Annual Departmental Report

2021-2022

Program Information

Program/Department: Computer Science / Computer Science
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This document is to be kept in the department and an electronic file is due to the AVP of Institutional Research & Planning by June 1, 2022.

A. Departmental Special Section for AY21-22

Department Lessons Learned and Accomplishments

Due to the COVID-19 pandemic, the department adapted to remote teaching during 2020 and spring 2021, mainly using the synchronous delivery (ONSYNC) rather than the standard asynchronous delivery (ONLINE). We also used ONSYNC for conducting departmental meetings as well as meetings with the administrative assistant. They were quite productive.
However, we still can't conduct the programming contest as the COVID risk is still there. We also did not have our yearly "Program Advisory Committee" meeting as we felt that remote meeting was not very conducive for the discussions.

Even after the university returned to normal in-person teaching mode in fall 2021, we still experienced the following issues:

1. Some students still had serious technical issues such as poor laptop performances, poor connection issues and inability to connect to the software labs. As a result, there were still unusually many dropouts or fail grades particularly among the freshmen.
2. Conducting hardware labs and team projects were challenges and did not do full justice to the content as there was still some safety measures such as face mask and social distance requirements.
3. One-on-one help that is provided in software labs also became a time-consuming process.
4. Nevertheless, some students, particularly in the higher-level courses thrived in the ONSYNC method of teaching and performed extremely well.

For the most part, the academic year went smoothly. However, there are still students who have mental and psychological issues. The COVID also caused a lot of issues for faculty as we have to prepare for the classes in both face-to-face and online modes in case some students still have issues attending the classes on campus.

B. Program Learning Outcomes (PLOs) (Educational Objectives)

I. List of PLOs and the timeline for assessment.

PLO #	PLO – Stated in assessable terms	Where are the learning outcomes for this level/program published? (please specify) Include URLs where appropriate	Timing of assessment (annual, semester, bi-annual, etc.)	When was the last assessment of the PLO completed?
1.	Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.	The learning outcomes are published in the computer science department website: https://www.fitchburgstate.edu/academics/programs/computer-science-bs	Annual	June 2021
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.		Annual	June 2021
3.	Communicate effectively in a variety of professional contexts.		Annual	June 2021
4.	Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.		Annual	June 2021
5.	Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.		Annual	June 2021

6.	Apply computer science theory and software development fundamentals to produce computing-based solutions.		Annual	June 2021

II. PLO Assessment (Please report on the PLOs assessed and/or reviewed this year. Programs should be assessing at least one each year.)

Using the table below, list and briefly describe the **direct method(s)** used to collect information assessing whether students are learning the core sets of knowledge (K), skills (S) and attitudes (A) identified as essential.

PLO # (from above)	**Assessment description (exam, observation, national standardized exam, oral presentation with rubric, etc.)**	**When assessment was administered in student program (internship, 4th year, 1st year, etc.)**	**To which students were assessments administered (all, only a sample, etc.)**	**What is the target set for the PLO? (criteria for success)**	**Reflection on the results: How was the "loop closed"?**
1.	The capstone course CSC 4400 is used to assess the PLO # 1. PLO # 1 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used to assess four performance indicators (a) – (d): • Assignments 1 and 2 in CSC 4400. See the table in Appendix A for the assessment results.	4th year	All	"Target %tile scoring better than 70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their performance on each PI	The proficiency target was clearly realized for all PIs. This 100% exemplary performance may be attributed to assessment-based curricular changes discussed and initiated at the end of the academic year 20 as part of our perpetual effort towards implementing continuous improvement. **Action:** We decide to continue monitoring the outcome to ensure consistency in quality in the following year.

					Also, we are looking for adding more instruments to make sure each PLO is assessed with multiple instruments.
2.	The capstone course CSC 4400 is used to assess the PLO # 2. PLO # 2 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used to assess four performance indicators (a) – (d): • Assignment 4 in CSC 4400. See the table in Appendix A for the assessment results.	4th year	All	"Target %tile scoring better than 70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their performance on each PI	Target criteria was met for all PIs. **Action:** In the future, more class time will be allocated to coverage of unit testing and students will be given additional time to complete the assignment if necessary. This will be implemented when CSC 4400 is offered in Spring, 2022. Assessment will be monitored to document the effectiveness of the intervention as part of our continuous improvement program.
3.	The capstone course CSC 4400 is used to assess the PLO # 3. PLO # 3 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used	4th year	All	"Target %tile scoring better than 70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their	Target performance was clearly realized for this outcome. All students worked well within their respective teams (PI-d). Some students achieved less than proficient scores in other areas of communication. The

	to assess four performance indicators (a) – (d): • Assignments 1, 2, and 5 in CSC 4400. See the table in Appendix A for the assessment results.			performance on each PI	unfamiliar remote learning environment and other effects of pandemic stress may have negatively affected the performance of some students. **Action:** We decide to continue monitoring the outcome to ensure consistency in quality in the following year. Also, we are looking for adding more instruments to make sure each PLO is assessed with multiple instruments.
4.	The course CSC4100 is used to assess the PLO # 4. PLO # 4 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used to assess four performance indicators (a) – (d): • Quizzes 1-4 in CSC 4100. • Projects 1-4 in CSC 4100	4th year	All	"Target %tile scoring better than 70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their performance on each PI	After replacing the one credit hour course CSC 4102 with three credit hour course CSC 4100, the students' performance have been improved dramatically. Our proficiency target was almost realized for all PIs. **Action:** We decide to continue monitoring the outcome to ensure consistency in quality in the following year.

	See the table in Appendix A for the assessment results.				Also, we are looking for adding more instruments to make sure each PLO is assessed with multiple instruments.
5.	The capstone course CSC 4400 is used to assess the PLO # 5. PLO # 5 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used to assess four performance indicators (a) – (d): • Assignment 6 in CSC 4400. See the table in Appendix A for the assessment results.	4th year	All	"Target %tile scoring better than 70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their performance on each PI	The proficiency target was realized for all PIs. Even though "students working in teams" is emphasized mostly in the capstone courses, it is encouraging to see that most students worked together well and produced a quality product. There were a couple of students with personal or technical issues that could not keep up the pace with the team. Pandemic stress played a major role in their lagging behind with the project work. In the end all students satisfactorily completed the project. **Action:** We decide to continue monitoring the outcome to ensure consistency in quality in the following year.
6.	The capstone course CSC 4400 is used to	4th year	All	"Target %tile scoring better than	The proficiency target was met for this outcome. All

	assess the PLO # 5. PLO # 5 is assessed through the assessment of four rubric-based performance indicators (a)-(d). The following instruments are used to assess four performance indicators (a) – (d): • Assignment 8 in CSC 4400. See the table in Appendix A for the assessment results.			70% proficient" in the Table in Appendix A. We assess the students' outcomes based on their performance on each PI	students achieved exemplary scores for PI-a, PI-b, and PI-c. For some students, the sprints took some getting used to. Most students found a rhythm by mid-semester but a couple struggled to make progress from sprint to sprint due to pandemic stress and other technical factors. **Action:** We decide to continue monitoring the outcome to ensure consistency in quality in the following year.

You may use this comment box to provide any additional information, if applicable:

Summary of Findings: Briefly summarize the results of the PLO assessments reported in Section II above combined with other relevant evidence gathered and show how these are being reviewed/discussed. How are you "closing the loop"?

Reflection Prompt	Narrative Response
Other than GPA, what data/ evidence is used to determine that graduates have achieved the stated outcomes for the degree? (e.g., capstone course, portfolio review, licensure examination)	The performance indicators for each PLO are used to determine that graduates have achieved the stated outcomes and thus the PLO.
Who interprets the evidence? What is the process? (e.g. annually by the curriculum committee)	The instructors of the courses which are used to assess the PIs conduct the assessments and collect all the required data and documents. They interpret the evidence in the department curriculum meetings and the department curriculum committee discusses and makes recommendations on what changes/actions the instructor needs to be taken.
What changes have been made as a result of using the data/evidence? (close the loop)	We observed a few areas where some improvements can be made as noted in discussions. In particular, students' understanding of legal issues and responsibilities (CSSO-4) is still lacking. More attention needs to be given in providing a set of frameworks for this analysis. Students may also be given time to fine-tune discussion skills. Even though most of the target criteria for the student outcomes were met, there are still areas where some improvements can be made. One particular area of improvement is the assessment process itself. We didn't align our assessment instruments well with these outcomes though most of our course lectures and assignments were designed with the ABET student outcomes in mind. In our next assessment cycle, the design of our assessment instruments should directly link to the performance indicators of the outcomes to be assessed.

	The assessment process used prior to ABET site visit in Fall 2019 was based on the assessment process that was approved by ABET 6 years prior to the last visit. Capstone course was not assessed then. Based on the feedback from this recent site visit team, we have completely revamped the assessment process and introduced a new set of courses for assessment. This assessment cycle is the first complete cycle and we hope to find evidence of "closing the loop" in the future based on this new process.

C. Assessment Plan for Program/Department

I. Insert the program or department Assessment Plan

Our assessment basically follows the ABET assessment plan. We will provide a complete program assessment every year based on 24 performance indicators. Three courses CSC4400 and CSC4100 Ethics and Impacts of Computing Solutions are used for assessment purposes. The next assessment cycle will start from fall 2021 to spring 2022. See the rubric for each of the PLOs (CSSO-x with ABET terms) in Appendix A.

II. Explain any changes in the assessment plan including new or revised PLOs, new assessments that the program/department plans to implement and new targets or goals set for student success.

For PLO #4 we split the PI (a) "Understand legal and ethical responsibilities" into PI (a) "Understand legal responsibilities" and PI (b) "Understand ethical responsibilities" due to the changes of instruments.

III. If you do not have a plan, would you like help in developing one?

☐ Yes

D. Program Review Action Plan or External Accreditation Action Letter/Report

Annual Reflection/Follow-up on Action Plan from last Program Review or external accreditation (only complete the table that is appropriate for your program)

I. Programs that fall under Program Review:

i. Date of most recent Review:
October, 2019

ii. Insert the Action Plan table from your last Program Review and give any progress towards completing the tasks or achieving targets set forth in the plan.

Specific area where improvement is needed	Evidence to support the recommended change	Person(s) responsible for implementing the change	Timeline for implementation	Resources needed	Assessment Plan	Progress Made this Year
In AY2020, the committee recognized difficulties related to providing complete coverage of CSSO-4 with our required 1-credit course (CSC 4102 – Ethical Issues in Computer Science).	student performance on PI (b) was not good with most students falling below the proficiency level with 1 credit hour CSC 4102. Clearly more time needs to be spend on explaining legal responsibilities as opposed to ethical and moral considerations.	Nadimpalli Mahadev, Frits Lander	Starting from fall 2021, the new 3 credit hour course CSC 4100 replaced the 1 credit hour course CSC 4102	NA	The instruments of CSC 4100 has been used in 3021-2022 assessment plan.	After replacing the one credit hour course CSC 4102 with three credit hour course CSC 4100, the students' performance have been improved dramatically. Our proficiency target was almost realized for all PIs.

iii. If you do not have an action plan, would you like help in developing one based on your last program review and needs of the program?

☐ Yes

II. Programs with external Accreditation:

i. Professional, specialized, State, or programmatic accreditations currently held by the program/department.
ii. Date of most recent accreditation action by each listed agency.
iii. Date and nature of next review and type of review.

List key issues for continuing accreditation identified in accreditation action letter or report.	**Key performance indicators as required by agency or selected by program (licensure, board or bar pass rates; employment rates, etc.)(If required.)**	**Update on fulfilling the action letter/report or on meeting the key performance indicators.**
See section D(I)		

E. Departmental Strategic Initiatives

Accomplished Initiatives AY 21-22 **Add more rows as needed**	**Corresponding Strategic Plan Goal & Strategy** **Goal # followed by Strategy # ex: 1.3**	**Indicate if a Diversity, Equity and Inclusiveness (DEI) Goal**
		☐

Planned Initiatives for AY 22-23 Add more rows as needed	Associated Strategic Plan Goal & Strategy Goal # followed by Strategy # ex: 1.3	Indicate if a Diversity, Equity and Inclusiveness (DEI) Goal

F. Departmental Reflection:

Take this section to reflect on--

1) *Initiatives that you may be considering for 22-23 academic year that you did not already capture above.*

2) *Any other thoughts or information that you would like to share*.

Appendix A:

FITCHBURG STATE UNIVERSITY COMPUTER INFORMATION SYSTEMS ASSESSMENT REPORT

As part of the continuous improvement process, we decided to match the assessment cycle with academic year. While the data is collected as needed in each of FA/SP semesters, the department will meet at the end of each Spring semester to review the data against performance targets and identify where action is needed and discuss appropriate action to be implemented for the next assessment cycle.

A table is created to summarize the outcome assessment of each SO followed by an analysis regarding any steps needed for continuous improvement with respect to that outcome. You find in those tables that we set the performance target of at least 70% of the class meeting the proficiency requirements as stated in the rubrics.

Minutes of these discussions will be included with the report each assessment cycle. The minutes for the FA20-SP21 cycle are included here.

Please note: All the performance data and the descriptions of the instruments used, are included in the Appendix A of this report. Appendix B includes the department minutes from the assessment discussions. Appendix C includes the ABET's Post-30-Day Due-Process Response. Appendix D includes parts of the report we submitted prior to that ABET response.

Glossary

Proficiency Score:

Represents the minimum score in each instrument that qualifies at meeting the Proficiency level or better (as defined in the Rubric).

Number Proficient:

Actual number of students that meet or exceed the proficiency score.

% Proficient:

Percentage of the students that meet or exceed the proficiency score.

Assessment Cycle: Fall 21 - Spring 22

This report provides assessment data, analysis, and evidence of continuous improvement across the six student outcomes for the Computer Science Program (CSSOs) using our previously established process for the FA20-SP21 assessment cycle. All CSSOs except for CSSO-4 were assessed using instruments embedded in the capstone course CSC 4400 (Software Engineering). CSC 4400 had eighteen (18) 3rd and 4th year Computer Science majors enrolled and the instruments were administered to them all.

The remaining outcome (CISSO-4, Professional Responsibilities) was assessed using instruments embedded in CSC 4100 (Ethics & Impacts of Computing). Thirteen (13) Computer Information Systems majors were enrolled in CSC 4100 and the instruments were administered to them all. These 13 students were grouped into three teams. The assessment of each performance indicator (PI) was rubric-based. Our student proficiency target was to have at least 70% of the students achieve at the exemplary or proficient level for every PI.

In CSC 4400, students worked in teams to develop a software product by going through the steps of the software development lifecycle on a practical project. The assessment instruments were project-related documentation and oral presentations developed by the students. The students progressed through the class by completing four agile development "sprints". "Sprint" is the term used to describe a time-limited period of focused development activity. Students submit documentation of their development activity for each of the four sprints which were used as assessment instruments. When presentations were used as an assessment instrument, style-related rubric items were excluded from the assessment to focus on content. CSC 4100 closely followed textbook content and assessment instruments were written assignments taken directly from the textbook.

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

Assessment Methods for CSSO-1

Assessment instrument *Assignment 1*: Students were instructed to deliberate and produce a project description document that explained: required functionalities, user interface design, database design, and considerations for how a front-end interface might be programmed to use a back-end database. The assignment challenged students to consider examples from their lives and think about how each functionality for the proposed project could be implemented. The identified functionalities and methods for implementing them were prioritized. In making design decisions to include in the submitted project description, students considered multiple approaches to project development (**PI-c**). By programming the front-end user interface to work with a back-end database, student work directly addressed **PI-d**.

Assessment instrument *Assignment 2*: Students were instructed to produce a use case diagram and user interface prototypes in both oral and written forms for the functionality they specified in their project description document (assignment 1). Use case diagrams, demonstrate an understanding of the application domain (**PI-a**). User interface protocols demonstrate understanding of the inputs, outputs and other requirements for the problem (**PI-b**).

Assessment Results for CSSO-1

CSSO-1 Assessment Results								
					Rubric summary (n = 18)			Results (n=18)
Performance Indicator	Semester	Course	Instrument	Instructor	Exemplary	Proficient	Other	% Proficient or better
a) Understand the application domain.	SP 22	CSC 4400 Software Engineering	Assignment 2	N Mahadev	18	0	0	100
b) Understand the inputs, outputs and other requirements for the problem.	SP 22	CSC 4400 Software Engineering	Assignment 2	N Mahadev	18	0	0	100
c) Compare and contrast multiple approaches to solving the problem.	SP 22	CSC 4400 Software Engineering	Assignment 1	N Mahadev	18	0	0	100
d) Understand relevant computing principles.	SP 22	CSC 4400 Software Engineering	Assignment 1	N Mahadev	18	0	0	100

CSSO-1 Analysis

The proficiency target was clearly realized for all PIs. This 100% exemplary performance may be attributed to assessment-based curricular changes discussed and initiated at the end of the academic year 20 as part of our perpetual effort towards implementing continuous improvement. The prerequisite for CSC 4400 be changed from CSC 3011 (Data Modeling and Database Design) to CSC 3050 (Web Programming) as a suggested intervention for difficulties observed in past semesters and we believe this made a significant difference here. A proposal to change the prerequisite was submitted to the All-University Committee (AUC) as AUC#6 on 10/20/2020. The proposal was recommended by the AUC Curriculum Committee and approved by President Lapidus on 2/25/2021. The new prerequisite was informally enforced during academic advising in 2020 to assure that students registering for the course had the appropriate prerequisite. The new prerequisite introduced students to the technologies required for creating projects with a front-end web interface and back-end database. This intervention provided students with an understanding of the necessary computing principles that facilitated their ability to compare and contrast various approaches and confidently make progress on their development project implementations.

Rubric for CSSO-1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

Performance Indicator	Exemplary	Proficient	Marginal	Weak
a) Understand the application domain.	Demonstrates a mature understanding of 1. What the design is meant to accomplish. 2. The deployment environment. 3. The available computing resources.	Demonstrates some understanding of 1. What the design is meant to accomplish. 2. The deployment environment. 3. The available computing resources.	Demonstrates some awareness of 1. What the design is meant to accomplish. 2. The deployment environment. 3. The available computing resources.	Shows no awareness of 1. What the design is meant to accomplish. 2. The deployment environment. 3. The available computing resources.
b) Understand the inputs, outputs and other requirements for the problem.	Demonstrates a mature understanding of 1. The requirements of the application. 2. Inputs and outputs associated with the problem domain. 3. How to design tests to validate problem solutions.	Demonstrates some understanding of 1. The requirements of the application. 2. Inputs and outputs associated with the problem domain. 3. How to design tests to validate problem solutions.	Demonstrates some awareness of 1. The requirements of the application. 2. Inputs and outputs associated with the problem domain. 3. How to design tests to validate problem solutions.	Shows no awareness of 1. The requirements of the application. 2. Inputs and outputs associated with the problem domain. 3. How to design tests to validate problem solutions.
c) Compare and contrast multiple approaches to solving the problem.	Demonstrates full ability to 1. Identify various approaches to achieve a solution. 2. Decide criteria for best solution 3. Evaluate and identify best solutions	Demonstrates some ability to 1. Identify various approaches to achieve a solution. 2. Decide criteria for best solution 3. Evaluate and identify best solutions	Demonstrates very little ability to 1. Identify various approaches to achieve a solution. 2. Decide criteria for best solution 3. Evaluate and identify best solutions	Shows no ability to 1. Identify various approaches to achieve a solution. 2. Decide criteria for best solution 3. Evaluate and identify best solutions.
d) Understand relevant computing principles.	Demonstrates a mature understanding of 1. Underlying mathematical and computational ideas. 2. Underlying design principles.	Demonstrates some understanding of 1. Underlying mathematical and computational ideas. 2. Underlying design principles. 3. Efficient solution development methods.	Demonstrates some awareness of 1. Underlying mathematical and computational ideas. 2. Underlying design principles. 3. Efficient solution development methods.	Shows no awareness of 1. Underlying mathematical and computational ideas. 2. Underlying design principles. 3. Efficient solution development methods.

	3. Efficient solution development methods.			

CSSO-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.

Assessment Instruments for CSSO-2

Assessment instrument *Assignment 4:* This presentation required each team to select user stories to implement. For each user story, students were instructed to: identify design principles to use (**PI-a**), establish a task list and create a testing plan for each task (**PI-b**), and maintain a shared dashboard that indicates degree of completion for each task. During the presentation each student demonstrated the completed tasks including the testing process (**PI-c, PI-d**). Similar Sprints were carried out three more times, each time the students incrementing and integrating the functionalities.

Assessment Results for CSSO-2

CSSO-2 Assessment Results								
					Rubric summary (n = 18)			**Results (n=18)**
Performance Indicator	**Semester**	**Course**	**Instrument**	**Instructor**	**Exemplary**	**Proficient**	**Other**	**% Proficient or better**
a) Identify design principles appropriate to the problem.	SP 22	CSC 4400 Software Engineering	Assignment 4	N Mahadev	13	3	2	88.9
b) Plan and document computing-based solution development.	SP 22	CSC 4400 Software Engineering	Assignment 4	N Mahadev	13	3	2	88.9
c) Design and implement test cases for solution evaluation.	SP 22	CSC 4400 Software Engineering	Assignment 4	N Mahadev	13	3	2	88.9
d) Implement a computing-based solution.	SP 22	CSC 4400 Software Engineering	Assignment 4	N Mahadev	13	3	2	88.9

CSSO-2 Analysis

Target criteria was met for all PIs.

CSSO-2 Prescribed Intervention from last cycle quoted below

"In the future, more class time will be allocated to coverage of unit testing and students will be given additional time to complete the assignment if necessary. This will be implemented when

CSC 4400 is offered in Spring, 2022. Assessment will be monitored to document the effectiveness of the intervention as part of our continuous improvement program."

this intervention clearly worked as more stress was placed on unit testing as well in each sprint.

Rubrics used to assess CSSO-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.

Performance Indicator	Exemplary	Proficient	Marginal	Weak
a) Identify design principles appropriate to the problem.	Demonstrates a mature understanding of 1. Underlying mathematical and computational ideas. 2. Modularize the problem. 3. Selecting appropriate design elements for the solution.	Demonstrates some understanding of 1. Underlying mathematical and computational ideas. 2. Modularize the problem. 3. Selecting appropriate design elements for the solution.	Demonstrates some awareness of 1. Underlying mathematical and computational ideas. 2. Modularize the problem. 3. Selecting appropriate design elements for the solution.	Shows no awareness of 1. Underlying mathematical and computational ideas. 2. Modularize the problem. 3. Selecting appropriate design elements for the solution.
b) Plan and document computing-based solution development.	Demonstrates full ability to 1. Identify the sequence of tasks and the dependencies. 2. Identify the needed tools. 3. Document the process.	Demonstrates some ability to 1. Identify the sequence of tasks and the dependencies. 2. Identify the needed tools. 3. Document the process.	Demonstrates some awareness of how to 1. Identify the sequence of tasks and the dependencies. 2. Identify the needed tools. 3. Document the process.	Demonstrates no awareness of how to 1. Identify the sequence of tasks and the dependencies. 2. Identify the needed tools. 3. Document the process.
c) Design and implement test cases for solution evaluation.	Demonstrates full ability to 1. Identify all test cases and set of exceptions. 2. Implement the tests and exception handling methods.	Demonstrates some ability to 1. Identify all test cases and set of exceptions. 2. Implement the tests and exception handling methods.	Demonstrates some awareness of how to 1. Identify all test cases and set of exceptions. 2. Implement the tests and exception handling methods.	Demonstrates no awareness of how to 1. Identify all test cases and set of exceptions. 2. Implement the tests and exception handling methods.
d) Implement a computing-based solution.	Demonstrates full ability to 1. Identify an appropriate computational solution. 2. Develop logical design of the solution.	Demonstrates some ability to 1. Identify an appropriate computational solution. 2. Develop logical design of the solution.	Demonstrates some awareness of how to 1. Identify an appropriate computational solution.	Demonstrates no awareness of how to 1. Identify an appropriate computational solution.

	3. Implement the solution appropriate to the computing context. 4. Test the implementation in phases.	3. Implement the solution appropriate to the computing context. 4. Test the implementation in phases.	2. Develop logical design of the solution. 3. Implement the solution appropriate to the computing context. 4. Test the implementation in phases.	2. Develop logical design of the solution. 3. Implement the solution appropriate to the computing context. 4. Test the implementation in phases.

CSSO-3: Communicate effectively in a variety of professional contexts

Assessment Instruments for CSSO-3

Assessment instrument *Assignment 2*: Students were instructed to produce a use case diagram, user stories, use case scenarios, a system specification, and an SRS-style listing of user requirements in both oral and written forms for the functionality they specified in their project description document (assignment 1). Here, students demonstrated how stakeholder requirements were translated into software specifications for their chosen project (**PI-a**).

Assessment instrument *Assignment 1*: Students were instructed to deliberate and produce a project description document that explained: required functionalities, user interface design, database design, and considerations for how a front-end interface might be programmed to use a back-end database. The assignment challenged students to consider and discuss examples from their lives and think about how each functionality for the proposed project could be implemented (**PI-d**). Students in each team worked together to develop consistent user interfaces, share the same database, agree on the technologies to be used, assign programming tasks, and motivate each other. Difficulties in communication among the team members can be identified from this assignment.

Assessment instrument *Assignment 5*: Students were instructed to elaborate on one selected functionality from their project and present to an audience consisting of: a simulated *customer* and a simulated *project manager*. The instructor plays both roles. Each team member focuses on obtaining approval from the simulated customer by presenting the prototype for a user story (**PI-b**). Approval for technical aspects of the project is sought from the simulated project manager who evaluates the presentation of the solution plan, testing plan, and development timeline (**PI-c**).

Assessment Results for CSSO-3

CSSO-3 Assessment Results								
					Rubric summary (n = 18)			**Results (n=18)**
Performance Indicator	**Semester**	**Course**	**Instrument**	**Instructor**	**Exemplary**	**Proficient**	**Other**	**% Proficient or better**

a) Understand and translate stakeholder requirements into computing specifications.	SP 22	CSC 4400 Software Engineering	Assignment 2	N Mahadev	18	0	0	100
b) Present solution prototypes to the customer.	SP 22	CSC 4400 Software Engineering	Assignment 5	N Mahadev	13	2	3	83.3
c) Communicate the solution design to the project managers.	SP 22	CSC 4400 Software Engineering	Assignment 5	N Mahadev	13	2	3	83.3
d) Participate in group discussions with team members.	SP 22	CSC 4400 Software Engineering	Assignment 1	N Mahadev	18	0	0	100

CSSO-3 Analysis

Target performance was clearly realized for this outcome. All students worked well within their respective teams (**PI-d**). Some students achieved less than proficient scores in other areas of communication. The unfamiliar remote learning environment and other effects of pandemic stress may have negatively affected the performance of some students.

Rubric for CSSO-3 Communicate effectively in a variety of professional contexts.

Performance Indicator	Exemplary	Proficient	Marginal	Weak
a) Understand and translate stakeholder requirements into computing specifications.	Demonstrates full ability to 1. Interact with stakeholders to establish requirements. 2. Communicate the specifications to all the stakeholders. 3. Document the specifications.	Demonstrates some ability to 1. Interact with stakeholders to establish requirements. 2. Communicate the specifications to all the stakeholders. 3. Document the specifications.	Demonstrates some awareness of how to 1. Interact with stakeholders to establish requirements. 2. Communicate the specifications to all the stakeholders. 3. Document the specifications.	Demonstrates no awareness of how to 1. Interact with stakeholders to establish requirements. 2. Communicate the specifications to all the stakeholders. 3. Document the specifications.

b) Present solution prototypes to the customer.	Demonstrate full ability to present the prototypes to customers and solicit feedback.	Demonstrate some ability to present the prototypes to customers and solicit feedback.	Demonstrate some awareness of how to present the prototypes to customers and solicit feedback.	Demonstrate no awareness of how to present the prototypes to customers and solicit feedback.
c) Communicate the solution design to the project managers.	Demonstrate full ability to organize and present the solution design to the project managers.	Demonstrate some ability to organize and present the solution design to the project managers.	Demonstrate some awareness to organize and present the solution design to the project managers.	Demonstrate no awareness to organize and present the solution design to the project managers.
d) Participate in group discussions with team members.	Demonstrate leadership through peer evaluation.	Demonstrate significant contribution through peer evaluation.	Demonstrate inconsistent contribution through peer evaluation.	Demonstrate no contribution to the team discussions.

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

Assessment Instruments for CSSO-4

Introduction. This outcome was assessed using written student responses to chapter questions from the textbook (Ethics for the Information Age, 8th edition by Michael J. Quinn) for the course CSC 4100 (Ethical Issues in Computer Science).

Assessment instrument *Quiz 1* : By thoughtfully answering Quiz 1 questions students demonstrate their understanding of general ethical theories, their limitations and ways to determine one's own ethical responsibilities (**PI-a**)

Assessment instrument *Quiz 2*: By thoughtfully answering Quiz 2 questions, students demonstrate their understanding of legal issues, their limitations, and how they may differ from the ethical and moral considerations (**PI-b**)

Assessment instrument *Quiz 3*: By thoughtfully answering Quiz 3 questions, students demonstrate their understanding of how to assess the social impacts of various information technologies. (**PI-b, PI-c**)

Assessment instrument *Quiz 4*: By thoughtfully answering Chapter 9 discussion questions, students demonstrate their understanding of issues related to professional ethics, ethical decision-making in the workplace (**PI-c**)

Assessment instrument *Project 1*: In Project 1, each team was required to read and summarize the ACM Code of Ethics and Professional Conduct. Students demonstrated their understanding of fundamental ethical principles, professional responsibility, professional leadership principles, and principles involving compliance with the Code (**PI-a, PI-b**)

Assessment instrument *Project 2* : In completing Project 2, students demonstrated understanding of the impact of computing technologies on privacy and copyright issues (**PI-c**).

Assessment instrument *Project 3*: In Project 3, each team used an example of online voting to discuss the roles of governments in shaping the policies that govern the conduct of computing solutions and the future trends in computing technologies and their potential impacts (**PI-c, PI-d**).

Assessment instrument *Project 4*: Project 4 involved the discussion on the future trends in computing technologies and their potential impacts with the computer simulations (**PI-c**)

Assessment Results for CSSO-4

CSSO-4 Assessment Results								
					Rubric summary (n = 13)			
Performance Indicator	**Semester**	**Course**	**Instrument**	**Instructor**	**Exemplary**	**Proficient**	**Other**	**% Proficient or better**
a) Understand ethical responsibilities.	SP 22	CSC 4100	Project 1 Quiz 1	Frits Lander	13 4	0 4	0 5	100% 61.5%
b) Understand legal responsibilities	SP 22	CSC 4100	Project 1 Quiz 3	Frits Lander	13 5	0 5	0 3	100% 77.0%
c) Understand social impacts of potential solutions.	SP 22	CSC 4100	Project 2 Project 3 Project 4 Quiz 3 Quiz 4	Frits Lander	13 13 13 5 4	0 0 0 5 4	0 0 0 3 3	100% 100% 100% 77.0% 77.0%
d) Make informed ethical decisions.	SP 22	CSC 4100	Project 3	Frits Lander	5	2	3	70%

CSSO-4 Analysis

As part of the continuous improvement, the one credit hour Ethics course CSC 4102 was replaced with this three-credit hour course CSC 4100 in Spring 2022. The results show that the students' performance have been improved dramatically over the last assessment cycle. Our proficiency target was almost realized for all PIs.

Rubric for CSSO-4 Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

Performance Indicator	Exemplary	Proficient	Marginal	Weak

a) Understand ethical responsibilities.	Demonstrate full ability to identify and evaluate ethical issues in computing practices.	Demonstrate some ability to identify and evaluate ethical issues in computing practices.	Demonstrate some awareness of how to identify and evaluate ethical issues in computing practices.	Demonstrate no awareness of how to identify and evaluate ethical issues in computing practices.
b) Understand legal responsibilities.	Demonstrate full ability to identify and evaluate legal issues in computing practices.	Demonstrate some ability to identify and evaluate legal issues in computing practices.	Demonstrate some awareness of how to identify and evaluate legal issues in computing practices.	Demonstrate no awareness of how to identify and evaluate legal issues in computing practices.
c) Understand social impacts of potential solutions.	Demonstrate full ability to identify impacts of potential solutions on society.	Demonstrate some ability to identify impacts of potential solutions on society.	Demonstrate some awareness of how to identify impacts of potential solutions on society.	Demonstrate no awareness of how to identify impacts of potential solutions on society.
d) Make informed ethical decisions.	Demonstrate full ability to make proper ethical choices.	Demonstrate some ability to make proper ethical choices.	Demonstrate some awareness of how to make proper ethical choices.	Demonstrate no awareness of how to make proper ethical choices.

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

Assessment Instruments for CSSO-5

Assessment instrument *Assignment 6*: Students were instructed to complete a peer evaluation survey related to team dynamics. Every team member was rated by the other team members in terms of: cooperation (**PI-a**), contribution (**PI-b**), communication (**PI-c**), and management skills (**PI-d**). Responses from the Likert scale (1 through 4 where 1 is the highest possible rating) were compiled for each student and adjusted to align with the rubric. In the CSSO-5 Assessment Results table, **s** indicates computed score.

CSSO-5 Assessment Results								
					Rubric summary (n = 18)			**Results (n=18)**
Performance Indicator	**Semester**	**Course**	**Instrument**	**Instructor**	**Exemplary** **s** < 1.5	**Proficient** 1.5 ≤ **s** < 2.5	**Other** **s** > 2.5	**% Proficient or better**
a) Cooperate fully within the team.	SP 22	CSC 4400	Assignment 6	N Mahadev	18	0	0	100

b) Contribute fully within the team.	SP 22	CSC 4400	Assignment 6	N Mahadev	16	2	0	100
c) Communicate effectively with the team.	SP 22	CSC 4400	Assignment 6	N Mahadev	15	2	1	94.4
d) Demonstrate time and project management skills.	SP 22	CSC 4400	Assignment 6	N Mahadev	13	4	1	94.4

CSSO-5 Analysis

The proficiency target was realized for all PIs. Even though "students working in teams" is emphasized mostly in the capstone courses, it is encouraging to see that most students worked together well and produced a quality product. There were a couple of students with personal or technical issues that could not keep up the pace with the team. My experience with these students suggests that pandemic stress played a major role in their lagging behind with the project work. In the end all students satisfactorily completed the project.

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

Performance Indicator	Exemplary	Proficient	Marginal	Weak
a) Cooperate fully within the team.	Considered by peers as fully with team project.	Considered by peers as significantly cooperating with the team project.	Considered by peers as somewhat cooperating with the team project.	Considered by peers as not cooperating with the team project.
b) Contribute fully within the team.	Considered by peers as contributing to the team project.	Considered by peers as significantly contributing to the team project.	Considered by peers as somewhat contributing to the team project.	Considered by peers as not contributing to the team project.
c) Communicate effectively with the team.	Considered by peers as an excellent communicator.	Considered by peers as a good communicator.	Considered by peers as having communication issues.	Considered by peers as non-communicative.
d) Demonstrate time and project management skills.	Demonstrate full ability to set milestones and meet them.	Demonstrate some ability to set milestones and meet them.	Demonstrate some awareness of setting milestones and meet them.	Demonstrate no ability to set milestones and meet them.

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

Assessment Instruments for CSSO-6

Assessment instrument *Assignment 8*: Students develop their projects by going through four agile development "sprints" during the semester. For each sprint, every student submits documentation of their progress. In this assignment, students are providing documentation of their progress across all four sprints. The submission documents each stage of software development from conceptualization, through design, implementation, and testing. Submissions are assessed based on each team member's stories, task lists, progress reports, and consistency with group presentations. For each task, the documentation includes descriptions of: the required algorithms and data structures (**PI-a**), the development methodology used (**PI-b**), the required development technologies (**PI-c**). Each group member contributes to the maintenance of a project dashboard that shows progress toward project completion and consistent student contributions to the dashboard were assessed along with the submitted documentation (**PI-d**).

Assessment Results for CSSO-6

CSSO-6 Assessment Results								
					Rubric summary (n = 18)			Results (n=18)
Performance Indicator	Semester	Course	Instrument	Instructor	Exemplary	Proficient	Other	% Proficient or better
a) Determine appropriate algorithms and data structures for a given problem.	SP 22	CSC 4400	Assignment 8	N Mahadev	12	2	2	87.5
b) Identify appropriate software engineering methodology for a given project.	SP 22	CSC 4400	Assignment 8	N Mahadev	12	2	2	87.5
c) Identify the computing technologies to be used in a given project.	SP 22	CSC 4400	Assignment 8	N Mahadev	12	2	2	87.5
d) Design and document the development and testing processes.	SP 22	CSC 4400	Assignment 8	N Mahadev	12	2	2	87.5

CSSO-6 Analysis

The proficiency target was met for this outcome. All students achieved exemplary scores for PI-a, PI-b, and PI-c. For some students, the sprints took some getting used to. Most students found a rhythm by mid-semester but a couple struggled to make progress from sprint to sprint due to pandemic stress and other technical factors.

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

Performance Indicator	Exemplary	Proficient	Marginal	Weak
a) Determine appropriate algorithms and data	Demonstrate full ability to identify appropriate algorithms and data	Demonstrate some ability to identify appropriate algorithms and data	Demonstrate very little ability to identify appropriate algorithms and data	Show no ability to identify appropriate algorithms and data

structures for a given problem.	structures needed for the given problem.	structures needed for the given problem.	structures needed for the given problem.	structures needed for the given problem.
b) Identify appropriate software engineering methodology for a given project.	Demonstrate full ability to make the case for using certain methodology appropriate for the project.	Demonstrate some ability to make the case for using certain methodology appropriate for the project.	Demonstrate very little ability to make the case for using certain methodology appropriate for the project.	Show no ability to make the case for using certain methodology appropriate for the project.
c) Identify the computing technologies to be used in a given project.	Demonstrate full ability to identify existing technologies that can be used in the project.	Demonstrate some ability to identify existing technologies that can be used in the project.	Demonstrate very little ability to identify existing technologies that can be used in the project.	Show no ability to identify existing technologies that can be used in the project.
d) Design and document the development and testing processes.	Demonstrate full ability to design tests and components for the product as well as document the designs.	Demonstrate some ability to design tests and components for the product as well as document the designs.	Demonstrate very little ability to design tests and components for the product as well as document the designs.	Show no ability to design tests and components for the product as well as document the designs.

Current Assessment Summary

Overall, proficiency targets were realized for most CS program student outcomes: CSSO-1, CSSO-2, CSSO-3, CSSO-5, and CSSO-6. The proficiency targets were dramatically improved after we replaced the one credit hour Ethics course CSC 4102 with three-credit hour course CSC 4100.

Continuous Improvement

We actively make changes to our courses and curriculum to improve our student outcomes in a continuous and regular way. The effect of the aforementioned interventions will be measured during the next assessment cycle and their effectiveness will be reported on in the next assessment cycle. Previous assessment cycles raised two issues that have been the focus of recent documented continuous improvement efforts.

Final Word

We take pride in the work we do and courses we teach. Each of us individually adapts to changing circumstances within the courses we teach to make undocumented improvements every semester. We handle issues in our individual courses as they arise because that is what is required of conscientious instructors. We constantly review our curriculum and course delivery and adapt to numerous external and internal factors: discussions with the Program Advisory Board, discussions with our feeder community colleges, the changing liberal arts and science requirements of the university, the conferences we attend to understand trends in CS educational practice, the assessments administered in each course we teach, the feedback we

receive from students in and outside of class, and the departmental retreats and other meetings where we discuss improvements to courses and curriculum. The systematic assessments such as those reported here play an important role. However, documenting all aspects of our process is a major, time-consuming task that continues to grow and take us away from what ought to be our main focus: student learning. Faculty salaries are based on a 9-month contract from September 1 through May 31. Many of the hundreds of hours we have collectively spent trying to make this document comply with reviewer suggestions have been contributed without compensation. Each of us is assigned four courses to teach every semester. We do not have the luxury of TAs that monitor our labs, maintain our equipment, tutor our students, and grade student work. Here, everything is on us: the faculty. The University assigns new administrative duties to the department leadership every year and provides less and less support. This has the effect of draining our energies from the important duties of teaching, helping students, and advancing our curriculum. With every ABET review, we encounter radically different expectations. With each review, we collectively spend thousands of hours, many without compensation, adapting to develop new assessment materials and procedures to satisfy the feedback we receive. Then, when the next review team steps in, our diligent follow-through … based on the feedback we received by the previous review team … is rejected. There needs to be a simplified, streamlined, and consistent process that will honor our sincere effort and not be radically changed from one site visitation to the next. It should not assume that we have the same resources available to those who teach in affluent or prestigious technical universities. We sincerely work every day to make our program as helpful as possible to our students moving forward. Processes that add to administrative burden diminish our ability to focus on what's important: quality teaching to promote student learning.