ECEN 4013

Design of Engineering Systems

Agenda

Project 1 Questions

Engineering Ethics

Questions about Project #1?

Engineering Ethics

- What is the difference between ethics and morals?
- Ethics are standards of distinguished by a certain community or social setting
  - IEEE
  - ACM
  - NSPE

Engineering Ethics

IEEE Code of Ethics

Text in red are changes made within the last 2 years

IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members, and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

IEEE Code of Ethics

I. To uphold the highest standards of integrity, responsible behavior, and ethical conduct in professional activities.

IEEE Code of Ethics

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment;

IEEE Code of Ethics

2. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;

IEEE Code of Ethics

3. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;

IEEE Code of Ethics

4. to avoid unlawful conduct in professional activities, and to reject bribery in all its forms;

IEEE Code of Ethics

5. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, to be honest and realistic in stating claims or estimates based on available data, and to credit properly the contributions of others;

IEEE Code of Ethics

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;

IEEE Code of Ethics

II. To treat all persons fairly and with respect, to not engage in harassment or discrimination, and to avoid injuring others.

IEEE Code of Ethics

7. to treat all persons fairly and with respect, and to not engage in discrimination based on characteristics such as race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;

IEEE Code of Ethics

8. to not engage in harassment of any kind, including sexual harassment or bullying behavior;

IEEE Code of Ethics

9. to avoid injuring others, their property, reputation, or employment by false or malicious actions, rumors or any other verbal or physical abuses;

IEEE Code of Ethics

III. To strive to ensure this code is upheld by colleagues and co-workers.

IEEE Code of Ethics

10. to support colleagues and co-workers in following this code of ethics, to strive to ensure the code is upheld, and to not retaliate against individuals reporting a violation.

ACM Code of Ethics

1. GENERAL ETHICAL PRINCIPLES.

1.1 Contribute to society and to human well-being, acknowledging that all people are stakeholders in computing.

1.2 Avoid harm.

1.3 Be honest and trustworthy.

ACM Code of Ethics

1. GENERAL ETHICAL PRINCIPLES.

1.4 Be fair and take action not to discriminate.

1.5 Respect the work required to produce new ideas, inventions, creative works, and computing artifacts.

1.6 Respect privacy.

1.7 Honor confidentiality.

ACM Code of Ethics

2. PROFESSIONAL RESPONSIBILITIES.

2.1 Strive to achieve high quality in both the processes and products of professional work.

2.2 Maintain high standards of professional competence, conduct, and ethical practice.

2.3 Know and respect existing rules pertaining to professional work.

2.4 Accept and provide appropriate professional review.

ACM Code of Ethics

2. PROFESSIONAL RESPONSIBILITIES.

2.5 Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks.

2.6 Perform work only in areas of competence.

2.7 Foster public awareness and understanding of computing, related technologies, and their consequences.

2.8 Access computing and communication resources only when authorized or when compelled by the public good.

2.9 Design and implement systems that are robustly and usably secure.

ACM Code of Ethics

3. PROFESSIONAL LEADERSHIP PRINCIPLES.

3.1 Ensure that the public good is the central concern during all professional computing work.

3.2 Articulate, encourage acceptance of, and evaluate fulfillment of social responsibilities by members of the organization or group.

3.3 Manage personnel and resources to enhance the quality of working life.

3.4 Articulate, apply, and support policies and processes that reflect the principles of the Code.

ACM Code of Ethics

3. PROFESSIONAL LEADERSHIP PRINCIPLES.

3.5 Create opportunities for members of the organization or group to grow as professionals.

3.6 Use care when modifying or retiring systems.

3.7 Recognize and take special care of systems that become integrated into the infrastructure of society.

ACM Code of Ethics

4. COMPLIANCE WITH THE CODE.

4.1 Uphold, promote, and respect the principles of the Code.

4.2 Treat violations of the Code as inconsistent with membership in the ACM.

Statistics

- There are over **94,924** Electrical Engineers currently employed in the United States.
- 10% of all Electrical Engineers are women, while **90%** are **men**.
- The average age of an employed Electrical Engineer is **44** years old.
- The most common ethnicity of Electrical Engineers is White (63%), followed by Asian (16.2%), Hispanic or Latino (11.1%), and Black or African American (4.8%).
- In 2021, women earned 95% of what men earned.
- **6%** of all Electrical Engineers are **LGBTQ**.

Statistics

- There are over **15,911** Computer Engineers currently employed in the United States.
- 13.7% of all Computer Engineers are women, while **86.3%** are **men**.
- The average age of an employed Computer Engineer is **42** years old.
- The most common ethnicity of Computer Engineers is White (53.5%), followed by Asian (15.0%), Hispanic or Latino (15.0%), and Black or African American (10.7%).
- In 2021, women earned 98% of what men earned.
- **11%** of all Computer Engineers are **LGBTQ**.

Statistics reported by https://www.zippia.com/

The Mars Climate Orbiter “Mishap”

…actually, it reached Mars safely after traveling approximately 140 million miles and disintegrated during atmospheric entry.

The Mars Climate Orbiter

In September 1999 the Mars Climate Orbiter (formerly the Mars Surveyor 1998 Orbiter) disintegrated after making an improperly low entry into the upper Martian atmosphere because the ground-based computer software produced thruster force output in Imperial pound-seconds (lbf*s) rather than the specified newton-seconds (N*s).

1 lbf = 4.448 Newton

…from the final investigation

"The MCO-MIB has determined that the root cause for the loss of the MCO spacecraft was the failure to use metric units in the coding of a ground software file, 'Small Forces," used in trajectory models. Specifically, thruster performance data in Imperial units instead of metric units was used in the software application code titled SM-FORCES (small forces)."

…from the final investigation

"The output from the SM-FORCES application code as required by a MSOP Project Software Interface Specifications (SIS) was to be in metric units of Newton-seconds (N-s). Instead, the data was (*sic*) reported in Imperial units of pound-seconds (lbf-s)."

…from the final investigation

"The Angular Momentum Desaturation (AMD) file contained the output data from the SM_FORCES software. The SIS, *which was not followed*, defines both the format and units of the AMD file generated by ground-based computers."

…from the final investigation

"Subsequent processing of the data from AMD file by the navigation software algorithm therefore underestimated the effect on the spacecraft trajectory by a factor of 4.45, which is the required conversion factor from force in pounds to Newtons. An erroneous trajectory was computed using this incorrect data."

…from the final investigation

“The discrepancy between calculated and measured position, resulting in the discrepancy between desired and actual orbit insertion altitude, had been noticed earlier by at least two navigators, whose concerns were dismissed.”

…from the final investigation

“A meeting of trajectory software engineers, trajectory software operators (navigators), propulsion engineers, and managers, was convened to consider the possibility of executing TCM-5, which was in the schedule. Attendees of the meeting recall an agreement to conduct TCM-5, but it was ultimately not done.”[1]

…from the final investigation

[1] Arthur G. Stephenson, Lia S. La Piana, Daniel R. Mulville, Peter J. Rutledge, Frank H. Bauer, David Folta, Greg A. Dukeman, Robert Sackheim, *et al*. “Mars Climate Orbiter Mishap Investigation Board Phase 1 Report,” NASA (November 10, 1999).

… the ethics question

What, if any, ethics violations were in evidence in this experience?

Other Real World Examples

Examples of Real World Engineering Ethics Problems

Stephen H. Unger

Science and Engineering Ethics, V. 6(2000): pp423-430

Use of Unlicensed Software

Jim Warren was a senior software systems expert, hired by NewSoft, a start-up company, to help in the development of a new product. He soon learned that the product was based on proprietary software for which NewSoft did not have a license. Jim assumed that this was some sort of mistake and spoke to the company president about the matter.

Use of Unlicensed Software

He was assured that the situation would be rectified. But time passed and nothing happened except that Jim found other instances of the same practice. Repeated efforts to get NewSoft to legalize its operations failed and Jim, after threatening to notify the victimized companies, was discharged.

Use of Unlicensed Software

Law enforcement officials were brought into the picture and lawyers on all sides began negotiating. At this date it is not clear whether criminal charges will be filed. There appears to be a strong possibility of some sort of out-of-court settlement among the companies involved. We don't know how this will ultimately affect Jim Warren.

… the ethics question

What, if any, ethics violations were in evidence in this experience?

Government Testing

Ralph Sims had worked for the US Government for many years as an engineer, rising to a fairly high managerial position. On retirement, he accepted an executive position with SuperCom, a company producing electronic equipment for the military.

Government Testing

Shortly after coming on board, Ralph was informed by a subordinate that, for a long time, a key test on an important product was not being made in the manner specified by the contract. This had been going on for several years and the subordinate felt very uncomfortable about it. Ralph, who had considerable expertise in the technology involved, looked into the matter carefully. It turned out that, in his previous career, he had acquired some knowledge about the specified test.

Government Testing

He found that, a shorter, and hence less costly, test had indeed been substituted for the required one. But, after some study, he concluded that SuperCom's test was actually as effective as the specified test. Nevertheless, by this unauthorized substitution, SuperCom was violating the contract and exposing itself both to criminal and to civil prosecution. He took his findings to upper management and urged them to apply to the contracting agency for a contract change authorizing the simpler test. Ralph felt confident that such a change would be accepted.

Government Testing

But his arguments were not accepted and SuperCom continued on their previous course. The apparent reason was the company president's reluctance to confess that the company had been deceiving the government for years. Ralph did not see why he should get into an unpleasant battle with the SuperCom's leaders over this, since there were no safety issues and even the quality of the product was not actually at stake. Nevertheless, he did not wish to be involved in a dishonest and probably illegal operation. Therefore, he chose the course of quietly resigning, without "turning in" the company.

Government Testing

About three years later, a SuperCom employee reported the deception to the government, and a criminal investigation was launched. When he resigned, Ralph had signed a non-disclosure agreement as a condition for receiving some severance pay. Nevertheless, when called upon by the prosecutor's office to give information about the situation, he cooperated fully.

Government Testing

To his dismay, when the indictments came down, he was one of the people charged with complicity in the fraud. This necessitated his hiring an attorney and undergoing both the expenses and anguish of being a defendant in a criminal case. Fortunately for him, after many months, a new prosecutor was assigned to the case. Shortly afterward, the charges against Ralph were dropped. But, meanwhile, the affair had cost him months of anguish, embarrassment, and a damaged reputation due to publicity whose effects can never be fully repaired.

Government Testing

The trial took three months. All five of the company's employees were acquitted. There was a hung jury in the case against the president. The company was fined $800,000 and its estimated legal expenses were estimated at close to million dollars. Furthermore, it is no longer permitted to work on government contracts involving testing.

… the ethics question

What, if any, ethics violations were in evidence in this experience?