

## Program Assessment Report (PAR) Template Part I (Revision for 2020)

### Program: Bachelor in Computer Science

1. **Mission:** What is the mission of your program? How does it align with the mission of the college and university? How do your PLOs inform or reflect your mission? [250 words max]

**Mission:** Our mission is to provide a high-quality undergraduate and graduate education in computer science that prepares students for productive careers and lifelong learning.

**Program Educational Objectives (PEOs):** Within a few years of graduation, graduates of the Bachelor of Science in Computer Science program will be actively contributing individually and in teams, ethically applying expertise to solve problems, effectively communicating, and building on their knowledge to grow in their careers.

**Student Outcomes:** The computer science program will enable students to attain, by the time of graduation:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing based solutions.

Our mission, objectives, and outcomes, with consistent focus on high-quality preparation for lifelong success, align closely with the College of Engineering mission: "With an unshakeable focus on learning, we empower all to think critically and solve our world's complex challenges," and the University's mission of offering programs that foster innovation and creativity, student success, and lifelong learning.

2. **Assessment Process:** Responses to this item reflect the **current state** in the department/program. Provide a current 'snapshot' of your PLO assessment process.
  - a. *Engagement & Process:* Describe how the department discusses, uses, and shares information about student learning outcomes achievement (i.e., How does the assessment process work beyond individual courses? Who is involved? How do the department's faculty interact around this topic? How often? How are results shared and with whom?). [750 words max]

Assessment is driven and shaped by our program's ABET-CAC (Accreditation Board for Engineering and Technology – Computing Accreditation Commission) requirements. An annual assessment report prepared by a subset of the department undergraduate curriculum committee and including the most recent assessments (all within the previous two years) of all student educational outcomes (SEOs) is presented to all department faculty each fall. It is also shared with the department's industrial advisory board (IAB). These reports inform continuous improvement efforts, particularly when any particular assessment fails to meet satisfaction criteria. Every six years or less, the program is evaluated for re-accreditation by ABET-CAC, for which a comprehensive self-study report that includes all assessments since the prior visit is assembled. All reports are also annually reviewed by the College of Engineering Accreditation Committee which oversees and supports all COEN department accreditation efforts.

Each individual SEO is assessed at least biennially, if not annually, via one or more instruments in relevant required courses in the major as defined in the Assessment Plan maintained by the department. The assessment instruments consist of the Senior Outcome Assessment (an external professional exam), Alumni Surveys, Alumni Focus Groups, In-Class Assessments, feedback from the Industrial Advisory Board, Senior Exit Surveys and Employer Surveys. Most SEOs are assessed in two or more courses with the exception of Outcome 4 regarding

legal and ethical principles which is assessed in the one, most relevant, required course. When a course is scheduled for outcome assessment, the course coordinator and any other instructors of course sections in that semester participate in gathering and reporting on instrument data and in identifying opportunities for continuous improvement related to the outcome. See here for the current assessment plan:

<http://cs.boisestate.edu/~mvail/assessment/assessment-plan.pdf>

- b. *Strengths & Challenges*: What is going well in the assessment of this program? Are there any challenges, gaps, or areas for improvement in the assessment of this program? [250 words max]

We are fortunate that most department faculty are familiar with our assessment processes and are willing to collect relevant data and report on their assessment results in a timely manner when assessment is scheduled in their courses. We are also fortunate that department faculty as a whole are passionately invested in continuous improvement of the program, as well as individual courses, so continuous improvement has not required any heavy-handed oversight. Faculty are eager to address any opportunities for improvement revealed by assessment.

While transitioning to a new set of student educational outcomes presented a challenge, it went smoothly. We intentionally started the process early to allow plenty of time to reveal and address any issues. We were able to involve course coordinators and other impacted faculty throughout the process and the first rounds of assessment under the revised plan and with new and revised instruments went very well.

3. **Continuous Improvement**: Responses to this item are **backwards looking** in that you are reflecting on action items and next steps that were identified in your last report.

- a. *Curriculum, instructional, or programmatic changes* (see previous PAR Template II, column 4; previous Curriculum Map; and Follow-Up Report, question III): Were you able to address action items and next steps identified in your last report? Please refer to specific items and discuss the 2-4 most significant changes. Discuss items that were not addressed, those you are continuing to work on, or new items that were substituted for the original action items/next steps. If new items were introduced, please provide brief rationale. [750 words max]

The last PAR review report highlighted the increased use of evidence-based practices (EBIPS) to engage students, e.g. group activities in CS230. Since then, we have introduced an earlier required prerequisite course CS-HU 130 (Foundational Values), which introduces ethics and diversity in computing. Specifically, in that course, students do group activities (graded) where they discuss ethical issues. They are also introduced to a formal rubric that they can use in ethical situations to guide their thinking. This is now being propagated to multiple courses (including CS 230) this year. Another change has been the emphasis on evidence-based practices in the tenure progress and annual review of faculty. With more than 2/3rds of the faculty having joined within the last four years, this has helped increase the adoption of EBIPS.

One of the reviewers asked if the ULOs were being addressed by CS 230 and CS 481 (Senior Design, FF) courses. ULOs 1 and 2 address the written and oral communication that both are covered by PLO 3, which is formally assessed by Review of Student Work in CS 230. Note that ULO 1 mentions writing in multiple contexts, for a variety of audiences. PLO 3 mentions a variety of professional contexts. We have chosen to interpret that a professional should be able to address multiple contexts. In the Senior Design (CS 481) course, the teams have to write, present and demo their projects to the general public (as part of the public showcase at the end of the class). FF are supposed to address ULOs 1-4. Our senior design course addresses all six PLOs, which cover the four ULOs 1-4. ULOs 3-4 are being formally assessed as part of our ABET assessment. ULOs 1-2 are being reinforced by being used (and graded) as part of the Senior Design course.

- b. *Assessment process changes or improvements* (see previous PAR Template 1, question 6 and/or any self-identified areas for improvement): Have you made any changes to address the challenges, gaps, and/or areas for improvement identified in the assessment process? [250 words max]

Beginning optionally for the 2018-19 school year and mandatory thereafter, ABET-CAC introduced a new replacement set of outcomes for all computing programs that required substantial revision to the department's Assessment Plan, course/outcome mappings, and replacement or revision of previous assessment instruments. The department (along with other COEN departments affected by similar ABET outcome revisions) elected to adopt the new criteria for the 2018-19 year. A transition plan mapping old outcomes and instruments to new outcomes and appropriate relevant courses was developed and presented to faculty. The Assessment Plan was revised accordingly and assessments have been carried out according to the revised plan and version 2 outcomes since fall 2018. The inexact mapping of old to new outcomes left a few gaps where there were not the usual multiple data points in each two-year window for the first year, but that gap is closed after a second year under the new plan. See <http://cs.boisestate.edu/~mvail/assessment/> for more details.

- c. *Response to scores of "no evidence" or "beginning:"* If your program received such ratings on the last PAR, please indicate specifically what has been done to move the program forward in these areas? [250 words max]

No such ratings were received on the last PAR.

4. **Curriculum Map:** Complete the Curriculum Map Template and provide a summary analysis based on the following questions.

- Are students provided with multiple learning opportunities to develop the learning outcomes?
- Are courses in the major sequenced in a logical pattern to facilitate student achievement of the learning outcomes?
- How are learning experiences such as internships, service-learning courses, or other opportunities reflected on the map and how do they support the development of the PLOs?

Undergraduate programs, please also address:

- Considering ULOs 1 through 6, which ULOs are reinforced within your curriculum and to what extent? How are students provided with opportunities to develop these outcomes prior to and during their Finishing Foundations experience? Provide relevant examples as appropriate.

Review of the Curriculum Map shows that each PLO is addressed in at least four courses and each ULO is addressed in at least three courses. See below for how many times each ULO is addressed in the combination of foundation and major-specific courses.

ULO#	#Courses
1	8
2	5
3	4
4	6
5	4
6	3

Looking across the rows, we see that each PLO (and ULO as a result) has a good mix of I(introduce), R(einforce) and Em(phasize) categories so students can progress in their development of outcomes. For example, ULO 4 (Innovation and Teamwork) is introduced in CS-HU 130 (Foundational Values), where student teams analyze complex ethical problems associated with computing and create novel solutions to mitigate. Then in CS 230 (Ethical Issues in Computing), student teams develop and present a term paper on an ethical problem. In CS-HU 271 (Agile Development), student teams learn how to use agile development process to develop software products as a team. Then the students continue on to CS 321 (Data Structures) course, where the final project is developed as a team using concepts developed in earlier courses such as CS-HU 130 and CS-HU 271.

During Senior Design (CS 481), students address ULOs 1-4. ULO 1 and 2 (Written Communication and Oral Communication) is emphasized throughout the semester. The students work in teams with external sponsors on projects, so they have to communicate with the sponsors that come for a variety of backgrounds (technical and

non-technical). They have to communicate within the team to collaboratively develop a solution. At the end of the semester, they have to present at the senior design showcase, which is open to the public. ULO 3 (Critical Inquiry) and ULO 4 (Teamwork and Innovation) are core elements of the Senior Design course. Each problem is a real-life unique situation, which requires critical inquiry by the team to develop solutions within time and resource limits.

Internships aren't an official part of the program. Around 70-80% of the students hold paid internships with industry or research positions with faculty. Since the credits for internships aren't required, most students do not sign up for them. However, the department maintains very active connections with industry and curates plenty of opportunities for students. One example is the weekly industry seminar on Fridays in both spring and fall. This exposes students to different companies and most companies actively recruit via these seminars.

Service learning is gaining popularity with several faculty. It has been used in several elective courses last year. However, at present they aren't on a required path in the undergraduate program. That is something the department will consider in the future as faculty expertise in service learning grows.

## Program Assessment Report (PAR) Template Part II (Revision for 2020)

### Program: Bachelor in Computer Science

<p><b>List the Current Intended Program Learning Outcomes</b> (one per row, typically 6-8 per program) Learner-centered statements that address: What should students know, be able to do, and become as a result of completing the program?</p>	<p><b>Measures Used to Assess Outcomes</b> What evidence is used by the department/ program to determine whether the outcome has been achieved?</p> <p><b>Direct measure(s)</b> such as portfolios, embedded assignments, lab reports, etc.</p> <p><b>Indirect measure(s)</b> such as surveys, focus groups, etc. of students, alumni, employers, supervisors, etc.</p> <p><b>Informal method(s)</b> such as faculty observations, informal reports, discussions, etc.</p>	<p><b>Interpretation of Key Findings</b> What have you discovered about student learning in each of the intended learning outcomes areas?</p>	<p><b>Actions Taken or Planned Based on Findings</b> Based on the assessments and results reported in this table, how have or will the findings be used by the faculty to make changes to the curriculum, specific courses, and/or to the pedagogy used in the program? Please report: (1) actions already taken, and/or (2) actions planned for the future. Provide relevant examples.</p> <p>* NOTE: These items reflect new action items based on assessment reported in this table. You will report on these action items in your next assessment report.</p>
<p>EXAMPLE: Apply literary criticism in the traditions of the discipline.</p>	<p>EXAMPLE: Review sample of entry-level assignments from XYZ 150 using a rubric – establishes baseline. Review of sample of final projects from XYZ 450 by program faculty to consider course and program revisions.</p>	<p>EXAMPLE: The sample of graduating projects did not show as much growth as expected. We expected to see more students achieving mastery on this PLO. Approximately 35% of the graduating seniors were mastering this outcome – we are targeting 60%</p>	<p>EXAMPLE: After reviewing the assessment results and our curriculum map, we noticed this topic was not being developed so we added PLO to XYZ 280 and XYZ 350. We expect to see a 60% of students mastering PLO by our next PAR reporting cycle.</p>
<p><b>Note:</b> We had to completely change our PLOs in 2018-2019 due to accreditation changes from ABET. Our assessment cycle is 2 years long. As a result, we do not have a full data set for all the PLOs. We though by the end of 2019-2020 assessment cycle at the start of Fall'20.</p>			
<p>1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.</p>	<p>1. CS MFT exam (prepared by an external, national board and administered by ETS) 2. Senior Exit Surveys 3. CS 354 (Programming Languages):</p>	<p>1. Students scored at 92<sup>nd</sup> percentile and 96<sup>th</sup> percentile in two categories of the exam that measure this outcome as compared to 200+ other CS departments. This was in 2018-2019, the last data point. Preliminary results from</p>	<p>• In CS 354, students had trouble identifying appropriate “competing” languages for comparison. The instructor will add a pre-submission to coach the students.</p>

	<p>students analyze a new programming language and present on a website</p> <ol style="list-style-type: none"> <li>4. CS 453 (Operating Systems): Device driver project</li> <li>5. CS 481 (Senior Design): Product Backlog scrum document that measures requirements analysis</li> <li>6. CS 421 (Algorithms): Specific exam problems</li> </ol>	<p>this year at a higher level.</p> <ol style="list-style-type: none"> <li>2. In CS 453, 79% of the students achieved success. In CS 354, 90% of the student teams achieved success.</li> <li>3. CS 421 and CS 481 will be assessed at the end of the 2019-2020 cycle as changed the outcomes in 2018 to a new set</li> </ol>	<ul style="list-style-type: none"> <li>• The Senior Exit Survey had the old outcomes, which were replaced in 2018 so the results cannot be used. We have fixed the survey this year and will have usable data at the end of the 2019-2020 cycle</li> </ul>
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.	<ol style="list-style-type: none"> <li>1. CS MFT Exam</li> <li>2. Senior Exit Survey</li> <li>3. CS 321 (Data Structures): Final project</li> <li>4. CS 481 (Senior Design): Semester long project</li> </ol>	<ol style="list-style-type: none"> <li>1. Students scored at 77<sup>th</sup> percentile in the country in the subarea that covers this PLO in the MFT. Our minimum expectation is 70<sup>th</sup> percentile</li> <li>2. Data on CS 321 and CS 481 will be analyzed in the 2019-2020 cycle</li> </ol>	
3. Communicate effectively in a variety of professional contexts.	<ol style="list-style-type: none"> <li>1. Senior Exit Survey</li> <li>2. CS 230 (Ethical Issues in Computing): Student teams researched and presented a topic</li> <li>3. CS 354 (Programming Languages)</li> </ol>	<ol style="list-style-type: none"> <li>1. Success rate in CS 230 and CS 354 were at 98% and 100%. The high success rate is correlated to the improvements in University Foundational courses as well as the Technical Writing course (old number ENGL 202)</li> </ol>	<ol style="list-style-type: none"> <li>1. Some students didn't start with a clear thesis so remind students about the importance of stating a clear thesis at the start of the presentation</li> </ol>
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.	<ol style="list-style-type: none"> <li>1. Senior Exit Survey</li> <li>2. CS 230 (Ethical Issues in Computing): Study and analyze licenses</li> </ol>	<ol style="list-style-type: none"> <li>1. Students achieved a 94% success rates based on review of their class assignments.</li> </ol>	
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.	<ol style="list-style-type: none"> <li>1. Senior Exit Survey</li> <li>2. CS 321 (Data Structures): Final project based on teamwork</li> <li>3. CS 481 (Senior Design): Semester long project that includes quantitative peer assessment</li> </ol>	<ol style="list-style-type: none"> <li>1. Since we restarted with new outcomes in 2018-2019, this outcome hasn't been assessed yet as we have a two-year cycle. The raw data for 2019-2020 has been collected and an analysis will be ready by Fall'20</li> </ol>	
6. Apply computer science theory and software development fundamentals to produce computing based solutions.	<ol style="list-style-type: none"> <li>1. Senior Exit Survey</li> <li>2. CS MFT Exam: aggregate mean results</li> <li>3. CS 361 (Theory of Computing): Programming Project that made students apply concepts from class</li> <li>4. CS 453 (Operating Systems): Advanced Programming Project to develop a software library</li> </ol>	<ol style="list-style-type: none"> <li>1. Students scored at the 90<sup>th</sup> percentile on the overall MFT exam as compared to around 200 other CS departments nationally</li> <li>2. Success rate was 82% in CS 361 and 94% in CS 453</li> </ol>	<ol style="list-style-type: none"> <li>1. Plagiarism was identified as an issue during the assessment of CS 361 (but not enough students to fail the overall assessment). The class coordinator will modify the instrument to reduce the chances of plagiarism</li> </ol>

