ETHICAL AND MORAL CONSIDERATIONS

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OUTLINE

- Why study ethics?
- Code of ethics
- Basic ethics questions
- Ethical conflict
- Consequences of unethical practices
- Ethical case studies

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WHY STUDY ETHICS?

- Accreditation agencies (ABET) deem it a critical part of all engineering curricula, including EE and CmpE
- Virtually all professional societies have a code of ethics:
  - ❑ IEEE Code of Ethics: http://www.ieee.org/about/corporate/governance/p7-8.html
  - ❑ ACM Code of Ethics: http://www.acm.org/about/code-of-ethics

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IEEE Advancing Technology for Humanity

acm Association for Computing Machinery

CODE OF ETHICS

- Highlights from the IEEE Code of Ethics:
  - ❑ “To accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment”
  - ❑ “To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist”
  - ❑ “To be honest and realistic in stating claims or estimates based on available data”
  - ❑ “To avoid injuring others, their property, reputation, or employment by false or malicious action”

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SOME BASIC ETHICS QUESTIONS

- What forms the basis of our views and our understanding of ethics?
- Why is ethical behavior important to society?
- What could happen if the issue of ethics was completely disregarded?
- How can ethical practices best be learned, promoted, and ensured?

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ETHICAL CONFLICT

- Duty/Responsibility vs. Malice/Indifference
  - ❑ Example: FTDI counterfeit IC driver issue
- Duty vs. Self-Interest (“Conflict of Interest”)
  - ❑ Examples: Bribery, misuse of position, mishandling classified or proprietary material, etc.
- Duty vs. Duty
  - ❑ Maximize profit for employer vs. obligation to society
  - ❑ Confidentiality vs. whistle-blowing (Edward Snowden)

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CONSEQUENCES

- Some consequences of unethical practices:
  - ❑ Injury or loss of human life
  - ❑ Loss of business contracts or customers
  - ❑ Damage to a business's image or reputation
  - ❑ Fines and penalties
  - ❑ Jail time
- What other consequences can you think of?

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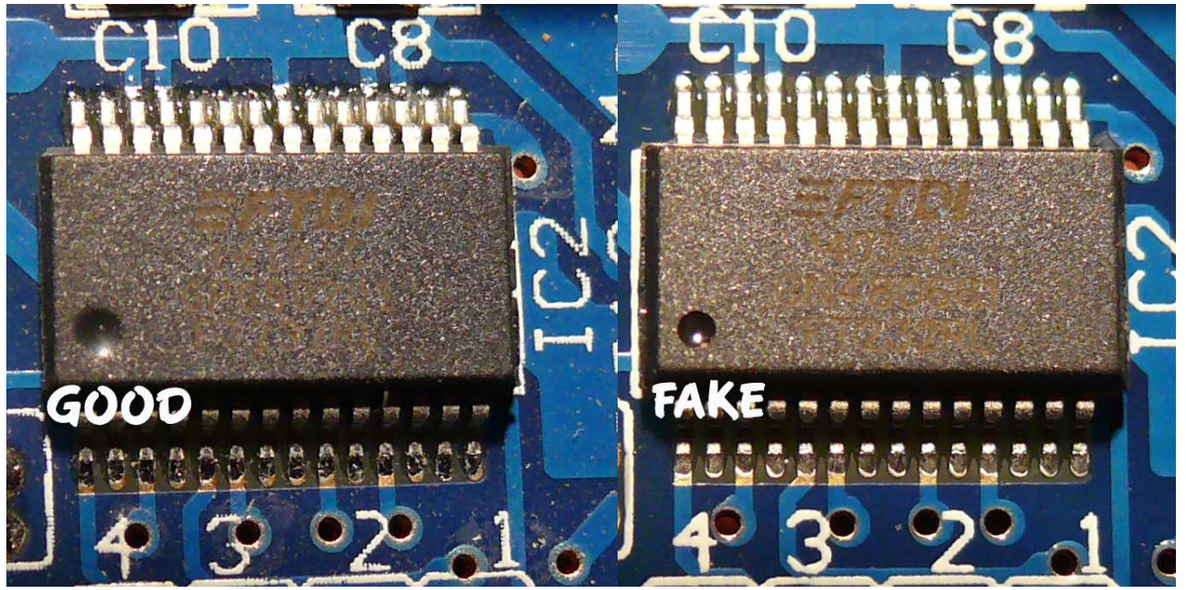
ETHICS CASE STUDIES

FTDI Counterfeit ICs Driver Scandal

The Setup: Future Technology Devices Incorporated (FTDI) is a leading manufacturer of USB to serial converter ICs popular among hobbyists. This popularity has lead to cloning and knockoffs, particularly in emerging markets. Both original and counterfeit ICs rely upon a driver produced by FTDI in order to function properly.



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ETHICS CASE STUDIES

FTDI Counterfeit ICs Driver Scandal

What Happened: FTDI released an updated driver for their USB-to-Serial devices on their website (9/29/2014). The updated driver would identify software-compatible FTDI clones and brick them by rewriting the USB Product ID to “0000”. The new driver was automatically added to Windows Update, whereupon it was automatically mass-installed to many, many devices.

Aftermath: The driver was quickly pulled from Windows Update and an emergency patch was committed the following week to work with bricked devices. The CEO was forced to issue a public apology. Substantial damage was done to the reputation of FTDI.

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ETHICS CASE STUDIES

FTDI Counterfeit ICs Driver Scandal

Ethical Questions to Ponder:

- Did FTDI's actions constitute unethical behavior? If so, at what point, and why?
- As a customer who has purchased a gadget containing an FTDI chip, how did you know if the chip was legitimate or not?
- What sorts of devices could use a USB interface featuring an FTDI chip? What sorts of damage could be done if the devices became inoperable?

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ETHICS CASE STUDIES

The Ford Pinto

The Setup:

- Early 1970s, gas prices are rising in the United States
- American customers are interested in smaller, more efficient cars (specialty of Japanese car manufacturers)
- Ford created a compact car, the Pinto, to compete
- Due to the rushed design process, errors were made and the fuel tank was designed poorly. Ford was aware of this issue from internal studies and had a patent on a safer fuel tank design.
- US regulations only required front-end crash testing at speeds less than 20 MPH at the time

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ETHICS CASE STUDIES

The Ford Pinto

The Setup, continued:

- The cost of modifying a Pinto in 1970 was determined to be $11 (~$150 today)
- In order to determine whether or not the redesign was necessary, Ford performed an economic analysis. The following economic assumptions were used:

Cost of a human life: $200,000 (~$1.2 million today)
Cost of a severe burn injury: $67,000 (~$415,000 today)
Cost to replace destroyed vehicle: $700 ($4,327 today)
Estimated deaths: 180
Estimated burn injuries: 180
Estimated vehicles destroyed: 2100

Estimated vehicles sold: 11 million
Estimated light trucks sold: 1.5 million

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ETHICS CASE STUDIES

The Ford Pinto

What Happened:

- The results of the economic analysis can be seen below:

Category	Cost/incident	# Incidents	Cost
Burn Deaths	$200,000	180	$36M
Burn Injuries	$67,000	180	$12M
Burned Vehicles	$700	2100	$1.5M
Total:			**$48.5M**

Category	Cost/unit	# Units	Cost
Cars	$11	11M	$121M
Light Trucks	$11	1.5M	$16.5M
Total			**$137.5M**

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ETHICS CASE STUDIES

The Ford Pinto

What Happened:

- Ford Pinto was delivered to market
- Some cars were burned, some burn injuries occurred, and some deaths resulted from the previously mentioned problems
- Ford became engaged in a high-profile court case

Incriminating Evidence:
"We'll never go to a jury again. Not in a fire case. Juries are too sentimental. They see those charred remains and forget the evidence. No sir, we'll settle." Ford Employee

- Ford was forced to recall the Pinto at a significant cost

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ETHICS CASE STUDIES

Ethical Questions

- Did Ford's actions constitute unethical behavior? If so, at what point, and why?
- What is the monetary value of a human life?
- If you had the option to pay $150 to make your car 1% safer, would you do so? Why or why not?

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ETHICS CASE STUDIES

Focus on Product Safety

- When has a product been “tested enough” to ensure operator safety under various operating conditions and failure modes?
- How long is a company liable for injuries resulting from safety-related product failures?
- Who, in a given company, is responsible for ensuring that a product has been “adequately” and/or “reasonably” designed and tested to ensure operator safety

Time Limits for Filing Product Liability Cases: State-by-State

A plaintiff in each state must bring an action within a certain period of time prescribed in the state’s statute of limitations. In most states, the time period begins when the plaintiff discovered or should have discovered his or her injury, under what is known as the discovery rule. A few states begin this time period when the injury actually occurred. Some states have also enacted statutes of repose, which bar actions that are not brought within a specified period of time after some event has occurred, such as the initial sale of a product.

INDIANA	An action must be brought within two years of the date on which the injury occurred. The state has enacted a 10-year statute of repose.

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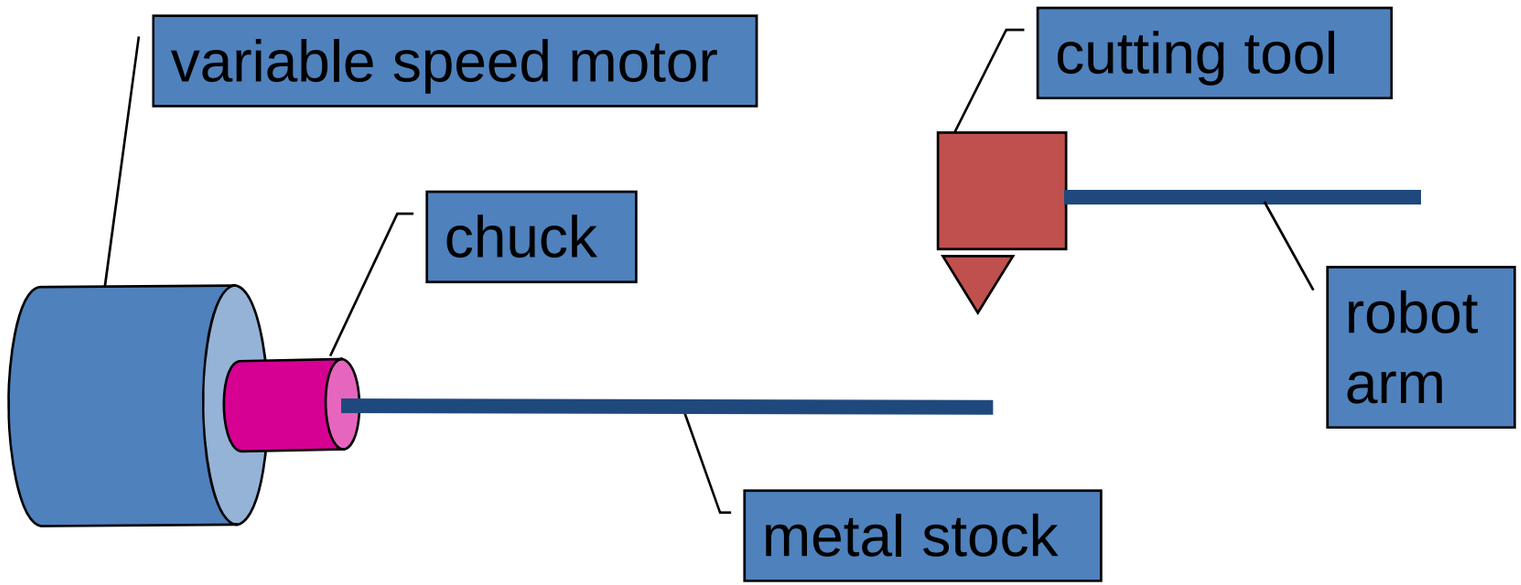
ETHICS CASE STUDIES

CNC (Computer Numerically Controlled) Lathe



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ETHICS CASE STUDIES

CNC Lathe Characteristics

- Mechanical system with large inertial forces
- Flying metal debris generated as part of the milling process must be safely contained
- Multiple embedded microprocessors
- Embedded control software (firmware)
- Operator programs written in a special language designed for milling parts (production mode)

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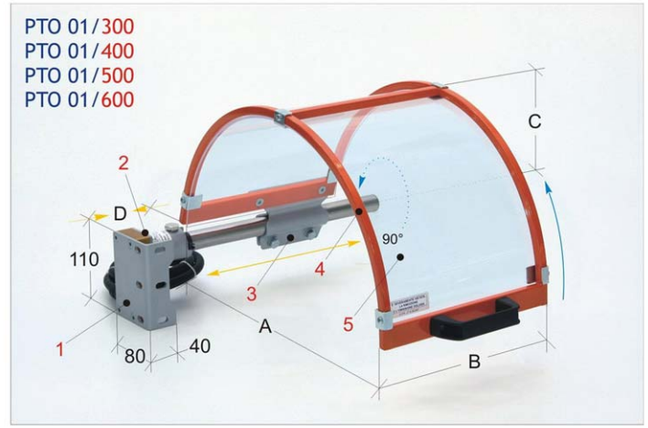
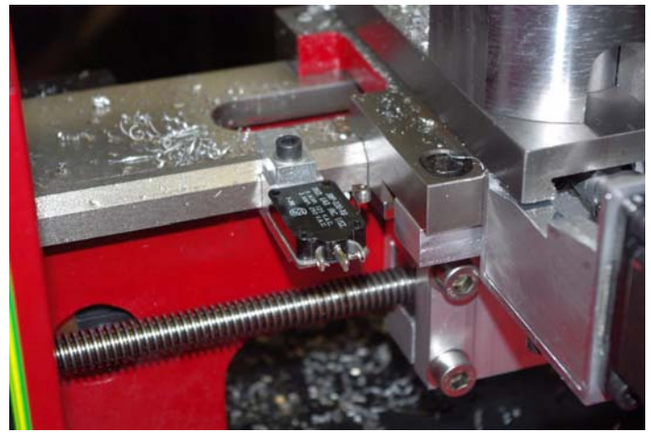
ETHICS CASE STUDIES

CNC Mechanisms/Features to Ensure Operator Safety

- Mechanical
  - safety shields to prevent flying debris from hitting the operator
  - mechanical limit switches that shut entire system down if “robot arm” out-of-range
- Computer control hardware
  - feedback sensors to monitor position, motor speed, operating temperature, etc.





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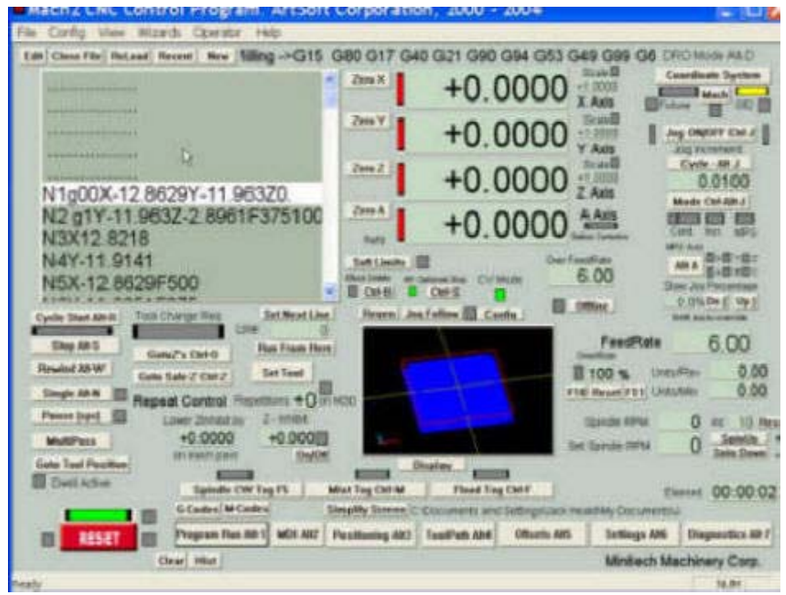
ETHICS CASE STUDIES

CNC Mechanisms/Features to Ensure Operator Safety

- Embedded software (firmware)
  - code to monitor feedback sensors, report status, and shut down system if dangerous operating conditions develop
  - mechanism to reset processor/shut down system if software execution disrupted (“watchdog”)
- User “milling” programs
  - automatic identification of commands/parameters that might cause dangerous operating conditions



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ETHICS CASE STUDIES

CNC Product Testing to Ensure Safe Operation

- Two aspects of operational safety
  - safety under “normal” operating conditions
  - safety in the event of malfunction (“graceful shutdown”)
    - hardware failures
      - components (integrated circuits, discrete parts)
      - sensors, cables
    - software failures
      - control code bug
      - transient execution error (due to power glitch/noise)

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ETHICS CASE STUDIES

CNC Product Safety Issues

- Who, in a given company, is responsible for ensuring that a product has been “adequately” and/or “reasonably” designed and tested to ensure operator safety?
- How should a product be tested to ensure operator safety under all possible conditions?
- What kinds of tests should be performed to “simulate” various failure modes?
- When has a product been “tested enough” to verify “graceful shutdown” in the event of failure? (i.e., has demonstrated “reasonable care”)

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ETHICS CASE STUDIES

Hacked Car

- CBS 60 Minutes – No real security on the Internet

FEBRUARY 5, 2015, 5:29 PM. *Lesley Stahl reports on the U.S. military's Defense Advanced Research Projects Agency (DARPA) and Dan Kaufman, who heads its software unit, working on cyber warfare and making the Internet more secure.*

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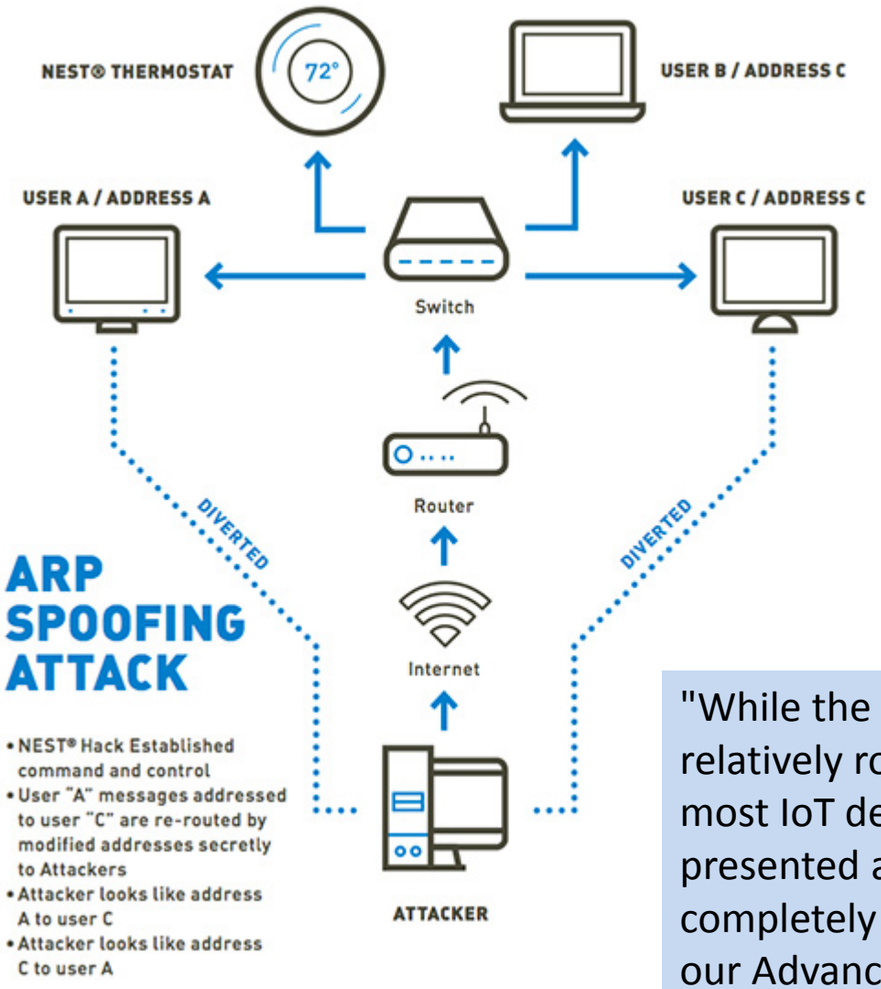
ETHICS CASE STUDIES

Nest (IoT device in general) Hacking Vulnerability

TrapX confirmed the design flaws discovered in the Nest Learning Thermostat. They validated the attack vector presented at the Black Hat 2014 Conference by compromising the device and an entire home network.



"While the Nest Learning Thermostat has relatively robust security compared to most IoT devices, the attack vectors presented at Black Hat enabled our lab to completely compromise the device within our Advanced Test Bed Facility (ATBF)…"

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ETHICS CASE STUDIES

Nest Learning Thermostat Class Action Lawsuit

- Claim (filed March 2014) – Faulty temperature readings actually cause an increase in energy cost, due to faceplate and base heating up by as much as 10° F
- Complaint seeks $5M in damages, alleging Nest has violated warranty and consumer protection laws

"…customer reports and Defendant's own admissions show that Nest is so defective it cannot correctly gauge ambient temperature."

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ETHICAL IMPACT ANALYSIS

Homework Assignment

- Outline the ethical challenges your team would have to resolve in the process of bringing your design to market
  - testing under a variety of operating conditions
  - placement of warning labels
  - providing cautions in user documentation
  - adding safety mechanisms

- Discuss how you would address each of these challenges

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