California State Polytechnic University, Pomona

Academic Program Review - Self-Study
College of Science
MS Computer Science

AY 2021-2022

March 22, 2022

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1 INTRODUCTION

1.1 Program Overview

The Department of Computer Science is part of the College of Science. The department offers programs leading to the B.S. in Computer Science, the Minor in Computer Science, the Minor in Data Science, and the M.S. in Computer Science. This self-study is for the AY2021-22 program review of the M.S. in Computer Science.

1.2 Mission, Vision & Values

The following provides a summary of the vision, mission and values of the university, college and department/academic program(s).

UNIVERSITY[1]	**Mission** - We cultivate success through a diverse culture of experiential learning, discovery, and innovation. **Vision** - Cal Poly Pomona will be the model for an inclusive polytechnic university that inspires creativity and innovation, embraces local and global challenges, and transforms lives. **Values** • **Academic Excellence** – We demonstrate academic quality, relevance, and excellence through our teaching, learning, scholarship, and creative activities with student centered faculty in an evidence-based culture. • **Experiential Learning** – Our polytechnic identity fosters an integrative approach to education through collaboration, discovery, learn-by-doing, and innovation. Our approach encourages reflection, informed risk-taking, and continuous learning. • **Student Learning and Success** – We are deeply committed to educational experiences and supportive services that engage our students, enhance personal well-being and growth, provide career opportunities, and foster ethical citizenship. • **Inclusive** – Our diversity across multiple dimensions reflects and enhances our community. We are welcoming and respectful, and we value diversity. • **Community Engagement** – We nurture mutually beneficial and meaningful relationships with community partners and stakeholders. • **Social and Environmental Responsibility** – As global citizens, our individual and collective actions reflect our commitment to one another, society, and the environment.

[1] Source: https://www.cpp.edu/~aboutcpp/calpolypomona-overview/mission-and-values.shtml

COLLEGE OF SCIENCE[2]	**Mission**- Educate, mentor, and inspire students through scientific inquiry and hands-on learning. **Vision**- Fostering curiosity and a culture of scientific discovery. **Values** • Curiosity • Integrity • Collaboration • Inclusivity • Innovation
Department of Computer Science	**Mission, Vision, and Values** The M.S. in Computer Science provides an opportunity for students to enhance their understanding of the principal hardware and software themes. Students learn how to analyze and formulate solutions for many advanced problems which occur in computer systems. The program stresses technical competence and encourages students in independent work and judgment.

The M.S. in Computer Science provides courses for advanced education in Computer Science and affords opportunities to conduct research. It is our objective to help students achieve a high level of professional competence and lifelong learning. Our Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the M.S. in Computer Science prepares our students to achieve. Graduates of the M.S. program in Computer Science will have an ability to:

- PEO 1: Engage in the professional practice of computing in development, research and management, with job titles such as Computer Programmer, Software Engineer, Database Administrator, Cybersecurity Analyst, Systems Analyst, Systems Programmer, Research Scientist, and Software Development Manager.
- PEO 2: Pursue further education in computing or related disciplines. Some will work in the fields of teaching and research.
- PEO 3: Engage in life-long learning in order to remain current in the computing profession, research and innovation.

The PEOs are consistent with the mission, vision, and values of the college and the university and contribute to the success of the missions.

Our Student Learning Outcomes (SLOs) are narrow statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that graduate students acquire in their matriculation through the program. Graduates of the M.S. program in Computer Science will acquire:

- SLO 1: An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.

[2] Source: https://www.cpp.edu/sci/about/

- SLO 2: An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.
- SLO 3: An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.
- SLO 4: An ability to apply a breadth of advanced knowledge and skills in applied areas of computer science.
- SLO 5: An ability to reason and problem solve to conduct independent research in the area of specialization.
- SLO 6: An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.

1.3 History

In the 2018-19 academic year, the university converted from a quarter to a semester-based curriculum. The minimum requirement for the master's degree was changed from 45 quarter units to 30 semester units.

This is our first program review for the master’s program in computer science. The feedback and recommendations from this program review will be used as important input for the improvement of the program.

1.4 Inclusive Polytechnic Education

Table 1 provides a summary of how the MS in Computer Science aligns to the elements of the Cal Poly Pomona Inclusive Polytechnic Education.

Table 1- Alignment of Program Activities to the Inclusive Polytechnic Education

Department Activity (Curricular and Co-Curricular)	Elements of Inclusive Polytechnic Education							
	Application of Knowledge	Critical Thinking & Problem Solving	Creativity, Discovery, & Innovation	Diverse & Multi-Disciplinary Perspectives	Integration of Technology	Collaborative Learning	Community & Global Engagement	Professional & Career Readiness
CS 5250 - Advanced Computer Architecture (3 units)	X	X			X			
CS 5300 - Advanced Algorithm Design and Analysis (3 units)	X	X			X			
CS 5800 - Advanced Software Engineering (3 units)	X	X			X	X		
CS 6640 - Graduate Seminar (1 unit)	X	X		X	X	X		X
CS 6910 - Directed Research (1-3 units)	X	X	X	X	X			X
CS 6950 - Master's Degree Project (1 unit)	X	X	X	X	X		X	X
CS 6960 - Master's Degree Thesis (1-3 units)	X	X	X	X	X		X	X

The M.S. in Computer Science offers four major required courses (CS5250, CS5300, CS5800, and CS6640) to help students develop their solid foundation in hardware and software design. To ensure that students receive an inclusive polytechnic education, as illustrated in Table 1, the program also offers CS6910, CS6950, and CS6960 to provide students with two options for the M.S. degree in Computer Science: the project option (1-unit of CS6910 and 1-unit of CS6950) and the thesis option (2-unit of CS6910 and 3-unit of CS6950). Furthermore, our curriculum as presented in *Appendix A*, provides students with elective courses to obtain a breadth of advanced knowledge and skills in a wide range of computer science fields, including but not limited to Computer Theory and Algorithms, Cyber Security and Operations, Computer Communication Networks, Robotics, Data Science and Artificial Intelligence, Software Engineering, High-Performance Computing, Human-Computer Interaction, and Special Topics for Graduate Students.

In addition to curricular activities, students are encouraged to participate in extra-curricular activities such as joining student club seminars, publishing papers with their faculty advisors, and attending conferences or symposiums to present their research work.

1.5 Credit Hour

As of July 1, 2011 federal law (Title 34, Code of Federal Regulations, sections 600.2 and 600.4) requires all accredited institutions to comply with the federal definition of the credit hour. For all CSU degree programs and courses bearing academic credit, the "credit hour" is defined as "the amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates not less than:

- *One hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or*
- *At least an equivalent amount of work as required in paragraph (1) of this definition for other academic activities as established by the institution, including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours."*

A credit hour is assumed to be a 50-minute period. In courses in which "seat time" does not apply, a credit hour may be measured by an equivalent amount of work, as demonstrated by student achievement.

The program has three graduate-level courses that do not meet in the traditional face-to-face classroom setting, which are “CS 6910 Directed Research”, “CS 6950 Master's Degree Project”, and “CS 6960 Master's Degree Thesis". These courses are designed to provide students with two culminating experience options for the M.S. degree in Computer Science.

When students take at least 1 unit of CS 6910 for the project option or 2 units of CS 6910 for the thesis option, they work closely with their research faculty advisor to conduct individual research in a specialized area. Throughout the semester, they need to spend at least three hours per week working on their project or at least six hours per week on their thesis. The faculty advisors meet with supervised students weekly to discuss their research and creative work. Concurrently, the student should form a project committee in consultation with their research faculty advisor (their research faculty advisor and 1 additional committee member) or a thesis committee (their research faculty advisor and 2 additional committee members). By the end of CS 6910 course, students need to present a project or thesis proposal to the committee and get approval with a letter grade from their faculty advisor. All of their committee members read the proposal and sign a “CS6950/6960 Course Approval Form” as well. Students need to submit the completed approval form to the CS Department Office no later than the 5th day of instruction of the semester in which a CS 6950 (project) or CS 6960 (thesis) course is requested. This approval form provides an intermediate verification and clarification of information for the CS Department Office to create the CS6950 or CS6960 course for students to register.

After students register for their CS6950 or CS6960 course, they work with their project or thesis committee on their research work. Specifically, in “CS 6950 Master's Degree Project”, students conduct independent work on practical application of an existing methodology or procedure under

supervision of a project advisor. They need to spend at least three hours per week working on their project. In “CS 6960 Master's Degree Thesis”, students perform an independent investigation intended to be an extension of an existing body of knowledge. They need to spend at least nine hours per week to advance their progress for a thesis. In both CS6950 and CS6960, the research faculty advisors meet with supervised students weekly to monitor their research progress and ensure they are on track to complete their research successfully. By the end of the course, students make an oral presentation and write the project/thesis report in an acceptable form to report research results. Credit is assigned upon successful completion of the thesis/project and oral presentation. The final version of the thesis/project report is reviewed and approved for formatting by the library for preservation.

2 PROGRAM QUALITY

2.1 Student Profile at Admission and Enrollment

Table 2 presents admission trends of new students for each of the past five fall semesters (Fall 2015 – Fall 2020), which were compiled using data requested from the Office of Academic Research and Resources. Some of the data may be missing due to students not reporting information or because we were not able to locate it.

Table 2 – Admission trends[3]

	Fall 2020	Fall 2019	Fall 2018	Fall 2017	Fall 2016
Applied	**194**	**124**	**184**	**169**	**180**
Gender					
Male	157	92	138	130	133
Female	37	32	46	39	47
Not Reported	0	0	0	0	0
URM Status					
URM	6	0	2	4	3
Non-URM	36	11	18	21	26
Not Reported	152	113	164	144	151
1st Generation Status					
1st Generation	15	3	7	12	12
Not 1st Generation	19	5	12	11	13
Not Reported	160	116	165	146	155
Admitted	**107**	**46**	**66**	**64**	**64**
Gender					
Male	90	31	49	46	44
Female	17	15	17	18	20
Not Reported	0	0	0	0	0
URM Status					
URM	6	0	2	4	3
Non-URM	36	11	18	21	26
Not Reported	65	35	46	39	35
1st Generation Status					
1st Generation	15	3	7	12	12
Not 1st Generation	19	5	12	11	13
Not Reported	73	38	47	41	39
Enrolled	**41**	**11**	**19**	**21**	**24**
Gender					
Male	34		15	18	20
Female	7		4	3	4
Not Reported	0		0	0	0
URM Status					
URM	6		1	3	3
Non-URM	35		18	18	21
Not Reported	0		0	0	0
1st Generation Status					
1st Generation	15		6	10	10
Not 1st Generation	18		12	10	11
Not Reported	8		1	1	3

*Note: Students who did not report their demographics are counted as "Not Reported". If a cohort has less than 15 students a breakdown was not provided.

[3] ARAR Office data request

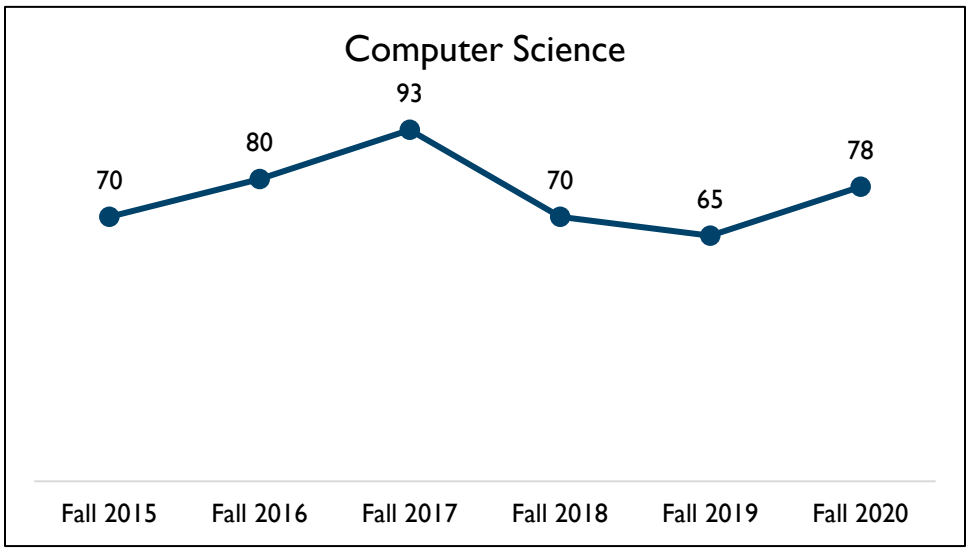

Figure 1 – Student Enrollment [4]

Figure 1 shows the numbers of enrolled graduate students for the past five fall semesters (Fall 2015 – Fall 2020). We can see the number of applications and enrollments were pretty consistent for the past few years except for Fall 2019, which may be caused by the requirements of unconditional admission for all international students. The M.S. program in Computer Science is based on the presumption that students have an undergraduate degree with a major in computer science, or equivalent coursework in the principal computer science and mathematics subjects required for such an undergraduate degree. Students without such preparation cannot be admitted.

The graduate coordinator and other CS faculty members actively provide invited talks and hold information sessions at CS undergraduate program clubs at Cal Poly Pomona such as Computer Science Society (ACM student chapter) and SheCodes (ACM-W student chapter). Such events attract many of our current BS students to pursue the MS degree. Also, many of our BS graduates work at local defense contractors such as NASA JPL, Boeing, Raytheon, and Northrop Grumman and come back to pursue the MS degree as part-time student after 2-3 years as these employers highly value the hands-on training that CPP CS program provides.

To support enrollment, the program offers

- Afternoon or Evening classes with a wide range of topics in computer science to attract working professionals.
- Core knowledge of advanced computer architecture, algorithm design and analysis, and software engineering that apply computational theory to the design of software systems.
- Flexible curriculum for students to create their own track by choosing courses that fit their interests.
- Graduate seminar that keeps students apprised of the latest computer science research.
- Learn by doing through the process of MS project/thesis work.

[4] Source: Tableau Enrollment Headcount Dashboard
https://analytics.cpp.edu/#/site/production/views/EnrollmentDashboard/HeadcountFTES?:iid=1

- Directed study and thesis to demonstrate the ability to identify, formulate and solve problems within the discipline.
- State-of-the-art classes such as Big Data, Data Science, Cloud Computing, AR/VR, and Cyber are introduced by the faculty members.
- Students have the flexibility to choose a more coursework option (Project) or a more research option (Thesis).

2.2 Curriculum and Pedagogy

As presented in *Appendix A*, the M.S. program in Computer Science at California State Polytechnic University, Pomona offers four major required courses to help students develop their solid foundation in hardware and software design. The program also offers a wide variety of elective courses designed to enable students to obtain a breadth of advanced knowledge and skills in many computer-science fields. All graduate students must conduct a research or project under the supervision of a faculty advisor. Students have the option of culminating their degree by completing either a master project (2 units) or a master thesis (5 units). In particular, a student under the master project option must complete at least 1 unit of CS6910 and 1 unit of CS6950, while the master thesis option requires the completion of at least 2 units of CS6910 and 3 units of CS6960.

Please note that our curriculum changed from 45 quarter units to 30 semester units, due to semester conversion in AY2018-19. Moreover, due to the disruptions of Covid-19, we moved to a temporary virtual instruction mode in the middle of Spring 2020. This sudden shift to online teaching was challenging for students and faculty. Thanks to the amazing training sessions about remote teaching provided through the Center for the Advancement of Faculty Excellence (CAFE) at Cal Poly Pomona, our faculty members were able to adapt quickly to online teaching and continuously provide students with advanced course work in a wide range of computer science fields. We are starting back to in-person instruction in Spring 2022.

Curriculum Comparison
Appendix A, Appendix B, and *Appendix C* present the curriculum of the M.S. programs in Computer Science at *California State Polytechnic University, Pomona*, *California State University Los Angeles*, and *California State University, Fullerton*, respectively. All these M.S. programs require the same number of semester units, with a flexible curriculum of many advanced topics for students to create their own track by choosing courses that fit their interests.

In the M.S. program at Cal Poly Pomona, graduate courses are usually offered in either afternoon or evening to accommodate the schedules of working graduate students. The program requires 10 units of major-required courses (CS5250, CS5300, CS5800, and CS6640) for graduate students to complete. Students then need to complete either 15 or 18 units of electives depending on their thesis/project option. Those courses are specially designed to help our graduate students enhance their core knowledge of advanced computer architecture, algorithm design and analysis, and software engineering that apply computational theory to the design of software systems. Furthermore, we have consistently strived to offer a wide range of elective courses and integrate latest computer science research into classroom, with the goal of helping our students obtain a breadth of advanced knowledge and skills and project-based experience through “learning by doing” in the computer science fields of their interest.

The M.S. program at CSULA requires 6 units in each of the following areas: software design and implementation, system infrastructure, and computing in the world. Students then need to

complete either 12 units of electives with a comprehensive exam or 6 units of electives with the Thesis option.

The M.S. program at CSU Fullerton also provides a relatively flexible curriculum. Students need to complete 9 units of required electives with 3 units in each of the following areas: computer applications, computer systems, software engineering, and theoretical computer science. They then need to complete 15 units of electives. All students are required to complete either a project or thesis to graduate.

2.3 Student Retention and Graduation Rates – Graduation Initiative 2025

Table 3 shows the cumulative continuation and graduation rates of first-time students, which were obtained from Cal Poly Pomona's Institutional Research, Planning and Analytics.

Table 3 – Cumulative Graduation & Continuation Rates by Percentage[5]

Year	Cohort Headcount	Cumulative Graduation & Continuation Rates							
		Within 1 Year		Within 2 Years		Within 3 Years		Within 4 Years	
		Cont.	Grad.	Cont.	Grad.	Cont.	Grad.	Cont.	Grad.
Fall 2005	7	71.4%	0.0%	28.6%	14.3%	14.3%	28.6%	0.0%	42.9%
Fall 2006	8	75.0%	0.0%	50.0%	12.5%	37.5%	25.0%	12.5%	62.5%
Fall 2007	11	63.6%	0.0%	63.6%	0.0%	9.1%	54.5%	9.1%	54.5%
Fall 2008	18	72.2%	0.0%	44.4%	22.2%	16.7%	44.4%	16.7%	44.4%
Fall 2009	11	72.7%	9.1%	45.5%	27.3%	9.1%	54.5%	0.0%	63.6%
Fall 2010	30	70.0%	6.7%	50.0%	20.0%	23.3%	40.0%	6.7%	53.3%
Fall 2011	15	60.0%	0.0%	46.7%	13.3%	6.7%	40.0%	0.0%	46.7%
Fall 2012	12	100.0%	0.0%	58.3%	33.3%	16.7%	66.7%	8.3%	83.3%
Fall 2013	20	75.0%	0.0%	60.0%	5.0%	25.0%	40.0%	5.0%	60.0%
Fall 2014	19	84.2%	5.3%	31.6%	42.1%	0.0%	57.9%	0.0%	57.9%
Fall 2015	17	82.4%	0.0%	76.5%	5.9%	23.5%	58.8%	5.9%	64.7%
Fall 2016	26	100.0%	0.0%	46.2%	50.0%	7.7%	80.8%	11.5%	80.8%
Fall 2017	21	76.2%	4.8%	57.1%	28.6%	4.8%	76.2%		
Fall 2018	19	94.7%	0.0%	42.1%	42.1%				
Fall 2019	10	90.0%	0.0%						
Fall 2020	41								

To improve student persistence and graduation rates, we have made the following efforts,

- One week before the class starts in each semester, the department offers a dedicated MS program orientation for incoming students. This orientation complements the university graduate studies program orientation that introduces generic graduate program policies to incoming students. In the CS department program orientation, the students are introduced to the curriculum, plan of study ("MS contract"), CS specific program policies, repository of program paperwork and planning process for their project or thesis. The orientation also includes research introductory presentations from CS faculty members to provide an overview of the MS project or thesis topics available for the students to pursue.
- After the orientation, all new graduate students must consult and receive approval from the graduate coordinator before registering courses for their first semester. If meeting is

[5] Source: IRPA data request for Continuation and Graduation Rates

necessary, the graduate coordinator will meet with students to prepare a study list that will define all courses and other requirements for culminating experience and graduation. The graduate coordinator is also available during either office hours or by appointment.

- Computer Science graduate courses are, in general, offered on a routine schedule. The required courses CS 5250, CS 5300, CS 5800 and CS 6640 are offered every year. All other graduate courses CS 5xxx are offered every two years. Project and thesis courses CS 69x0 are offered on-demand to ensure timely graduation for students.
- Graduate courses traditionally meet in late afternoons and evenings for students who may have to work during the day.

2.4 Assessment of Student Learning

Tables 4-7 present a curriculum matrix, an alignment matrix, an assessment plan, and an assessment data collection timeline of the MS program in Computer Science at Cal Poly Pomona, respectively, which we are proposing to implement.

Table 4 – Curriculum Matrix

(I = Introduction, D = Development, M = Mastery, X = Assessment Data to Be Collected)

Student Learning Outcome	Course Number																												
	CS5100	CS5170	CS5180	CS5190	CS5210	CS5220	CS5250	CS5300	CS5310	CS5350	CS5370	CS5400	CS5500	CS5550	CS5650	CS5660	CS5700	CS5750	CS5800	CS5850	CS5860	CS5990	CS6640	CS6910	CS6940	CS6950	CS6960
SLO 1: An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.	I			I		D	D	D X	D	D	D			D	D	D	D		D		D	D	D	D	M	M	M
SLO 2: An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.	I	I	I		D		D X	D		D	D	D		D	D	D	D		D			D	D			M	M
SLO 3: An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.		I	I	I	I	D		D		D		D			D			D	M X	M						M	
SLO 4: An ability to apply a breadth of advanced knowledge and skills in applied areas of computer science.	I	I	I	I	I					D				D			M		M X				M				
SLO 5: An ability to reason and problem solve to conduct independent research in the area of specialization.			I	I	I	D				D		D		D	D	D				D	D			M	M	M X	M X
SLO 6: An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.	I	I	I		I									D	D	D	D		D	D	D	D	D X	M	M	M	M

Table 5 – Alignment Matrix

Student Learning Outcome	Program Educational Outcomes			Graduate Institutional Learning Outcomes				Strategic Vision		
	PEO 1	PEO 2	PEO 3	GILO1	GILO2	GILO3	GILO4	Innovation and Creativity	Civic Engagement	Problem Solving
SLO 1 An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.	X					X				X
SLO 2. An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.	X					X				X
SLO 3. An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.	X					X				X
SLO 4. An ability to apply a breadth of advanced knowledge and skills in applied areas of computer science.	X		X		X					X
SLO 5. An ability to reason and problem solve to conduct independent research in the area of specialization.	X	X	X		X		X	X	X	X
SLO6 An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.	X	X	X	X					X	

Cal Poly Pomona's Graduate Institutional Learning Outcomes (GILOs)

GILO 1	Communications: Excel in written and oral communication, with the ability to convey complex ideas clearly, consistently, and logically.
GILO 2	Information Literacy: Evaluate the validity and comparative worth of diverse information sources related to the relevant discipline.
GILO 3	Evaluation of Theories: Evaluate the major theories and approaches to inquiry specific to the discipline.
GILO 4	Scholarship and Creative Activities: Utilize research and/or scholarship to achieve a relevant product consistent with disciplinary ethics and standards.

The Department of Computer Science's Program Educational Objectives (PEOs)

PEO 1	Engage in the professional practice of computing in development, research and management, with job titles such as Computer Programmer, Software Engineer, Database Administrator, Cybersecurity Analyst, Systems Analyst, Systems Programmer, Research Scientist, and Software Development Manager.
PEO 2	Pursue further education in computing or related disciplines. Some will work in the fields of teaching and research.
PEO 3	Engage in life-long learning in order to remain current in the computing profession, research and innovation.

Table 6 – Overall Assessment Plan

PEO/SLO Alignment	*SLOs*	*Courses where each SLO is addressed.*	*Assessment activity (signature assignment) used to measure each SLO.*	*Assessment tool used to measure outcome success*	*How assessment data will be reported as evidence SLO performance criteria have been met*	*Designated personnel to collect, analyze, and interpret student learning outcome data for the program*	*Student learning outcome data dissemination schedule*	*Closing the loop strategies*
PEO 1	*SLO 1. An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.*	*CS 5300 / CS 5310 / CS 5350 / CS 5370*	*Project/Assignment in CS5300*	*A pool of performance indicator assignments/projects/presentation (score-based) is provided to instructors.*	*For each SLO, the number of artifacts, the number (and percentage) of students that achieves each category in the rubrics will be reported.*	*Course instructors (usually tenured, tenure-track faculty) collect the data.* *Assessment Committee summarizes, analyzes and presents to Department.*	*Once every year, assessment committee prepares an annual assessment report to Department, which includes the direct assessment data for SLOs, and indirect assessment (surveys) data collected during the academic year. Once every three years, all 6 SLOs are completely assessed.*	*After Department receives assessment report, in a department meeting, an improvement plan will be discussed and approved by the department. The improvement plan will be then implemented.*
PEO 1	*SLO 2. An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.*	*CS 5250 / CS 5650 / CS 5660*	*Project/Problem in test assigned in CS5250*					
PEO 1	*SLO 3. An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.*	*CS 5800 / CS 5300 / CS 5400 / CS 5850 / CS 5750*	*Project assigned in CS5800*					
PEO 1, 2	*SLO 4. An ability to apply a breadth of advanced knowledge and skills in applied areas of computer science.*	*CS 5800 / CS 5550 / CS 5210 / CS 5190 / CS 5170 / CS 5700 / CS 5100*	*Project assigned in CS5800*					
PEO 2, 3	*SLO 5. An ability to reason and problem solve to conduct independent research in the area of specialization.*	*CS 6910 / CS 6950 / CS 6960 / CS 6640*	*Master Thesis/Project report and defense in CS6950 or CS6960*					
PEO 1, 2, 3	*SLO6. An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.*	*CS 6640 / CS 6910 / CS 6950/6960*	*Presentation/Paper assigned in CS6640*					

Table 7 – Assessment Data Collection Timeline

Student Learning Outcome	Academic Year		
	AY 22-23	AY 23-24	AY 24-25
SLO 1. An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.	Direct data collected from CS5300; Graduating student survey		
SLO 2. An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.	Direct data collected from CS5250; Graduating student survey		
SLO 3. An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.		Direct data collected from CS5800 Graduating student survey	
SLO 4. An ability to apply a breadth of advanced knowledge and skills in applied areas of computer science.		Direct data collected from CS5800 Graduating student survey	
SLO 5. An ability to reason and problem solve to conduct independent research in the area of specialization.		Alumni survey and/or Industry Advisory Board survey	Direct data collected from CS6950 (project defense) or CS6960 (thesis defense); Graduating student survey,
SLO6. An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.		Alumni survey and/or Industry Advisory Board survey	Direct data collected from CS6640; Graduating student survey,

We are currently working on developing a new assessment plan for the M.S. program in Computer Science, as shown in Tables 4 to 7. To assess the attainment of student learning outcomes, the new plan presents a three-year assessment cycle to systematically collect direct and indirect assessment data through several courses and surveys. As proposed in Table 6, we plan to have

- Direct assessment data collected by instructors
    - CS5300 for SLO 1
    - CS5250 for SLO 2
    - CS5800 for SLO3 and SLO4
    - CS6950 and/or CS6960 for SLO5
    - CS6640 for SLO6
- Indirect assessment data collected from graduate students, alumni graduates, and/or industry employers
    - Graduating Student Survey for all SLOs
    - Alumni Survey and/or Industry Advisory Board survey for all SLOs

The department will discuss and improve the proposed assessment plan based on feedback from this program review.

2.5 Student Support, Satisfaction and Services

2.5.1 Co-Curricular

All graduate students need to either complete a master thesis or project in order to graduate. The master thesis or project is typically a one year-long research project approved by a committee of three (thesis) or two (project). All graduate students are involved in direct research with a faculty advisor. Some of them also publish papers together with the faculty and attend conferences to present their work.

2.5.2 Academic Advising

In the M.S. program in Computer Science, each graduate student will receive advice from two faculty advisors: a general advisor and a research advisor. Both these faculty advisors are tenured/tenure-track CS faculty members.

- The general faculty advisor is the department's graduate coordinator, who oversees all aspects of the M.S. program in Computer Science. The general advisor is responsible for pre-admission advising for prospective students, admission application review, on boarding new MS students and registration, program of study review and approval of current MS students and overseeing graduation process in co-ordination with university graduate studies office and registrar's office.
- The research faculty advisor is a tenure-track/tenured faculty member, who directs the supervised graduate student's project or thesis work in a specialized computer science area.

Unfortunately, there is no dedicated CS department staff to help with the MS program faculty advisors to better support the students. As of Spring 2022, there are 95 graduate students studying in the program. Considering the number of graduate students to serve, the department desperately needs a dedicated staff that can cumulatively improve student enrollment, retention and graduation rates.

2.5.3 Student Satisfaction

In Spring 2021, we conducted a current graduate student survey in CS6640 to collect indirect assessment data about how well the M.S. program fulfills the Student Learning Outcomes (SLOs). *Appendix D* presents a copy of the Graduating Student Survey form. Please note that it is normal to have lower scores in this category since all the students participating in the survey might not have completed the courses corresponding to all the SLOs.

The survey responses include student ratings on each SLO (rating scale from 1=poor, 2=fair, 3=good, 4=very good, to 5=excellent) and comments for the program improvement. Below shows the average rating of each SLO among all survey responses,

	SLO 1	SLO 2	SLO 3	SLO 4	SLO 5	SLO 6
Average rating	3.8	3.4	3.6	3.6	3.9	3.9

Based on the feedback from this survey, the department will investigate ways to improve student attainment of the SLOs. For example, SLO 2 has a relatively low score. We can look into how to improve this SLO. Strategies for establishing effective communication with students and promoting graduate courses and research projects to help students gain practical knowledge and skills are being considered.

2.6 Stakeholders

We collected the alumni survey data at the beginning of Fall 2021. *Appendix E* shows a copy of the Alumni Survey form. Below shows the average rating of each SLO among all survey responses,

	SLO 1	SLO 2	SLO 3	SLO 4	SLO 5	SLO 6
Average Score	4.1	4.4	3.8	4.2	4.2	4.2

The survey data illustrates that student achievement on the SLO3 is relatively low and needs to be improved. The department will work with faculty members to design more hands-on, applied projects/courses for students to improve their practical, problem-solving skills in computer science.

3 FACULTY

3.1 Overview of Faculty

Figures 2 to 5 provide data over 5 years on the historical Full Time Equivalent-Faculty, Full Time Equivalent-Student, Student to Faculty Ratio, and Major to Faculty Ratio, respectively. Please note that the data for the following contains information for **both undergraduate and graduate programs**. Figure 5 provides some details by degradation of the faculty to undergraduate major ratio.

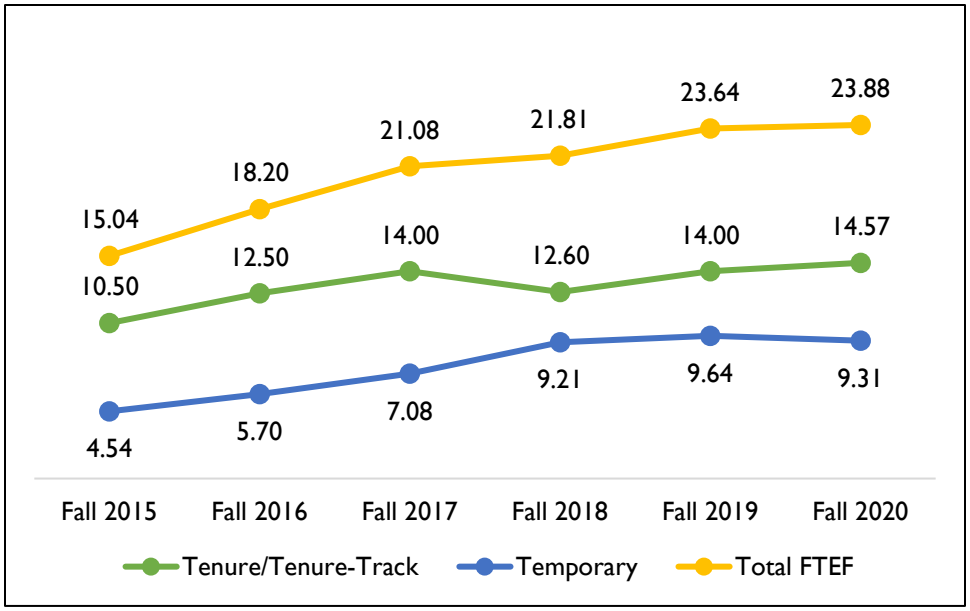

Figure 2 – Full Time Equivalent-Faculty (FTE-F)[6]

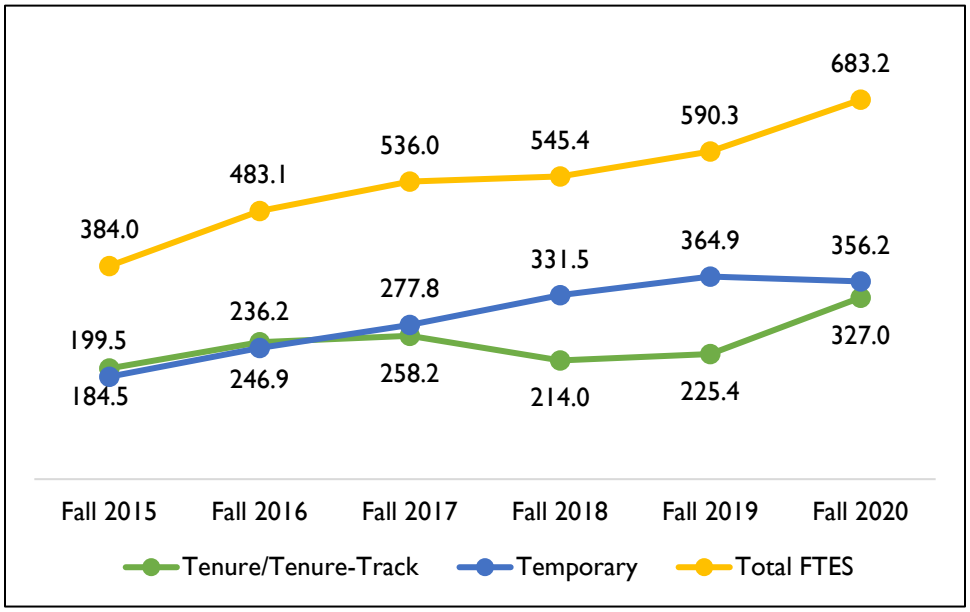

Figure 3 – Full Time Equivalent-Student (FTE-S)[7]

[6] ARAR "FTE-Faculty with Status Detail Tenure-Track and Temporary Faculty", Falls 2011-2020 Report https://www.cpp.edu/arar/campus-data/fte_faculty_with_status_detail-tenured_tenure-line_and_temporary_faculty_falls_2011_to_2020.pdf

[7] ARAR "FTE-Faculty with Status Detail Tenure-Track and Temporary Faculty", Falls 2011-2020 Report https://www.cpp.edu/arar/campus-data/fte_taught_with_percentages_by_tenure-line_and_temporary_faculty_falls_2011_to_2020.pdf

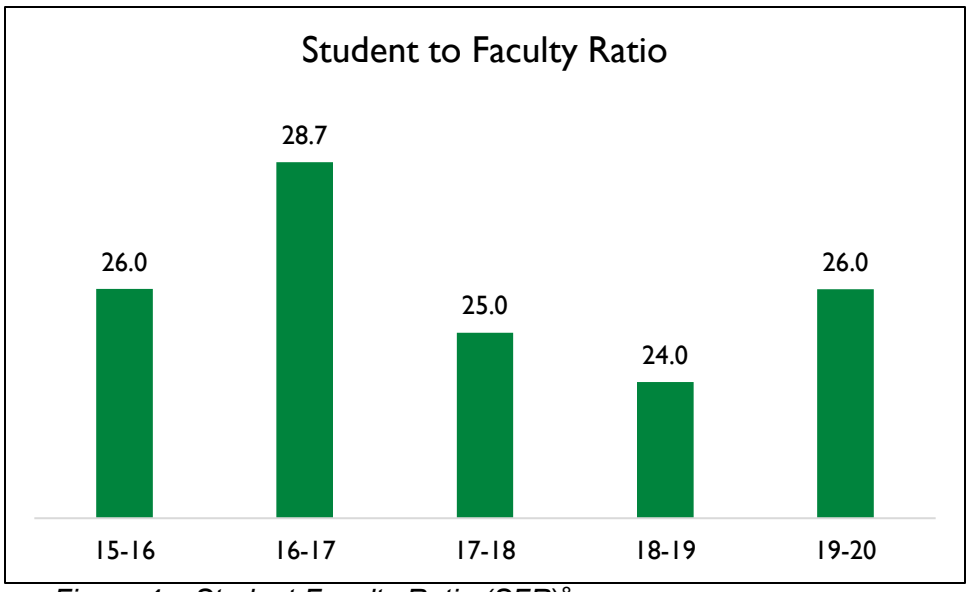

Figure 4 – Student Faculty Ratio (SFR)[8]

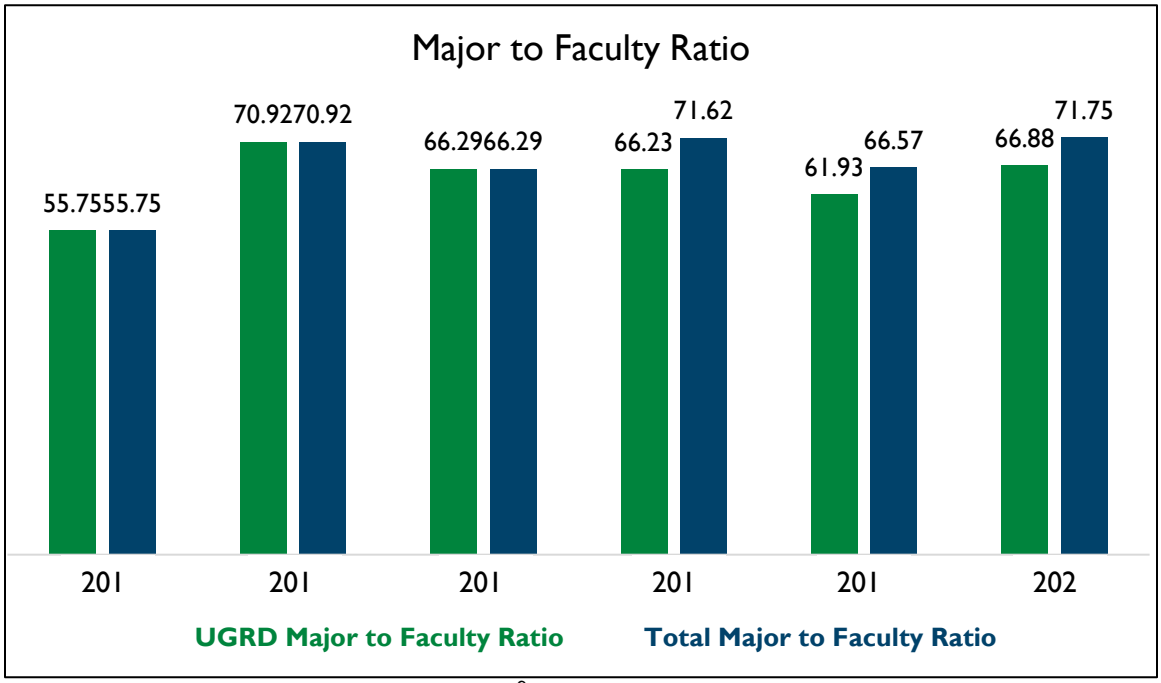

Figure 5 - Major to Faculty Ratio (MFR)[9]

*Note: 2015-2017 are for undergraduate only since that was the only data collected for those years.

[8] ARAR "Student Faculty Ratio (SFR)" Report https://www.cpp.edu/~arar/campus-data/student-faculty-ratio.shtml

[9] ARAR "Major to Faculty Ratio", Falls 2011-2020 Report https://www.cpp.edu/arar/campus-data/major_to_faculty_ratio_falls_2011_to_2020.pdf

At the time of this program review, we have 15 tenure/tenure track faculty: 14 full-time, and .3 for the chair. All tenure-track faculty have Ph.D.s. In the 2020-21 academic year, we had 18 part-time lecturers. We have a very well qualified lecturer pool: 2 have Ph.D.s, 2 are ABD, the others have their masters. Some of our faculty have extensive industry experience.

The primary disciplinary areas of faculty within our program are cyber security and operations, cloud computing, mobile computing, software entrepreneurship, wireless communication networks, machine learning, data mining, high-performance computing, robotics, human-computer interaction, 3D game programming, and data science.

Our graduate courses are mostly taught by tenure-line faculty except for CS 5250 (usually taught by a lecturer with a Ph.D. degree) and CS 5300 (occasionally taught by a lecturer ABD when a tenure-line is not available). We do not have teaching assistants. Some of our undergraduate courses with large enrollments (>71) are provided with graders. Graduate students can serve as a good resource for graders for our undergraduate classes.

Our capacity to grow should be supported by continuous hiring of tenure-line faculty and consistent grader support. As demand for computer science majors increases, we are experiencing CS courses that are fully enrolled with a long waitlist of students expressing interest. We are working on hiring two new faculty members, which could help the department offer more courses/sections for students to select from and accommodate more students for timely graduation in the M.S. program in computer science.

3.2 Faculty Support

The department faculty members are actively engaged in professional development. The department frequently supports faculty members for their travel expenses to conferences and workshops. The department also encourages faculty to apply for internal/external funding opportunities for faculty professional development, such as the Research, Scholarship, and Creative Activity Program (RSCA), the Provost's Teacher-Scholar Support Program, and the Strategic Interdisciplinary Research Grant Program (SIRG).

We conducted a faculty satisfactory survey for program review in the CS department at the beginning of Fall 2021. The following lists some primary improvements that the department faculty are hoping to take place

- reduced teaching workload so that faculty can spend more time focusing on scholarship and creative activities with students
- more grader/TAs support for CS courses
- a dedicated staff that can cumulatively improve student enrollment, retention and graduation rates
- more internal funding support for faculty research with mentored students
- more physical space for teaching and research activities

4 UNIVERSITY SUPPORT AND RESOURCES

4.1 Personnel

The department has only one full-time administrative assistants - administrative support coordinator (ASC) who oversees the operation of the office. We also have some part-time student assistants to help with the front desk and answer general questions addressed to Computer Science and Masters in Computer Science email accounts. ASC helps with more high-level tasks such as course scheduling, hiring of student assistants/graders, event scheduling, purchasing office supplies, handling issues related to student registration, processing various paperwork for students and faculty alike and making sure all postings (i.e., schedule, Dean's list office hour, etc.) are accurate and up to date. Student assistants answer phones and basic questions from students, faculty, and anyone else who might come into the office. They also assist ASC in her everyday job duties.

We do see an urgent need for a permanent administrative support assistant (ASA) as student assistants can only work part time and there needs to be constant trainings for new assistants. We also need to have someone who can access student data and better support the department office. Adequate staff support is essential for student success and growth of the department.

4.2 Facilities and Space

The department has four classrooms and two labs to schedule regular sessions. Some larger classrooms (>70) can also be requested centrally through the university. Each of the classrooms is a "smart classroom", including whiteboards, a multimedia podium, a ceiling-mounted projector, and a screen. The multimedia podium includes a computer, a document camera (for projecting from paper originals), a DVD player, and an input for a laptop. Any of these information sources can be projected onto the screen. We also have two laptop carts with a total of 48 laptops for the classrooms. This allows the students to have access to computers in the traditional classroom setting.

We have two teaching laboratories, one open Software Engineering Laboratory, and two mobile laptop carts:

- Windows Workstation Laboratory
    - 36 individual seats for students and an instructor station
    - Dual-boot (Windows 10 / CentOS 7) Intel i7 processor

- Software Engineering Laboratory
    - 10 group tables for students' teamwork and an instructor station
    - 14 GPU workstations (Windows 10 / i7 processor / Nvidia RTX 2070) for VR/AR projects/classes
    - 20 Dual-boot (Windows 10 / CentOS 7) Intel i7 processor

- Linux Laboratory
    - 36 individual seats for students and an instructor station
    - Dual-boot (Windows 10 / CentOS 7) Intel i7 processor

- Two mobile laptop carts (secured in regular classrooms)
    - One with 36 devices and the other with 18 devices
    - Dual-boot (Windows 10 / Ubuntu 18.04) Intel i5 processor

Much of the computing infrastructure used by the program (e.g., networking, file storage, web publishing) is provided by the Division of Information Technology & Institutional Planning (IT), and funded by the university. Since this is the same centrally-provided computing environment that provides campus email, access to student records, administrative data, and wi-fi, it is assured of continued funding and support.

The department classroom laboratories consist primarily of client workstations with office productivity and software development applications installed, which are used to access centrally-provided services. The department's equipment budget has been adequate for this purpose. All the computers in the labs are usually refreshed on a 4-year cycle. During Summer 2018, all the computers in the Software Engineering Laboratory were replaced, and laptops were also installed for the laptop carts placed in 8-302 and 8-345. During Summer 2019, all computers in the Windows Workstation Laboratory and the Linux Laboratory were replaced. During Fall 2019, new GPU workstations were installed in the Software Engineering Laboratory for the AR/VR projects/classes. Additionally, we also installed new computing desks for 3-2636 in Summer 2018.

In addition to the teaching laboratories mentioned above, the computer science department has 3 research laboratory spaces shared by multiple faculty members. In particular,

- The Data Science Hub (https://www.cpp.edu/sci/ds/index.shtml) led by CS Data Science cluster faculty members provides learning and research opportunities in broader Data Science area such as Big data security and privacy, Hearth informatics, Social network analysis and parallel and distributed frameworks for Big data analysis.
- Intelligent Robotics Lab led by Dr. Tang supports research and teaching in robotics and artificial intelligence. Her research is focused on multi-robot systems, unmanned systems, machine learning and educational robotics. This lab is currently equipped with Lego Mindstorm EV 3 robots, Husky UGV, Boston Dynamics robots, iRobot Create with several specialized sensors (URG lidar, webcams) that provide a reasonable set of sensors and motors for both research and teaching.
- The Computational Intelligence Lab led by Dr. Ji supports research and teaching in data intelligence and high-performance computing. The lab is currently equipped with a multi-camera array and depth sensors for capturing 3D image data and GPU workstations for efficient data processing and mining.
- The Human-centered, Adaptive, and Personalized Information Interaction Lab (https://www.cpp.edu/~hapii/) led by Dr. Steichen supports research in novel solutions that aim to understand and support each individual user through Personalization. The HAPII lab uses state-of-the-art usability and user experience research equipment, including eye trackers and other physiological sensors.

- The PolySec cybersecurity lab (https://www.cpp.edu/~polysec/) led by the CS cybersecurity cluster faculty members provides research opportunities and well-balanced curriculum in information assurance, cyber security and forensics based on ACM and NSA/CSS Cyber Ops program supported by over $4M federal grants.
- The CPP Virtual Reality lab (https://www.cppvr.org/dat) led by Dr. Husain supports teaching and research in state-of-the-art VR/AR technologies. The lab is equipped with Holo Lens, Oculus Rift, HTC Vibe and TPCAST.

We installed new computing desks and projector for 3-2642 research lab in Summer 2019. We also renovated two other labs in Summer 2020: renovation of our Software Engineering Open Lab to facilitate better teamwork; and a new research lab for activities with secure equipment (such as robots or haptic devices), shared by multiple faculty members.

The department has a laboratory committee to discuss and make suggestions for improving the utilization of teaching and laboratory facilities.

4.3 Library

The University Library supports student learning through a wide variety of services. The Reference and Instruction Department provides assistance to students in accessing the Library's rich information resources and helps students develop information skills that not only serve their immediate research needs but also prepare them for graduate studies, careers, and lifelong learning. Librarians use a variety of methods, including course-integrated library instruction, special workshops, personal assistance in-person or via email, chat, phone, or by appointment, instructional guides, tutorials, and a FAQ.

The Circulation Desk is located on the 2nd floor of the Library and is open all hours that the Library is open. Library staff assist in renewing materials, tracking down missing materials, placing holds on materials checked out to another borrower, paying fees, and updating patron records. Other services include checking out Course Reserve materials, Document Delivery, and items from other CSU campuses.

The Computer Science Subject Librarian, Julie Shen, who is a tenured full librarian with a 1.0 time base, works with the faculty and students of the M.S. Computer Science Program. Below are some of the resources used by the librarian to support this program.

Select Journal titles
The Library provides program-supporting subscription access to key journals and conference proceedings (select titles listed below):

- ACM/IEEE International Conference on Human-Robot Interaction
- IEEE Transactions on Information Forensics and Security
- International Conference on Computer Graphics and Interactive Techniques (SIGGRAPH)
- International Conference on Database and Expert Systems Applications (DEXA)
- International Conference on Software Engineering (ICSE)
- International Journal of Intelligent Systems

- Journal of the ACM
- Journal of Machine Learning Research
- Lecture Notes in Computer Science
- Pattern Recognition

Databases
Here are some key databases used for M.S. Computer Science:
- ACM Digital Library
- Engineering Village
- IEEE Explore
- Web of Science

Other useful databases can be viewed here: https://libguides.library.cpp.edu/az.php?s=60025

Reference and Instruction Statistics
Librarians and library staff assisted students and faculty with research questions related to M.S. Computer Science during the period under review.
- 2016/17 – 3 questions
- 2017/18 – 27 questions
- 2018/19 – 9 questions
- 2019/20 – 33 questions
- 2020/21 – 43 questions

Library instruction was provided to the M.S. Computer Science program in the following ways:
- 2016/17 – 2019/20: 0 students received instruction
- 2020/21: 27 students received instruction

Library Research Tutorials Usage by M.S. Computer Science:
- 2016/17 – 10 users
- 2017/18 – 36 users
- 2018/19 – 19 users
- 2019/20 – 4 users
- 2020/21 – 1 use

Library Research Guides Usage by M.S. Computer Science:
- 2016/17 – 1329 users
- 2017/18 – 1049 users
- 2018/19 – 563 users
- 2019/20 – 406 users
- 2020/21 – 685 users

Technical Collection
The University Library has an up-to-date collection of books, mostly electronic, to support the computer science curriculum. The Library has an endowment that pays for computer science books.

Most books on computer science topics are available electronically by password authentication. They can be found in the following databases: E-Book Central (Proquest), EBSCO ebooks, IEEE-Wiley Digital Library, O'Reilly Online Learning (formerly Safari), SpringerLink (includes Lecture Notes in Computer Science), and Synthesis Digital Library (Morgan and Claypool).

The University Library also subscribes to a wide variety of databases that specifically support research in computer science. These include ACM Digital Library, Ei Village (Compendex), and IEEE Xplore. In addition, a number of other interdisciplinary databases also support computer science scholarships, such as Academic Search Premier (EBSCO), JSTOR, MathSciNet, Science Direct (Elsevier), SpringerLink journals, Web of Science (Thomson Reuters), and Wiley Online Library.

Process for Faculty to Request Books or Subscriptions
Julie Shen, a computer science subject librarian and head librarian for reference services, is the main contact for questions related to library resources for computer science.

Process for Users to Locate and Obtain Information
Julie Shen, a computer science subject librarian, is the main contact for computer science students and faculty regarding research assistance. Additionally, the Library has the following services to support students and faculty who are trying to locate and obtain information: Knowledge Center for walk-in or phone assistance; an SMS service for messages sent directly to your mobile phone; an online FAQ containing the most frequently asked questions; research guides to support specific course assignments; videos and tutorials authored by librarians; and an online chat service available 24 hours a day, 7 days a week that is staffed by Cal Poly librarians as well as librarians from all over the world. As part of the California State University System, Library users can request materials from any of the other 22 campuses through a resource sharing service called CSU+. Additionally, the Library has an efficient interlibrary loan service called Document Delivery for resources that our Library does not have. Users can log in and supply information about articles or other documents, and usually a PDF copy is made available for download within 3 days to 2 weeks.

The current library resources are sufficient for our student needs. All the services that the library is providing are useful and should be continued for a successful graduate program in CS. The domain of CS changes rapidly and the students need to be updated in all the latest scholarly findings in their project/thesis domain.

The CS program engages the library CS liaison during CS 6640 Graduate Seminar (required core course) to introduce library resources and available databases for students to use in their literature review activities for the Seminar. This helps the students to be aware of these available resources to also use during their projects and theses.

4.4 Other Campus Resources

High-Performance Computing (HPC) Center
Cal Poly Pomona HPC supports research and instruction across the campus. The cluster currently includes a total of two DL360 management nodes, 20 DL160 compute nodes and four GPU nodes with a total of eight Tesla P100 GPUs. It has been used to support CS courses such as Machine Learning, and Parallel and Distributed Computing. It has also been used to support CS research in Machine Learning, Data Science, etc. The IT department provides the necessary technical support for faculty and students.

Campus Wireless Network
Cal Poly Pomona provides a campus wireless network for Wi-Fi enabled devices. “eduroam” wireless provides faculty, staff and students with a more secure and consistent Wi-Fi experience on campus. It also provides Wi-Fi access at many universities nationally and internationally using

the same CPP Wi-Fi credentials. Guest Wi-Fi is still provided for temporary visitors and guests to the CPP campus.

4.5 Budget

The regular budgeting process includes line items that allow for purchasing resources. The University also provides internal funding opportunities to improve infrastructure, facilities, and equipment, such as the Special Projects for Improving the Classroom Experience (SPICE) grant, or Lottery Fund. The department has been active in getting funds from the aforementioned internal grants to support our infrastructure.

We would like to request adequate budget for student graders. CS is a practical field that requires lots of hands-on programming projects which cannot be automatically graded. Adequate support of graders will help faculty devote more time to other teaching and research activities, for example, curriculum development and grant proposals.

5 CONCLUSION

The objective of the M.S. in Computer Science at California State Polytechnic University, Pomona is to help students achieve a high level of professional competence and lifelong learning. The program stresses technical competence and encourages students in independent work and judgment. Our curriculum provides students with advanced course work and project-based experience to enhance their understanding of the principal hardware and software themes. Students learn how to analyze and formulate solutions for many advanced problems which occur in computer systems.

The department is working on developing a new assessment plan for the M.S. program in Computer Science. As of Spring 2022, there are 95 graduate students studying in the program. To better serve students, the department desperately needs a permanent administrative support assistant that could help with the MS program to improve the student enrollment, retention and graduation rates. We are also looking for adequate budget support for student graders to support CS faculty so that they can spend time focusing on scholarship and creative activities.

Appendix A

Curriculum of the M.S. in Computer Science at California State Polytechnic University, Pomona

The M.S. degree in Computer Science at California State Polytechnic University, Pomona, requires at least 30 **semester units** of course work. Courses taken must satisfy the following requirements, which is available at
https://catalog.cpp.edu/preview_program.php?catoid=57&poid=14893&returnto=4370

Major Required: 10 units

- CS 5250 - Advanced Computer Architecture (3)
- CS 5300 - Advanced Algorithm Design and Analysis (3)
- CS 5800 - Advanced Software Engineering (3)
- CS 6640 - Graduate Seminar (1)

Major Electives: 15-18 units

Select 18 units (with Master's Degree Project) or 15 units (with Master's Degree Thesis)

- CS 5100 - Computer-Assisted Instruction (3)
- CS 5170 - Natural Language Processing (3)
- CS 5180 - Information Retrieval (3)
- CS 5190 - Computer Vision (3)
- CS 5210 - Robotics (3)
- CS 5220 - Distributed Intelligence in Robotics (3)
- CS 5310 - Computability and Complexity Theory (3)
- CS 5350 - Parallel and Distributed Algorithms (3)
- CS 5370 - Scheduling Algorithms (3)
- CS 5400 - Topics in Compiler Design (3)
- CS 5500 - Advanced Information Security (3)
- CS 5550 - Digital Image Processing (3)
- CS 5560 - Game Theory and its Applications in Communication Networks (3)
- CS 5650 - Advanced Computer Networks (3)
- CS 5660 - Distributed Computing Systems (3)
- CS 5700 - Human Computer Interaction (3)
- CS 5750 - Topics in Database Systems (3)
- CS 5850 - Software Verification and Validation (3)
- CS 5860 - Software Metrics and Models (3)
- CS 5990 - Special Topics for Graduate Students (1-3)
- CS 6990 - Master's Degree Continuation (0)

Culminating Experience: 2 or 5 units

Choose Option 1 or Option 2.

Option 1

- CS 6910 - Directed Research (1-3) (one unit must be taken)
- CS 6950 - Master's Degree Project (1)

Option 2

- CS 6910 - Directed Research (1-3) (two units must be taken)
- CS 6960 - Master's Degree Thesis (1-3) (three units must be taken)

Appendix B

Curriculum of the M.S. in Computer Science at California State University, Los Angeles

The M.S. degree in Computer Science at California State University, Los Angeles, requires at least 30 **semester units** of course work. Courses taken must satisfy the following requirements, which is available at
https://ecatalog.calstatela.edu/preview_program.php?catoid=70&poid=31556

Program Requirements (30 Units)

A total of 30 units are required, with 18 units in 5000-level core courses. A thesis or comprehensive examination is required.

Core Courses (18 units)

Select two courses from each of the three areas of study:

I. Software Design and Implementation (6 units)

Select two courses.

- CS 5035 - Topics in Functional Programming (3)
- CS 5112 - Design and Analysis of Algorithms (3)
- CS 5220 - Advanced Topics in Web Programming (3)
- CS 5337 - Advanced Software Engineering (3)

II. System Infrastructure (6 units)

Select two courses.

- CS 5440 - Advanced Topics in Operating Systems (3)
- CS 5470 - Advanced Computer Networks (3)
- CS 5780 - Advanced Information Security (3)
- CS 5781 - Computer and Network Security (3)

III. Computing in the World (6 units)

Select two courses.

- CS 5550 - Advanced Computer Graphics (3)
- CS 5660 - Advanced Topics in Artificial Intelligence (3)
- CS 5661 - Topics in Data Science (3)

Electives (6 or 12 units)

Students completing CS 5960 Comprehensive Exam select 12 units and students completing CS 5990 Thesis select 6 units to satisfy the degree requirement.

- CS 4075 - Concurrent and Distributed Programming (3)

- CS 4112 - Competitive Programming (3)
- CS 4188 - Compilers (3)
- CS 4220 - Current Trends in Web Design and Development (3)
- CS 4222 - Principles of Data Base Systems (3)
- CS 4470 - Computer Networking Protocols (3)
- CS 4471 - Computer Networks Configuration and Management (3)
- CS 4540 - Topics in Advanced Computer Science (1-3)
- CS 4550 - Computer Graphics (3)
- CS 4551 - Multimedia Software Systems (3)
- CS 4555 - Introduction to 3D Computer Game Programming (3)
- CS 4556 - Multiplayer Online Game Design and Development (3)
- CS 4635 - Modeling and Simulation (3)
- CS 4660 - Artificial Intelligence (3)
- CS 4661 - Introduction to Data Science (3)
- CS 4662 - Advanced Machine Learning and Deep Learning (3)
- CS 4663 - Deep Learning (3)
- CS 4780 - Cryptography and Information Security (3)
- CS 5035 - Topics in Functional Programming (3)
- CS 5112 - Design and Analysis of Algorithms (3)
- CS 5188 - Languages and Translators (3)
- CS 5220 - Advanced Topics in Web Programming (3)
- CS 5337 - Advanced Software Engineering (3)
- CS 5390 - Advanced Software Architecture (3)
- CS 5440 - Advanced Topics in Operating Systems (3)
- CS 5470 - Advanced Computer Networks (3)
- CS 5540 - Graduate Topics in Computer Science (3)
- CS 5550 - Advanced Computer Graphics (3)
- CS 5660 - Advanced Topics in Artificial Intelligence (3)
- CS 5661 - Topics in Data Science (3)
- CS 5780 - Advanced Information Security (3)
- CS 5781 - Computer and Network Security (3)
- CS 5980 - Graduate Directed Study (1-3)

Comprehensive Examination or Thesis (0 or 6 units)

Complete one of the following.

- CS 5960 - Comprehensive Examination (0)
- CS 5990 - Thesis (3) (complete 6 units)

Appendix C

Curriculum of the M.S. in Computer Science at California State University, Fullerton

The M.S. degree in Computer Science at California State University, Fullerton, requires at least 30 **semester units** of course work. Courses taken must satisfy the following requirements, which is available at
https://catalog.fullerton.edu/preview_program.php?catoid=61&poid=28642

Degree Requirements

At least 15 of the total units shall represent courses offered by the Department of Computer Science. Courses offered by other disciplines, not listed here, and related to the student's objectives in Computer Science may be approved by petition to the Department of Computer Science.

Required Courses (6 units)

- CPSC 589 - Seminar in Computer Science (3)
- CPSC 597 - Project (3) * or
- CPSC 598 - Thesis (3) *

Note:

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* A "C" (2.0) or better will satisfy the graduate writing requirement.

Required Electives (9 units)

Select one course (3 units) from three of the four categories below. Taking two or more courses in the same category will result in only the first course counting toward the required electives.

Computer Applications (3 units)

- CPSC 531 - Advanced Database Management (3)
- CPSC 566 - Advanced Computer Graphics (3)
- CPSC 583 - Expert Systems Design Theory (3)
- CPSC 585 - Artificial Neural Networks (3)

Computer Systems (3 units)

- CPSC 551 - Operating Systems Design (3)
- CPSC 552 - Cyber Forensics (3)
- CPSC 558 - Advanced Computer Networking (3)

Software Engineering (3 units)

- CPSC 541 - Systems and Software Standards and Requirements (3)
- CPSC 542 - Software Verification and Validation (3)
- CPSC 543 - Software Maintenance (3)
- CPSC 544 - Advanced Software Process (3)
- CPSC 545 - Software Design and Architecture (3)
- CPSC 546 - Modern Software Management (3)
- CPSC 547 - Software Measurement (3)
- CPSC 548 - Professional, Ethical and Legal Issues for Software Engineers (3)

Theoretical Computer Science (3 units)

- CPSC 535 - Advanced Algorithms (3)

Electives (15 units)

Maximum 9 units at the 400-level

Graduate Student Advisement

The graduate program adviser provides overall supervision of the graduate program. The individual student chooses an adviser for the thesis or project from the Computer Science Department's full-time faculty on the basis of the student's particular interests and objectives.

Total (30 units)

Graduating Student Survey -Appendix D

In this survey, we refer MSCS to the Master of Science program in Computer Science. The information in the survey is needed for the assessment of our MSCS program. Please fill out this survey. Thank you for your input.

* Required

Your Name

Your answer

Date

MM DD YYYY

/ /

Email

Your answer

Check all that apply.

You entered the department as *

- ○ A conditional graduate student
- ○ An unconditional graduate student
- ○ A transfer from another graduate degree program at Cal Poly Pomona

Why did you choose to enroll in a graduate program? *

- ○ To qualify for a pay increase
- ○ To qualify for a promotion
- ○ To qualify for a new job or profession
- ○ Other: _____

Why did you choose Cal Poly Pomona? *

- ○ Location
- ○ Reputation
- ○ Curriculum
- ○ Cost
- ○ Other: _____

Did you participate in any internship program at Cal Poly Pomona? *

- ○ Yes
- ○ No

If yes on the above question, why?

- ◯ To gain real-life work experiences
- ◯ It is good for my resume.
- ◯ It helps my financial needs.
- ◯ Other: _____

Other than the internship program, did you work while you pursued this MS degree? *

- ◯ Yes
- ◯ No

If yes on the above question, which of the following best describes what you were doing?

	full-time	part-time
Employed as a software engineer	◯	◯
Employed as a database administrator	◯	◯
Employed as a network systems analyst/administrator	◯	◯
Employed as a web developer/administrator	◯	◯
Other	◯	◯

If “Other” is chosen above, please specify

Your answer

How many years have you spent to graduate? *

- 1-2
- 3-4
- more than 4

If more than 4 years, what was the reason for the delay?

Your answer

The employment sector where you are headed is:

- Corporate
- Government
- Consulting
- Other:

Your recent job offers are in the salary range of

- ○ 0 - $39,999
- ○ $40,000 - $49,999
- ○ $50,000 - $59,999
- ○ $60,000 - $69,999
- ○ $70,000 - $79,999
- ○ $80,000 - $89,999
- ○ $90,000 - $99,999
- ○ over $100,000

Employer for whom you will work immediately after graduation (name & address):

Your answer

Are you planning to enter a PhD program? *

- ○ Immediately
- ○ Maybe later
- ○ Never

Our MSCS has a number of goals for students enrolled/graduated in its program. Please provide your rating of the graduate program in terms of how well it fulfilled the following learning outcomes. (1=poor, 2=fair, 3=good, 4=very good, 5=excellent). *

	1 (poor)	2 (fair)	3 (good)	4 (very good)	5 (excellent)
An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.	○	○	○	○	○
An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.	○	○	○	○	○
An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.	○	○	○	○	○
A breadth of advanced knowledge and skills in applied areas of computer	○	○	○	○	○

science.					
An ability of reasoning and problem solving to conduct independent research in the area of specialization.	○	○	○	○	○
An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.	○	○	○	○	○

What you liked best about the program (“strengths”):

Your answer

What you liked least about the program (“weaknesses”):

Your answer

Your suggestions for how the department can better serve its graduate students:

Your answer

Thank you!

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Alumni Survey -Appendix E

In this survey, we refer MSCS to the Master of Science program in Computer Science and BSCS to the Bachelor of Science program in Computer Science. The information in the survey is needed for the assessment of our MSCS program. Please fill out this survey. Thank you for your input.

* Required

Your Name *

Your answer

Email *

Your answer

Degree completed at Cal Poly Pomona (select all that apply) *

- [ ] MSCS
- [ ] BSCS

Year of graduation *

Your answer

Term (Fall, Winter, Spring, Summer) of graduation

Your answer

How many years were you a student at Cal Poly Pomona? *

- 2 years or less
- 3 years or less
- 4 years or less
- 5 years or less
- 5+ years

Did you further your education after completing your degree at Cal Poly Pomona? *

- Yes
- No

If yes above, what type of additional education did you pursue? (select all that apply)

- Another master's degree (e.g., MBA, MS, MArch, etc.)
- Doctoral degree (e.g., EdD, PhD, PsyD, etc.)
- Other:

What is your current employment status? *

- ○ Employed full-time
- ○ Employed part-time
- ○ Unemployed

If employed, what are your current job title and company name?

Your answer

Does employment in your field require a specific license?

- ○ Yes
- ○ No

If yes above, what are the specific license?

Your answer

Our MSCS has a number of goals for students enrolled/graduated in its program. Please provide your rating of the graduate program in terms of how well it fulfilled the following student learning outcomes. (1=poor, 2=fair, 3=good, 4=very good, 5=excellent). *

	1 (poor)	2 (fair)	3 (good)	4 (very good)	5 (excellent)
An ability to frame and model real-world problems that can be addressed computationally, and evaluate multiple computational approaches and select the most appropriate one.	○	○	○	○	○
An ability to comprehend and apply the state-of-the-art concepts and design principles in advanced computer architecture.	○	○	○	○	○
An ability to build applications, either individually or in a team, that are robust, reliable, and maintainable.	○	○	○	○	○
A breadth of advanced knowledge and skills in applied areas of computer	○	○	○	○	○

science.					
An ability of reasoning and problem solving to conduct independent research in the area of specialization.	○	○	○	○	○
An ability to communicate effectively and defend results of research to peers and broader audiences, both in written and verbal formats.	○	○	○	○	○

Please rank the components of your education you found the most relevant to your success in your current profession from 1 (least relevant) to 7 (most relevant). *

	1 (least relevant)	2	3	4	5	6	7 (most relevant)
Major Curriculum	○	○	○	○	○	○	○
General Education	○	○	○	○	○	○	○
Co-Curricular	○	○	○	○	○	○	○
Faculty Advisors	○	○	○	○	○	○	○
Staff Advisors	○	○	○	○	○	○	○
Participating in Research	○	○	○	○	○	○	○
Clubs Related to Major	○	○	○	○	○	○	○

Please rate the extent to which you agree or disagree with the following statements. *

	Strongly disagree	Disagree	Agree	Strongly agree
My program effectively promoted co-curricular activities that occurred outside of the classroom (i.e., campus clubs, competition teams, research, etc.)	○	○	○	○
Personal interactions between you and your professors/advisors were encouraged	○	○	○	○
As a student at Cal Poly Pomona my department demonstrated sensitives concerning global issues such as geopolitical/environmental nuance	○	○	○	○

Please rate how effective your CPP education/program was in the following areas. *

	Not effective	Somewhat effective	Effective	Very Effective
Cultivate your communication skills with regard to writing and public speaking	○	○	○	○
Prepare you to be a life-long learner in your field of study	○	○	○	○
Encourage personal leadership development	○	○	○	○
Prepare you to be appreciative of cultural/ethnic differences in our communities	○	○	○	○
Promote or place emphasis on the importance of community engagement/outreach	○	○	○	○
Encourage and educate you on the available technologies applicable to your professional success	○	○	○	○
Promote an analytical approach to complicated problems concerning your professional growth and overall success	○	○	○	○

Collaborative learning efforts among your peers with your discipline	○	○	○	○
Encourage collaboration outside of your specific department/discipline	○	○	○	○

Would you recommend this program to your family and friends?

- ○ Not recommended
- ○ Somewhat recommended
- ○ Recommended
- ○ Highly recommended

What you like best about our MSCS program (“strengths”):

Your answer

What you like least about our MSCS program (“weaknesses”):

Your answer

Your suggestions for how the department can better serve its graduate students:

Your answer

Thank you!

Submit

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