Ethical Issues in Engineering Practice

Case Study

- ❏ Therac-25 was a radiation therapy machine capable of irradiating tumors with either electrons or X-rays.
- ❏ First to incorporate significant computer controls.
- ❏ However, the software used to control the therapy machine and monitor the dose delivered to the patient was inadequate.
- ❏ When it wasn't in the correct configuration, the software allowed the machine to be energized.
- ❏ When this happened, patients could receive doses orders of magnitude larger than planned.
- ❏ During the span of 1985-87, at least six patients using the Therac-25 were exposed to high doses of radiation, leading to serious injury or death.

Can we blame the Software?

Three important areas where engineers may encounter ethical concerns

Environmental Ethics

Computer Ethics

Ethics and Research

Environmental Ethics

Sustainable Design /Green Engineering

The process of applying natural, human, and economic resources to enhance the safety, welfare, and quality of life for all of society while maintaining the availability of remaining natural resources.

Sustainable design includes not only ensuring that a product has **minimal environmental impact** during its use, but also that it can be manufactured and disposed of **without harming the natural world.**

Moral Case for Sustainable Development

From the utilitarian standpoint in many of its formulations, future generations of humans (and even animals) should be included. However, what does this argument imply about the use of nonrenewable resources? Also, how can we know the needs of future generations?

From the Respect of Persons (Right Ethics) standpoint, we have an obligation, to respect equally the rights of all people (both present and future generations). But, if developed countries have achieved their present state of material prosperity by exploiting the resources of the earth, don't underdeveloped countries have the same right?

From the standpoint of virtue ethics, the virtues of care and respect for nature come into special prominence. Care should extend to all members of the present generation as well as future generations, especially care for the poor and disadvantaged.

Resolving environmental problems

Cost-oblivious approach

Cost is not taken into account, but rather the environment is made **as clean as possible**. No level of environmental degradation is seen as acceptable. This approach bears a striking resemblance to **rights and duty ethics.**

However it is-

➢ Difficult to uphold, especially in a modern urbanized society.

➢ Difficult to enforce, since the definition of "as clean as possible" is vague

➢ Not feasible to be oblivious to cost, as we do not have infinite resources to apply to a problem.

Resolving environmental problems

Cost-benefit analysis

The goal is not to achieve a completely clean environment, but rather to achieve an economically beneficial balance of pollution with health or environmental considerations. The problem is analyzed in terms of the **benefits** derived by reducing the pollution/improvements in human health and the **costs** required to solve the problem.

However-

➢ What is the true cost of a human life or the loss of a species or a scenic view? These values are difficult to determine.
➢ It is difficult to accurately assess costs and benefits, and much guesswork must go into these calculations.
➢ Doesn't necessarily take into account who shoulders the costs and who gets the benefits. Example: Landfills/ Waste Dumps.
➢ Cost–benefit analysis doesn't necessarily take morality or ethics into account.

Responsibilities of an Engineer

➢ When looking at the environmental aspects of his work, an engineer can appeal to both professional and personal ethics to make a decision.

➢ Must follow the applicable federal, state, and municipal laws and regulations.

➢ Professional codes of ethics tell us to hold the safety of people and the environment to be of paramount importance.

➢ Our personal ethics can also be used to determine the best course when we are confronted with an environmental problem.

➢ An engineer should not make decisions in areas in which he isn't competent.

Computer Ethics

➢ Using the computer to **commit an unethical act** such as the use of a computer to hack into a database

➢ Using the computer as an **engineering tool**, but improperly
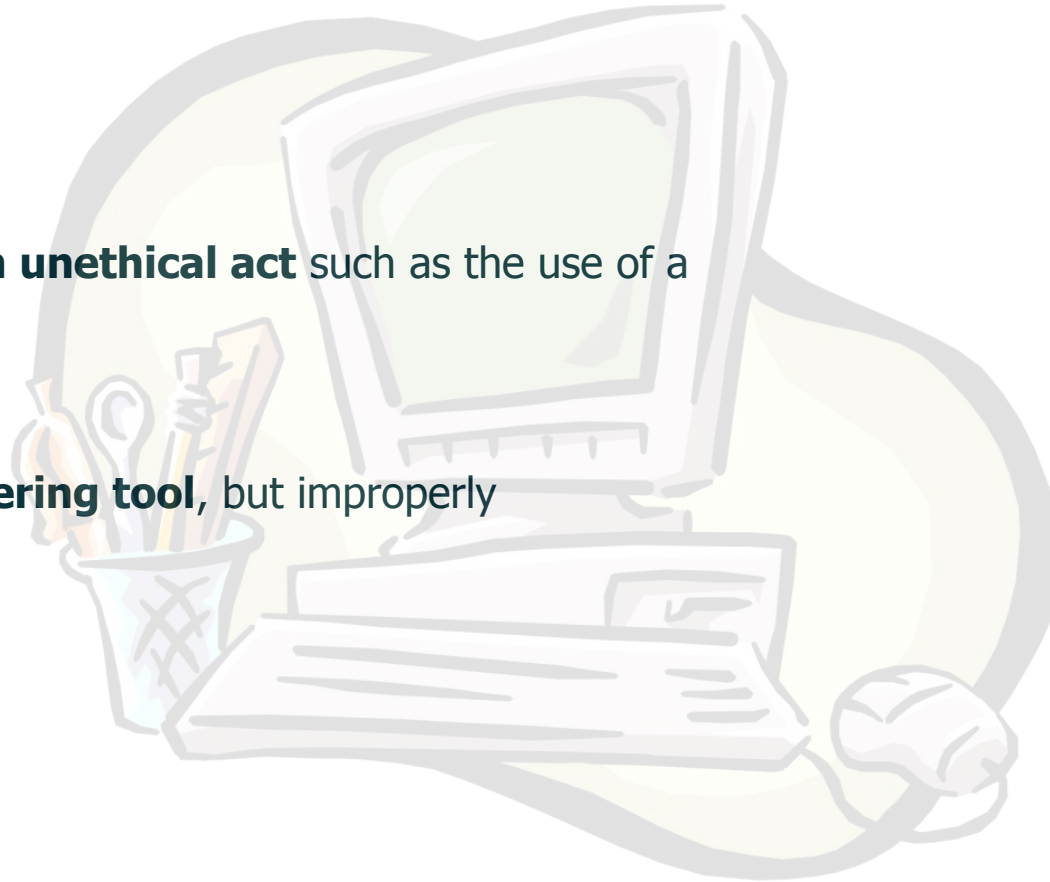
Computers as a Tool for Unethical Behavior
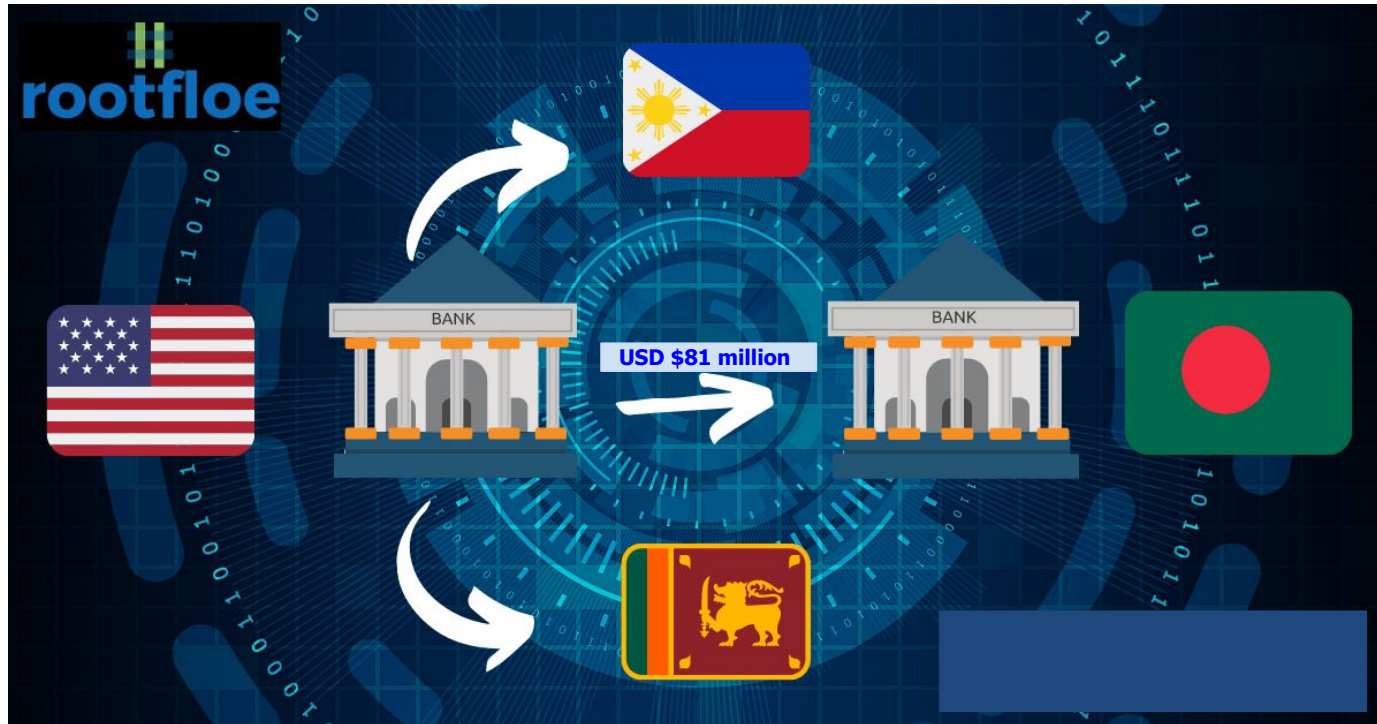
Computers as a Tool for Unethical Behavior

➢ Computer ethics issues arise with **regard to privacy**. By privacy, we mean the basic right of an individual to control access to and use of information about himself. Invasions of privacy can be harmful to an individual in **two ways.**

   ○ The leaking of private information can lead to an **individual's being harassed or blackmailed.**

   ○ Personal information can also be considered **personal property**

➢ **Copyright infringement** is also a concern in computer ethics. Computers and the Internet have made it easy to share copyrighted materials. Copying without the permission of the owner of the copyright is illegal and unethical.

Computers as a Tool for Unethical Behavior

➢ Ethical issues also arise when computers are used for "**hacking.**" Hacking comes in many forms:

- ○ Unauthorized access to a database
- ○ Implanting false information in a database
- ○ Disseminating viruses over the Internet.

➢ The issuance of **computer viruses** is also unethical.

➢ The internet provides a platform for the rapid spread of **misinformation and propaganda**. False information can be deliberately spread to deceive or manipulate individuals or groups.

Computers as an Engineering Tool

➢ Who is responsible when a flaw in software used to design a bridge leads to the failure of the bridge? Is it the fault of the engineer who designed the bridge? Or is it the fault of the company that designed and sold the defective software?

➢ Who is at fault when a software package is used for a problem that it isn't really suited for?

➢ What happens when existing software is used on a new and innovative engineering design that software hasn't yet been developed for?

Software can never be a substitute for good engineering judgment. Engineers should be knowledgeable about the limitations and applicability of a software package

Ethics and Research

Honesty in approaching the research problem

Avoiding preconceived notions about what the results will be, being open to changing the hypothesis when such action is warranted by the evidence, and generally ensuring that an **objective frame of mind** is maintained.
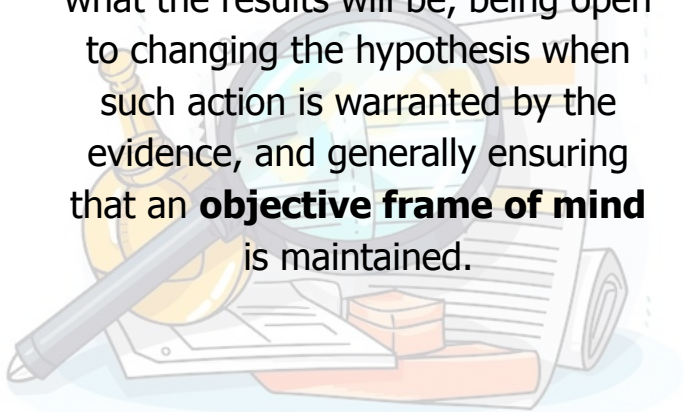
Honesty in reporting the results

Results must also be **accurately reported.** The results of the experiment must not be overstated, but rather an accurate assessment and interpretation of the data must be given

Types of Dishonesty in Research

❏ Falsification of data: distortion in representing data (e.g., omission of relevant data)

❏ Fabrication of data: making up data (e.g., for tests that were not actually done)

❏ Failure to respect intellectual property of others (e.g., violating trade secrets, patents, trademarks, and copyrights)

❏ Plagiarism: falsely appropriating the work of others as one's own

❏ Inappropriate attribution of authorship (e.g., listing someone as an author who didn't warrant credit for this)
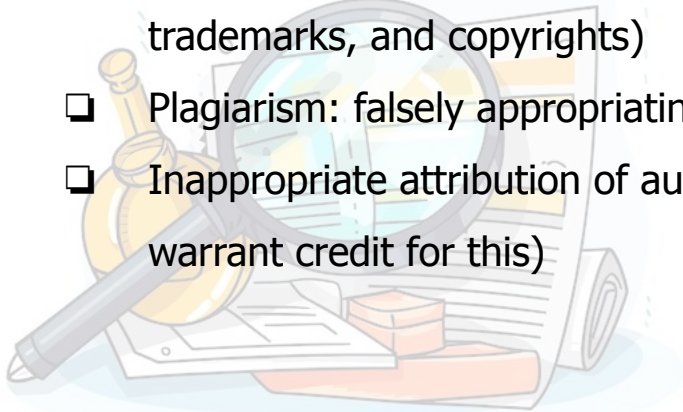
Analyzing Ethical Problems in Research

- ❏ The easiest means to determine the best ethical course in performing research and experiment is to **consult the codes of ethics** of the engineering professional societies.
- ❏ All of the codes include language requiring engineers to be honest in reporting the results of work and assigning credit for work done
- ❏ Utilitarianism or rights and duty ethics can be applied to research, but it is perhaps **easiest to examine research issues using virtue ethics.**
- ❏ Virtue ethics clearly tells us that the i**naccurate reporting** of experimental results is unethical.
- ❏ Likewise, **not giving credit** to everyone who has participated in a project is dishonest, and virtue ethics indicates that this practice is unacceptable.
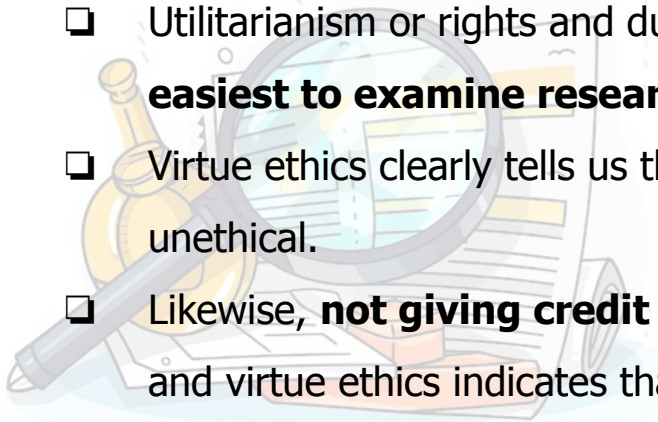
THANKS!

Does anyone have any questions?

References

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