

Institutional Effectiveness
2023-2024

Program: Computer Science MS

College and Department: College of Engineering, Department of Computer Science

Contact: Gerald Gannod

Mission:

Our mission is to be widely recognized for enabling students to have a 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.

Attach Curriculum Map (Educational Programs Only):

Attached Files: See Appendix 1

PG 1: Breadth and depth of knowledge

Define Outcome:

PG 1: The student should gain a breadth of knowledge in the discipline and depth in the specific area of his/her specialization.

Assessment Methods:

Graduating GPA - Since our curriculum requires both breadth and depth, we believe a GPA of 3.5 or higher at the time of graduation demonstrates success in these areas. We will track the proportion of students with at least a 3.5 graduating each school year. Our target percentage is at least 70%. We will use this metric to evaluate not only the effectiveness of instruction, but also the quality and background of students accepted into the program, which may result in refinement of the acceptance criteria and process.

Criteria for Success (Thresholds for Assessment Methods):

The student should achieve at least a 3.25 GPA in breadth of knowledge in the discipline and a 3.5 GPA in the specific (depth) area of his/her specialization.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning, 2.A Technology Infused Programs

Results and Analysis:

	2020-2021	2021-2022	2022-2023	2023-2024
Number of graduates	17	17	21	20
% with at least 3.25 breadth	88.2%	88.2%	90.4%	80%
% with at least 3.5 depth	94.1%	88.2%	76.2%	85%

From Fall 2017 to Summer 2023, our objective was an **overall** GPA of 3.5. Over those **six** years, we were able to reach our targeted percentage of 70%. Starting with the 2023-2024 academic year, we defined a more granular objective of 3.25 breadth and 3.5 depth, which was measured by 3 key courses in each area. (We only started keeping track of this finer detail going back to 2020-2021.) For the **2023-2024** academic year, the average breadth GPA was **3.62** and the average depth GPA was **3.77**. In addition, **5** students achieved a 4.0 GPA.

Use of Results to Improve Outcomes:

Starting in Spring 2024 we implemented data collection of this information into Qualtrics. While it is taking the faculty some time to make this adjustment, we hope in the long run it will make it easier on everyone. The results indicate the students are doing well in both, but, as would be expected (as it is not their area of interest), a little worse in breadth – albeit still good. We will be getting together at the end of the summer to discuss all of our course offerings, particularly in terms of what is being taught in each of the courses.

PG 2: Graduates Will Mentor Graduate Students, Undertake Research, and Publish Their Work

Define Outcome:

PG 2: Graduates of the program, who go into academia, will mentor graduate students, undertake research, and/or publish their work in peer-reviewed journals and conferences.

Assessment Methods:

Provide evidence of former graduate students' mentoring and research

accomplishments: Students who go into academia and do research will produce various forms of accomplishments: mentor students, research, grants, publish papers, etc. To capture this information, information from these student's academic websites will be collected to include the following: number of graduate students mentored; number of external research grants as PI or co-PI; and number of peer-reviewed publications.

Criteria for Success (Thresholds for Assessment Methods):

This is the first time we have started collecting this information. As such, thresholds for each of the following will be set equal to the number of students that go into academia, which at this time is unknown (because it has never been collected in the past):

- number of graduate students mentored
- number of external research grants as PI or co-PI
- number of peer-reviewed publications

The justification for this criteria is that in academia, the success of a CS professor, at any institution requiring research, is measured in one's ability to procure grants, publish papers, and mentor graduate students. Tenure is primarily based on these metrics.

Link to 'Tech Tomorrow' Strategic Plan:

2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:

	2020-2021	2021-2022	2022-2023	2023-2024
Number in Academia	1	2	1	0
Number of graduate students mentored	15	0	0	0
Number of external grants as PI or co-PI	0	0	0	0
Number of peer-reviewed publications	7	1	1	0

This program goal was defined in 2023-2024, and thus this was the first year collecting this data. Information regarding former students was not collected until Spring 2021. The numbers in this table represent the academic year that the MS student was awarded their MS degree AND they went on to get their PhD. Thus, the “Number in Academia” represents how many in that academic year pursued the academic path (PhD) the following year, and the other 3 data points represent their known information AFTER graduation, as of 2023-2024 (i.e., not that the mentoring, grants, and publications happened the following year). It should also be noted that these were not direct-admit-to-PhD students who happened to get their MS degree along the way.

Use of Results to Improve Outcomes:

Given this is a new metric, no additional actions were taken during the planning year designed to impact performance. Our goal next year will be to determine specific goal metrics and determine a better (and easier) way to collect this data.

SLO 1: Demonstrate knowledge of techniques, methods, and disciplines

Define Outcome:

SLO 1: The student should demonstrate knowledge of the techniques, methods, and disciplines of computer science research.

Assessment Methods:

Score on Oral Defense and Thesis/Project Assessment Form –Thesis/Project presentations and reports provide evidence of student research and communication skills. At an M.S. student's defense (thesis and project only), committee and audience members submit an Oral Defense and Thesis/Project Assessment Form. These results are tabulated and stored on the MS Teams server each semester. Each area of evaluation is on a scale of 1 to 4, with 4 being excellent, 3 being good, 2 being an area that could use improvement, and 1 being a weak evaluation.

Criteria for Success (Thresholds for Assessment Methods):

We have set our desired level of attainment at 3.0 (good) for each area, as any score of 3.0 or higher is considered having attained that skill and not in need of improving.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning, 2.A Technology Infused Programs

Results and Analysis:

In order to collect more detailed data related to student learning, an Oral Defense and Thesis/Project Assessment Form was implemented in Spring 2021. A copy of the form can be found in attached Appendix 2.

Area / Average	2022-2023	2023-2024
Number of Students (reported evaluations)	12	15
Mastery of basic principles	3.80	3.86
Advanced problems in their chosen specializations	3.72	3.84
Oral presentation	3.46	3.63
Quality of written English	3.46	3.53
Technical writing content	3.32	3.27

These scores were better than the previous academic year. Given the increased publication record of our MS students (see previous section), it is not surprising that our students are getting better at presenting and writing.

Attached Files: See Appendix 2

Use of Results to Improve Outcomes:

In 2023-2024, we implemented the form in Qualtrics (as opposed to paper copies at the defense), with the hopes of making it easier for attendees to report their results. As noted, we had an increase in the number of MS students evaluated, but that could also be due to the increased numbers in our program. Our plan this year is to continue using the Qualtrics approach, but do a better job of making sure that faculty remembers to provide it to all audience members at their student's defense.

SLO 2: Progress and Graduate

Define Outcome:

SLO 2: The student should progress and graduate in a timely fashion.

Assessment Methods:

Time to degree completion - Timely graduation is important for students and for the responsible use of department resources. Students going beyond 2.5 years for their M.S. should be an exception. Note that we use the 2.5-year measure due to the fact that many graduate students defend late in their intended semester of graduation and will miss the defense deadline for graduation. As such, while a student successfully defends their thesis or project in one semester, they are listed as a graduate of the following semester. We will use this metric to determine the process for matriculating students through the program, including the clarification of key milestones and periodic demonstrations of progress.

Criteria for Success (Thresholds for Assessment Methods):

Our desired level of attainment is 80% graduating within 2.5 years. Given the diversity of students in our program (full-time, part-time, working, remote, etc.), achieving 80% should be considered noteworthy. Note that we are NOT including direct-admit PhD students who are also pursuing their M.S. degree because their timelines can be very different.

Link to 'Tech Tomorrow' Strategic Plan:

3.A Efficiency and Effectiveness

Results and Analysis:

	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Number of graduates ¹ [1]	7	10	16	11	15	19	21
% completing degree in 2.5 years or less	57.1%	100%	87.5%	81.8%	88%	100%	71.43%

Since **2017**, **16** of the **99** graduates (**15.2%**) were unable to complete the degree in 2.5 years or less. In **2023-2024**, we did not meet our goal of 80% completing in 2.5 years or less. This class was a bit different from previous MS classes as 8 of the 21 students were direct-admit-to-PhD who were getting their MSCS along the way – hence no rush to complete the MS portion of their journey.

Use of Results to Improve Outcomes:

No actions were taken during the planning year designed to impact performance. Our goal this next year is to automate more of the tracking of a student's pathway in the program, allowing for automatic notifications of deadlines (so they won't be missed, resulting in having to extend their time in the program).

Summative Evaluation:

The CSC Department has in place a framework/process for the continual improvement of the MS program to ensure its learning outcomes are met and that the outcomes are themselves updated as necessary to reflect any changes that may occur in vision, mission, or the needs of the profession and research community. Overall, except for PG2 (which is a new goal that we are still collecting metrics on) and SLO2 (which we have noted and are planning on addressing this year), we met every objective for **2023-2024**, and have shown improvement in some areas (SLO1), and there are currently no areas of concern.

Assessment Plan Changes:

Information that is regularly collected for the evaluation of program objectives and learning outcomes was outlined in the previous sections of this report. As responses to the identified results, changes implemented in **2023-2024**, or planned for **2024-2025**, are as follows.

Some students have been removed from this SLO because, as stated earlier, we are not counting direct-admit-to-PhD students who happen to get their Masters along the way, and thus their timeline is different from typical Masters students.

Create a Repository of Student Artifacts (SLO 1) While Theses are submitted and stored by the University, students create many other artifacts that demonstrate what they have learned: reports, publications, presentations, and projects. Starting in Spring 2023, we created a repository where graduate student advisors can store these artifacts. In addition, we created a new Qualtrics survey to help collect more information, including students' future plans.

Graduate Student Tracker (All) In order to better manage our growing graduate program, in the Fall of 2022, we employed a student worker to help us better track the progress and successes of our graduate students. This included e-mail reminders to students and advisors of upcoming deadlines, follow-through on the creation of advisory committees and programs of study, and tracking of exams and defenses. We continued this in the Fall of 2023, but then, in the Spring of 2024, we had a student create a new Qualtrics survey for collecting defense information that was previously done via pen and paper. Our plan this next year is to continue automating some of the manual processes (like the first ones mentioned).

Fast-Track Program While not currently tied to a specific program goal or student learning outcome, enrollment in our MS program has increased significantly. In order to increase enrollment further, the department has put additional effort into increasing the number of qualified Tennessee Tech students enrolled in our MS program. While the Fast-Track program (allowing a student to take courses as an undergraduate for graduate credit) has been in place for several years, starting in Spring 2022, we held a seminar on Fast-Track. In 2023-2024, we had over 150 students attend the six sessions that were held throughout the semesters. We also proactively contacted students (via e-mail) who met the minimum criteria for admittance into the Fast Track program, encouraging them to sign up. Our plan this next year is to continue holding the fast-track informational sessions and implement at least two fast-track "automatically selected into fast-track" campaigns.

Student Future Plans While not currently tied to a specific program goal or student learning outcome, one indirect way to evaluate the quality of our students can be through the positions that are garnered after graduating. In the Spring of 2023, at the end of every student's defense, we had them complete a survey regarding where they were going next. In addition, we sent out surveys to previous graduates, to see where they ended up being employed. In summary, by the end of the Summer of 2024, we had received 55 responses indicating a wide range of companies and organizations across a large variety of positions, broken down by destination, with 12 going into Academia, 38 going into Industry, and 5 were "unknown." One idea we will explore is a tool to automatically crawl sites like LinkedIn for our graduates.

List of Appendices:

Appendix 1: Computer Science MS Curriculum Map

Appendix 2: SLO1 Results- Oral Defense and Thesis/Project Assessment Form

Appendix 1: Computer Science MS Curriculum Map

Appendix 1: Curriculum Map

Computer Science - Master's Program

Course	Title	Student Outcomes	
		SLO1	SLO2
CSC 5100	Operating Systems	X	X
CSC 5200	Computer Networks	X	X
CSC 5220	Data Mining/Machine Learning	X	X
CSC 5240	Artificial Intelligence	X	X
CSC 5260	Advanced Data Science	X	X
CSC 5320	Computer Architecture	X	X
CSC 5400	Analysis of Algorithms	X	X
CSC 5570	IT Security	X	X
CSC 5575	Info Assurance & Cryptography	X	X
CSC 5580	Software Reverse Engineering	X	X
CSC 5585	Software and Systems Security	X	X
CSC 5760	Parallel Programming	X	X
CSC 5770	Distributed & Cloud Computing	X	X
CSC 6220	Data Mining	X	X
CSC 6230	Machine Learning	X	X
CSC 6240	Math/Theory-Machine Learning	X	X
CSC 6260	Advanced Topics in A.I.	X	X
CSC 6400	Advanced Analysis of Algorithms	X	X
CSC 6575	Internet Security	X	X
CSC 6580	Advanced Reverse Engineering	X	X
CSC 6585	Secure Software Development	X	X

CSC 6730	Advanced Networking	X	X
CSC 6740	Parallel/Distributed Algorithm	X	X
CSC 6780	Distributed Computing	X	X
CSC 6910	Computer Science Seminar	X	X
CSC 6980	Masters Project	X	X
CSC 6990	Research & Thesis	X	X

Appendix 2: SLO1 Results- Oral Defense and Thesis/Project Assessment Form

Appendix 2: Oral Defense and Thesis/Project Assessment Form

**Master of Science in Computer Science
Oral Defense and Thesis/Project Assessment Form**

Presenter's Name: _____

Committee Member: _____ Faculty: _____ Student: _____ Other: _____
(Please check one)

Date: _____

1. Each M.S. candidate is expected to demonstrate **mastery of the basic principles** of at least one of the specializations of CS. Please assess this candidate using the following scale:

- 1 - shows little or no mastery of the specialization*
- 2 - shows marginal mastery of the specialization*
- 3 - shows basic mastery of the specialization*
- 4 - shows excellent mastery of the specialization*

2. Each M.S. candidate is expected to be able to apply these basic principles to solve **advanced problems in their chosen specialization**. Please assess this candidate using the following scale:

- 1 - shows little or no ability to apply basic principles to solve advanced problems*
- 2 - shows marginal ability to apply basic principles to solve advanced problems*
- 3 - shows basic ability to apply basic principles to solve advanced problems*
- 4 - shows excellent ability to apply basic principles to solve advanced problems*

3. Graduates of the M.S. program in Computer Science will be able to communicate their ideas effectively with their technical peers and with others outside their discipline. Please assess this candidate's **oral presentation** using the following scale:

- 1 - **all** aspects of content, presentation, and responses to questions **not** at a graduate level*
- 2 - **some** aspects of content, presentation, and responses to questions **not** at a graduate level*
- 3 - **solid** content, presentation, and responses to questions at a graduate level*
- 4 - **excellent** content, presentation, and responses to questions at a graduate level*

----- Evaluation of thesis writing (if applicable) -----

4. Graduates of the M.S. program in Computer Science will display *grammatical* quality in their writing. Please assess this candidate's **quality of written English** using the following scale:

- 1 - **weak** grammatical form **throughout**; inconsistencies in voice/tense/punctuation; not at a graduate level*
- 2 - grammatical form **weak in places**; some inconsistencies in voice/tense/punctuation; needs work*
- 3 - grammatical form **solid** in most places; consistent in voice/tense/and punctuation; at a graduate level*
- 4 - **excellent** grammatical form and use of voice/tense/punctuation*

5. Graduates of the M.S. program in Computer Science will display *technical* quality in their writing. Please assess this candidate's **technical writing content** using the following scale:

*1 – **weak**, consisting of the following: poor organization; unclear problem statement/technical approach; issues with figures/tables; missing relevant references.*

*2 – **needs some work**, including some of the following: unclear organization; problem statement/technical approach need some work; some issues with figures/tables; missing some relevant references.*

*3 – **good**, consists of the following: appropriate organization; clear problem statement and technical approach; no issues with figures/tables; solid list of references.*

*4 – **excellent**, exhibiting the following: well organized, and consistently demonstrates a mastery of the proposed technical approach, including meaningful figures/tables, and relevant references.*