

CMSC 132:

OBJECT-ORIENTED PROGRAMMING II



Software Process Models

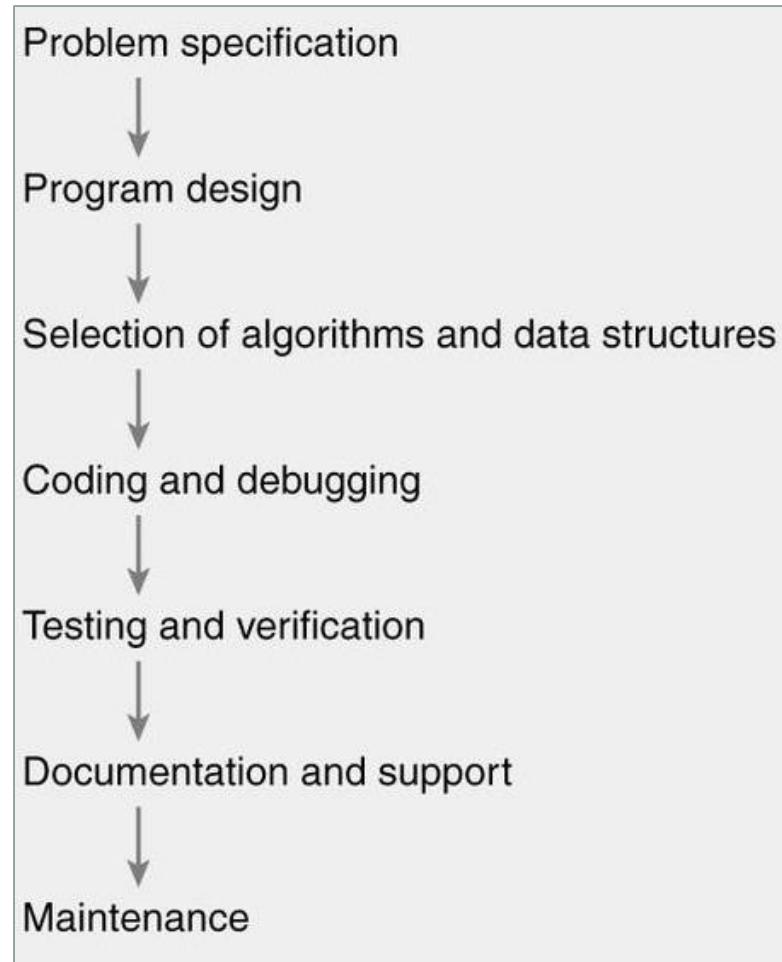
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Software Process Models

- 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) (prominent example)
 - 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

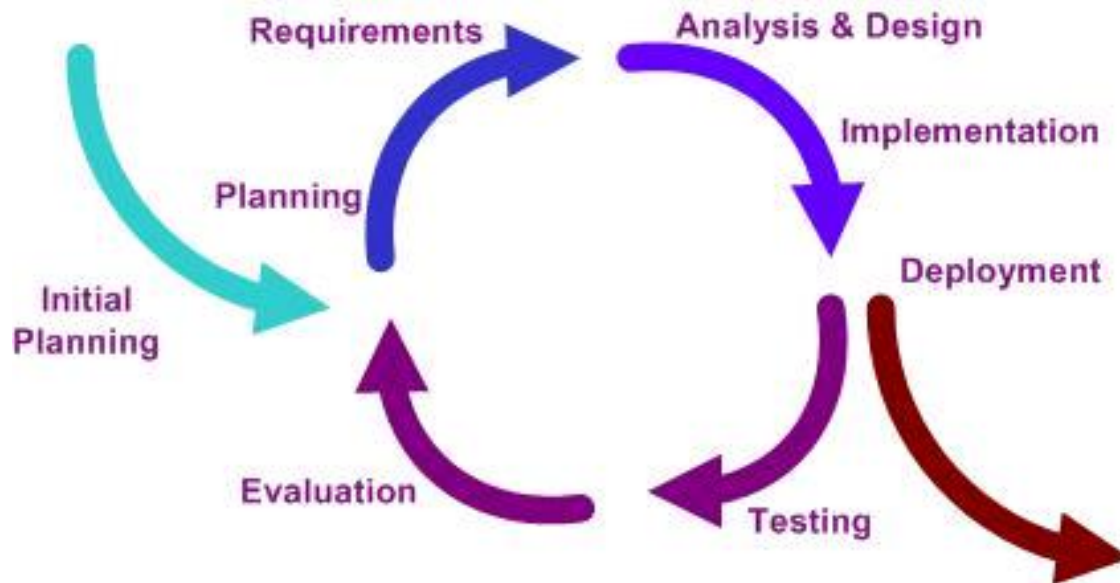


Waterfall Model

- 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



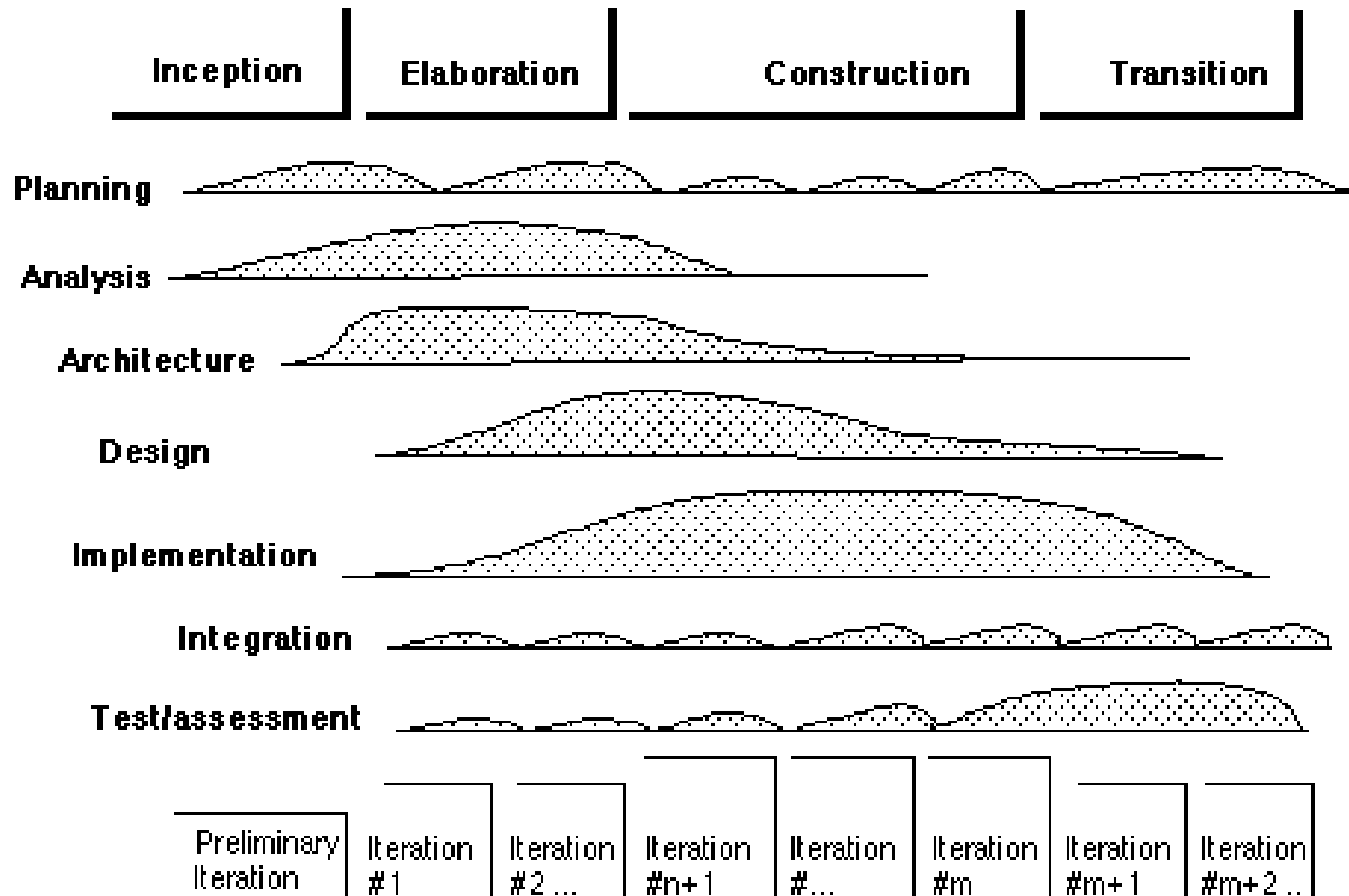
Iterative Software Development

- 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

Rapid Prototyping

- Goal → explore requirements
 - Without building the complete system
- Start with part of the functionality
 - That will yield significant insight
- Build a prototype
 - Focus on core functionality
- Use the prototype to refine the requirements
- Repeat the process, expanding functionality