

# **Section 8**

## **Professional Ethics**

1. Professionalism
2. Code of ethics
3. Case studies

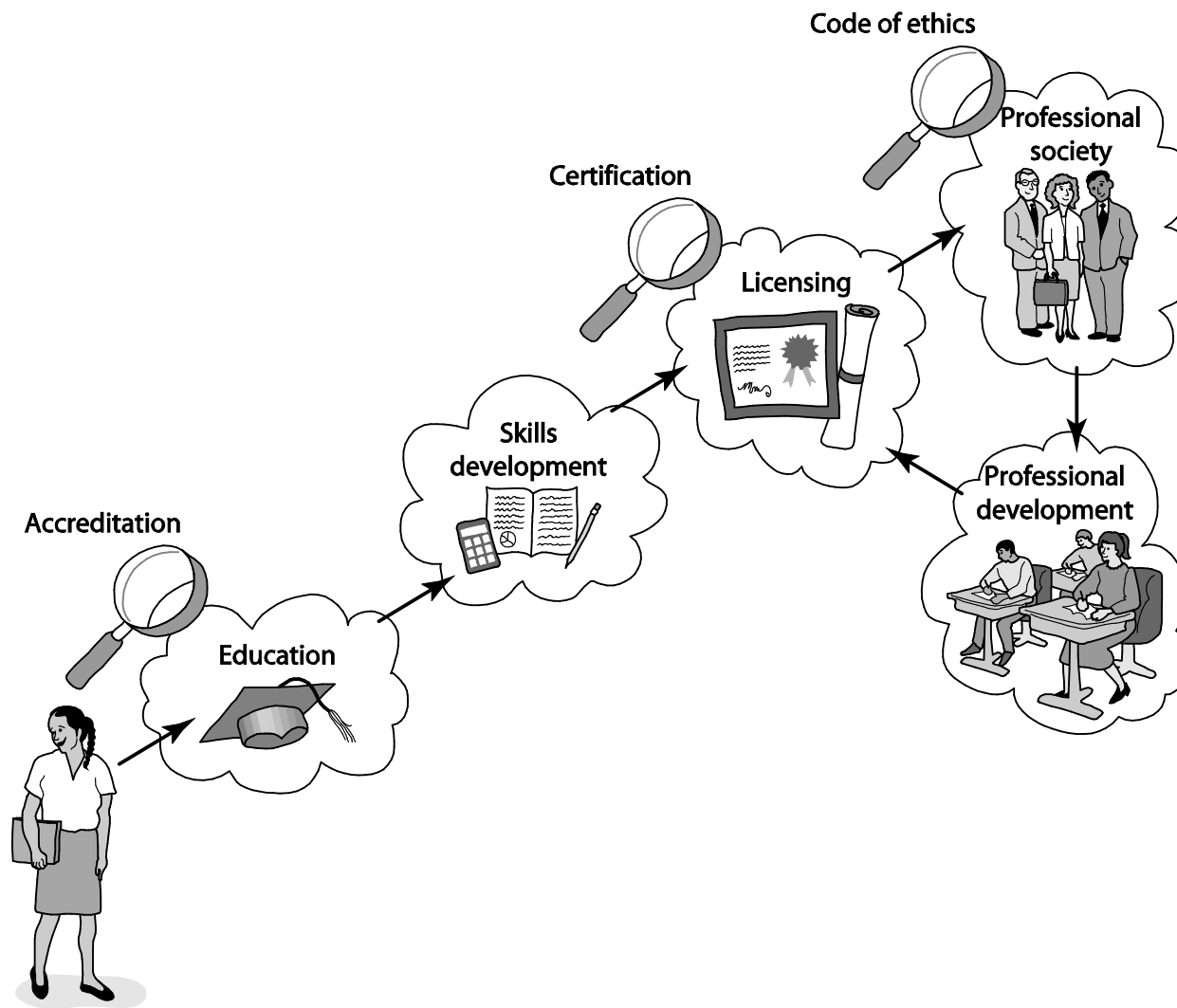
# Professional Ethics

- Learning outcomes
  - become familiar with the principles of the ACM Software Engineering Code of Ethics
  - use a systematic process to analyze ethical dilemmas, determine possible courses of action, and select the most ethical course of action

# 8.1 Professionalism

- Informally, a profession is a vocation that requires:
  - a high level of education
  - practical experience
- We pay professionals well
  - for example: doctors, lawyers
- We trust professionals to:
  - correctly ascertain and treat problems
  - take actions for the good of their clients

# Attributes of a Mature Profession



# Computer-related Careers

- Certification and licensing is not required
- University/college degree is not required
- Apprenticeship is not required
- Membership in a professional society is optional
- No specific requirements for continuing education
- Most programmers, systems analysts are part of teams
- **Ability to harm the public can be similar to members of more mature professions**

# Software Reliability

- Computer systems are sometimes unreliable
  - erroneous information in databases
  - misinterpretation of database information
  - malfunction of embedded systems
- Effects of computer errors
  - inconvenience
  - bad business decisions
  - fatalities

# Data Entry or Retrieval Errors

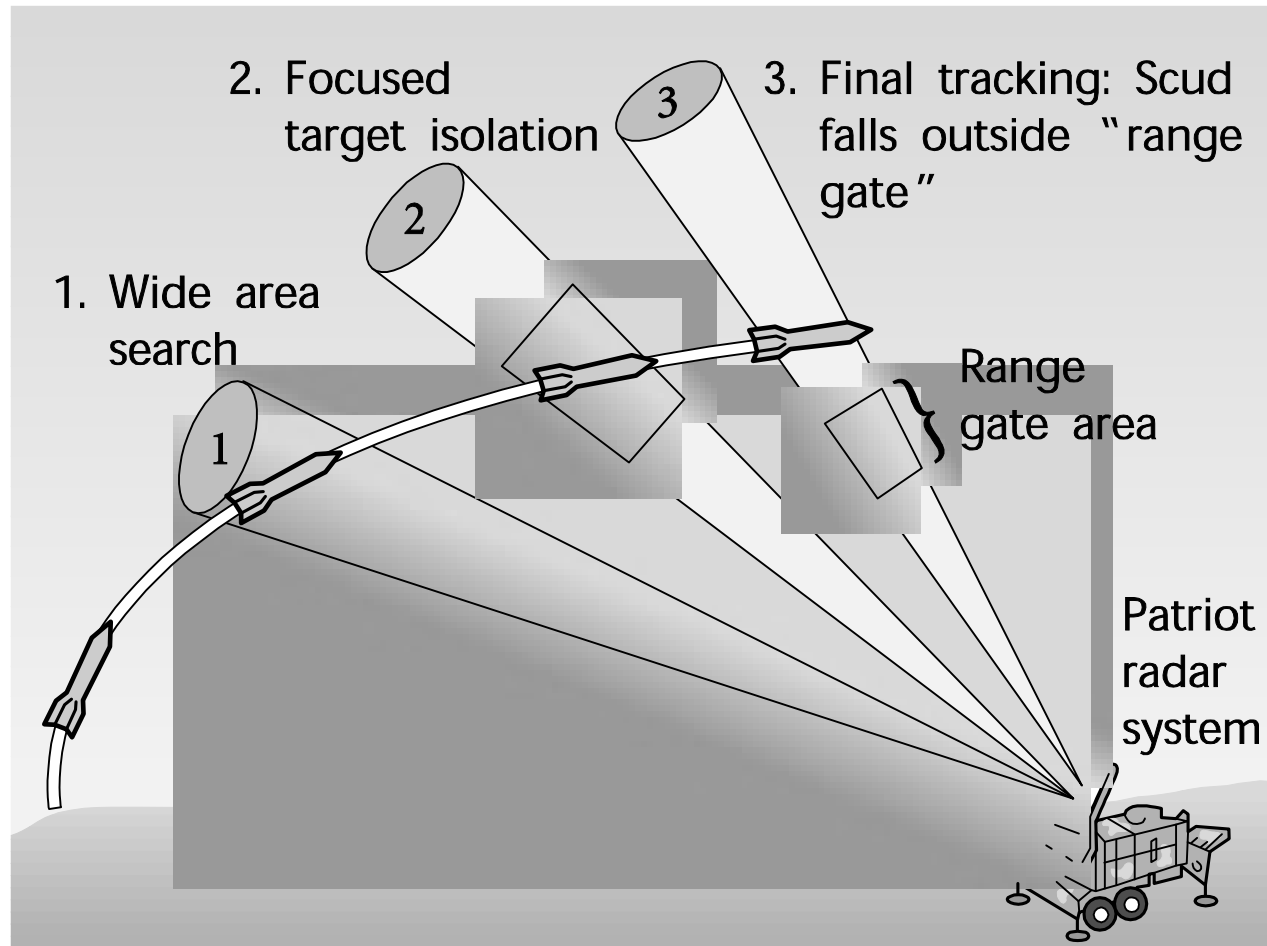
- A computerized system may fail because:
  - wrong data is entered
  - people incorrectly interpret the data they retrieve
- Example: disfranchised voters
  - November 2000 U.S. general election
  - Florida disqualified thousands of voters
  - Reason: people identified as felons
  - Cause: incorrect records in voter database
  - Consequence: may have affected election's outcome

# Notable Software System Failures

- Patriot missile
  - designed as anti-aircraft missile
  - used in 1991 Gulf War to intercept Scud missiles
  - one battery failed to shoot down Scud that killed 28 people
  - designed to operate only a few hours at a time
  - kept in operation > 100 hours
  - tiny truncation errors added up
    - clock error of 0.3433 seconds meant tracking error of 687 meters



# Notable Software System Failures (cont.)



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# Notable Software System Failures (cont.)

- Ariane 5
  - 1996 satellite launch vehicle
  - 40 seconds into maiden flight, rocket self-destructed
    - \$500 million of uninsured satellites were lost
  - statement assigning `float` value to `int` raised an exception
  - the exception was not caught, so the system crashed
  - code was reused from Ariane 4
    - slower rocket
    - smaller values being manipulated
    - exception was impossible

# Notable Software System Failures (cont.)

- Therac-25

- history

- AECL and CGR built Therac-6 and Therac-20
    - Therac-25 built by AECL
      - PDP-11 an integral part of the system
      - hardware safety features replaced with software
      - reused code from Therac-6 and Therac-20
    - first Therac-25 shipped in 1983
      - patient in one room
      - technician in adjoining room

- results

- 6 accidents
    - 3 fatalities
    - 2 separate investigations

# Notable Software System Failures (cont.)

- Therac-25 (cont.)

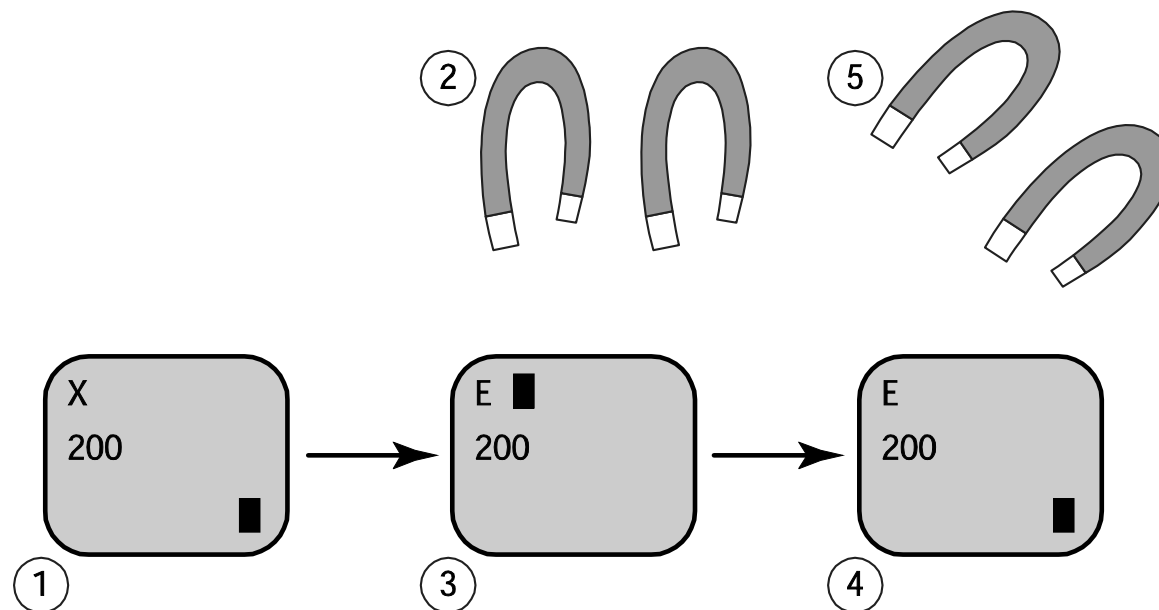
- software errors

- race condition:

- order in which concurrent tasks access a shared variable affected program behaviour

- two race conditions in Therac-25

- command screen editing
      - movement of electron beam gun



# Notable Software System Failures (cont.)

- Therac-25 (cont.)
  - analysis
    - AECL focused on fixing individual bugs
    - system not designed to be fail-safe
    - no devices to report overdoses
    - AECL did not communicate fully with customers
  - software lessons
    - difficult to debug programs with concurrent tasks
    - design must be as simple as possible
    - documentation is crucial
    - code reuse does not always lead to higher quality

## 8.2 Code of Ethics

- ACM Software Engineering Code of Ethics and Professional Practice
- Principles:
  - Public:
    - act in the public's best interest
  - Client and employer:
    - act in the client's and employer's best interest
  - Product:
    - ensure products meet highest standards
  - Judgment:
    - maintain integrity and independence

# Code of Ethics (cont.)

- Principles (cont.):
  - Management:
    - promote ethical management of software development
  - Profession:
    - advance integrity and reputation of profession
  - Colleagues:
    - be fair and supportive to colleagues
  - Self:
    - participate in lifelong learning

# Making Ethical Decisions

- Brainstorming phase:
  - identify stakeholders
    - people involved, directly or indirectly
  - for each stakeholder:
    - identify risks, benefits, consequences, costs
    - identify rights
  - identify all possible courses of action
    - I-win-you-lose
    - you-win-I-lose
    - the third option: we-both-win
      - Stephen Covey's Habit #4



# Making Ethical Decisions (cont.)

- Analysis phase:
  - identify impact of all courses of action on the stakeholders
  - consider:
    - software engineering Code of Ethics
    - your morals and experience
  - categorize each action as:
    - ethically obligatory
    - ethically prohibited
    - ethically acceptable
  - choose the best option, considering the ethical merits

## 8.3 Case Studies

- Protecting personal data at a community clinic
  - three sites, including a shelter for battered women and children
  - director wants:
    - computerized records for clients (names, forwarding addresses)
    - networking between the three sites
    - Web access and email
    - laptop for staff members when they visit clients at home
  - very small budget
    - director reluctant to pay for security features

# Case Studies (cont.)

- Kickbacks and disclosure
  - you work as a programmer for the university
  - the Student Orientation office is selecting a brand of security software to recommend to all new students
  - you have been asked to:
    - evaluate a dozen software packages
    - make a recommendation
  - one of the software companies:
    - takes you out to dinner
    - offers to pay your expenses to attend professional conference
    - offers to give university a percentage of every sale

# Professional Ethics Recap

- What we learned:
  - became familiar with the principles of the ACM Software Engineering Code of Ethics
  - used a systematic process to analyze ethical dilemmas, determine possible courses of action, and select the most ethical course of action