Software Process Models

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Software Process Models

- Software methodology
  - Codified set of practices
  - Repeatable process for producing quality software
- Software process model
  - Methodology for organizing software life cycle
- Major approaches
  - Waterfall model
  - Iterative development
    - Unified model
    - Agile software development
    - Extreme programming (XP)
  - Formal methods
Waterfall Model

- **Approach**
  - Perform steps in order
  - Begin new step only when previous step is complete
  - Result of each step flow into next step
Waterfall Model

- Advantages
  - Simple
  - Predictable results (emphasizes predictability)
    - Software follows specifications
  - Reasonable for small projects
- Problems
  - In real life
    - May need to return to previous step
    - Steps may be more integrated
    - Steps may occur at same time
  - Unworkable for large projects
Iterative Software Development

• Approach
  • Iteratively add incremental improvements
  • Take advantage of what was learned from earlier versions of the system
  • Use working prototypes to refine specifications
Iterative Software Development

• Goals
  • Emphasize adaptability instead of predictability
  • Respond to changes in customer requirements

• Examples
  • Unified model
  • Agile software development
  • Extreme programming (XP)
Unified Model

- Development divided into phases (iterations)
  - Inception
  - Elaboration
  - Construction
  - Transition
- During each phase
  - Multiple iterations of software development
  - Development treated as mini-waterfalls
  - Emphasis gradually shifts from specification to testing
Unified Software Life Cycle Model
Agile Software Development

- Agile approach
  - Based on iterative development
    - Short iterations (timeboxes) lasting 1-4 weeks
  - Working software as principal measure of progress
    - Produced at end of each iteration
- Adds a more people-centric viewpoint
  - Face-to-face communication preferred
  - Co-locate programmers, testers, “customers”
- Relies on adapting to feedback rather than planning as the primary control mechanism
  - Less specification & documentation
Extreme Programming (XP)

- Prominent example of Agile methodology
  - Iterative, adaptive software development
- Describes set of day-to-day practices
  - Followed by managers & programmers
  - Intended to encourage a set of values
- Appropriate for environments with
  - Small teams
  - Rapidly-changing requirements
Extreme Programming Values

• Communication
  • Rapidly building & disseminating institutional knowledge among programming team

• Simplicity
  • Implement simplest code needed by customer without emphasis on future versions

• Feedback
  • From testing, team members, customers

• Courage
  • Willingness to rewrite / refactor software to add or change features
**Extreme Programming Practices**

- **Pair programming**
  - Pairs of programmers combine software development efforts at one computer
  - Especially useful for novice programmers
- **Test-driven development**
  - Tests are designed first, before writing software
- **Continuous integration**
  - Tests performed throughout development process
- **On-site customer**
  - Customer available at all times to answer questions
Formal Methods

- Mathematically-based techniques for
  - Specification, development, and verification
  - Software and hardware systems
- Intended for high-integrity systems
  - Safety
  - Security
- Levels
  - 0 – Informal implementation of formal specifications
  - 1 – Formal code development & verification
  - 2 – Theorem prover to ensure correctness
Choosing A Software Model

• Which software process model is appropriate?
• For class programming projects
  • Code and test probably suffices
  • But software in real world not like class projects
• Some big questions
  • Do you understand what you are trying to build?
  • What is the cost of change?
  • How many people have to interact with the design?
  • How easy is it to get the entire thing in your head?
Do You Understand The Problem?

• In many cases, the things we want software to do are not well understood
  • Examples
    • Provide a web interface for student applications
    • Allow users to view and manipulate photographs
    • Build a better search engine
  • Hard to understand constraints / interactions
  • May have to build prototype
    • To understand how users can effectively use it
What Is The Cost Of Change?

- Possible situation
  - Most coding already complete
  - Realize need to change something in the design or even the requirements
- How expensive is that?
  - If hugely expensive better get requirements & design right before completing too much code
- Some people believe recent software development techniques have substantially reduced cost of change
  - Possible reasons
    - Safer programming languages
      - E.g., not C/C++/assembly language
    - Object-oriented design & programming
    - Test-driven development