CIS 490/590

• Computer Ethics
• Ethics in the Information Age
• Art Farley
Computer Ethics in the Information Age

- Ethics
- Computers
- Information Age
Ethics

- Ethical issues arise when considering an action that can have both positive and negative consequences for oneself and others.

- Ethics provides means for addressing questions regarding the design of appropriate action in those situations.
Technology and Ethics

- Dynamic between society and technology
- People discover/develop new technology
- People adopt/use that technology
- Use of technology changes society
- Impacts of technology
- Positive and negative effects
- Ethical issues
Information Technology

• The systems and devices used in the creation, storage, manipulation, and dissemination of information (e.g., numbers, text, sound, images, video)

• We are making ever greater use of information technology
  • Costs keep falling
  • Capabilities keep rising
Computers

- Central element of information technology
- Embedded in many/most devices
- Perform most operations
The Information Age

• Unprecedented access to information, based upon widening use of information technology

• Primary catalysts
  • Ubiquitous, embedded computing
  • High-speed communication networks
CIS 490/590

- Course Goals
  - awareness of impacts on society of computing and information technologies
  - awareness of impacts of your actions
  - ability to apply ethical theories to evaluate ethical issues that arise due to expanding use of information technology
CIS 490/590

- understand the range of issues involved
- free speech and censorship
- intellectual property
- privacy and surveillance
- security
- economic/workplace impacts
Information Technology

- History
- types of communication technology
- succession of technologies
  earliest technologies
History of Information Technology

- Earliest information technologies
  - languages
    - sign
    - spoken
  - written
Gutenberg’s Printing Press

• First in action ... 1450

• Powerful mass communication tool

• Printing press’s impact on Reformation
  
  • More than 300,000 copies of Luther’s publications

• Protestants out-published Catholics by 10-to-1 in the middle 16th century
Newspapers

- Newspapers: Stimulated free public expression
- Governments responded to this freedom
  - Licensing, censorship
- Impact on American Revolution
  - Newspapers helped unify colonies
  - Swayed public opinion toward independence
Information Age
Technologies

- Communication
- Computation
  electronic
Telecommunication Technologies

Pre-digital Era
Telecommunication Systems

- Telegraph (1844), Telephone (1876)
- Typewriter and teletype (1873, 1908)
- Radio (1895 ... 1910’s)
- Television (1927 ... 1950’s)
- Cell Phone (1980’s)

digital systems?
Digital Networking

- National Networks
  - ArpaNet 1970’s
  - NSFNet 1980’s
  - Internet 1990’s
- Local Networks
  - Ethernet 1970’s
  - Wireless 2000’s

network applications
Network Applications

- Email and FTP  1970’s
- World Wide Web 1990’s
  - search engines
  - e-commerce
- social networks 2000’s
- cloud computing 2010’s
If you find you have an idea as we are discussing things in class but don’t want or don’t get a chance to speak, you can add a problem to the end of the weekly homework where you would say something like:

“When we were discussing <whatever> issue in class, I had the following idea: <the idea>.."
Blown to Bits

• Message
Blown to Bits

- We are in the middle of an explosion in digital information processing, the outcome of which we can’t imagine.
  - smaller, faster, cheaper
  - more efficient, more reliable
- It will have significant social implications and raise a significant number of ethical issues in the near future.
Blown to Bits

- Tanya Rider
  - crashed into a ravine while driving home one evening
  - she was rescued 8 days later, having nearly died of dehydration
  - how was she found and rescued?
  - why did it take so long?
Tanya Rider

• not classified as a missing person given her bank account showed ATM activity (husband)

• only after her husband became a suspect in her disappearance could police use cell phone records to locate her, overruling her privacy in a possible criminal investigation

• interaction between technology and legal rights
Blown to Bits

- The explosion of bits
  - information, misinformation, data, garbage
    - recorded, saved, only seen by computers
  - enough memory in digital cameras alone to hold all the books in Library of Congress a thousand times over
Blown to Bits

- After expanding by 62 percent to nearly 800,000 petabytes in 2009, the digital universe will grow to 1.2 million petabytes, or 1.2 zettabytes in 2010. Voice, TV, radio, and print media will complete their transition from analog to digital by 2020, which will help push the amount of digital information created or replicated to nearly 50 times that of 2010.
Orders of Magnitude

- gigabyte (GB) $10^9 2^{30} \ldots$ gigaflop
- terabyte (TB) $10^{12} 2^{40} \ldots$ teraflop
- petabyte (PB) $10^{15} 2^{50} \ldots$ petaflop
- exabyte (EB) $10^{18} 2^{60} \ldots$ exaflop
- zettabyte (ZB) $10^{21} 2^{70} \ldots$ zettaflop
- yottabyte (YB) $10^{24} 2^{80} \ldots$ yottaflop
Looking forward, supercomputers are now looking towards exascale - supercomputers that are capable of an exaflop (1,000 petaflops) or more. The Department of Energy is planning to build its first exaflop computer in 2020 — but there are some serious heat, power, and software hurdles to cross before then. IBM is planning to build an exaflop supercomputer before 2024 for the Square Kilometer Array — a 3,000-kilometer-wide telescope being built across South Africa and Australia.
Blown to Bits

• We now have the technology and storage capacity to record every word spoken by every human being.

• Should we? An ethical issue.
Blown to Bits

- amount of new disk storage each year
- enough to hold one page of information about every person on earth every minute
- they can come back to haunt one when least expected... e.g., Elliot Spitzer... when analyzed by computers
Bits

- What/Where are they?
- How do they behave?
  - non-exclusive
  - non-rivalrous
• Thomas Jefferson

• If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea, which an individual may exclusively possess as long as he keeps it to himself; but the moment it is divulged, it forces itself into the possession of everyone, and the receiver cannot dispossess himself of it. Its peculiar character, too, is that no one possesses the less, because every other possesses the whole of it.
Bits

- How they behave? What/Where are they?
  - non-exclusive ... hard to stop the spread
  - non-rivalrous ... can be taken from me without me losing them

- 7 koans --- paradoxes, conundrums, rules
Bit Koans

• #1: It’s all just bits. Bits are bits.
  • digital convergence of representation

• #2: Perfection is the norm.
  • lossless copying/transmission
Bit Koans

• #3: There is want in the midst of plenty
  • not all information has been encoded
  • not everyone has access

• #4: Processing is power.
  • to organize and interpret information
Bit Koans

• #5: More of the same can be a new thing
  • exponential growth leads to new worlds
    • recognizing an epidemic when few have it (Kodak)

• #6: Nothing goes away.
  • unless there is policy or technology change
Bit Koans

- #7: Bits move faster than thought
- the Internet makes bits available anywhere
- telecommuting... manufacturing bits
Conclusion

• Technology itself is often neutral in its impacts
• Uses have positive and negative impacts
• Regulate uses, not technology
Conclusion

- Information technology has a long history
- Rate of technological change accelerating
- Wrong question: “What will IT do to us?”
- Right question: “What will we make of IT?”

(quoting Seymour Papert)
History of Computing: The Early Period

• Started nearly 3,000 years ago:
  Mathematics, logic, numerical computation, algorithms
  Contributions made by the Egyptians, Babylonians, Indians, Chinese, Greeks, Persians

• 800ad: Al Kwarizmi
  Basic algebraic methods ... algorithms
Early Computing

- 1614: Logarithms
  - Invented by John Napier to simplify computations

- Around 1622: First slide rule created
Computing: Early Period

- 1672: The Pascaline .... Blaise Pascal
  - One of the first mechanical calculators
  - Could do addition and subtraction

- 1674: Leibnitz’s Wheel .... Gottfried Leibnitz
  - Could do addition, subtraction, multiplication, and division
The Pascaline: One of the Earliest Mechanical Calculators
Computing: Early Period

- 1801: The Jacquard loom .... Joseph Jacquard
  - Automated loom
  - Punched cards to represent desired pattern

- 1823: The Difference Engine .... Charles Babbage
  - Did addition, subtraction, multiplication, and division to 6 significant digits
  - tabulated logarithms and trigonometric functions
Computing: Early Period

• 1830s: The Analytic Engine .... Babbage
  • General-purpose mechanical computer
  • Components were functionally similar
    • Store (modern terminology: memory)
    • Operator (modern terminology: processor)
      • Mill (modern terminology: arithmetic/logic unit)
    • Output (modern terminology: input/output)
  • Lady Lovelace... first programmer (ADA)
Computing: Early Period

• 1890: U.S. census carried out with card processing machines

• Built by Herman Hollerith

These machines could automatically read, tally, and sort data entered on punched cards

• Tabulating Machine Co. ==> IBM 40 years later
The Birth of Computers: 1940-1950

- Electronic computers
  - Did not begin until after 1940
  - Was fueled in part by World War II
- Early computers
  - Mark I
  - ENIAC
Photograph of the ENIAC Computer
Programming the ENIAC

- By wire
The Birth of Computers: 1940-1950

- Stored program computer model
  - Proposed by John Von Neumann in 1946
  - Both data and algorithm stored in the memory
  - Is known as the Von Neumann architecture
- First stored program computers
  - EDVAC, EDSAC
The Modern Era: 1950 to the Present

• First generation of computing (1950-1958)
  • Vacuum tubes used to store data and programs
  • Each computer was multiple rooms in size
  • Computers were not very reliable nor efficient
The Modern Era

• Second generation of computing (1958-1965)
  • Transistors and magnetic cores replaced tubes
  • Dramatic reduction in size
    • Computer could fit into a single, large room
  • Increase in reliability and efficiency of computers
  • Reduced cost of computers
• High-level programming languages born
The Late 1950’s

- Second generation UNIVAC.. first commercial computer
The Modern Era

- Third generation of computing (1965-1975)
  - Integrated circuits rather than individual electronic components were used
  - IBM 360 series ... punched card programming
  - Further reduction in size and cost
  - First minicomputers ... DEC PDP-6, PDP-8
  - Computers became closet-sized
- Software industry formed
The Modern Era

- Fourth generation of computing (1975 - 1990)
  - First microcomputers developed
  - Desktop and personal computers appear
- Appearance of
  - local networks... Ethernet
  - Electronic mail, FTP
The Altair 8800, the World’s First Microcomputer
Microcomputers

- 1980
  - Microsoft DOS
  - PCs
    - Tandy and Commodore
    - floppy discs
  - 1980
    - VisiCalc ...
    - Wordstar
Microcomputers

- 1984
- Apple Macintosh computers
Computing: The Modern Era

- Fifth generation of computing (1990 - ?)
  - Massively parallel processors
  - High-resolution graphics
  - Handheld devices, smart phones, tablets
  - Powerful multimedia user interfaces incorporating sound, voice recognition, touch, photography, video, and television
  - Embedded, ubiquitous computing
Computing: The Modern Era

- Recent developments
  - Integrated global telecommunicationss incorporating data, television, telephone, fax, the Internet, and the World Wide Web
  - Wireless data communications
  - Massive storage devices/cloud computing
  - Ubiquitous, embedded computing, IoT