Annual Program Assessment Report

Academic Year Assessed: AY 2018-2019
College: NACOE
Department: Gianforte School of Computing
Submitted by: John Paxton

Assessment reports are to be submitted annually by program/s. The report deadline is September 15th .

Program(s) Assessed:

Indicate all majors, minors, certificates and/or options that are included in this assessment:

Majors/Minors/Certificate	Options
Computer Science B.S.	**Professional and Interdisciplinary**

Annual Assessment Process (CHECK OFF LIST)

1. Data are collected as defined by Assessment Plan
   YES__x___ NO_____
2. Population or unbiased samples of collected assignments are scored by at least two faculty members using scoring rubrics to ensure inter-rater reliability.
   YES__x___ NO_____
3. Areas where the acceptable performance threshold has not been met are highlighted.
   YES__x___ NO_____ NA_____
4. Assessment scores were presented at a program/unit faculty meeting.
   YES__x___ NO_____
5. The faculty reviewed the assessment results, and responded accordingly (Check all appropriate lines)
   Gather additional data to verify or refute the result. _____
   Identify potential curriculum changes to try to address the problem _x____
   Change the acceptable performance threshold, reassess _____
   Choose a different assignment to assess the outcome _____
   Faculty may reconsider thresholds_____
   Evaluate the rubric to assure outcomes meet student skill level _____
   Use Bloom's Taxonomy to consider stronger learning outcomes _____
   Choose a different assignment to assess the outcome_____

   OTHER: Learning outcomes are updated for AY 2020. A new custom exam will be used.

6. Does your report demonstrate changes made because of previous assessment results (closing the loop)? YES_x____ NO_____

1. Assessment Plan, Schedule and Data Source.

a. Please provide a multi-year assessment schedule that will show when all program learning outcomes will be assessed, and by what criteria (data). (You may use the table provided, or you may delete and use a different format).

ASSESSMENT PLANNING CHART					
PROGRAM LEARNING OUTCOME	2016-2017	2017-2018	2018-2019	2019-2020	***Data Source****
A: an ability to apply knowledge of computing and mathematics appropriate to the discipline	x	x	x	X See note below	Capstone portfolio and custom exam for A-K
B: an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution	x	x	x	x	
C: an ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs	x	x	x	X	
D: an ability to function effectively on teams to accomplish a common goal	x	x	x	x	
E: an understanding of professional, ethical, legal, security, and social issues and responsibilities	x	x	x	x	
F: an ability to communicate effectively with a range of audiences	x	x	x	x	
G: an ability to analyze the local and global impact of computing on individuals, organizations and society	x	x	x	x	
H: recognition of the need for, and an ability to engage in, continuing professional development	x	x	x	x	
I: an ability to use current techniques, skills, and tools necessary for computing practices	x	x	x	x	
J: an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices	x	x	x	x	
K: an ability to apply design and development principles in the construction of software systems of varying complexity	x	x	x	x	

Note: To stay in alignment with ABET accreditation, we are changing our learning outcomes this fall to be:

1. Analyze a complex computing problem and to 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.

We will continue to use the capstone portfolios as an assessment tool, but will update our custom exam to assess these outcomes more effectively.

b. What are your threshold values for which you demonstrate student achievement? (Example provided in the table should be deleted before submission)

Threshold Values		
PROGRAM LEARNING OUTCOME	Threshold Value	Data Source
Example: 6) Communicate in written form about fundamental and modern microbiological concepts	The threshold value for this outcome is for 75% of assessed students to score above 2 on a 1-4 scoring rubric.	Randomly selected student essays
Outcomes A, B, C, D, E, F, G, H, I, J, K	More than half of the students assessed must receive a 3 or 4 on a 1-4 scoring rubric.	Randomly selected portfolios and capstone exams

2. What Was Done

a) Was the completed assessment consistent with the plan provided? YES__x___ NO_____
If no, please explain why the plan was altered.

b) Please provide a rubric that demonstrates how your data was evaluated.

Custom Exam Grading Rubrics

Question 1 – Measures Outcome A: Provide an analysis of the running time of MERGESORT on an unordered array of size n. Include the recurrence relation and provide the solution to it.

1. Incorrect running time or nothing written

2. Correct running time stated, no analysis
3. Correct running time stated, partially correct recurrence relation
4. Correct running time stated, fully correct recurrence and analysis

Question 2 – Measures Outcome A: Identify and explain the running time of QUICKSORT with respect to its worst case, best case and average case behavior on input arrays of size n.

1. Completely incorrect running times or nothing written
2. One case correctly discussed with explanation
3. Two cases correctly discussed with explanations
4. All cases correctly discussed with explanations

Question 3 – Measures Outcome E: Explain the GNU General Public License, and discuss two issues with it.

1. Cannot explain what the GNU GPL is
2. Can explain what it is, but cannot discuss issues
3. Can explain what it is and can discuss one issue
4. Can explain what it is and can discuss two issues

Note: if the student thinks that outsourcing can only occur abroad, take off 1 point but otherwise give credit.

Question 4 – Measures Outcome E: Identify three rules from a Professional Code of Conduct that apply to computing professionals**.**

1. Cannot identify any rules
2. Can identify one rule
3. Can identify two rules
4. Can identify three rules

Question 5 – Measures Outcome G: Define outsourcing and discuss two issues relating to it**.**

1. Incorrect definition or nothing written
2. Correct definition but no further discussion
3. Correct definition and one issue discussed
4. Correct definition and two issues discussed

Question 6 – Measures Outcome G: Discuss three ways that computing impacts individuals and society in either a positive or negative manner**.**

1. Nothing described
2. One way computing impacts individuals and society described
3. Two ways computing impacts individuals and society described
4. Three ways computing impacts individuals and society described

Question 7 – Measures Outcome H: Question 7: List any unpaid community service (e.g. the Gallatin Valley Food Bank or coaching), unpaid university service (e.g. Engineering Ambassadors or Swing Cats) or unpaid departmental service (e.g. AWC or ACM) that you were involved with during your time at MSU.

For each activity, (1) **estimate** the total amount of time that you spent, (2) **describe** briefly your main activities and (3) **list** any officer positions that you held.

1. No involvement
2. Spent 10 hours or less
3. Spent 40 hours or less
4. Spent more than 40 hours

Question 8 – Measures Outcome H: During your time at MSU, list any major non-classroom, non-paid activities that you engaged in to help prepare for your computer science career. For example, you might have taught yourself a programming language or attended a workshop on a CS topic. For each activity, **estimate** the number of hours spent**.**

1. Spent 10 hours or less
2. Spent 50 hours or less
3. Spent 100 hours or less
4. Spent more than 100 hours

Question 9 – Measures Outcome I: Name the most sophisticated IDE that you use and describe three nontrivial features it has**.**

1. No IDE stated or a very basic IDE such as BlueJ is stated
2. A sophisticated IDE stated and one feature described
3. A sophisticated IDE stated and two features described
4. A sophisticated IDE stated and three features described

Question 10 – Measures Outcome K: Name the most sophisticated version control system that you use and describe three nontrivial features it has**.**

1. No version control system stated
2. A version control system stated and one feature described
3. A version control system stated and two features described
4. A version control system stated and three features described

Capstone Portfolio Grading Rubrics

Indicator 1: Program – Measures Outcome C. Attach a source listing of the program that you wrote for your capstone course (CSCI 468 or CSCI 483). Include the specifications for the program.

Evaluation:

1 – No program in portfolio.
2 – Program submitted with no, or incomplete, specifications.
3 – Program did not meet specifications
4 – Specifications and a matching program both submitted.

Indicator 2: Teamwork – Measures Outcome D. Describe how your team worked on this capstone project. List each team member's primary contributions and estimate the percentage of time that was

spent by each team member on the project. Identify team members generically as team member 1, team member 2, etc.

Evaluation:

1 – No team project information in portfolio.
2 – One or more team members did not affect the success of the project.
3 – Some team members only completed a specific component of the project, without regard to the rest of the project.
4 – Demonstrated genuine teamwork, where the team worked together to develop the project.

Indicator 3: Design pattern – Measures Outcome K. Identify one design pattern that was used in your capstone project and describe exactly where in the code it is located. Highlight the design pattern in yellow. Explain why you used the pattern and didn't just code directly.

Evaluation:

1 – No design pattern information in portfolio.
2 – A design pattern was used, but wasn't justified as the best approach.
3 – A design pattern was used, but with incomplete justification.
4 – A fully justified design pattern was used.

Indicator 4: Technical writing – Measures Outcome F. Include the technical document that accompanied your capstone project.

Evaluation:

1 – No technical documentation example in portfolio.
2 – Documentation contained ten or more grammatical and/or spelling errors per page, or was poorly formatted.
3 – Documentation had less than ten grammatical or spelling errors per page, but did not accurately describe the project.
4 – Documentation fully described the project.

Indicator 5: UML – Measures Outcome B. Show UML diagrams for your capstone project. What parts of the UML diagrams did you create?

1 – No UML information in portfolio.
2 – Diagrams and code don't match.
3 – Diagrams and code match, at most two types of UML diagrams used in the project.
4 - Diagrams and code match, more than two types of UML diagrams used in the project.

Indicator 6: Design trade-offs – Measures Outcome J. Describe a design trade-off decision (e.g. execution time *vs.* space requirements or compile time) in your capstone project and justify the design decisions that you made.

Evaluation:

1 – No design trade-off information in portfolio, or the example given is not explained as a design trade-off.
2 – A design trade-off is described, but no justification is given.
3 – A design trade-off is described, but the decision made was not justified correctly.
4 – A design trade-off is described, with correct analysis.

Indicator 7: Software development life cycle model – Measures Outcome I. Describe the model that you used to develop your capstone project. How did this model help and/or hinder your team?

Evaluation:

1 – No life cycle information in portfolio.
2 – Development did not follow the life cycle described.
3 – Development followed the life cycle model described.
4 – Development followed the life cycle model described, and benefits and/or problems were described.

3. How Data Were Collected

a) How were data collected? (Please include method of collection and sample size).

- All 90 graduating seniors took our 75-minute custom exam as part of CSCI 481. 19 exams were randomly selected for grading.
- 20 groups of graduating seniors submitted a CS Professional Option capstone project during Spring 2019 as part of CSCI 468. 7 groups of students were randomly selected for grading by Hunter Lloyd and Binhai Zhu.
- 7 groups of graduating seniors submitted a CS Interdisciplinary Option capstone project during Spring 2019 as part of CSCI 483. 5 groups of students were randomly selected for grading by Hunter Lloyd and Binhai Zhu.

b) Explain the assessment process, and who participated in the analysis of the data.

- Brendan Mumey and John Paxton applied the evaluation rubric to the custom exam. In cases where more than 50% of the students did not receive a 3 or 4 (on a 1-4 scale), the outcome area of the question was identified as a weakness.
- Hunter Lloyd and Binhai Zhu applied the evaluation rubric to the capstone portfolio of the professional option, CSCI 468. In cases where more than 50% of the students did not receive a 3 or 4 (on a 1-4 scale), the outcome area of the indicator was identified as a weakness.
- Hunter Lloyd and Binhai Zhu followed the same process for the capstone portfolio of the interdisciplinary option, CSCI 483.

4. What Was Learned

Based on the analysis of the data, and compared to the threshold values provided, what was learned from the assessment?

a) Areas of strength

- Both evaluators found that at least 90% of our students answered custom exam Questions 5, 6 and 9 effectively. This indicates strong performance on outcomes G and I.
- Both evaluators found that all interdisciplinary option capstones met the criteria for Indicators 4 and 5 effectively. This indicates strong performance on outcomes F and B.
- Both evaluators found that all professional option capstones met the criteria for Indicator 4 effectively. This indicates strong performance on outcomes F.

b) Areas that need improvement

- Custom Exam Question 1 indicated a weakness with respect to Outcome A.
- Custom Exam Question 7 indicated a weakness with respect to Outcome H.
- Indicator 5 for the Professional Option capstone indicated a weakness with respect to Outcome B.
- Indicator 6 for the Interdisciplinary Option capstone indicated a weakness with respect to Outcome J.
- Indicator 7 for the Interdisciplinary Option capstone indicated a weakness with respect to Otucome I.

5. How We Responded

a) Describe how "What Was Learned" was communicated to the department, or program faculty. Was there a forum for faculty to provide feedback and recommendations?

- The CS faculty discussed the weakness regarding Custom Exam Question 1 at our annual retreat in August. We decided that graded recurrence relations should be included in CSCI 232, CSCI 246 and CSCI 432. Additionally, instructors in other courses will incorporate relevant mathematics as appropriate.
- The weakness regarding Custom Exam Question 7 is less critical because Custom Exam Question 8 also measures the same outcome and students performed well on Question 8. In addition, we are redesigning our custom exam to better support the new ABET accreditation learning outcomes that we are adopting this fall.
- The CS faculty discussed the weakness regarding Professional Option Indicator 5 at our annual retreat in August. We decided that the CSCI 468 instructor should remind students of the importance of using UML to communicate the design of their compiler capstone project. Furthermore, the course should remind students of at least one tool that creates UML diagrams.
- The CS faculty discussed the weakness regarding Interdisciplinary Option Indicator 6 at our annual retreat in August. We decided that the CSCI 482 instructor should encourage students to reflect on the software development cycle that they will deploy– before implementation begins.

- The CS faculty discussed the weakness regarding Interdisciplinary Option Indicator 7 at our annual retreat in August. We decided that the CSCI 482 instructor should encourage students to contemplate design trade-off decisions early in the semester – before implementation begins.

b) Based on the faculty responses, will there be any curricular or assessment changes (such as plans for measurable improvements, or realignment of learning outcomes)?
YES___x___ NO_____

If yes, when will these changes be implemented?

The above changes will all result in minor changes to existing courses in the curriculum.

Because we adopted ABET's new learning outcomes for Fall 2019, we have designed a new custom exam and corresponding grading rubric that will be used during AY 2019-2020. Our portfolio evaluation tool does not need to be redesigned and will continue to be used as is.

To meet the new ABET learning outcomes, we have created a new course, CSCI 366, Computer Systems, that will be piloted during Spring 2020.

Please include which outcome is targeted, and how changes will be measured for improvement. If other criteria is used to recommend program changes (such as exit surveys, or employer satisfaction surveys) please explain how the responses are driving department, or program decisions.

Not applicable. Because our learning outcomes are changing, we will be assessing the new learning outcomes this coming year, not the old ones. However, many of the new learning outcomes have a strong relationship to the current ones.

c) When will the changes be next assessed?

Graduating seniors will continue to submit capstone portfolios and take our (revised) custom exam. The CS faculty will next assess the effectiveness of the changes at our annual retreat in August 2020.

6. Closing the Loop

a) Based on assessment from previous years, can you demonstrate program level changes that have led to outcome improvements?

Improvements to individual courses have resulted in improved performance on some learning outcomes where previous weaknesses were identified.

During AY 2019-2020, we will pilot CSCI 366, Computer Systems, during Spring 2020. Without this course, we would no longer be able to meet the recently updated ABET learning outcomes that we adopted.

Submit report to programassessment@montana.edu