

Institutional Effectiveness Report

Name of the Program/Department: BS in Computer Science

Year: 2021/2022

Name of the Preparer: M. Padmaja Rao

Mission

The Computer Science Department aims to instill in our students a sound knowledge of all key domains of the computing sciences while encouraging critical thinking, teamwork, innovation, and a lifelong love for learning. We have a vision of graduating engineers, who are ethical, creative in problem solving, effective communicators, respectful of their peers, and have a desire to serve their community. Our internship program and placement efforts actively assist students in finding computing jobs.

Program Learning Outcomes

1. Computer Science students at FMU will DEVELOP AND DEMONSTRATE critical thinking skills along with creativity to analyze and solve software engineering and computational problems.
2. Computer Science students at FMU will DEVELOP AND DEMONSTRATE the ability to effectively communicate technical knowledge through presentations and writings.
3. Computer Science students at FMU will DEMONSTRATE an understanding of ethical challenges that may arise in the field of software engineering and be guided by high ethical standards.
4. Computer Science students at FMU will DEMONSTRATE that they know the core concepts within each computer science discipline: programming, computer architecture, networking software engineering, algorithms, operating systems, compiler theory, theory of computation, and database management.

Executive Summary

During the 2021-2022 academic year, the Computer Science Program assessed five Student Learning Outcomes (SLOs). The SLOs covered areas such as ethics, written and oral communication skills, critical thinking ability, and creative problem solving.

The CS program employed department-developed rubrics and holistic evaluations in assessing the five SLOs. We measured two of the five SLOs by presenting juniors in CS 340, Software

Design and Development, with an ethics module that consisted of a series of readings, case studies, and discussion questions that engaged the student in ethical reflection. Ten students were evaluated by three faculty members using ethics and written communication rubrics. The other three SLOs were measured in lower level course, CS 190 (Programming Fundamentals) to get a based line assessment and then again in higher level course, CS 480 (Capstone I)/CS 482 (Capstone II) through the capstone projects of graduating seniors. The CS 190 projects were assigned team or individual projects, which were presented via YouTube videos. The CS 480/482 projects were team or individual projects. These projects were either original idea projects, projects that students worked with companies or research projects. The students in CS 480/482 projects presented their projects at the annual Computer Science Symposium. Three faculty members using critical thinking, creative problem solving, and oral communication rubrics evaluated both sets of projects. The CS 190 students meet the target for all three SLOs. For the Capstone and CS 340 (higher level course) assessments, we aimed to have 80% of student meet or exceed expectations for each SLO. We achieved our target for each of the five SLOs as 100% of students met or exceeded expectations in their demonstration of ethical reasoning, written and oral communication, critical thinking ability, and creative problem-solving skills.

We implemented an indirect assessment in the form of a survey for the six graduating seniors in the Spring 2022 semester. This survey addressed all the five SLOs: Ethics, Written Communication, Oral Communication, Critical Thinking, and Creative Problem Solving SLOs. The students would will help us have a better understanding of our student's perception of their growth in the areas of our program's student learning objectives. We used a Likert Scale ranging from 1 to 5 for the survey questions. The students rating an average of 4.4 out of 5 for all the five SLOs.

Based on these findings, the Computer Science program will continue to implement some strategies to increase student involvement and interdisciplinary thinking and anticipate seeing improved markers in the Class of 2023.

Student Learning Outcomes

SLO 1.0 – ETHICS: Eighty percent (**Benchmark:** 80%) of students in CS 340 (2015-2016 **Baseline:**100%) will meet or exceed the expectations when identifying elements and dilemma, relationships among direct and indirect stakeholders, positive and negative issue consequences and DEMONSTRATE the ability to recommend a response that balances the positive and negative consequences for the stakeholders in ethics case study modules.

SLO 2.0 – WRITTEN COMMUNICATION: Eighty percent (**Benchmark:** 80%) of students in CS 340 (2015-2016 **Baseline** = 93.75%) will meet or exceed the expectations when DEMONSTRATING the proper use of vocabulary, organized presentation of information, thoughtful presentation of well-reasoned arguments, and written reports which are free of grammatical and spelling errors in their response to ethics case study modules.

SLO 3.0 – ORAL COMMUNICATION: Eighty percent (**Benchmark:** 80%) of students in CS 480/CS 482 (2015-2016 **Baseline:** 100%) will meet or exceed the expectations when demonstrating the proper use of vocabulary, organized presentation of information, appropriate

amount of eye contact with audience, effective use of body language, minimal use of written notes, and understandable projection of voice in their presentation of their final capstone project.

SLO 4.0 – CRITICAL THINKING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed expectations when identifying and understanding the information systems problem at their heart of their project, gathering and managing functional and non-functional requirements, implementing risk management, implementing project timeline and team management, and implementing a viable solution that meets functional and non-functional requirements for their self-assigned projects.

SLO 5.0 – CREATIVE PROBLEM SOLVING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed expectations in their approach to solving business problems by demonstrating creative ability, elaborate on the problem in ways to show insights beyond the stated situation, identifying components of the situation that are beyond the given information, identifying unanswered questions that are of consequence to the solution, and developing a solution that transforms the assumptions of the situation and can be feasibly implemented in the context of their self-assigned projects.

Assessment Methods for Lower Level Computer Science courses

During the Fall 2021 and Spring 2022 semesters, we implemented an end of the semester course project in CS 190, Programming Fundamentals. Although CS 190 is not part of our core CS curriculum, all freshman CS majors take this course as it is a prerequisite to CS 226, Programming and Algorithm Design, a core CS course. This course is also taken by physics, engineering and mathematics majors. In order make it easier to evaluate this artifact, CS majors were encouraged to work into teams. **Ten students/teams were assessed.** The same team project was given to all the teams. The skills necessary to implement this project were taught to the students in this course. Since it was difficult for the evaluators to find the time to be present for the presentation of these projects, we asked the students to video record their demonstrations and post them on YouTube. CS faculty evaluated these projects for the SLO 3.0, SLO 4.0, SLO 5.0.

Assessment Methods for Upper Level Computer Science courses

SLO 1.0 - ETHICS Eighty percent (**Benchmark: 80%**) of students in CS 340, (2015-2016 **Baseline: 100%**) will meet or exceed the expectations when identifying elements and dilemma, relationships among direct and indirect stakeholders, positive and negative issue consequences and DEMONSTRATE the ability to recommend a response that balances the positive and negative consequences for the stakeholders in ethics case study modules. **Ten students were assessed.** This will be evaluated by three faculty members using a departmentally-developed rubric assessing student responses to a standardized ethics module. The Ethics Rubric, in the appendix, was used by the CS faculty for assessment. CS faculty is plans on meeting and setting a new **Target** for this assessment for the next academic year.

SLO 2.0 – WRITTEN COMMUNICATION: Eighty percent (**Benchmark: 80%**) of students in CS 340, (2015-2016 **Baseline: 93.75%**) will meet or exceed the expectations when DEMONSTRATING the proper use of vocabulary, organized presentation of information, thoughtful presentation of well-reasoned arguments, and written reports which are free of

grammatical and spelling errors in their response to ethics case study modules. **Ten students were assessed.** This will be evaluated by three faculty members using a departmentally-developed rubric assessing student responses to a standardized ethics module. The Written Communication Rubric, in the appendix, was used by the CS faculty for assessment. CS faculty is plans on meeting and setting a new **Target** for this assessment for the next academic year.

SLO 3.0 – ORAL COMMUNICATION: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed the expectations when demonstrating the proper use of vocabulary, organized presentation of information, appropriate amount of eye contact with audience, effective use of body language, minimal use of written notes, and understandable projection of voice in their presentation of their capstone project. **Ten students were assessed.** This will be evaluated by three faculty members using a departmentally-developed rubric during the students' final capstone presentation at the annual symposium. The Oral Communication Rubric, in the appendix, was used by the CS faculty for assessment. CS faculty is plans on meeting and setting a new **Target** for this assessment for the next academic year.

SLO 4.0 – CRITICAL THINKING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482, (2015-2016 baseline: 100%) will meet or exceed expectations when identifying and understanding the information systems problem at their heart of their project, gathering and managing functional and non-functional requirements, implementing risk management, implementing project timeline and team management, and implementing a viable solution that meets functional and non-functional requirements for their self-assigned projects. **Ten students were assessed.** This will be evaluated by three faculty members using a departmentally-developed rubric and holistic evaluations based on regular meetings and written and oral communications assessing the process and product for each student's capstone projects. The Critical Thinking Rubric, in the appendix, was used by the CS faculty for assessment. CS faculty is plans on meeting and setting a new **Target** for this assessment for the next academic year.

SLO 5.0 – CREATIVE PROBLEM SOLVING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed expectations in their approach to solving business problems by demonstrating creative ability, elaborate on the problem in ways to show insights beyond the stated situation, identifying components of the situation that are beyond the given information, identifying unanswered questions that are of consequence to the solution, and developing a solution that transforms the assumptions of the situation and can be feasibly implemented in the context of their self-assigned projects. **Ten students were assessed.** This will be evaluated by three faculty members using a departmentally-developed rubric and holistic evaluations based on regular meetings and written and oral communications assessing the process and product for each student's capstone projects. Below is the rubric used by the CS faculty for assessment. CS faculty is plans on meeting and setting a new **Target** for this assessment for the next academic year.

Assessment Results

The assessment results from lower level CS 190 course are given in Table 1. We met our **target** in all SLOs.

SLO	Benchmark	CS 190 Baseline (2020-2021)	CS 190
Oral Communication	80%	55%	87%
Critical Thinking	80%	50%	93%
Creative Problem Solving	80%	83%	97%

Table 1: Assessment results from Fall/Spring 2022

The assessment results for the higher level courses (CS 340, CS 480 and CS 482) are:

SLO 1.0 – ETHICS: Eighty percent (**Benchmark:** 80%) of students in CS 340 (2015-2016 **Baseline:**100%) will meet or exceed the expectations when identifying elements and dilemma, relationships among direct and indirect stakeholders, positive and negative issue consequences and DEMONSTRATE the ability to recommend a response that balances the positive and negative consequences for the stakeholders in ethics case study modules. They were evaluated by three faculty members using a departmentally-developed rubric assessing student responses to a standardized ethics module. Since 100% of students for the 2021-22 academic year met or exceeded expectations for this learning outcome, our target of 80% was reached.

SLO 2.0 – WRITTEN COMMUNICATION: Eighty percent (**Benchmark:** 80%) of students in CS 340 (2015-2016 **Baseline:** 93.75%) will meet or exceed the expectations when DEMONSTRATING the proper use of vocabulary, organized presentation of information, thoughtful presentation of well-reasoned arguments, and written reports which are free of grammatical and spelling errors in their response to ethics case study modules. They were evaluated by three faculty members using a departmentally-developed rubric assessing student responses to a standardized ethics module. Since 100% of students for the 2021-22 academic year met or exceeded expectations for this learning outcome, our target of 80% was reached.

SLO 3.0 – ORAL COMMUNICATION: Eighty percent (**Benchmark:** 80%) of students in CS 480/CS 482 (2015-2016 **Baseline:** 100%) will meet or exceed the expectations when demonstrating the proper use of vocabulary, organized presentation of information, appropriate amount of eye contact with audience, effective use of body language, minimal use of written notes, and understandable projection of voice in their presentation of their final capstone project. They were evaluated by three faculty members using a departmentally-developed rubric during the students' final capstone presentation at the annual symposium. Since 100% of students for the

2021-22 academic year met or exceeded expectations for this learning outcome, our target of 80% was reached.

SLO 4.0 – CRITICAL THINKING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed expectations when identifying and understanding the information systems problem at their heart of their project, gathering and managing functional and non-functional requirements, implementing risk management, implementing project timeline and team management, and implementing a viable solution that meets functional and non-functional requirements for their self-assigned projects. They were evaluated by three faculty members using a departmentally-developed rubric and holistic evaluations based on regular meetings and written and oral communications assessing the process and product for each student’s capstone projects. Since 100% of students for the 2021-2022 academic year met or exceeded expectations for this learning outcome, our target of 80% was reached.

SLO 5.0 – CREATIVE PROBLEM SOLVING: Eighty percent (**Benchmark: 80%**) of students in CS 480/CS 482 (2015-2016 **Baseline: 100%**) will meet or exceed expectations in their approach to solving business problems by demonstrating creative ability, elaborate on the problem in ways to show insights beyond the stated situation, identifying components of the situation that are beyond the given information, identifying unanswered questions that are of consequence to the solution, and developing a solution that transforms the assumptions of the situation and can be feasibly implemented in the context of their self-assigned projects. They were evaluated by three faculty members using a departmentally-developed rubric and holistic evaluations based on regular meetings and written and oral communications assessing the process and product for each student’s capstone projects. Since 100% of students for the 2021-22 academic year met or exceeded expectations for this learning outcome, our target of 80% was reached.

The assessment results for higher level courses are

SLO	Benchmark	CS 340	CS 480/CS 482
Ethics	80%	100%	
Written Communication	80%	100%	
Oral Communication	80%		100%
Critical Thinking	80%		100%
Creative Problem Solving	80%		100%

Table 2: Assessment results from Spring 2022

SLO 1.0: Ethical reasoning Computer Science students will be aware of ethical issues that they might encounter in the context of practicing software engineering.

- 100% of juniors in CS 340 met or exceeded expectations in ethics.
- **We conclude that the benchmark has been achieved** since over 80% of the student met or exceeded expectations in the Spring of 2022.

SLO 2.0: Computer Science students will be able to demonstrate superior written communication skills

- Written communication skills have been assessed at the junior level. 100% of the students met or exceeded expectations in the Spring 2022.
- **We conclude that the benchmark has been achieved.** Over 80% of the student met or exceeded expectations in Spring 2022.

SLO 3.0: Computer Science students will be able to demonstrate superior oral communications skills

- Graduating seniors were tested in CS 480/CS 482 for oral communication skills. 100% of the seniors met or exceeded expectations in oral communication in their capstone projects in Spring 2022.
- **We conclude that the benchmark has been achieved.** Over 80% of the student met or exceeded expectations in Spring 2022.

SLO 4.0: Computer Science graduates will analyze information system problems critically and logically.

- 100% of graduating seniors tested met or exceeded expectations using critical thinking in their capstone projects in Spring 2022.
- **We conclude that the benchmark has been achieved.** Over 80% of the student met or exceeded expectations in Spring 2022.

SLO 5.0: Computer Science graduates will demonstrate creativity in their approach to solving information systems problems.

- 100% of the graduating seniors met or exceeded expectations giving creative solutions in their capstone projects in Spring 2022.
- **We conclude that the benchmark has been achieved.** Over 80% of the student met or exceeded expectations in Spring 2022.

A survey was given to the Spring 2022 graduates. We used a Likert Scale from 1 to 5, where 1 is the lowest score and 5 is the highest, for the survey questions. The questions were targeting the student’s perception of growth in all five SLOs. The average rating in all five areas was very positive.

SLO	Average Rating (1 - lowest to 5 highest)
Communication Skills (Written and Oral)	4.3
Critical Thinking	4.2
Creative Problem Solving	4.5
Ethics	4.6

Table 3: Results from Spring 2022

Action Items

The Computer Science faculty would like to aim to have all our students exceed expectations especially in the areas OF oral and written communications and ethics.

1. Oral Communication

In their junior year, Computer Science students do a presentation in CS 340. Although the course instructor (Rao) does review presentations with each student, the CS faculty concluded that students would benefit more from a review of video-taped presentations and have begun implementing this method with the Class of 2018. As we expected this experience and analysis continues to have a positive impact on their senior capstone presentations at the Computer Science Symposium in Spring 2022. We will continue to implement this action. We implemented the incorporation of an extra practice session with reflection component before the seniors' presentations at the CS Symposium in Spring 2019. We saw better results; we will continue this action for the 2022-2023 seniors.

2. Written Communications

English 318, Technical Writing, is a requirement for Computer Science majors. The CS faculty would like to continue to work closely with the Technical Writing instructor so that the course includes an emphasis of content organization and depth of discussion. The 2021-2022 juniors were required to have a minimum of one visit to the writing center before submitting their writings. We saw better results this year because of this requirement and will continue to implement it for the 2022-2023 juniors.

3. Ethics

In their junior year, the CS 340 instructor (Rao) introduced ethics discussions using the ACM/IEEE Software Engineering Code of Ethics. This was followed by giving the students a software engineering module which consists of a series of readings, case studies and discussion questions that engage the student in ethical reflection. Students were given six weeks to complete the assignment. The CS faculty believed that the students should be given one or more examples on how to approach the discussions in the module before beginning the assignment that might result in broader and deeper discussions. This proved to be true with 2021-2022 juniors. Rao will continue to implement this action with the 2022-2023 junior class.

4. Critical Thinking

In their junior year, in CS 313 (Systems Design and Development) and CS 340 (Software Design and Development), the juniors design and implement an information system. The CS faculty would like there to be a greater emphasis in these courses on the requirement document as an evolving document which is to be updated and evaluated all throughout the design and implementation of their systems. The students' final projects should be even more strictly evaluated for adhering to this document or meeting requirements. Rao will continue to implement this action with the 2022-2023 junior class. This process also be continued to be implemented in CS 480/CS 482, with the capstone projects. We believe this will result in the improvement of the students conceptual and analytical skills.

5. This is the second year we implemented an assessment of the lower level course and saw a marked improvement. We will continue to implement our freshman CS 190 course

projects for evaluation and evaluate Oral Communications, Creative Problem Solving, Critical Thinking SLOs. The Computer Science Program faculty will meet over the summer and discuss setting and modifying our targets and benchmarks for the lower (100) level course.

6. Since we have consistently exceeded our benchmark for the higher-level direct assessments, the CS faculty plan on meeting and setting new targets for the next academic year, which will hopefully be achieved in the next five years.
7. We will administer the graduating survey for both semesters in an academic year.

Appendix

Ethics Rubric

Criteria	Does Not Meet Expectations Score: 1	2	Meets Expectations Score: 3	4	Exceeds Expectations Score: 5
Identification of the situation	Does not correctly identify the dilemma		Identifies and explains the main dilemma		Identifies multiple elements of the issue(s) and specifically identifies the dilemma of the decision maker
Identification of stakeholders	Identifies few of the critical stakeholders		Identifies most of the critical stakeholders		Identifies and explains the relationship among direct and indirect stakeholders
Identification of implications	Identifies few of the positive and negative consequences of the situation		Identifies the positive and negative consequences of the issue for all direct stakeholders		Identifies the positive and negative consequences of the issue by explaining the implications for all direct and indirect stakeholders
Recommended response	Does not articulate a reasonably good response to the situation		Indicates a good response to the situation that demonstrates a consideration of positive and negative implications for the direct stakeholders		Recommended response clearly indicates the desire to balance the positive and negative consequences of the situation for all direct and indirect stakeholders

Range: 4 – 20

Evaluation of score:

1. Below expectations: 10 or less
2. Meets expectations: 11 to 14
3. Exceeds expectations: 15 or higher

Written Communication Rubric

Criteria	Does not meet expectations	Meets Expectations		Exceeds Expectations
	Score: 1	2	Score: 3	4
Use of vocabulary	Uses slang or inappropriate vocabulary		Uses vocabulary relevant to the subject and information is readily understood by the reader	Vocabulary indicates understanding of the managerial issue
Organization	Writing lacks logical sequence, lack of linkages between concepts which causes the reader to become confused		Presents information in a logical sequence which reader can understand and easily follow	Definite flow of information with focus and linkage of sections/ information
Writing Mechanics	Frequent grammar errors and/or misspellings		Less than 2 grammar error and/or misspellings	Free of grammatical errors and misspellings
Depth of Discussion	Few of the issues, recommendations and/or explanations are supported		Most of the issues, recommendations and/or explanations are relevant and supported	All issues, recommendations and/or explanations are well integrated, relevant, and supported

Score Range: 4 - 20

Evaluation of score:

1. Below expectations: 10 or less
2. Meets expectations: 11 to 14
3. Exceeds expectations: 15 or higher

Oral Communication Rubric

Criteria	Does not meet expectations	Meets Expectations		Exceeds Expectations
	Score: 1	2	Score: 3	4
Organization	Lacks logical sequence, may jump around and/or lose focus		Presents information in a logical sequence which audience can understand and easily follow	Presents information that indicates understanding of the need to gain attention, keep attention and enhance the audience's understanding Focus and linking of sections/information is easily followed by the audience
Use of vocabulary	Uses slang or inappropriate words		Uses appropriate vocabulary /grammar	Vocabulary indicates knowledge and understanding of the business issues
Eye contact	Has minimum/excessive/ no eye contact with the audience to the point that the audience is distracted		Maintains and manages eye contact with audience the majority of the time	Maintains and manages eye contact with total audience throughout the presentation
Elocution	Mumbles; frequently uses words or sounds, such as "uhs," "like", "you know"; words are mispronounced		Voice is easily understood, delivery is mostly clear and natural without many inappropriate words such as: "uhs," "like", "you know"	Voice is understandable to all audience, degree of inflection is appropriate
Mannerisms	Frequently demonstrates distracting mannerisms, such as bad		Displays no or minimal distracting mannerisms	Uses body language effectively and naturally to maintain audience's interest

	posture, shifting of feet, jingling of coins etc.				
Presentation of Information	Reads information or appears to be uncomfortable with the information		Refers to notes or presentation material minimally		Speaks with no referring to notes

Range: 6 - 30

Evaluation of score:

1. Below expectations: 15 or below
2. Meets expectations: 16 – 21
3. Exceeds expectations: 22 or higher

Creative Problem Solving Rubric

Criteria	Does not meet expectations Score: 1		Meets Expectations Score: 3		Exceeds Expectations Score: 5	
	2	4	4	5		
Understanding of the problem	Fails to provide sufficient information to indicate an understanding of the chosen problem		Provides sufficient information that indicates an understanding of the problem		Identifies multiple elements of the problem and elaborates on the problem in ways that show insights beyond the stated situation	
Analysis of the problem	Does not include all relevant components of the situation and shows little understanding of the complexity of the problem		Identifies all relevant components of the given situation and demonstrates an understanding of the complexity of the problem		Identifies components of the situation that are beyond the given information and identifies unanswered questions that are of consequence to the solution	
Development of solution	Solution to the problem is a minor change to the current situation or not likely to be perceived as being implemented as a solution to the problem		Response has the potential for being implemented as a solution to the problem and reflects a solution that is not currently being used		Response transforms the assumptions of the situation and is successfully implemented as a solution to the problem	

Range: 3 - 15

Evaluation of score:

1. Below expectations: 7 or less
2. Meets expectations: 8 to 10
3. Exceeds expectations: 11 or higher

Critical Thinking Rubric

Criteria	Does Not Meet Expectations Score: 1	2	Meets Expectations Score: 3	4	Exceeds Expectation Score: 5
Problem Quality	Not rigorous		Satisfactory		Rigorous
Requirements Gathering	Does not identify appropriate requirements or includes irrelevant information		Identifies minimal relevant requirements that are necessary for solving the problem		Identifies all relevant requirements that are necessary for solving the problem
Requirements Organization	Fails to correctly arrange information to indicate understanding of the problem		Orders information that indicates understanding of information to utilize in decision making		Organizes information that clearly indicates understanding of the information's priority to the decision making process and clearly shows dependencies between the requirements
Proper Evaluation	Fails to correctly provide an acceptable software solution to the problem		Provides an acceptable software solution to the problem		The software solution addresses all aspects of the problem

Range: 4 - 20

Evaluation of score:

1. Below expectations: 10 or less
2. Meets expectations: 11 to 14
3. Exceeds expectations: 15 or higher