Weber State University
Biennial Report on Assessment of Student Learning

Cover Page

Department/Program: Computer Science
Academic Year of Report: 2022/23 (covering Summer 2021 through Spring 2023)
Date Submitted: Nov 15, 2023
Report author: Dr. Hugo Valle

Contact Information:
Phone: (801) 626-7008
Email: hugovalle1@weber.edu

We have updated the Institutional Effectiveness website, which includes an update for each program page. All Biennial Assessment and Program Review reports will now be available on a single page. Please review your page for completeness and accuracy, and indicate on the list below the changes that need to be made. Access your program page from the top-level results page. Select the appropriate college and then your program from the subsequent page.

A. **Mission Statement**

_X__ Information is current; no changes required.

Update if not current:

B. **Student Learning Outcomes**

_X__ Information is current; no changes required.

Update if not current:

C. **Curriculum (please note, we are using Google Sheets for this section so that updates are easier to make)**

_X__ Information is current; no changes required.

Update if not current (you may have access to the Google Sheet if that is easiest, or we can make the updates):

D. **Program and Contact Information**

__X_ Information is current; no changes required.

Overview

The Computer Science program at the School of Computing employs a technical, scientific approach, requiring a solid foundation in mathematics and natural science. The program blends scientific and engineering principles implemented through actual, practical, and applications-oriented experience as well as the intellectual study of computation. It is designed to provide a sound fundamental understanding of logic and of digital computer organization as well as the interaction between hardware, software, and the interconnection of system components. Also emphasized is software engineering which includes understanding operating systems design, implementing the theory of computing, analysis of algorithms, simulation design, and the development of knowledge-based systems. The objectives of the Computer Science program are to provide students with an education that will help them achieve their academic and career goals while simultaneously meeting the needs of industry partners.

Contact Information:

Hugo E. Valle, PhD.
Associate Professor, School of Computing
Computer Science Program Coordinator
Office: 801-626-7008
Noorda Building, Office 242C
1465 Edvalson St, Dept 2401
Ogden UT 84408

School of Computing Website

E. Assessment Plan (please see our website for details on how to develop a program assessment plan)

___ Information is current; no changes required.

We continue our course assessment rotation as stated in the current sheet. A complete assessment of all our courses takes 6 years.

Course	2022-2023	2023-2024	2024-2025	2026-2027	2027-2028	2028-2029
CS 1030 Foundations of Computer Science	CA/RI	Imp				
CS 2130 Computational Structures	CA/RI	Imp				
CS 3230 Object Oriented User Interface Development with Java	CA/RI	Imp				
CS 4110 Concepts of Formal Languages and Algorithms for Comp.	CA/RI	Imp				
CS 1400 Fundamentals of Programming		CA/RI	Imp			
CS 2550 Database Design & Application Development		CA/RI	Imp			
CS 2705 Network Fundamentals and Design		CA/RI	Imp			
CS 3030 Scripting Languages		CA/RI	Imp			
CS 1410 Object-Oriented Programming			CA/RI	Imp		
CS 2450 Software Engineering I			CA/RI	Imp		
CS 3100 Operating Systems			CA/RI	Imp		
CS 4450 Advanced Software Engineering Methods			CA/RI	Imp		
CS 2350 Web Development					CA/RI	Imp
CS 2420 Introduction to Data Structures and Algorithms					CA/RI	Imp

CS 3550 Advanced Database Programming					CA/RI	Imp
CS 4230 Java Application Development					CA/RI	Imp
CS 2810 Computer Architecture/Organization	Imp					CA/RI
CS 3750 Software Engineering II	Imp					CA/RI
CS 3280 Object-Oriented Windows Application Development	Imp					CA/RI
CS 4760 Capstone Project	Imp					CA/RI

CA/RI – Course Assessment and Recommended Improvements (to be approved by CS Faculty and CS Industry Advisory Council)
Imp – Implement Improvements

New: High Impact Educational Experiences in the Curriculum
In response to the recent USHE requirement that all students have at least 1 HIEE in the first 30 credit hours and 1 HIEE in the major or minor we are asking programs to map HIEEs to curriculum using a traditional curriculum grid. This helps demonstrate how and where these goals are accomplished.

Courses	Department/Program use of High Impact Educational Experiences

	HIEE 1	HIEE 2	HIEE 3	HIEE 4	Etc…
CS 2450 - Software Engineering I	In the last 3 modules, students work in teams on a final project using Agile Development practices. The teams rotate roles between a team member or team leader.				
CS 4790 - Capstone Project	Most activities for a capstone course are in teams. The teams work in full-stack projects, including the documentation, implementation and deliverable. Some of these projects directly benefit organizations in our community.				
CS 4850 - Faculty Directed Research	This is a one on one research with a faculty member. Students can practice all the skills from the program and demonstrate competence.				
CS 4890 - INT Cooperative Work Experience	Students can experience and practice their skills in industry. *Note: This is now a requirement for our degree*				

HIEEs include capstone courses or experiences, community-engaged learning, evidence-based teaching practices, internships, project-based learning, study abroad/away, supplemental instruction, team-based learning, undergraduate research, pre-professional/career development experiences.

Additional information (HIEE planning, assessment, or other information):

F. Report of assessment results since the last report:

There are varieties of ways in which departments can choose to show evidence of learning. This is one example. The critical pieces to include are 1) learning outcome being assessed, 2) method(s) of measurement used, 3) threshold for 'acceptable – that is, the target performance, 4) actual results of the assessment, 5) interpretation/reflection on findings 6) the course of action to be taken based upon the interpretation, and 7) how that action will be evaluated.

A. Evidence of Learning: Courses within the Major
(**this is a sample page for purpose of illustration only**; a blank template can be found on the next page or at this site)

Evidence of Learning: General Education, Creative Arts Courses.

Within our program, we offer two General Education courses that encompass the creative arts. The first, CS 1010, falls directly under our program's purview and supervision, ensuring alignment with our educational objectives. The second, ETC 2001, though assigned to a distinct entity, is currently included in our assessment efforts. The development of the ETC 2001 course was prompted by an ABET requirement necessary for our program's certification, further underscoring our commitment to meeting and exceeding accreditation standards.

Gen ED SS Assessment for CS 1010: Introduction to Interactive Entertainment. Analysis form Spring 2023

Gen Ed Learning Goal Students will:	**Measurable Learning Outcome** Students will demonstrate their understanding by:	**Method of Measurement** Direct and Indirect Measures*	**Target Performance**	**Actual Performance**	**Interpretation of findings**	**Action Plan/Closing the Loop**
Students will create works of art and/or increase their understanding of	Learning Outcome 1.	**Creative Assignment Projects:** High Concept Document	85% of students will earn a C or higher on their projects.	50 of 55 (90.9%) students earned a C or higher.	Students are performing nominally near the threshold for	No action required at this time.

creative processes in writing, visual arts, interactive entertainment, or performing arts.		Signature Assignment - Game Design Document			evidence of student learning.	
		<u>Individual Design Practice Questions & Discussions:</u> Games & Video Games Designing & Developing Games Understanding Your Machine Making Money From Your Game Game Worlds The Major Genres Understanding Your Player Game Concepts Creative & Expressive Play Character Development Storytelling Gameplay Core Mechanics Game Balancing Creating the User Experience	85% of students will earn a C or higher on their assignments.	48 of 55 (87.3%) students earned a C or higher.	Students are performing nominally near the threshold for evidence of student learning.	No action required at this time.

GE Learning Goal	Measurable Learning Outcome	Method of Measure.	Target Performance	Actual Performance	Interpretation of findings	Action Plan/Closing the Loop
Students will demonstrate knowledge of key themes, concepts, issues, terminology and ethical standards employed in creative arts disciplines. They will use this knowledge to analyze works of art from various traditions, time periods, and cultures.		**Demonstrate Knowledge in Individual Game Reviews:** Game Review 1 Game Review 2 Game Review 3	85% of students will earn a C or higher on their projects.	52 of 55 (94.5%) students earned a C or higher.	Students are performing nominally near the threshold for evidence of student learning.	No action required at this time.
		Demonstrate Knowledge in Individual Exercises: Character Development Cheese & Quakers	85% of students will earn a C or higher on their projects.	47 of 55 (85.4%) students earned a C or higher.	Findings fall short of the threshold objective. The students who did not reach the stated threshold were students who didn't submit 1 of the 2 exercises. The omitted assignments earned zero points and significantly impacted the overall collective grade for these assignments.	No action required at this time.
		Creative Assignment Projects: High Concept Document	85% of students will earn a C or higher on their projects.	50 of 55 (90.9%) students earned a C or higher.	Students are performing nominally near the threshold for	No action required at this time.

		Signature Assignment - Game Design Document			evidence of student learning.	

*At least one measure per objective must be a direct measure.

ETC 2001: Engineering Culture

Gen ED SS Assessment for ETC 2001. Analysis from Fall 2022, Spring 2023

GEN ED SS Outcome 1
Outcome:
Students will describe how individuals and groups influence and are influenced by social contexts, institutions, physical environments and/or global process.

Method of Measurement:
The following essay question was administered to the students at the end of the fall 2022 semester and at the end of the spring 2023 semester:

> *In a paragraph or two, provide some concrete examples where the course deepened your understanding of the relationship between individual engineers and larger social forces like the engineering profession, government, universities, or industry.*

Threshold:
The threshold for acceptable performance was a good faith effort to answer the question with at least three sentences of prose and an ability to answer the question by reference to topics and readings that were explored in the course.

Findings:
More than 90 percent of students met the threshold in fall 2022 and more than 90 percent met the threshold in spring 2023.

Action Plan:
Our strategy for enhancing this outcome revolves around continually underscoring how individuals are influenced and, to some extent, molded by the society and institutions in which they are immersed. Students often accentuate their individuality, self-reliance, and the capacity to shape their own destinies, all of which are qualities deserving of cultivation. However, these attributes frequently overshadow the impact of broader social forces on individuals. Just as individuals contribute to shaping society, society in turn shapes the individual. Over the course of the many semesters this course has been taught we have striven to dwell on this dialectical relationship and how it manifests itself in the lives of individual engineers and in the engineering profession as a whole. Since the last time this Gen Ed Assessment was formally reported out (in the fall of 2020) new readings have been added that impel students to dwell more on the various ways engineering culture socializes individual engineers into their profession. These readings give students new opportunities to examine how their individual experience is shaped by larger institutional forces. Over time, it's noteworthy that there wasn't substantial variation in this outcome from one semester to the next.

GEN ED SS Outcome 2
Outcome:
Students will apply basic social science concepts, theories, and/or methods to a particular issue and identify factors that influence change.

Method of Measurement:
The following essay question was administered to the students at the end of the fall 2022 semester and at the end of the spring 2023 semester:

> *In a paragraph or two, provide some concrete examples where the course deepened your understanding of historical change and what drives this change. If you can, try to answer this by direct reference to a formal theory of change.*

Threshold:
The threshold for acceptable performance was a good faith effort to answer the question with at least three sentences of prose and an ability to answer the question by reference to topics and readings that were explored in the course.

Findings:
More than 90 percent of students met the threshold in fall 2022 and more than 90 percent met the threshold in spring 2023.

Action Plan:
In general, students excelled in answering this question, with a significant majority surpassing the criteria for acceptable performance. A contributing factor to their success in this category is the extensive exploration of two contrasting theories of historical change in the course: technological determinism and instrumentalism. Consequently, the students are exceptionally well-prepared to excel in achieving this learning outcome. We intend to maintain the current teaching approach due to the positive outcomes it has yielded.

GEN ED SS Outcome 3
Outcome:
Students will identify an argument about a social phenomenon and understand alternative explanations.

Method of Measurement:
The following essay question was administered to the students at the end of the fall 2022 semester and at the end of the spring 2023 semester:

> *In a paragraph or two, provide some concrete examples where you were forced to consider engineering culture, historical change or the Singularity from more than one perspective.*

Threshold:
The threshold for acceptable performance was a good faith effort to answer the question with at least three sentences of prose and an ability to answer the question by reference to topics and readings that were explored in the course.

Findings:
More than 90 percent of students met the threshold in fall 2022 and more than 90 percent met the threshold in spring 2023.

Action Plan:
The course dwells at length on two competing theories of historical change, and the students are intimately familiar with their respective weaknesses/strengths. So a number of students, not surprisingly, answered this question by referring to these two competing theories of change. Additionally, since the course is partly historical, some students contrasted 19th century perspectives versus 21st century perspectives on technology and engineering artifacts. However, an increasing number of students chose to highlight the contrasting ways engineering culture and engineering artifacts are experienced by different classes, races and sexes. This is almost certainly due to the increasing emphasis on DEI concerns in the class.. Next semester, we plan on dropping the Singularity concern from the question since it's not the most effective way to solicit information that is related to this learning outcome.

Gen ED SS Outcome 1,2 and 3

Student's understanding of the Gen Ed Social Science Learning Outcomes was also gauged by a signature assignment (see appendix 1 for a description of that assignment). We have also included a particularly good submission (appendix 2) and one of the poorer ones (appendix 3).

Findings and Action Plan

Previously, the assignment featured an open-ended question prompting students to assess whether technology is neutral and merely a tool. Students were required to present arguments both in favor of and against this assertion. However, after reading many essays, the submissions suggest that a significant proportion of responses favoring the neutrality of technology were lacking in depth. This deficiency stemmed from students' reluctance to challenge their own intuitions and view the world from a fresh, less familiar perspective. To address this issue, the question was restructured. Students are now required to argue that technology is not neutral and that it's not "just a tool". While this adjustment may restrict some students' creativity and results in more standardized responses, it has proven effective in reducing the number of subpar essays submitted. Furthermore, it encourages students to more seriously consider how individuals are influenced by broader social and technological forces, emphasizing that technologies are not merely tools that can be used instrumentally, but also have ancillary effects that are not always aligned with user's intentions.

Additionally, this report includes three appendixes with sample assessments for this course.

ETC 2001 Appendix 1 (see end of document)

ETC 2001 Appendix 2 (see end of document)

ETC 2001 Appendix 3 (see end of document)

Appendix A

Most departments or programs receive a number of recommendations from their Five/Seven-Year Program Review processes. This page provides a means of updating progress towards the recommendations the department/program is enacting.

Date of Program Review: 2019	**Recommendation**	**Progress Description**
Recommendation 1	Text of recommendation	
During our last ABET review, a recommendation to require a gen ed course that includes the topics of local and global impacts of computing solutions on individuals, organizations, and society as made. This was implemented via a new course, ETC 2001, in the Fall 2020 semester.		

Additional narrative:

Appendix B

Please provide the following information about the full-time *and adjunct faculty* contracted by your department during the last academic year (summer through spring). Gathering this information each year will help with the headcount reporting that must be done for the final Five-Year Program Review document that is shared with the State Board of Regents.

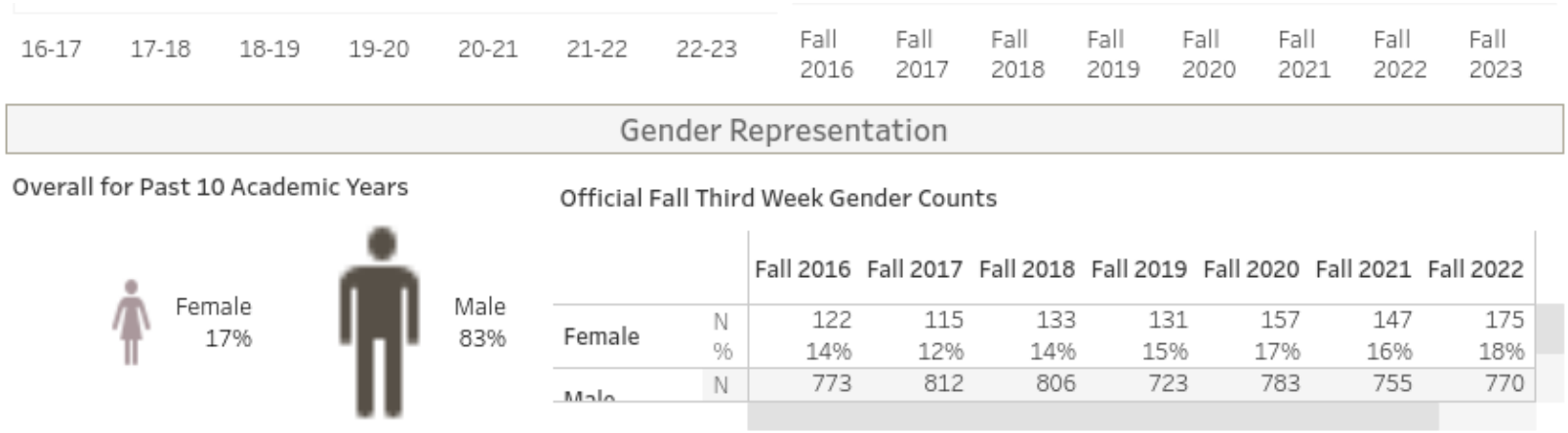
Faculty Headcount*	2021-22	2022-23	2023-24	Notes
With Doctoral Degrees (Including MFA and other terminal degrees, as specified by the institution)				
Full-time Tenured	12	11	12	
Full-time Non-Tenured (includes tenure-track)	6	7	9	
Part-time and adjunct	1	1	2	
With Master's Degrees				
Full-time Tenured	1	1	1	
Full-time Non-Tenured	7	9	9	
Part-time and adjunct	1	1	2	
With Bachelor's Degrees				
Full-time Tenured	0	0	0	
Full-time Non-tenured	2	2	2	
Part-time and adjunct	8	8	9	
Other				
Full-time Tenured				
Full-time Non-tenured				
Part-time				
Total Headcount Faculty*	38	40	46	

*Faculty headcounts represent faculty who teach at least one CS course during the year.

Please respond to the following questions.

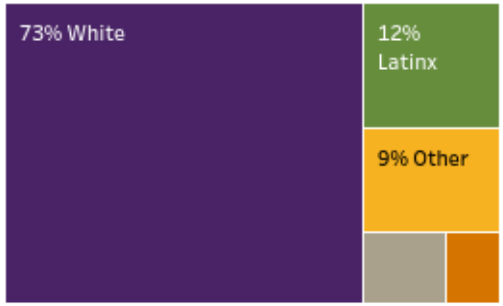
1) Review and comment on the trend of minority students enrolling in your classes (particularly lower-division, GEN Ed) and in your programs.

   The program has been witnessing a consistent and positive trend in the enrollments of minority students over the past few years. For instance, the percentage of female has risen from 14% in 2016 to 18% in 2022, demonstrating a clear and steady increase (see Figure 1). Similarly, the Latinx population has shown growth, moving from 10% in 2016 to 13% in 2022 (see Figure 2).



Ethnicity Classification

Overall for Past 10 Academic Years



		16-17	17-18	18-19	19-20	20-21	21-22	22-23
Latinx	N	119	153	163	144	148	142	163
	%	10%	12%	12%	12%	11%	11%	13%
Non-Reside..	N	23	25	26	18	19	29	58
	%	2%	2%	2%	1%	1%	2%	4%
Other	N	98	96	118	115	113	135	126
	%	8%	7%	9%	10%	9%	11%	10%
Unknown	N	56	46	48	39	47	51	44
	%	5%	4%	4%	3%	4%	4%	3%
White	N	933	984	959	888	990	911	909
	%	76%	75%	73%	74%	75%	72%	70%

We acknowledge that while there has been an increase in the enrollment of students from underrepresented backgrounds, there remains room for improvement in achieving more proportional representation in certain groups. We are actively engaged in collaboration with local K-12 schools to raise awareness about our program and to actively recruit students from these underrepresented groups."

2) What support (from enrollment services, advising, first-year transition office, access & diversity, etc.) do you need to help you recruit and retain students?

   As mentioned in the previous questions, we need to do more outreach in the K-12 system to recruit students from underrepresented groups.

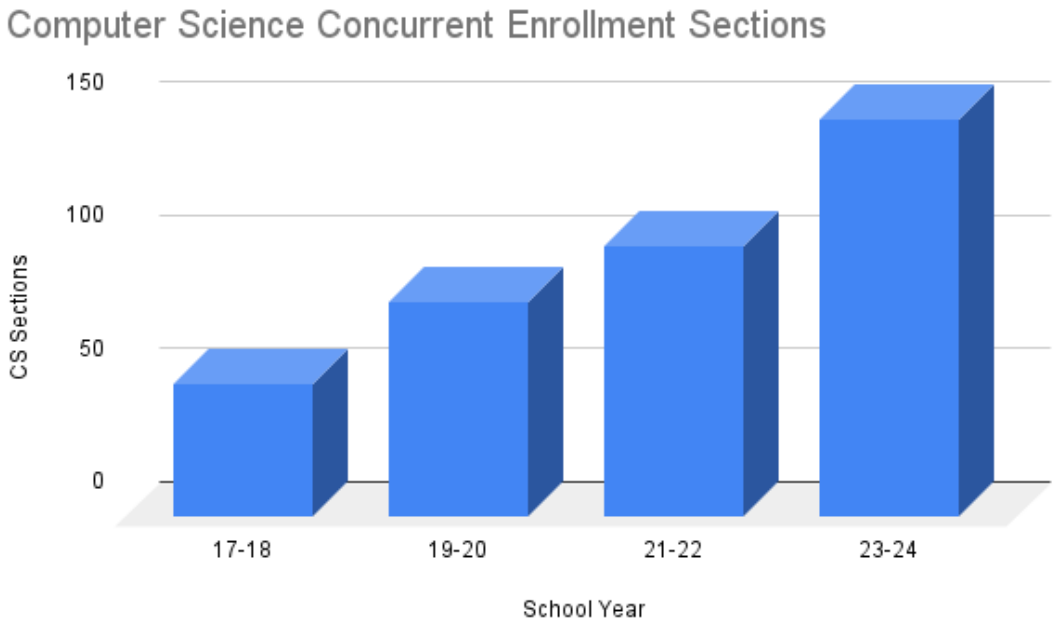
3) We have invited you to re-think your program assessment. What strategies are you considering? What support or help would you like?

   Presently, every course within our catalog is assigned to a course committee, which operates under the oversight of our program's curriculum committee. As part of a three-year cycle, each course undergoes evaluation by its committee members. During the first year, the committee assesses the existing course curriculum, offering recommendations and updates. In the second year, faculty members teaching these courses put the recommendations into action. Finally, in the third year, an

evaluation of the implemented changes takes place. It is during this phase that the committee assesses the impact of the changes and considers new recommendations.

4) Finally, we are supporting our Concurrent Enrollment accreditation process. Does your program offer concurrent enrollment classes? If so, have you been able to submit the information requested from the Concurrent Enrollment office? Staff from OIE will reach out to you in the next few months to assist in finalizing that data submission, as well as gather information for concurrent Gen Ed assessment.

   Our program is dedicated to providing Concurrent Enrollment courses in collaboration with the surrounding school districts. Over the past few years, we have witnessed remarkable growth in this initiative. In the school year 2017-2019, we offered 50 sections of Concurrent Enrollment courses. However, in the current academic year (2023-2024), we have expanded significantly to offer a total of 149 sections. This substantial increase in Concurrent Enrollment offerings underscores our commitment to empowering high school students with opportunities for advanced learning and college readiness.



Glossary

Student Learning Outcomes/Measurable Learning Outcomes

The terms ‘learning outcome’, ‘learning objective’, ‘learning competency’, and ‘learning goal’ are often used interchangeably. Broadly, these terms reference what we want students to be able to do AFTER they pass a course or graduate from a program. For this document, we will use the word ‘outcomes’. Good learning outcomes are specific (but not too specific), are observable, and are clear. Good learning outcomes focus on skills: knowledge and understanding; transferrable skills; habits of mind; career skills; attitudes and values.

- Should be developed using action words (if you can see it, you can assess it).
- Use compound statements judiciously.
- Use complex statements judiciously.

Curriculum Grid

A chart identifying the key learning outcomes addressed in each of the curriculum’s key elements or learning experiences (Suskie, 2019). A good curriculum:

- Gives students ample, diverse opportunities to achieve core learning outcomes.
- Has appropriate, progressive rigor.
- Concludes with an integrative, synthesizing capstone experience.
- Is focused and simple.
- Uses research-informed strategies to help students learn and succeed.
- Is consistent across venues and modalities.
- Is greater than the sum of its parts.

Target Performance (previously referred to as ‘Threshold’)

The level of performance at which students are doing well enough to succeed in later studies (e.g., next course in sequence or next level of course) or career.

Actual Performance

How students performed on the specific assessment. An average score is less meaningful than a distribution of scores (for example, 72% of students met or exceeded the target performance, 5% of students failed the assessment).

Closing the Loop

The process of following up on changes made to curriculum, pedagogy, materials, etc., to determine if the changes had the desired impact.

Continuous Improvement
An idea with roots in manufacturing, that promotes the ongoing effort to improve. Continuous improvement uses data and evidence to improve student learning and drive student success.

Direct evidence
Evidence based upon actual student work; performance on a test, a presentation, or a research paper, for example. Direct evidence is tangible, visible, and measurable.

Indirect evidence
Evidence that serves as a proxy for student learning. May include student opinion/perception of learning, course grades, measures of satisfaction, participation. Works well as a complement to direct evidence.

HIEE – High Impact Educational Experiences
Promote student learning through curricular and co-curricular activities that are intentionally designed to foster active and integrative student engagement by utilizing multiple impact strategies. Please see https://weber.edu/weberthrives/HIEE.html

ETC 2001 Appendix 1:

In an 800 word essay (not counting quotes you include from the readings) address the question at the bottom of this missive. Extensions may be considered if you petition the instructor with sufficient advance notice.
The essays must contain a title with a colon in it. For example: "Technology out of control: The legacy of Prometheus in Mary Shelley's Frankenstein"

Writing tips: Essays should have a thesis that is stated near the beginning of your paper. The thesis should be substantiated in the body of the essay. Make sure to consider counter-arguments and qualify accordingly. When building your argument make clear reference to the readings. Use any citation style you like but reference the author's name, the title of the essay and a page number if there is one.

The conclusion should summarize what was said previously in the paper. Write intelligible segues between your paragraphs so that the reader can easily follow your argument. Have a friend or relative read a draft of your essay to catch grammatical errors. Spell check your essay. You may reference and quote outside sources if you like but make the course readings your primary resource.

A good paper has a strong thesis, is structured, uses good evidence, employs solid logic and argumentation and has good mechanics. Many of these qualities are captured in the grading rubric associated with this assignment).

"Pundits often say that "technology is just a tool" — that technology is merely
what its users make of it, no more or no less. Leaving aside the kernel of truth, this is a misleading notion. Yes, a chair may be used to break a window or to sit on, but these are not equally likely outcomes of interacting with a chair. All technologies provide "affordances" (i.e., uses of technology that are made easier by design, materiality, and features). Most people will sit on chairs but they will not sit on desk lamps. "Sitting" is an affordance of chairs, but not of lamps. Unfortunately, for many who write about technology, fear of sounding like a technological determinist (an academic bogeyman) has too often led to a swing from "technology isn't everything" to the equally incorrect idea that "technology is almost nothing."(Zeynep Tufekci; The Social Internet: Frustrating, Enriching, but Not Lonely. Public Culture 1 January 2014; 26 (1 (72)): 13–23. doi: https://doi.org/10.1215/08992363-2346322 (Links to an external site.))
In a 800 word essay write a paper where you argue that, in spite of appearances, technology isn't neutral and that it isn't just a tool. Your paper should be structured and sequenced as follows:

1. In the first paragraph, clearly state your thesis. Make sure to define what neutrality means. Does a neutral technology have its own ends? Or is it just a means to an end? Does it have politics?
2. Next, articulate the counter-argument. In other words, provide some contexts and/or situations in which technology seems neutral. In this section, make sure to explicitly quote at least three readings by different authors. In this section try to use evidence that is descriptive rather than prescriptive. In other words, try to find passages in the readings where the author argues that the technology is regarded as neutral rather than ones where the author argues that the technology ought to be regarded as neutral. It is not always possible to maintain clear boundaries between descriptive and prescriptive argumentation. But at least

be aware of these distinctions as you construct your argument. In this section, make sure to explicitly quote at least two readings by different authors.

3. In the next part, articulate the argument. In other words, provide some contexts/situations in which technology does not seem to be neutral. In this section, make sure to explicitly quote at least three readings by different authors. As in the former section, try to find examples that are descriptive rather than prescriptive.
4. In your concluding pages specify how engineers (and you specifically) should use arguments for and against "the neutrality of technology" to guide engineering ethics. How might ethics be compromised when engineers view technology strictly instrumentally? Conversely, how might good ethical judgement be debased when engineers view technology strictly through the lens of technological determinism? In particular, consider how the student in Langdon Winner's piece "Engineering Ethics and Political Imagination" justified what he was doing. How might that anecdote inform your own ethics of engineering?
   How ought we regard the interactions between humans and technology? Should those interactions be interpreted through the lens of instrumentalism or determinism, or some combination of the two? What perspective(s) breed better ethical engineering?
5. To establish clear boundaries between the sections of your paper, make sure to include 4 headings. These heading should be:
   - Thesis (and a definition of neutrality)
   - Counter-Argument (Why Tech Is Neutral)
   - Argument (Why Tech Isn't Neutral)
   - My Engineering Ethics

Report due 11/15/2023

ETC 2001 Appendix 2:

Technological Neutrality: An Ethical Conundrum

Thesis

Technology is not as neutral as it may seem at first glance. The impacts of a technology can be subtle, or far reaching. In this essay, when I use the word "neutral" to describe technologies, I mean technologies that have no influence on the way humans use them. In a neutral technology, the creator of the technology does not embed their own ends into that technology's design. It is common for us to want to describe our relationship with technology as instrumental: we determine how an artifact will be used, and we are responsible for the consequences. While we would like to view ourselves as complete masters of our own destiny, with technologies being subject human ends, in reality technological artifacts impact the way we make decision, often in very small and subtle ways. The way a particular technology is designed influences the way a person will use it. This does not mean that we are slaves to technology, but to engineer in an ethical way it is important to consider the effects that an artifact can have on those interacting with it.

Counter-Argument

As stated before, we would like to view our relationship with technology as purely instrumental. Humans have motive and morals, machines don't. Humans make decisions for themselves, machines only do what they are told. As stated in the introduction to Does Technology Drive History? from MIT Press, "No technology, no matter how ingenious and powerful, ever has initiated an action not pre-programmed by human beings." (Marx & Smith, Does Technology Drive History, p. 36 - Reader) Although this idea may soon become outdated - and some would argue that it is already outdated now that artificial intelligence has come so far in such a short time - many people would like to hold on to this philosophy. Artificial intelligence technologies are built by humans: even if we don't completely understand how they make decision, we programmed them. This seems like an obvious conclusion: technologies don't act for themselves, so they must be neutral. In fact, when I was first introduced to the idea that technological artifacts may not be neutral, I felt a lot like Langdon Winner seems to:

To discover either virtues or evils in aggregates of steel, plastic, transistors, integrated circuits, chemicals, and the like seems just plain wrong, a way of mystifying human artifice and of avoiding the true sources, the human sources of freedom and oppression, justice and injustice. Blaming the hardware appears even more foolish than blaming the victims when it comes to judging conditions of public life. (Winner, Do Artifacts Have Politics, p. 57 - Reader)

Of course humans are to blame for their actions. Assigning responsibility to an unthinking, unconscious machine appears like it would be used as a "get out of jail free" card for those who don't want to accept the consequences for the choices they have made. Andrew Feenburg gives what he calls a "crude example:"

In America we say “Guns don't kill people, people kill people.” Guns are a means which is independent of the ends brought to them by the user, whether it be to rob a bank or to enforce the law. (Feenburg, What Is Philosophy of Technology, p. 44 - Reader)

When a school shooting or any other manner of gun violence occurs, we don't blame the gun. There is no question that the person pulling the trigger is responsible for that crime. But in other cases, it doesn't seem so black-and-white. Can a technology be designed in

a way that it influences the ways people interact with it? Furthermore, would such a technology always reflect the ends of the designer, or could it have unknowable impacts on society?

Argument

First, I would like to give an example of a technology that reflected the politics and ends of its creator. Langdon Winner describes the efforts of Robert Moses, the head civil engineer of New York from the 1920s to the 1970s, to enforce his political views via low-hanging overpasses on the parkway to Jones Beach.

Automobile-owning whites of "upper" and "comfortable middle" classes, as he called them, would be free to use the parkways for recreation and commuting. Poor people and blacks, who normally used public transit, were kept off the roads because the twelve-foot tall buses could not handle the overpasses. One consequence was to limit access of racial minorities and low-income groups to Jones Beach. (Winner, Do Artifacts Have Politics, p. 59 - Reader)

Robert Moses effectively designed a technology that was meant to segregate those he considered important, the white and wealthy, from those he was prejudiced against, the black and poor. These overpasses reinforced the structure of power in New York, at least in a small way: the wealthy and powerful could intermingle and establish connections on Jones Beach that could lead to more wealth and power, while those with difficulty accessing that area would have a harder time doing exactly that. The overpasses did not make it strictly impossible to go to Jones Beach if you weren't wealthy - for example you could carpool with someone who owned a car - but in making it more difficult to access, Robert Moses furthered his own political agenda. As Jenny Davis says when talking about technological affordances, "Technologies don't make people do things, but instead push, pull, enable, and constrain. Affordances are how objects shape actions for socially situated subjects." (Davis, How Artifacts Afford, p. 6)

So now we've seen an artifact that was infused with the desires and goals of its creator. But still, that appears to be the designer's fault: they could have built the technology differently so it was more neutral. But what about technologies that have unanticipated effects, or seem to make prejudiced decisions that don't reflect those of the engineer? One such example is described by Hannah Fry - the COMPAS algorithm. This algorithm was designed to predict whether person convicted of a crime was likely to reoffend, based on information from a questionnaire the person filled out. Its purpose was to help judges when deciding whether or not to post bail for a defendant. Fry describes the problem that was noticed after a large study was done on the results of the COMPAS algorithm:

"If you were one of the defendants who didn't get into trouble again after their initial arrest, the Luke Skywalkers, the algorithm was twice as likely to mistakenly label you as high risk if you were black as it was if you were white. The algorithm's false positives were disproportionately black. Conversely, of all the defendants who did go on to commit another crime within two years, the Darth Vaders, the white convicts were twice as likely to be mistakenly predicted as low risk by the algorithm as their black counterparts. The algorithms false negatives were disproportionately white." (Fry, Hello World: Being Human in the Age of Algorithms, p. 94 - Reader)

The most disturbing part of this scenario is that none of the questions the defendants answered had anything about race. Somehow, the algorithm was accidentally discriminating. As far as we know, the engineers who created the COMPAS algorithm didn't intentionally create it to label blacks as high risk more often than whites, but that almost makes it more of a question as to whether technology is truly neutral.

My Engineering Ethics

So why is this important to engineering ethically? What does it matter if the technologies we create are neutral or not? If we have an instrumental relationship or a deterministic? The answer that I find most appealing is that of responsibility. As engineers, we have a responsibility for the things we create, and those who use our technologies have a responsibility as well. Only by viewing technology as

something other than a neutral lump of metal and wires can we truly take that responsibility seriously. We must be conscious of the consequences of our creations, or we may end up like Victor Frankenstein, lamenting the monster we have created, and the devastating effects thereof (Shelly, Frankenstein: The Modern Prometheus, p. 26). While we can't predict all the outcomes of a technological creation - like the prejudice of the COMPAS algorithm couldn't be predicted - it is our responsibility to take the time to study and discuss the possible consequences, and when unpredicted ones arise, to be willing to step in and make changes to improve our creations. By taking responsibility, we will have more control over our destiny, and that of technology, and give others more control over their destiny as well.

ETC 2001 Appendix 3:

Thesis

Technology is something that is all around us and in use by everyone, in some instance, at any time of the day. Debates whether technology is neutral or not are very common between instrumentalists and determinists. Instrumentalists believe that technology is inherently neutral and that it is simply a tool used by society for a purpose and that we hold the ability to dictate and control what the purpose is. They also believe that technology grants affordances equally to any one person and does not have a bias. Determinists on the other hand view that technology is not neutral and that there are can be different affordances to different people depending on the piece of technology. They believe that our society is shaped by the needs of the technology, that we are not in control of that future and that it is determined by the technology, whether it is towards the progress or the demise of society.

In this essay I will be discussing examples of technology that seem to be neutral and give evidence towards the instrumentalist view that technology is neutral. In the next section I will discuss examples where technology is not neutral at all and has elements of bias or politics and is compelling evidence against the technology neutrality argument. In the final part of the essay I will be discussing how engineers should use arguments for and against the neutrality of technology as a guide to their ethics as an engineer.

Counter-Argument

Argument

One of the arguments that technology is not neutral is when the creation of that piece of technology demands a certain structure for the technology to operate efficiently or sociotechnology as it is referred to. This is because the technology has now dictated how society utilizes it rather than the other way around. One example is the invention of nuclear energy. "if you accept nuclear power plants you also accept a techno-scientific industrial-military elite. Without these people in charge, you could not have nuclear power" (Winner, "Do Artifacts Have Politics?" p68). When a piece of technology is created such as nuclear power, then the need to form a structured group to manage it arises. The nuclear resources must be managed and protected from persons who would attempt to seize it and use it for nefarious purposes. Nuclear power is then one example of a piece of technology that cannot exist as neutrally and the involvement of politics is unavoidable.

My Engineering Ethics

The ethics that encompass an engineer can be well defined when formed through the lens of a technological instrumentalist or determinist. When viewed strictly instrumentally then an engineer's ethics have a much higher chance of being compromised. If the engineer only sees the creation of their technology rather than the possible implications of its creation, then they could be blindly running towards the creation of something like the atomic bomb, that becomes a risk to the well-being of the planet. When viewed strictly through the lens of a determinist, good ethical judgement could be debased because of the mindset that the technology is making the demand and that we are simply at its will.

We ought to regard the interactions between humans and technology in an area more of the middle ground to instrumentalism and determinism. We should see that we do have the ability to dictate technology before it's creation and seek to understand what

implications that technology might have on society because some technologies will completely change the world rather than just becoming a part of it. We ought to understand that society has the control whether a piece of technology becomes autonomous from wants and needs. Importantly, we ought to understand that technology is not inherently neutral because of the vast diversity of people and cultures that exist, and that technology that is beneficial to one might not be to the other or could possibly even be detrimental.