Explore More!

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Module 11A: Engineering Ethics

Laboratory Outline

In ECE 110 we work with introductory topics in electronics, learning the essentials of circuit analysis and building basic circuits. As the semester progresses (and as you progress in later semesters) we see how new topics build upon the foundations of what we've learned. Both academically and ethically, as engineers we should always be aware of how our work fits into larger designs and larger applications. In this module you will be referred to some essential engineering ethics overviews, as well as a summary of a real-world example of what can happen when ethical boundaries are crossed.

Prerequisites

- None

Parts Needed

- The reading material linked to in this document

At Home: This exercise can be completed anywhere.

IEEE Code of Ethics

The IEEE (Institute of Electrical and Electronics Engineers) is the world's largest technical professional organization and is centered around the mission of fostering technological innovation and excellence for the benefit of humanity. Addressing the obligations engineers have to society, their clients, and to their profession, the IEEE Code of Ethics is as follows

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;

Notes:

6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Question 1: Provide an example of a popular company that has been publicly revealed to have broken ethical guidelines. Give a brief overview of their violations, and note which of the IEEE ethical points were they in direct violation of.

The Therac-25 accidents

The Therac-25 medical electron accelerator was a radiation machine used for treating cancer. Medical tech designed to help people in medical need, the Therac-25 was involved in six massive radiation overdoes and multiple deaths and serious injuries. A thorough study on the failure of the Therac-25 can be found on IEEE Xplore, which you can access through the Grainger Engineering Library website. The article can be found as “N. G. Leveson and C. S. Turner, "An investigation of the Therac-25 accidents," in Computer, vol. 26, no. 7, pp. 18-41, July 1993.” Summarized accounts can be found on Wikipedia.

While exhaustive, we encourage you to read the report in full. The types of specific engineering errors made may seem startling similar to some of the mistakes you may make in your own engineering coursework. Below is a list of some of the engineering decisions made in the design and continued operation of this radiation machine, and relevant questions. Having read the report or related summaries, address the following points:

Notes:

The device was a 2-in-1 machine, designed to administer two types of radiation treatments, with the control system managed almost entirely by software on an integrated computer.

Question 2: Why would this be a desirable design choice? What benefits could it offer?

Question 3: Why would this be a desirable economic choice?

Question 4: What problems could arise as a result of this design choice? How could it be corrected?

The Therac-25 inherited much of its code from past models, the Therac-6 and Therac-20, both successfully deployed machines that used integrated hardware to enact safety measures. The Therac-6 code was developed by one company, and integrated into the Therac-20 and then the Therac-25 by another company.

Question 5: In terms of software development, what sort care must be taken in such a situation? What practices or resources can help reduce development errors?

Notes:

Seen largely as a software integration problem, the Therac-25 software was managed by a single programmer.

Question 6: What business/ethical concerns arise when determining the number of engineers assigned to a task?

Question 7: In such a scenario, whose responsibility is it to address this potential shortcoming?

Learning Objectives

- Become acquainted with the ethical code of the IEEE.
- Understand the engineering ethics failure behind a real-life design disaster.
- Think of ways ethical shortcomings can be avoided in real world scenarios.

Explore Even More!

Understanding the ethical complications behind past engineering failures can help provide the insight needed to avoid future mishaps and ethical shortcomings. Search online and on the IEEE site for any of the three following well studied topics.

- Autonomous systems and robotic warfare
- E-Voting systems in America
- Volkswagen emissions scandal