Unit 1.
Introduction to SW Engineering

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Software Engineering

- **Meaning of Software and Engineering**
  - Software
    - Source codes, Object codes, Development documents, User manuals, etc.
  - Engineering
    - Application of a systematic approach, based on science and mathematics, toward the production of a structure, machine, product, process or system.
- **By Its Goals**
  - producing a High "Quality" software system
  - in a "Cost-effective" manner

The Only Course
with 'Engineering'
within C.S.

Software Crisis

- **40-Year-Old Software Productivity Problem**
  - Software has failed to keep up with hardware evolution.
  - No significant advances for the last few decades
  - Difficulty of writing correct, understandable, and verifiable software

- **Software Crisis manifested in Several Ways**
  - Projects running over-budget and over-time
  - Software with Inefficiency
  - Software with Low Quality
    - Usability, Performance, Maintainability, etc.
  - Software not Meeting requirements
  - Unmanageable Projects

Disasters
with SW Flaws

Causes to Software Crisis

- **Increased Software "Complexity"**
  - User Demands on Richer Functionality of Software
  - Heterogeneous Hardware Environment
  - Distributed Computing
  - Web-based and Mobile Applications
  - Software embedded in Hardware Systems
  - Context-aware Computing
- **Increased Software "Cost"**
  - Development Cost
  - Ownership Cost
    - Operation Cost + Maintenance Cost

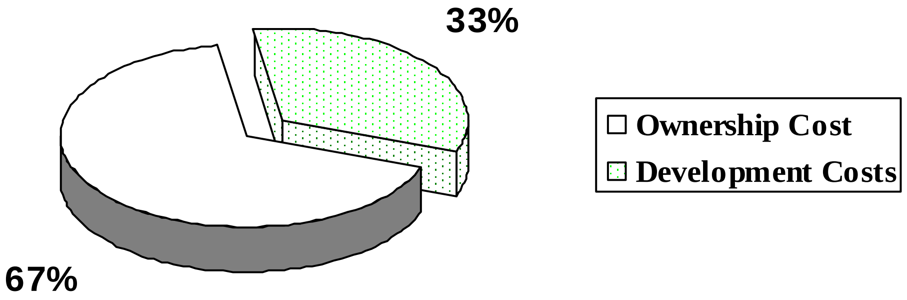
Software Complexity

- **Building Large-scaled Software**
  - is *not* a simple scaled-up problem.

- **Analogy**
  - *Foot* bridge over stream vs. *Road* bridge over river
- **Nature of the Problem**
  - *Complexity* of the Software

Software Cost (1)

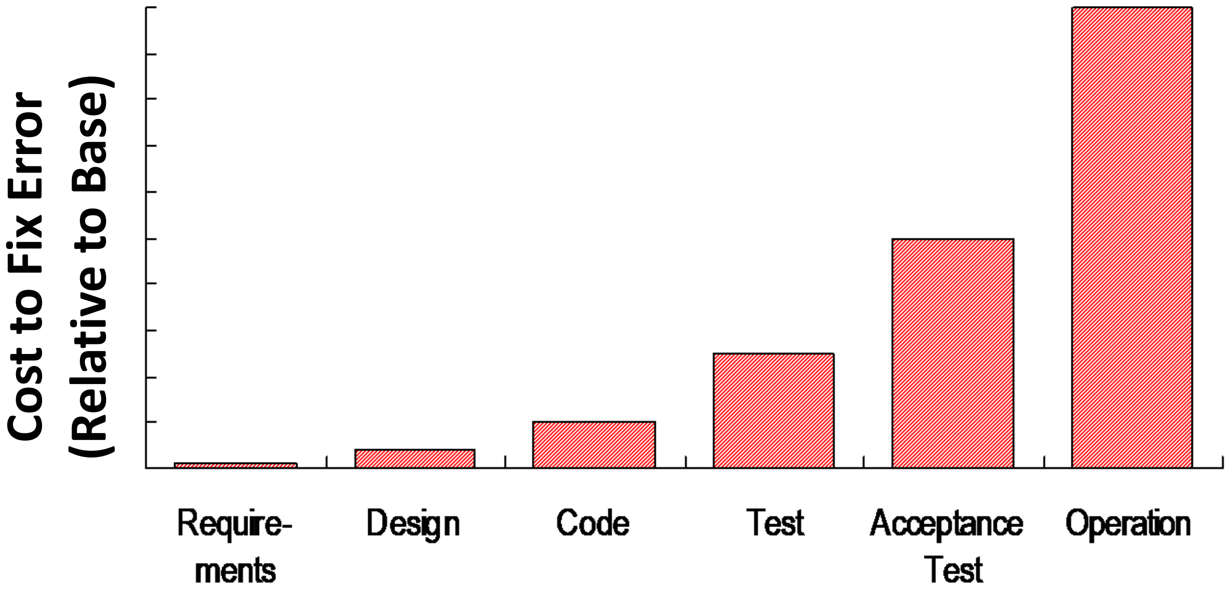
- Development Cost vs. Ownership Cost
  - Software ownership is generally twice as expensive as development.
    - Primarily, the cost of maintenance



- Message
  - Software product is not the final goal.
  - Maintenance becomes a significant issue.

Software Cost (2)

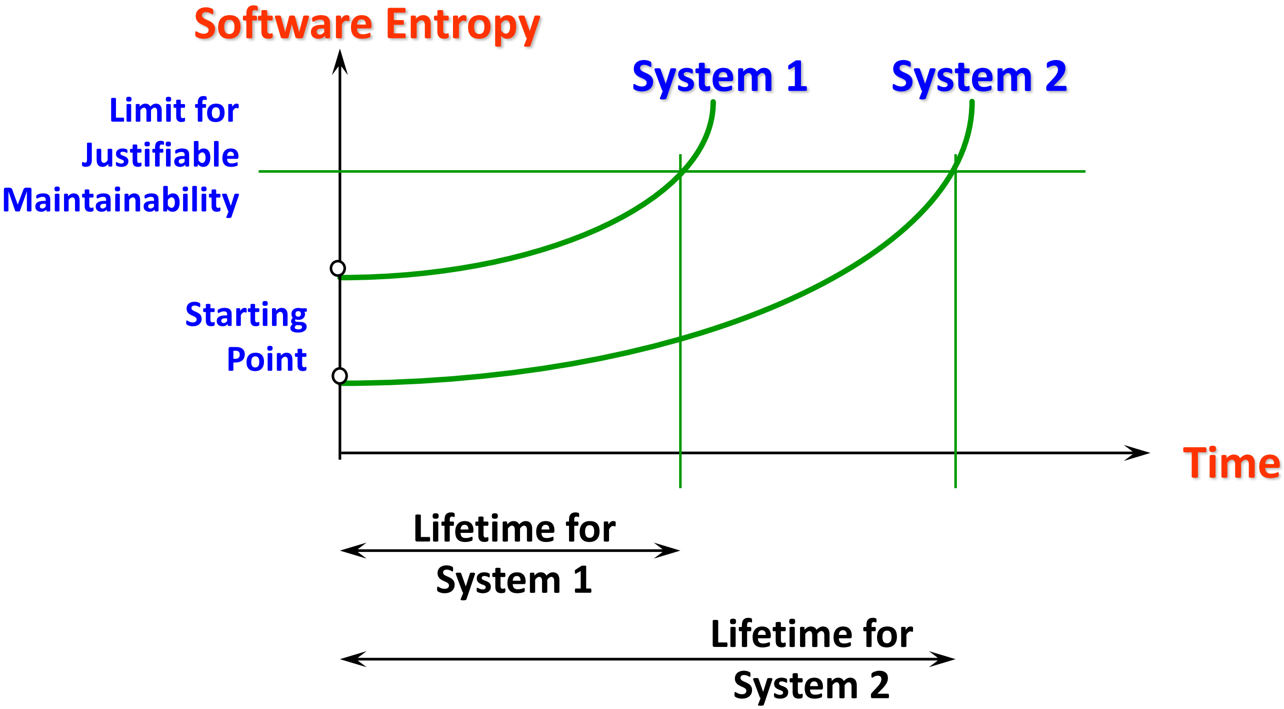
- Costs to Fix Errors
  - The sooner an error is discovered, the better.



  - More errors are found by outside testers and users than by developers.
  - More errors are found in the two latest stages.

Software Quality & Lifetime

- **Software Entropy**
  - **A program that is used will be modified.**
  - **Increased failure rate and complexity due to side effects of maintenance.**



Overcoming Software Crisis

- “Engineering” Approach to Software Development
  - Avoid Ad-hoc approach!
  - Utilize Effective Methodology!
- Reusing Software Assets
  - Components, Cloud Services, Design Patterns, Architectural Styles, Frameworks, etc.
- Focus more on Modeling and Design
  - Good design is a prerequisite to good implementation.

Q & A