Topics for Today

- Review of the “initial”
- SE Principles
- Readings for next week
The Need for Disciplined Practices

- The job of software engineers is to
  - Produce quality products
  - Produce them on schedule
  - And do this work for the planned costs

- In this class I hope we will learn some of this
  - You will also need a lot of practice!!

Overview

- Software engineering is based on a collection of fundamental principles
- These principles guide the development of all aspects of software development
  - Languages
  - Methods
  - Tools
  - Process
  - Project management

How it All Relates

- Tools
- Methodologies
- Principles
We Will Cover

- Rigor and formality
- Separation of concerns
- Modularity
- Abstraction
- Anticipation of change
- Generality
- Incrementality

Rigor and Formality

- Software development is a creative process
  - Creativity implies informality and chaos
- Rigor and formality seems to contradict creativity
  - Not necessarily so
  - Increase the confidence in the creative results
- Evident in
  - Programming languages, design notations, requirements specifications, process definitions

Separation of Concerns

- We cannot deal with all aspects of a problem simultaneously
  - One way to conquer complexity
- Separate issues and tasks
  - Separate functionality from efficiency
  - Requirements specification from design
- Various types of separation
  - In terms of time
  - In terms of qualities
  - In terms of views of an artifact
Modularity

• A complex system must be broken down into smaller modules

• Three goals with modularity
  - Decomposability
    - Break the system down into understandable modules
    - Divide and conquer
  - Composability
    - Construct a system from smaller pieces
    - Reuse, ease of maintenance, OO frameworks
  - Ease of understanding
    - The system will be changed; we must understand it
    - Understand in pieces versus understanding the whole

More Modularity

Two Essential Properties

Low Coupling

High Cohesion
Abstraction

• Identify the important aspects and ignore the details
• Must have different abstractions of the same reality
  • Provide different views
• Examples of abstraction
  • Design notations
  • Project planning
  • Etc.
• Two key concepts
  • Information hiding and data encapsulation

Anticipation of Change

• Change is inevitable
  • We might as well plan on it!
• This effects all aspects of Software Engineering
  • Make sure all artifacts are easy to change
  • Modularization and separation of concerns
  • Make sure you can maintain many versions of all artifacts
  • Configuration control
  • Plan for personnel turnover
  • Plan for a rapidly changing market
  • Plan for rapidly changing technology

Generality

• In every problem, attempt to find a more general solution
  • General problem is often easier to solve
  • A generalized solution may be reusable
  • If you are lucky, you may even be able to buy instead of build

• Attempt of the software industry to parallel hardware and manufacturing
Incrementality

• Move towards the goal in increments
  ● Very difficult to have a “big bang” approach to anything
• Areas where we see incrementality
  ● Identify useful subsets of an application and deliver in increments
  ● Prototyping
  ● All software development adds functions a few at a time
  ● The whole development process; the spiral model

Concluding Remarks

• These fundamental principles guide all aspects of software development
• Keep them in mind during the class and when
  ● Planning a new software project or product
  ● Design your software
  ● Evaluate new tools and technologies
  ● Evaluate new methodologies and management techniques
• Remember
  ● Tools, methodologies, and techniques will evolve, the principles remain the same

We Have Learned

• We need to revisit a few topics related to requirements
• You need to go over basic OO modeling
• Some fundamental principles

Next time
  ● Requirements: What, why, and how?
  ● Readings
    ● Rich traceability
    ● The WRSMP model
Original Engine System

Solution - Automate the Process