department	-	t
giving roles to projects. like teachers automatically assign students to a task instead of having the students assign themselves to a role	-	m

E. California Critical Thinking Skills Test (CCTST)

The university administers the California Critical Thinking Skills Test (CCTST). The data for the performance of computer science seniors is shown in the table below. For programs at TNTech with more than 20 students taking the exam, the CS students rank 1st. Overall, our students rank 4th.

	Year 100pt Mean (number of students tested)			
	2018-2019	2019-2020	2020-2021	2021-2022
CS	83.0 (N = 70)	81.0 (N = 81)	80.5 (N = 78)	79.8 (N = 104)
Rank at Institution for programs with N >= 20	1	1	1	1
Overall Rank	T-3	2	4	4