Annual Academic Assessment Report Cover Sheet

Assessment reports are due the 1st Wednesday after the Fall Term
Email to: assessment@unlv.edu

Program Information:

<table>
<thead>
<tr>
<th>Program Assessed</th>
<th>Computer Science BS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>Computer Science</td>
</tr>
<tr>
<td>College</td>
<td>Engineering</td>
</tr>
<tr>
<td>Department Chair</td>
<td>Sidkazem Taghva</td>
</tr>
<tr>
<td>Assessment Coordinator</td>
<td>Wolfgang Bein</td>
</tr>
<tr>
<td>Date Submitted</td>
<td>12/17/2018</td>
</tr>
</tbody>
</table>

Contact Person for This Report

<table>
<thead>
<tr>
<th>Name</th>
<th>Wolfgang Bein</th>
</tr>
</thead>
<tbody>
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<td>x51477</td>
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<tr>
<td>Email</td>
<td><a href="mailto:wolfgang.bein@unlv.edu">wolfgang.bein@unlv.edu</a></td>
</tr>
</tbody>
</table>

Please attach a narrative (not to exceed 4 pages, excluding appendices) addressing the following:

- What are the student learning outcomes? Please provide a numbered list.
- Which learning outcomes were assessed?
- How were they assessed? (Programs must use at least one direct assessment of student learning.)
- Undergraduate programs should assess at least one University Undergraduate Learning Outcome (UULO) each year, which may or may not overlap with a program learning outcome.
- Graduate programs should assess at least one outcome related to one of the following graduate level requirements each year:
  - student engagement in research, scholarship, creative expression and/or appropriate high-level professional practice.
  - activities requiring originality, critical analysis and expertise.
  - the development of extensive knowledge in the field under study.
- What was learned from the assessment results?
- How did the program respond to what was learned?

Please limit the narrative portion of your report to no more than four pages. You may attach appendices with data, tables, charts, or other materials as needed. Please explain the relevant conclusions from any appendices in your narrative. Please contact the Office of Academic Assessment if you have questions or need assistance.
Assessment Report

Program: BS in Computer Science

Submitted by

Wolfgang Bein

Department of Computer Science

University of Nevada, Las Vegas

December 2018
I. Introduction

Outcomes Assessed in 2018

Following 5 Outcomes (out of the 8 total outcomes) were assessed.

- **Outcome C**: Apply computer science theory and mathematical models to comprehend the tradeoffs involved in various design choices.
- **Outcome D**: Use current tools or techniques to implement and evaluate programs or computer-based systems.
- **Outcome F**: Communicate effectively with a range of audiences.
- **Outcome G**: Effectively communicate the professional, ethical, legal and security impacts associated with computing practice.
- **Outcome H**: Be proficient in an application area of computing and be able to explain the importance of maintaining professional development.

Both Direct Assessment and Indirect Assessment methods were used to assess the above outcomes

**Direct Assessment** was done by using either (i) Selected Question Method, or (ii) Model Question Method. Assessment questions in these methods were prepared by the instructors who taught the courses closely related to the corresponding outcomes. These assessment exams were scheduled at the end of the semester. For either method chosen by the instructor, the answers given by the students were organized in a rubric-categorized table. In this table, performance of student’s answers is grouped into four categories: (i) Unsatisfactory, (ii) Below Expectation, (iii) Satisfactory, and (iv) Exceeds Expectation. The tabulated responses are evaluated by the instructor to prepare semester-end assessment pages for each course. Results of the direct assessments for each outcome are summarized in a table. A threshold of 70% of students scoring satisfactory or more was set by the Assessment Committee as successful achievement of the outcome.

**Indirect Assessment** was done by using the following two instruments:
- Semester-end evaluations of outcomes by students taking the course. The responses were grouped into four categories: (i) Excellent, (ii) Good, (iii) Neutral, (iv) Fair, and (v) Poor. A median score of Good or better is considered achieving satisfactory outcome
- Exit Interviews. Each graduating student in their 4th year is given a questionnaire to collect their input regarding the level of achievement in each of eight student learning outcomes.
II. Assessment Results

Direct Assessment of Outcome C:

Courses used to cover Outcome C:

- CS 302 (1,2): Data Structures

Direct Assessment examinations were given by instructors of the course sections listed above to cover Outcome C on the final week of the semester. Tabulated results of direct assessment (Percentage Distribution) are as shown in the following table:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Unsatisfactory (U)</th>
<th>Below Expectation (BE)</th>
<th>Satisfactory (S)</th>
<th>Exceeds Expectation (EE)</th>
<th>Remark for S+EE (Is it &gt;= 70% Threshold?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2018</td>
<td>6.31</td>
<td>17.12</td>
<td>54.95</td>
<td>21.62</td>
<td>76.58 (&gt;=70%)</td>
</tr>
</tbody>
</table>

- Overall Results for Outcome C: In Spring, the targeted threshold of 70% was achieved by a significant margin.

- Notable suggested improvement(s) by instructor(s) and Assessment Committee:
  
  o **Consistency of Assessment across Sections:** Efforts are under way to standardize assessment questions across sections of the same course. For example, in Spring 2018, CS 302 assessment tests were synchronized (with minor changes for individual courses). It is intended to expanded this to other courses in subsequent semesters.

  o **Milestone Project:** The milestone course for the BS program is CS 302. In the milestone course the milestone project is an open-ended with some real-world applicability. Specifically, students are required to perform the design and submit a design document. The selection of data structures with applicable customization is left completely to the student. In section 1, the milestone project was a social network analysis (SNA) effort. This required students to create a series of SNA functions for large social networks including identification of influencer's (based on Eigen centrality), connected components, and using data from real anonymized social networks. The percentage of students completing this project satisfactorily was 91%. In section 2, the milestone project was an airport simulation. This required students to set up an event simulation and use appropriate data structures to implement an event container and a gate container. The percentage of students
completing this project satisfactorily was 71%. It is suggested that these milestone projects be further coordinated across section.

- **Enforcing Prerequisite**: Almost no students did not fulfill prerequisites. The department will continue to be vigilant on this issue.

**Direct Assessment of Outcome D**

Courses used to cover Outcome D:

- CS 218 (1,2): Assembly Language and Systems Programming
- CS 219 (2): Computer Organization
- CS 326 (1,2): Programming Languages, Concepts, and Implementation
- CS 370 (1,2): Operating Systems
- CS 472 (1): Software Engineering

Direct Assessment examinations were given by instructors of the course sections listed above to cover Outcome D on the final week of the semester. Tabulated results of direct assessment (Percentage Distribution) are as shown in the following table:

<table>
<thead>
<tr>
<th>Outcome D</th>
<th>Unsatisfactory (U)</th>
<th>Below Expectation (BE)</th>
<th>Satisfactory (S)</th>
<th>Exceeds Expectation (EE)</th>
<th>Remark for S+EE (Is it &gt;= 70% Threshold?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2018</td>
<td>4.25</td>
<td>15.30</td>
<td>45.89</td>
<td>34.56</td>
<td>80.45 (&gt;=70%)</td>
</tr>
</tbody>
</table>

- Overall Results for Outcome D: In Spring, the targeted threshold of 70% was achieved by a healthy margin.

- **Notable suggested improvement(s) by instructor(s) and Assessment Committee:**
  - **Early Intervention**: As part of a College of Engineering (CoE) wide effort, the Department of Computer Science in coordination with the CoE Academic Advising has performed extensive early intervention activities to benefit Outcome D. In Spring 2018, the scope of early intervention efforts was expanded. The intervention included working with the instructors and academic advising staff to identify issues, apply tutoring, and/or make schedule adjustments as appropriate. A CoE tracking system for identified early intervention was developed and deployed. It was decided for now to primarily focus on 100 and 200 level core courses, and consider expansion of early intervention course coverage to 300 level courses at a later time. Since there are a number of new CS instructors, CS hosted an informal get together with the instructors teaching 100 and 200 level courses, including the new instructors. The meeting helped introduce new instructors to
the new Academic Advising staff and served communicate the process and timeline for reporting under-performing students. From the meeting, a recommendation evolved regarding early reporting for students who are "no-show" (no attendance, no assignment submittals) within the first two weeks. It was further recommended that CS and Academic Advising investigate the possibility of an administrative drop for such "no-show" students. Additionally, a new reporting process is being implemented (spreadsheet-based) and a series of CS instructors volunteered to use and test the new system this semester. This represents a significant improvement from the previous reporting process.

Over the summer, a series of meetings occurred in an attempt to perform more aggressive intervention actions. This includes the possibility of more direct and timely CoE advising sessions. In future semesters, adding lab's sessions to some 200 level course with the primary intent of improving overall class is being considered.

- Enforcing Prerequisite: The Assessment Committee had previously recommended the need to close the loopholes in prerequisite enforcement to weed out students without the correct background. Almost no students did not fulfill prerequisites.

**Direct Assessment of Outcome F:**

Courses used to cover Outcome F:
- CS 301 (1): Social Implications of Computer Technology
- CS 472 (1): Software Engineering

Direct Assessment examinations were given by instructors of CS 301 to cover Outcome F on the final week of the semester. CS 472 includes a capstone project and students’ final capstone project presentations were assessed. During these project presentations, faculty and two industry professionals assessed the students on this outcome.

Tabulated results of direct assessment (Percentage Distribution) are as shown in the following table:

<table>
<thead>
<tr>
<th>Outcome F</th>
<th>Unsatisfactory (U)</th>
<th>Below Expectation (BE)</th>
<th>Satisfactory (S)</th>
<th>Exceeds Expectation (EE)</th>
<th>Remark for S+EE (Is it &gt;= 70% Threshold?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2018</td>
<td>0.00</td>
<td>2.33</td>
<td>44.19</td>
<td>53.49</td>
<td>97.67 (&gt;=70%)</td>
</tr>
</tbody>
</table>
Overall Results for Outcome F: The targeted achievement level is satisfied by a healthy margin.

Notable suggested improvement(s) by instructor(s) and Assessment Committee.
- It was suggested that the presentation evaluation metrics could be made more precise.

Direct Assessment of Outcome G:

Courses used to cover Outcome G:
- CS 301: Social Implications of Computer Technology

Direct Assessment examinations were given by instructors of CS 301 to cover Outcome G on the final week of the semester. Tabulated results of direct assessment (Percentage Distribution) are as shown in the following table:

<table>
<thead>
<tr>
<th>Outcome G</th>
<th>Unsatisfactory (U)</th>
<th>Below Expectation (BE)</th>
<th>Satisfactory (S)</th>
<th>Exceeds Expectation (EE)</th>
<th>Remark for S+EE (Is it &gt;= 70% Threshold?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2018</td>
<td>0.00</td>
<td>0.00</td>
<td>60.87</td>
<td>39.13</td>
<td>100.00 (&gt;=70%)</td>
</tr>
</tbody>
</table>

Overall Results for Outcome G: In Spring 2018 the targeted threshold of 70% was fully achieved.

Notable suggested improvement(s) by instructor(s) and Assessment Committee.
- Though coverage was expanded, students still had difficulty fully appreciate the ethical codes of professional associations. Emphasis will continue to be placed on the coverage the ethics codes of various professional organizations.

Direct Assessment of Outcome H:

Courses used to cover Outcome H:

- CS 449 (1) Computer and Network Forensics
- CS 458(1) Introduction to Data Mining
- CS 482 (1) Artificial Intelligence
- CS 489 (1) - Advanced Computer Science Topics
Direct Assessment examinations were given by instructors of CS 489 to cover Outcome H on the final week of the semester. Tabulated results of direct assessment (Percentage Distribution) are as shown in the following table:

<table>
<thead>
<tr>
<th>Outcome H</th>
<th>Unsatisfactory (U)</th>
<th>Below Expectation (BE)</th>
<th>Satisfactory (S)</th>
<th>Exceeds Expectation (EE)</th>
<th>Remark for S+EE (Is it &gt;= 70% Threshold?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2018</td>
<td>1.03</td>
<td>10.31</td>
<td>51.55</td>
<td>37.11</td>
<td>88.66 (&gt;=70%)</td>
</tr>
</tbody>
</table>

**Overall Results for Outcome H:** Outcome for outcome H were fully achieved in CS 489 (3). Similar results occurred in the other sections of 489, into which outcome H maps. The students are highly engaged in application areas.

- **Notable suggested improvement(s) by instructor(s) and Assessment Committee**
  - Exit Interviews from Spring 2018 continue to suggest the department offer a significant number of courses in applications areas relevant to IT practitioners; generally, suggestions in Spring 2018 are similar to those made in previous semesters. We have taken the recommendation of the students to heart and we have responded by numerous measures, including courses such as: CS 489 Big Data (Dr. Zhan), CS 489 Cloud Computing (Dr. Zhan), CS 420 Human Computer Interaction (Dr. Nazos), CS 490: Green Computing (Dr. Bein), CS 443 Information Assurance (Dr. Jo), CS 445 Internet Security (Dr. Kim), UNLV’s Hackathon (embedded in CS 445), CS 140 Python (Nyknahad), and also Python use in CS 326 (Hall). In the exit interviews, a few students mentioned introduction of more hardware-oriented courses, as well as robotics. It is noted that in these areas overlap exists with the ME and EE departments; the advising center is informing students during advising.

  - **Special Topics:** A number of exit interview suggestions mentioned specific programming languages or development environments. Specialized skills can and will be covered in independent study courses or special topics courses; however, the assessment committee recommends against turning the program too vocational.
Indirect Assessment for Outcomes D, F, G, and H

Courses evaluated by students for
- Outcome C: CS 301 (Section 1, 2)
- Outcome D: CS 218 (Section 1, 2), CS 219 (1), CS 326(1,1) CS 370 (1,2).
- Outcome F: CS 301 (1, 2, 3), CS 472 (1).
- Outcome G: CS 301 (1, 2, 3).
- Outcome H: CS 449 (1), CS 458 (1), CS 482 (1), CS 489.

Questionnaires for evaluating outcomes covered by the courses were distributed in the class at the end of the semester by an administrative member arranged by Dean Office / CS Office. Responses to these questions were collected and analyzed to access the outcomes. Outcome wise results are as follows:

<table>
<thead>
<tr>
<th>Indirect Assessment Method Results (Spring 2018)</th>
<th>Semester End Course/Instructor Evaluation by Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Achievement Level (E – Excellent, G – Good, N – Neutral, F – Fair, P – Poor, N/A – Not Available)</td>
</tr>
<tr>
<td>Outcome</td>
<td>E</td>
</tr>
<tr>
<td>C</td>
<td>59.15</td>
</tr>
<tr>
<td>D</td>
<td>51.96</td>
</tr>
<tr>
<td>F</td>
<td>37.98</td>
</tr>
<tr>
<td>G</td>
<td>75.82</td>
</tr>
<tr>
<td>H</td>
<td>69.79</td>
</tr>
</tbody>
</table>

Conclusion: For the above 4 outcomes, measured indirectly, the median achievement level is good (G) or better. This means achievement levels for Outcomes C, D, F, G, and H, as measured indirectly, is satisfactory.

Exit Interviews

Each graduating student in their 4th year is given a questionnaire to collect their input regarding the level of achievement in each of eight student learning outcomes. Responses to the outcomes are collected in four categories (Very well, pretty well, somewhat, not at all). In addition, comments can be provided.

Summary results from responses for outcomes D, F, G and H are as follows:
### Summary Results of Senior Exit Interview Outcomes D, F, G and H (Spring 2018)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>very well</th>
<th>petty well</th>
<th>somewhat</th>
<th>Not at all</th>
<th>% of students rating at least “pretty well”</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14</td>
<td>11</td>
<td>5</td>
<td>0</td>
<td>83.33</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>15</td>
<td>3</td>
<td>0</td>
<td>90.00</td>
</tr>
<tr>
<td>F</td>
<td>16</td>
<td>9</td>
<td>5</td>
<td>0</td>
<td>83.33</td>
</tr>
<tr>
<td>G</td>
<td>18</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>93.33</td>
</tr>
<tr>
<td>H</td>
<td>26</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>96.67</td>
</tr>
</tbody>
</table>

**Comments from students on the exit interview:** A number of exit interview suggestions mentioned specific programming languages or development environments. Specialized skills can and will be covered in independent study courses or special topics courses; however, the assessment committee recommends against turning the program too vocational.

**Assessment Result for University Undergraduate Learning Objectives (UULO’s)**

Both CS 301 and CS 472 emphasize written and oral communication components. Outcome F overlaps with UULO’s communication objectives such as effectively using the common genres and conventions for writing within a particular discipline, delivering effective oral presentations and production of effective visuals using different media. The direct assessment of Outcome F for CS 301 and CS 472 shows that over 98% of students achieved satisfactory or better. Thus almost all students achieved the UULO’s communication goals. Outcome G in CS 301 also includes the UULO’s Citizenship and Ethics goal, namely to examine various concepts and theories of ethics, and how to assess claims about ethical issues and to apply ethical concepts and to specific ethical dilemmas students will experience in their professional lives. The direct assessment of Outcome G for CS 301 shows that over 94% of students achieved satisfactory or better; almost all students achieved the UULO’s Citizenship and Ethics goals.

**III. Plan for Next Assessment Period (Spring 2019 and Fall 2019)**

- Repeat assessment of Outcomes A, B, C, D, previously done in 2017, by using both direct and indirect methods.
- Analyze assessed data to obtain key findings.
- Follow-up on the suggestions for improving outcomes as recommended in this assessment period.