ANNUAL PROGRAM REPORT

College	Science
Department	Computer Science
Program	Master's in Computer Science
Reporting for Academic Year	2016-2017
Last 5-Year Review	2010-2011
Next 5-Year Review	2017-2018
Department Chair	Matt Johnson
Date Submitted	6/21/2017

I. SELF-STUDY

A. Five-Year Review Planning Goals

The last Computer Science five year review identified the following goals for the Master in Computer Science program:

Curriculum:
i) Revamp the currently confusing breadth category requirements in which students must take 2 courses each from courses identified as either Development/Theory or Systems/Architecture.
ii) Address issues arising from allowing graduate students to take 3000 or 4000 level undergraduate courses towards their Master's degree electives.
iii) Improve preparedness of students, insuring that prerequisite courses adequately prepare students for later coursework.

Students:
i) Grow program in order to help address need for qualified tech workers in California.
ii) Improve student experience and graduation rate. Increased course offerings and more formal advising should result in better retention.

Faculty:
i) Recruit new faculty to reduce reliance on lecturers and to provide opportunities to offer classes and research support in areas of current Computer Science areas of development.
ii) Address workload of Graduate Coordinator, who is responsible for evaluating 1500-2000 applications per year, in addition to advising enrolled graduate students.

Resources:
i) Facilities for Department faculty offices, teaching labs, research labs, including co-locating office space to provide opportunities for faculty to work together more easily.
ii) Support from campus Information Technology for teaching and research needs.

iii) Need for funds for readers, TAs, and travel to academic conferences.
iv) Need for library resources, specifically to support graduate courses.

B. Progress Toward Five-Year Review Planning Goals

Please note: it has now been six years since the Department's last five year review (2010-2011). Due to semester conversion however, CAPR instituted a modified five year review plan, moving the next department review to 2017-2018.

Three major developments have occurred in the last two years which impacted several of the planning goals. They are the division of the Mathematics and Computer Science department into two separate departments, the move of the department office and faculty offices of the Department of Computer Science to the new Student and Faculty Support (SF) building, and the design, review, and approval of the new semester-based graduate and undergraduate programs as part of campus semester conversion.

Separation of department:
The faculty of the department of Mathematics and Computer Science had discussed the possibility of separation into two departments for many years. Combined departments were the result of Computer Science growing out of Mathematics departments, with some faculty teaching in both disciplines. Computer Science has been a distinct field of endeavor for several decades now, and only 2-3 faculty members of the combined department taught in both areas, limiting the need to house the two programs in one department. The great size of the department (nearly 30 faculty), and the large differences in the programs made it difficult to manage, and difficult for standard departmental policies to be developed. As a result, a request was made to separate the programs into two departments. That request was approved in July, 2015.

Move to SF building:
With the completion of the new Student and Faculty Support building, the Department of Computer Science department office and most faculty offices were moved from offices spread over all four floors of both Science buildings to the fifth floor of the new building.

New semester-based programs:
As part of the campus-wide semester conversion, the Department of Computer Science developed a new Master's program addressing shortcomings of the current program as well as plans for assessment. This program was reviewed and approved by the college and university curriculum committees.

Now, the progress towards the goals identified in section A will be addressed.

Curriculum:
i) Revamp the currently confusing breadth category requirements in which students must take 2 courses each from courses identified as either Development/Theory/ or Systems/Architecture.

The department faculty felt that the division of courses into two categories was less than clear in some cases. As part of semester conversion, the breadth categories are eliminated. Instead, the number of core courses was increased from 2½ (10 quarter units) to 5 (15 semester units), providing a more comprehensive shared learning experience for the students, and more flexibility in the remaining electives. The new requirements are much a simpler to understand, which should reduce confusion and need for advising. A larger number of required courses will also simplify scheduling and lead to a more predictable annual schedule allowing students to plan their schedules far in advance.

ii) Address issues arising from allowing graduate students to take 3000 or 4000 level undergraduate courses towards their Master's degree electives.

While the CSU and WASC allow a portion of Master's degree requirements to be fulfilled using undergraduate courses, there was substantial difficulty in ensuring that students did not use the same course to address both a requirement in their undergrad and grad programs. This policy required substantial, careful evaluation of undergraduate transcripts, and extensive advising, and caused a great deal of confusion for the students. As a result, the department chose not to allow undergraduate courses to be used towards Master's degree requirements. This new policy will reduce the time needed to evaluate transcripts during admission, and greatly simplify one area of advising for students.

iii) Improve preparedness of students, insuring that prerequisite courses adequately prepare students for later coursework.

As part of the semester conversion, the department has clarified the requirements for admission to the Master's program, and added several admission prerequisites to ensure that students are adequately prepared to succeed in the program. Scores earned on the GRE test have also been made a mandatory component of the admission packet, and minimum scores on the test have been established.

In a development that the Department applauds, the University will be enforcing course prerequisites as part of course enrollment. The Department has been checking course prerequisites by hand in the past, which is not practicable for large numbers of sections. As a result, some students successfully enrolled in courses for which they had not completed the course prerequisite often leading to less than successful results.

Lastly, and perhaps most importantly, all required courses will now be assessed to determine if students successfully learned the required course content. Now that the semester program has been approved, the Department will begin work on assessment instruments and rubrics for each required course. Assessment results will allow the Department to address any failing in the courses to ensure that students are prepared for later coursework.

In regards to the current quarter-based program, we successfully administered post-assessment examinations for four courses this year (most notably for the Capstone Experience). We are compiling results and modifying our process as needed.

Students:
i) Grow program in order to help address need for qualified tech workers in California.

Studies have shown for many years that there is a lack of qualified applicants for tech jobs in California and across the nation. The Department of Computer Science hopes to help address this shortage by growing our program and generating more qualified graduates. At the Master's degree level, there is limited demand from domestic students as most positions require a Bachelor's degree and some industry experience. As a result, the large majority of our student population is made up of students from other countries, predominantly India. They are attracted to the university due to our proximity to Silicon Valley. Our programs already possess the highest rate of degree-related job placement at CSUEB (from AACE data). Even so, the economic upturn has increased job opportunities for our graduates even more. The Bureau of Labor statistics projects another 22% increase in jobs over the next 6 years. Consequently, we are seeing a marked increase in the number of applications. Students are getting hired even more quickly and finding internships easily. Employers are contacting our department on a weekly basis.

Despite the demand for qualified Computer Science graduates, the Department does not have the faculty resources to cover the sections of courses needed to support both the undergraduate and graduate programs. The undergraduate program is growing quickly, by 20% or more each year, and undergraduate enrollment cannot be regulated by the Department. As a result, graduate enrollment must be reduced to keep the combined undergraduate and graduate enrollment to a manageable size. With the support of the CSCI Dean's office, the Department voted to significantly decrease the size of the Master's in Computer Science program, from roughly 300 students to roughly 100 students. This decrease in enrollment is being implemented by increasing the standards required of the applicants and by accepting applications for Fall quarter admission only, rather than accepting applications in Fall, Winter, and Spring quarter as has been traditional. Approximately 200 students have been accepted for Fall 2018 admission. If historical yields of 25% admits to enrollees holds for Fall, then approximately 50 enrollees will have been obtained. Since students typically complete the Master's degree requirements in two years, 50 new enrollees per year will give the desired 100 student population.

ii) Improve student experience and graduation rate. Increased course offerings and more formal advising should result in better retention.

The major curricular issues facing our students are the ability to plan for course offerings in advance, the ability to enroll in classes as needed, and availability of advising in particular in regards to choice of breadth courses and electives. All of these concerns should be met by the new semester-based curriculum. The larger set of required courses will lead to more predictability in scheduling, and more sections of the courses will be offered leading to ease of enrollment. The removal of the breadth requirements and the restriction to graduate level electives will make the program easier to understand and more flexible as students may take any graduate level elective offered in a quarter rather than having to choose from a particular set associated with a breadth category.

ITS, working with the Department of Computer Science, completed an implementation of the Degree Audit Record (DAR) online advising system for the Master's in Computer Science program. The system went live for Fall quarter 2016. This additional advising channel will allow advising to be done more efficiently and to provide all necessary information to the students so that they are kept informed of any decisions regarding substitutions, change of status, etc.

Faculty:

i) Recruit new faculty to reduce reliance on lecturers and to provide opportunities to offer classes and research support in areas of current Computer Science areas of development.

Faculty recruitment is one of the Department's main concerns. Even to maintain the program at its current size, new faculty will need to be hired as there are three faculty who completed their FERP periods at the end of this year, with one more member to complete his FERP period at the end of next year. In order to handle the enormous growth in the undergraduate program and address new areas, even more faculty will be required. Three years ago, a faculty search ended in failure with only a handful of applicants. This was despite extensive outreach efforts. Two years ago, the Department conducted a search for 2 positions. The Department was fortunate to fill one of the tenure track positions, and welcomed Dr. Varick Erickson, who joined us in Fall 2016. The Department again held searches for two positions in the last year. Again, one position was filled, and we will welcome Dr. Xianjun Ruan in Fall 2017. In both years, the Department was unable to fill the second position, and as has been typical, the first few applicants who have been offered a position have taken jobs elsewhere. The applicants have regularly pointed to insufficient compensation as the reason for turning down our offer, and it is typical that even other CSU campuses are able to provide more competitive offers. The Department will again be conducting a search for two positions next year, a roll-over of last year's

position, and a new one. The Department continues to seek diverse applicants with interests in emerging fields of current interest, and again is making significant efforts to provide outreach to under-represented groups.

ii) Address workload of Graduate Coordinator, who is responsible for evaluating 1500-2000 applications per year, in addition to advising enrolled graduate students.

The Graduate Coordinator evaluates applications for admission, and advises current students. The Coordinator receives 2 courses assigned time, which is insufficient in order to complete these tasks. The main concern is the number of applications, which have been in the range to 1500-2000 per year. Almost all applications are from abroad, and require significant evaluation in order to determine if the applicant has completed the 19 prerequisite courses that the Department has determined are necessary for successful preparation for entrance to the Master's program. A large percentage of the applicants are not prepared for the program and must be denied. The yield of enrolled students to applicants ranged from 3% to 20% over the last two years. An enormous amount of work was necessary on the part of International Admissions, the staff of the Department of Computer Science, and Graduate Coordinator for very little payoff in terms of enrolled students.

This payoff is especially an issue now that the Department has voted to decrease the size of the graduate program. Evaluating 2000 applications to enroll 50 students is not a workable system. In order to decrease the number of applications, the program will accept applications in Fall quarter only, rather than Fall, Winter, and Spring quarters as has been traditional. Also, a minimum requirement on GRE scores has been implemented, eliminating the need to evaluate some of the least competitive applications. Finally, the Department has met with the Office of International Admissions (IAO) to better streamline the admissions process in hopes of increasing the yield, so that admitted students are more likely to attend.

Resources:
i) Facilities for Department faculty offices, teaching labs, research labs, including co-locating office space to provide opportunities for faculty to work together more easily.

The Department was pleased that space was made available in the new Student and Faculty Support (SF) building for the department office and faculty offices. Faculty had been spread over all four floors of both Science buildings previously. Proximity to colleagues and the department office has already led to increased communication between department faculty, more frequent department committee meetings, and increased productivity. Unfortunately, space was not made available for all department faculty. In particular, faculty participating in the FERP program, and all lecturers are still housed in the Science buildings. In addition, there is not enough space in the new building even to house the faculty that would result from successful searches that have been approved for next year. Ideally, it would be beneficial to house the entire department in one place with enough made available for desired growth.

The College of Science has provided some limited additional teaching lab space, but this is still a significant concern as current space is insufficient to meet department needs. As our outside reviewer mentioned, if we choose to seek accreditation, our relative lack of teaching and experimental lab space would be a major concern to the accrediting board. The Department is in discussions with the Dean of the College of Science to address these issues.

ii) Support from campus Information Technology Services for teaching and research needs.

The centralization of Information Technology Services (ITS) on campus left the Department of Computer Science with no dedicated support for its teaching and research support needs. The centralized model

was unwieldy, slow, and has not served the Department well, leading to impact to the students as software and hardware testbeds and learning environments have become outdated or unusable. Our outside reviewer stated that even the support that was provided before centralization was insufficient. The College of Science approved a support position for the Department, similar to that provided for other lab-based disciplines, which was filled in January 2017. Unfortunately, due to lack of support for Human Resources, that hire was invalidated. Another search will be completed in the next few months.

iii) Need for funds for readers, TAs, and travel to academic conferences.

The need for additional resources to fund readers, Teaching Assistants, and travel to academic conferences is little changed. Our outside reviewer specified lack of funding for continuing development and other department needs was a significant issue. The lack of funding is especially an important factor as we attempt to hire new faculty who are especially in need of grading support, and are expected to publish and present at conferences.

iv) Need for library resources, specifically to support graduate courses.

Library offerings have been uneven, with important database subscriptions cancelled and re-established. Access to a wide range of journals and conference proceedings is especially important as we plan to increase the rigor of our graduate courses under the semester system.

C. Program Changes and Needs

Overview:

Issues will be considered in the order specified by the annual report instructions.

Curriculum:

The Master's in Computer Science program will be transformed for the semester-based system as described above. Under the quarter-based system, several changes have been made to the curriculum recently including:

i) New courses

Since our last five year review, three new hybrid courses have been added to the curriculum: Security in Mobile, Wireless, Grid and Pervasive Computing (CS 6526), Security Management (CS 6527) and Cloud Computing (CS 6593). Additionally, the new course Statistical Learning and Data Analysis (CS 6831) was added to the Computer Science curriculum. These are courses that provide students the opportunity to learn about more current technologies.

ii) Limits on comprehensive exam attempts

Most students in the Master's program complete their Capstone Experience by completing CS 6901 – Capstone Examinations. While most of these students complete the exams on their first attempt, some students struggle with the exams. In consultation with Graduate Programs, the Department has instituted a three-attempt limit on the examinations for new students. This limit will carry over

to the semester-based system.

iii) C grade requirement for graduate credit

The Academic Senate passed a resolution to allow credit towards Master's degree requirements only for courses in which a "C" grade or better was earned. The Department of Computer Science had allowed "C-" grades to count prior to this resolution.

Students:

One of the Department's main concerns regarding students is to ensure that they may enroll in the classes they need. This has been an issue due to inadequate staffing and the inability to recruit new faculty or qualified lecturers due to the competition from industry and other universities. Since the large majority of Computer Science master's students are international students, they must enroll in eight units per quarter to maintain their visa status. It is then incumbent upon the Department to ensure that adequate room in classes is available to the students.

i) Oversubscribed courses

In our previous annual report, we mentioned our problem with oversubscribed courses. Students with early registration appointment times would sign up for the maximum allowed by the system (4 enrollments and 4 waiting lists). They would then drop the courses they did not want on the last day of the Add/Drop period. This meant that students with later registration appointments, including all incoming students, would have to get on waiting lists. The incoming students would be unable to register for courses that we had told them they were required to take, and for visa reasons had to sign up for courses for which they were unprepared. It also meant that sometimes extra sections created to meet supposed demand would turn out to be unnecessary after all the drops. Early attempts to mitigate the problem by appealing to students to stop enrolling in extra courses had no impact on the problem.

The department addressed this by limiting early registration for courses starting in the Fall quarter of 2014. After three years, we have to say this has been the most beneficial change to the program since the start of the assessment process. New students have been able to enroll in appropriate courses, existing students have been able to find courses to satisfy requirements, and enrollment has reflected actual demand.

ii) Academic dishonesty

Another issue with broad impact to students has been academic dishonesty. The department chair receives copies of all academic dishonesty reports, and had to process a large stack of reports each quarter. In meetings with the students involved, he also found that students were dismissive of the measures taken at the university level. Anecdotally, some faculty observed repeated incidents with the same students despite previous reports on their file. Inevitably, some faculty had ceased to use the academic dishonesty process since they felt that the reports had no impact and were thus a waste of time. Students not involved in academic dishonesty were frustrated as well, feeling that they had to compete with students with an unfair advantage. Some did come forward to mention their frustrations and request the department to do something, though as might be expected, they did so anonymously. In a rather dramatic incident, a research group from another university

investigating the online solicitation of illicit aid for coursework provided an instructor with proof that a student in that instructor's course had offered to pay for someone to do their assignments. It turned out that work was shared with the rest of the class.

To handle this issue, the Chair proposed, and the Department accepted, levying department-level sanctions to a sufficient level to at least diminish the frequency. The first incident of reported academic dishonesty deprives the student of any opportunity or benefit requiring a department signature, whether a grader or TA position, a scholarship, or the opportunity to do an internship through the university's curricular practical training program. The second incident of reported academic dishonesty, even in the same academic term, results in declassification of the student. The effect of this is to remove them from the program. As with the early registration limits, this policy was started in the Fall quarter of 2014. While the punishments may seem harsh, in the seven quarters of enforcement, the number of academic dishonesty reports has plummeted. During that period, the teaching faculty has been essentially the same, as have the courses offered. The drop in reports may be partly due to a significant number of students leaving after the Fall quarter of 2014, either after being academically disqualified or to transfer to other (often unaccredited) regional universities. Departing students were found to be only those whose grades were below the standard for acceptable academic standing. This policy serendipitously has also allowed us to address the 4th ILO of the university, specifically "understanding the implications of values and ethics for leadership, teamwork and collaboration".

Faculty:

Name	Time Base
Brown, Kevin	1.0
Christianson, Leann	1.0
Erickson, Varick	1.0
Ertaul, Levent	1.0
Grewe, Lynne	1.0
Johnson, Matt	1.0
Jurca, Dan	0.44 (FERP)
Reiter, Eddie	0.5 (FERP)
Roohparvar, Farzan	1.0
Simon, Steve	0.44 (FERP)
Yang, David	1.0
Yu, Ytha	0.44 (FERP)
Zhong, Fay	1.0
TOTAL FTEF	**10.82**

i) Changes

Three faculty (Drs. Reiter, Jurca, Simon) have completed their FERP programs at the end of 2016-2017. Our last faculty on FERP (Dr. Yu) will complete his program at the end of 2017-2018. We have hired three new faculty since the last five year review, Dr. Fay Zhong (joined Fall 2015), Dr. Varick Erickson (joined Fall 2016), and Dr. Xianjun Ruan (joining Fall 2017.)

Staff:

The Department of Computer Science shares staff with the Department of Mathematics, and one staff member with the Department of Health Sciences. Our staff members consist of:

Name	Time Base	Shared With
Frazier, Sharonda	1.0	
Mendoza, Rosaura	0.4/0.4/0.2	Mathematics and Engineering
Snyder, Janet	0.5/0.5	Mathematics

Resources:

i) Lab space and lab tech support

The Computer Science Department was dramatically impacted by ITS centralization several years back. Up until three years ago, the Department had only one small computing lab with less than a dozen machines -- despite the number of students in the majors – and only one computer classroom. Three years ago we were finally able to obtain at least primary usage to a second newly renovated computer classroom, and access to a second small computer lab in VBT. The Department is still severely underequipped. Students often try to make do with their own laptops and general purpose space (like the Cave of the Science building), but this often leads to difficulties from incompatibilities among their laptops, or lack of required software. Many courses in the curriculum require dedicated servers that are isolated from the campus networks, as students write programs to interact or query these servers. Getting these configurations set up is difficult or impossible when ITS centrally manages all systems on campus. Classroom space, retiring faculty, equipment and software shortages, and lack of dedicated ITS support are all issues that severely impact the program and its future growth.

Starting this last year, a small open lab space, SC N337, was approved by the College of Science and updated equipment provided. The department IT support hire has managed the lab, hiring Computer Science students to staff the lab. Students have been enthusiastic regarding the resource and have used the lab for collaborative work and as a study space. The Department thanks for the College of Science for their support in this regard.

Assessment:

At the time of our last five year review, we were just starting to identify program learning outcomes and student learning outcomes. In the past four years, we have finalized our assessment process, and have conducted post-assessment examinations for targeted courses. The exams are deployed through Blackboard and automatically scored. In the last three years, we have also closed the loop on assessment by making changes based on our assessment data.

More importantly, going forward, we have incorporated assessment concepts in the new semester-based curriculum that has been reviewed and approved by the college and university curriculum committees. Specifically, the Department has increased the number of required courses in the program, each of which will be regularly assessed. This will allow data to be compared easily from course offering to offering and across student cohorts, providing opportunities to improve the quality of the program. The Department has been working to devise assessment instruments and rubrics for the semester-based system in 2016-2017 and will complete this work in 2017-2018.

II. SUMMARY OF ASSESSMENT

A. Program Learning Outcomes (PLO)

Students graduating with an M.S. in Computer Science from CSU East Bay will be able to:

1. Apply knowledge of mathematics and computational theory to analyze problems in computer science, and assess and determine the resources and requirements needed for their solution. (ILO 1,2)
2. Design, develop, and evaluate a computer-based system, process, component, or program to meet desired needs. (ILO 1,4)
3. Classify and explain the mechanisms, components and architecture of computing systems. (ILO 1)
4. Employ current techniques, skills, and tools necessary for computing practice, and justify the need for continuing professional development. (ILO 1)
5. Discuss professional, ethical, legal, and security issues and responsibilities and the impact of computing on individuals, organizations and society. (ILO 1,2)
6. Function successfully on teams to accomplish a common goal, and explain computer science concepts effectively in written and oral form. (ILO 1,5)

B. Program Learning Outcome(s) Assessed

Following our assessment plan, the Department is assessing one PLO per year. This is the fourth year that assessment has been done and so we are assessing PLO #4 this year. The department does collect assessment data for all targeted courses each year, however, so as to track trajectories for scores on all PLOs and allow for "closing the loop."

Post-assessment quizzes were administered for three courses this year (addressing PLO #4):

CS 6310 – Advanced Software Engineering, Elective, Developing PLOs 2 and 4
CS 6320 – Software Engineering of Web-Based Systems, Elective, Developing PLOs 2 and 4
CS 6525 – Network Security, Elective, Developing PLO 2 and Mastering PLO 4

C. Summary of Assessment Process

Instrument(s) and Sampling Procedure:
The Department created SLOs and PLOs for the Master in Computer Science program in the academic year 2012-2013. The Department made the decision to use Blackboard as a means to provide students with an assessment exam that addresses the SLOs of each course. The SLOs for each course have been mapped to the program PLOs and the ILOs of the university. The assessment exams were developed for the required courses in the program, as well as a representative set of elective courses. The assessment instruments were then made available to the department faculty via a BlackBoard repository. Instructors teaching courses which were to be assessed in a given year deployed the tests and reported the results back to the Graduate Coordinator.

Sample Characteristics:
The Department has been using this assessment mechanism for three years now and can evaluate its advantages and disadvantages. Unfortunately, evaluating the results of the assessment exams as they stand is challenging, as each assessment contains questions addressing multiple PLOs. Due to a BlackBoard limitation, the results for individual PLOs cannot be automatically aggregated and compared across multiple courses, and instead must be tabulated by hand. To solve this problem, for the

semester-based program, the Department agreed to develop assessment instruments that address only one PLO at a time. This will allow assessment to be automated, providing the opportunity to assess more courses, and assess those courses more frequently. The Department has developed most of the new assessment instruments for the semester-based program and will complete the remaining ones in early 2017-2018.

An additional challenge in the current system is assessing PLOs for both the Master's in Computer Science program and the Master's in Computer Network program. Since the programs share the great majority of the courses, but have different PLOs, it has been necessary to provide separate mappings of course SLOs to the PLOs of the two different programs, or to include additional questions on the assessment instruments to address the different PLOs. Fortunately, this difficulty will be eliminated under the semester-based program as the Master's in Computer Science and the Master's in Computer Networks have been combined into a single program with common PLOs. In addition, the PLOs for the Bachelor's and Master's programs have been coordinated so that matching PLOs for the undergraduate and graduate programs will be evaluated on the same timetable.

Data Collection:
Assessment data for PLO 4 was collected in three courses, all in Fall quarter 2016. The data were collected by the instructors of the classes from the BlackBoard tests that they had deployed.
The courses were:
CS 6310 Advanced Software Engineering
CS 6320 Software Engineering of Web-Based Systems
CS 6525 Network Security

Data Analysis:
In evaluating the assessment scores for PLO #4, we find mediocre results in two of the courses assessed, CS 6310 and CS 6320, and much better results in the last course assessed, CS 6525. PLO #4 is one of the more challenging outcomes for students to achieve in that it requires students to develop and master their coding skills. Developing good coding skills often takes years of practice and should be begun early in an undergraduate career. Again, most of the graduate students in the Master's in Computer Science program are international students, and many international Computer Science programs do not stress coding skills to the degree that is necessary to become proficient. As a result, many of our Master's students start at a disadvantage in regards to PLO #4. The Department addresses this disadvantage by requiring remediation of basic programming courses for many admitted students, and by emphasizing the need for programming projects in as many Master's degree courses as possible. Under the semester-based system, a new required graduate-level data structures and algorithm analysis has been added to help students get up to speed quickly.

Please also note that all of the courses used to assess PLO #4 are electives, which can lead to selection bias. It may be that students with poorer coding skills chose to take CS 6310 and CS 6320, where the assessment results are mediocre, and students with better skills chose to take CS 6525, where the results are good. It is not clear that the scores assess the program as a whole. That said, PLO #4 is to be developed in CS 6310 and CS 6320 while it is to be mastered in CS 6525, and the scores do actually reflect a better mastery of coding in CS 6525 than the earlier courses. The Department has again addressed the issue of consistency of assessment under semesters by assessing all PLOs in required classes rather than electives.

In regards to closing the loop and using the results of the assessment process to improve student learning for PLO #4, it would appear that the students in CS 6525 have successfully mastered the PLO and no further modifications are needed. In CS 6310 and 6320, we would like to see improvements in coding proficiency at the development level. As mentioned, the new required course in coding that will

be instituted under semesters will be the Department's first attempt to address this issue.

CS 6310:
This elective course in Advanced Software Engineering addresses material which is relatively well-defined, including both theoretical elements as well as significant elements of coding and development practice. It requires advanced understanding of software development issues, practical use of software development tools, and testing and software lifetime management, which is why it particularly addresses PLO #4. There is reasonable latitude available for addressing different areas or additional material, so fine-tuning would be aimed towards identifying subject material which most successfully results in student acquisition of the necessary skills and theory. In addition, as with most classes, it would be beneficial to provide additional learning opportunities for students who were unsuccessfully served by the current class format. These opportunities might include high impact educational practices such as collaborative projects or swapped classrooms.

CS 6320:
This elective course in Software Engineering of Web-Based Systems addresses material which has a well-defined core of material but is constantly being enhanced by new developments and advances in the industry standards. It clearly maps to PLO #4, in critiquing, planning and producing complex software applications as web systems typically involve many elements, both front-end interfaces and back-end databases, across multiple machines simultaneously. There is again a fairly wide range of subject areas that could be covered, and actual implementation of systems using standard tools, cloud-based services, industry-standard libraries and frameworks is an essential part of the class. Similarly to CS 6310, closing the loop will entail identifying the theoretical subject areas and software projects that lead to the most successful student learning.

CS 6525:
This elective course in Network Security addresses material which has a relatively well-defined core, but which also includes a constantly changing array of attacks and corresponding applications of security functionality. Both theory and implementation are critical to this subject, with familiarity with industry standard libraries and tools being necessary. After addressing subject material common to most security solutions, a wide range of subjects may be covered, providing the opportunity to adapt the class to the needs of the students. As in CS 6320, proficiency with current tools, services, and frameworks is essential. Based on the assessment data, students have been quite successful in mastering the material and gaining proficiency in security software development. Instructors should continue to use the current model, while incorporating high impact educational practices.

D. **Summary of Assessment Results**

Main Findings:
At the Development level, while students have attained a medium level of proficiency in PLO #4, the Department would like to work towards higher levels of proficiency for these classes. At the Mastery level though, students have attained a high level of mastery of PLO #4.

2016-2017 Assessment Results	**1**	**2**	**3**	**4**	**5**
CS 6310 Advanced Software Engineering (Fall 2016)		**70%**		**56%**	
CS 6320 Software Engineering of Web-Based Systems (Fall 2016)				**53.8%**	

CS 6525 Network Security (Fall 2016)				**97.8%**	
CS 6901 Capstone Exams (Fall 2016, Winter 2017, Spring 2017)	**55%**	**86%**	**60%**		

Recommendations for Program Improvement:
The Department has proposed a transformed curriculum for the semester-based system which includes a new required course in program development and analysis which will provide students with the opportunity to improve the coding skills essential to attaining proficiency in PLO #4. Also, as described above, the assessment tools that the Department is currently using are unwieldy, and there is the potential for selection bias in assessing certain PLOs since they are assessed in elective courses which not all students may take. Under the semester system, the Department plans to assess PLOs in required courses only and has created assessment tools which more clearly assess one PLO at a time.

Next Step(s) for Closing the Loop:
In the last year before the semester-based system begins, course instructors will be encouraged to include more program development, testing, and tool use in their courses. In addition, it would be beneficial to provide additional learning opportunities for students who were unsuccessfully served by the current class format. These opportunities might include high impact educational practices such as collaborative projects or swapped classrooms.

E. Assessment Plans for Next Year

The Department will continue using its current program assessment plan and will assess PLO #5 next year. Note that since Master's program PLOs were adapted to match the Bachelor's program PLOs under the semester-based system, assessment data from the current PLOs will not provide a meaningful comparison under the new system. The department will begin gathering assessment data regarding the semester-based PLOs beginning in Fall 2018.

III. DISCUSSION OF PROGRAM DATA & RESOURCE REQUESTS

A. Discussion of Trends & Reflections

Notable Trends:

The program data we were given through Academic Affairs still contains wildly inaccurate data for Computer Science:

1. It incorrectly combines data for the Department of Computer Science and the Department of Mathematics in certain tables, and provides separate but wholly incorrect information in others.
2. The data seems to only reflect majors and student headcounts for Mathematics.
3. It contains errors with regard to FERPer and lecturer counts. As a result, it does not convey meaningful information on FTEF and SFR.

The department currently has almost roughly 750 undergraduate majors and 200 graduate students. Enrollment for CS has increased by 30-35% this year, and over 50% in the last five years. The National Academy of Science, the Bureau of Labor Statistics, ABET and other data sources all predict a continuing

30% upswing in CS enrollment trends during each of the next five years.

Reflections on Trends and Program Statistics:

The program data we were given through Academic Affairs still contains wildly inaccurate data for Computer Science:

1. It incorrectly combines data for the Department of Computer Science and the Department of Mathematics in certain tables, and provides separate but wholly incorrect information in others.
2. The data seems to only reflect majors and student headcounts for Mathematics.
3. It contains errors with regard to FERPer and lecturer counts. As a result, it does not convey meaningful information on FTEF and SFR.

The graduate programs in Computer Science and Computer Networks receive between 1500-2000 applications each year. On average, we accept roughly 10% of applicants.

Although we are making a new hire in 2017-2018 (Dr. Xiaojun Ruan), three faculty members are ended their FERP agreements this year (Drs. Reiter, Jurca and Simon). This means our FTEF continues to drop even as we make new hires. Meanwhile, our enrollment in the major is increasing rapidly.

B. Request for Resources

1. Request for Tenure-Track Hires

The Department of Computer Science will be asking once again for a new tenure-track hire line in 2018-2019 for the following reasons:

1. Enrollment in the CS undergraduate program has increased by roughly 35% this academic year, and many required CS courses have large waitlists. The National Academy of Science, the Bureau of Labor Statistics, ABET and other data sources all predict a 30% upswing in CS enrollment trends annually during the next five years. A new hire is therefore necessary to accommodate current and future student demand for the major. This would positively affect the graduation rates of our majors, as students would be able to enroll in the courses they need to graduate on time. It would also enable the department to offer better advising to all majors, thereby improving achievement gaps.
2. Seven faculty members in Computer Science have retired since 2012! The department needs to "plug the holes" in curriculum coverage caused by the recent loss of so many senior faculty members. Due to the plethora of technology jobs in nearby Silicon Valley, it is extremely difficult – and often impossible – to find qualified temporary faculty to teach upper division or graduate courses in the discipline. It is therefore essential that we bring new tenure-track faculty members onboard.
3. In order to meet ABET accreditation standards, at least 50% of CS courses must be taught by tenure track faculty. This quarter (winter 2016), only 28.9% of courses with the CS-prefix were taught by tenure-track faculty in our department. To my knowledge, we are the only remaining program in Computer Science within the CSU that is not already accredited.
4. Faculty attrition has diminished our coverage of key areas in the discipline, and we have sharply

curtailed many elective offerings in the major as a result. A new hire would allow us to align the department's curriculum and research efforts with emerging technologies. As a rapidly changing applied discipline, Computer Science must continually evolve in order to provide our graduates with key knowledge and skills demanded by industry.

5. The Department of Computer Science has four faculty members currently in the FERP program. Three of these four (Drs. Jurca, Reiter and Simon) will be ending FERP agreements at the end of this academic year. All three teach in the area of computational theory, one of the three core areas in our discipline. Their impending departure means not only that FTEF will drop by 1.44 next year, but also that there will be a gap in curricular coverage within the major.

2. Request for Other Resources

The Department of Computer Science faces a critical shortage of instructional computer labs.

Computer Science is a laboratory discipline. The vast majority of our major courses need to have computers available in the classroom. Without the needed instructional labs we are unable to deliver our curriculum. The department currently has almost 1000 undergraduate and graduate majors, and enrollment is predicted to increase sharply for the next five years. We currently have only three computer classrooms available to support our program: NSCI 336, NSCI 104 (shared with Statistics), and a small lab (25 seats) in VBT 218. Through the generosity of the College of Science, the department was able to create an open Computer Science Lab for students to use *outside of the classroom* in NSCI 337.

As our outside reviewer mentioned, when we seek accreditation our relative lack of teaching and experimental lab space would be a major concern to the accrediting board.

C. Appendix

APR Faculty & Courses (Fall Terms)					
College of Letters, Arts and Social Science					
Department	**Math and Computer Science combined**				
DeptID	**12350 - Math and Computer Science, 12351 - Math, 12352 - Computer Science**				
Subjects	**CS, MACS, MATH**				
Faculty Data					
	HEADCOUNT				
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016

Professor	15	14	16	14	13
Associate Professor	6	6	6	6	6
Assistant Professor	3	2	2	2	4
Lecturer: Full-time	1	2	2	4	3
Lecturer: Part-time	16	18	18	21	27
Teaching Associate	27	18	24	24	18
Total	68	60	68	71	71
	FTEF				
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Professor	15.0	14.0	15.7	13.3	12.0
Associate Professor	5.7	5.7	5.7	5.7	5.7
Assistant Professor	3.0	2.0	2.0	2.0	4.0
Lecturer: Full-time	1.0	2.0	2.0	4.0	3.0
Lecturer: Part-time	7.8	9.2	9.6	10.1	12.4
Teaching Associate	10.1	8.4	8.7	9.1	7.4
Total	42.6	41.2	43.6	44.2	44.4
% Breakdown by Type					
	HEADCOUNT				
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Lecturer	25.0%	33.3%	29.4%	35.2%	42.3%
Tenure Track	35.3%	36.7%	35.3%	31.0%	32.4%
Teaching Associate	39.7%	30.0%	35.3%	33.8%	25.4%
	FTEF				
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016

Lecturer	20.7%	27.1%	26.6%	32.0%	34.7%
Tenure Track	55.6%	52.6%	53.5%	47.5%	48.8%
Teaching Associate	23.8%	20.4%	20.0%	20.5%	16.6%
Full-time Equivalent Students (FTES)					
	FTES				
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Lecturer	259.2	343.0	340.6	423.6	468.3
Teaching Associate	258.4	218.4	215.4	244.8	193.6
Tenure Track	309.4	341.8	401.4	284.9	389.3
Total	827.0	903.2	957.4	953.3	1057.5
Additional Categories					
	FTES				
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Major FTES	52	49	54	43	51
GE FTES	192	189	191	201	209
Waitlist FTES	2	4	5	6	3
Student-Faculty Ratios (SFR)					
Overall SFR (All FTES / All appointed FTEF)					
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Lecturer	29.5	30.8	29.4	30.0	30.4
Teaching Associate	25.5	26.0	24.7	27.0	26.3
Tenure Track	13.1	15.8	17.2	13.6	18.0

Total	19.4	21.9	21.9	21.6	23.8
Instructional SFR (All FTES / Course assignment FTEF for given subjects)					
Instructor Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Lecturer	29.4	31.5	30.0	30.0	30.4
Teaching Associate	25.5	26.0	30.7	27.1	26.8
Tenure Track	18.8	19.7	23.6	22.9	20.7
Total	23.3	24.6	27.1	26.8	25.4
Total Instructional SFR by Course Level					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Pre-College	--	--	30.1	27.9	27.6
Lower Division	25.7	27.2	27.6	29.2	29.3
Upper Division	21.6	18.6	21.9	20.3	15.8
Graduate Division	14.1	9.1	16.0	12.6	12.5
Average Instructional SFR by Course Type					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Activity	--	--	--	--	--
Lab	--	--	--	--	--
Lecture	25.2	26.0	27.8	27.4	26.5
Seminar	14.1	6.6	14.7	13.9	19.2
Supervision	--	5.6	--	2.8	3.8
Course Information					
Sections					

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Total	90	89	90	95	96
Average Enrollment					
Class Type	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Activity	0.0	0.0	0.0	0.0	0.0
Lab	0.0	0.0	0.0	0.0	0.0
Lecture	25.7	26.6	26.0	27.4	27.7
Seminar	13.7	9.7	8.8	8.5	10.7
Supervision	0.0	1.0	0.0	1.0	1.5
Total	25.3	25.7	25.2	26.4	26.1
Majors					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Enrollment Count	182	174	194	153	184
% of Enrollment	8.0%	7.6%	8.6%	6.1%	7.4%
General Education					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Enrollment Count	719	704	716	753	778
% of Enrollment	31.6%	30.8%	31.6%	30.1%	31.1%
Repeat Enrollments					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Repeats	281	328	336	338	313

% of Enrollment	12.3%	14.3%	14.8%	13.5%	12.5%
Waitlist (unduplicated by course)					
	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Waitlist	9	13	18	24	10
% of Enrollment	0.4%	0.6%	0.8%	1.0%	0.4%