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SOFTWARE ENGINEERING

CS 487

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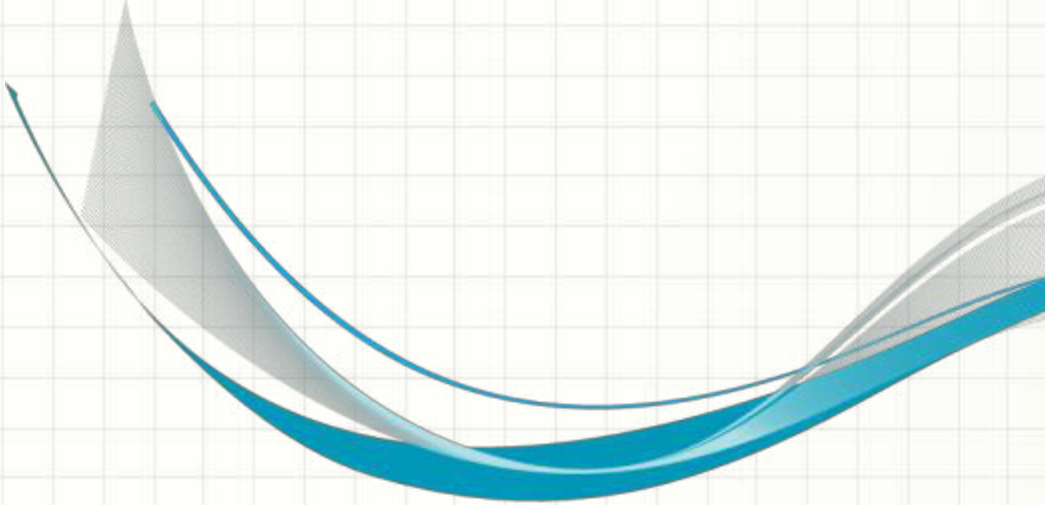
Computer Science

Summer ‘19

Homework #1

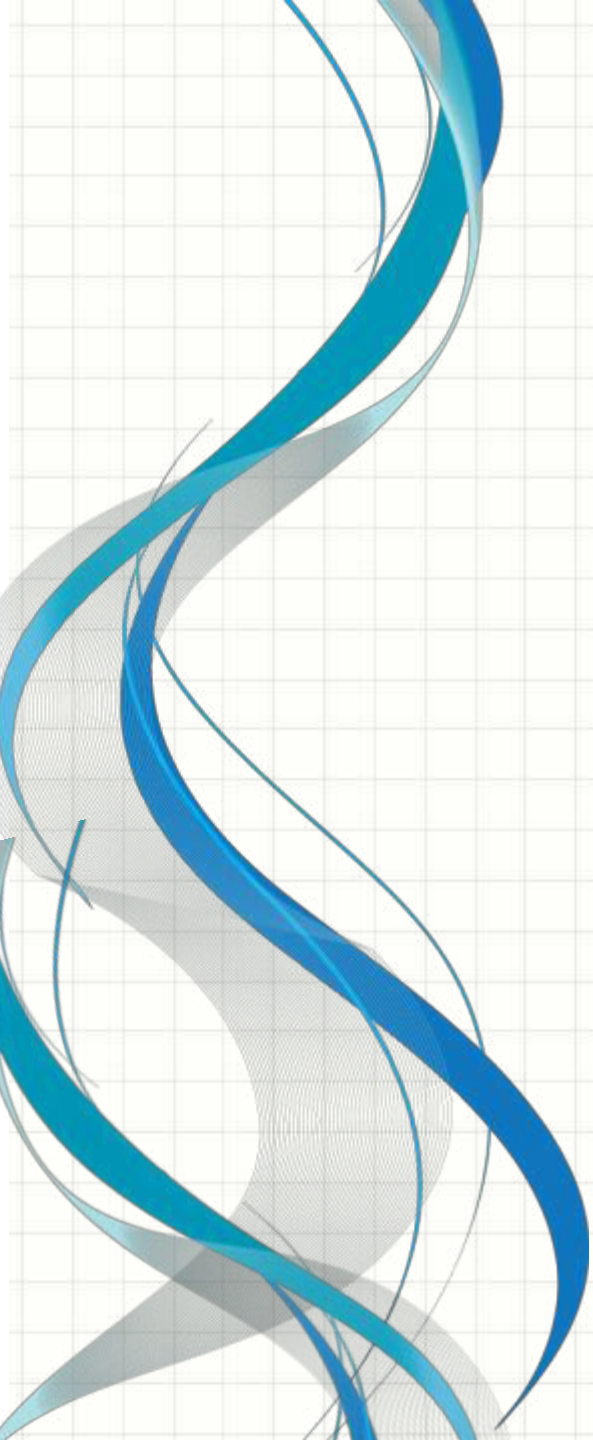
- Answer each of the following with respect to the software engineering process discussed in lecture:
  1. Describe the purpose of each development phases:
     - Analysis; Design; Build; Verify; Release; Maintenance
  2. True or False – Every development effort will have acceptance testing? Explain your answer.
  3. Analyze the effectiveness of the iterative approach
     - Draw a flowchart with 3 iterations
     - Plot the estimated likelihood of "success" (vertical axis) at the end of each iteration (horizontal axis)
     - Explain your plot – 1) Why are the likelihoods changing?, 2) Is it "worth it" to add more iterations?, and 3) How would you prove that it is "worth it"?
- Submit to Blackboard by 7/13/19



Lecture 2
Software Processes

Lesson Overview

- Software Processes and Agile Methods
- Reading
  - Ch. 2-3
- Objectives
  - Explore current software engineering approaches
  - Discuss the step-by-step approach to engineering software systems
  - Examine the roles of people and technology in the development and use of software systems
  - Analyze Agile methods and related approaches



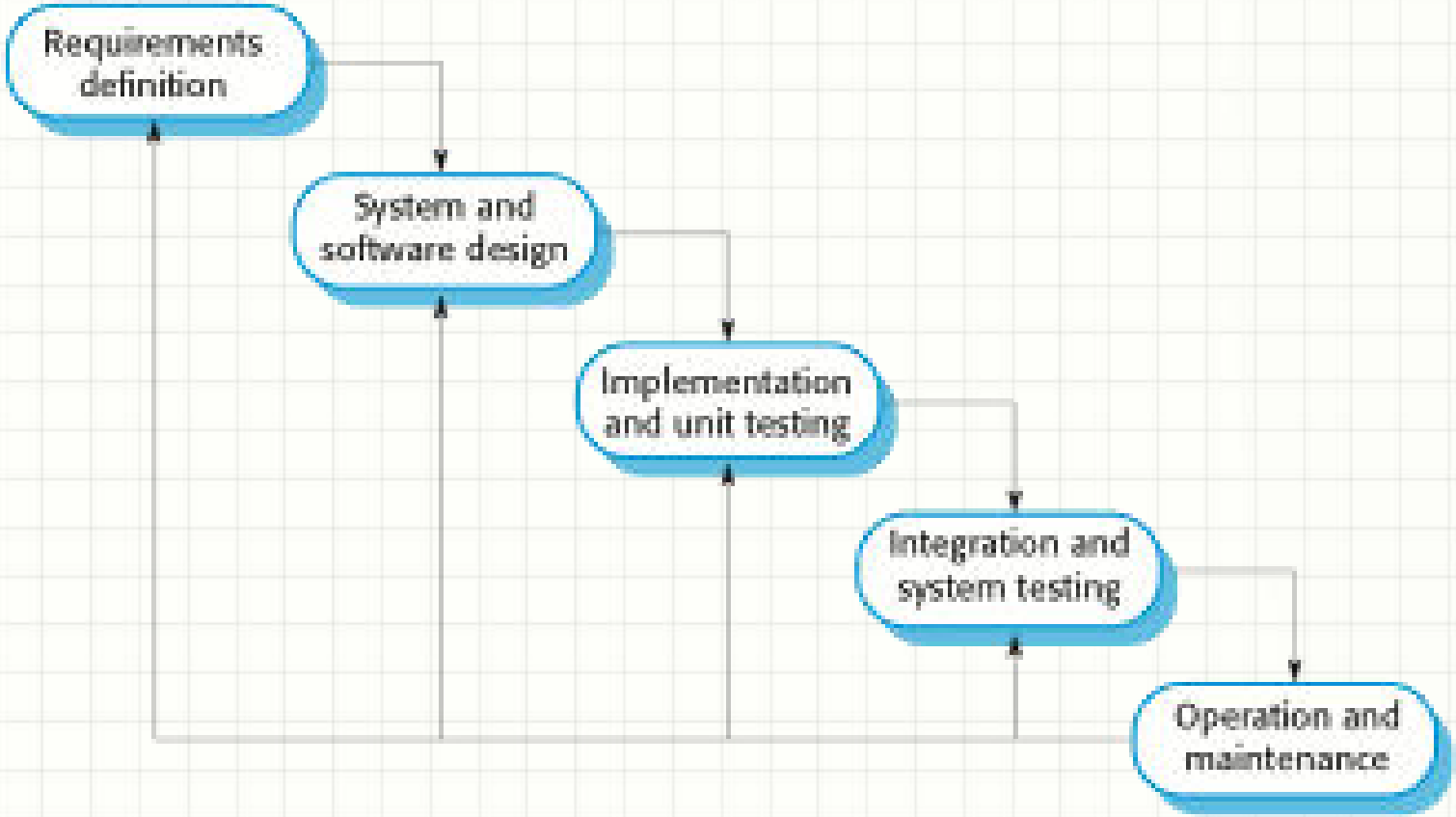
Software Processes

Software Process Models

- Software process
  - A set of activities that leads to the production of a software product
  - e.g., analysis, design, build, verification
- Generic models
  - Process frameworks meant to be tailored
    - Waterfall
    - Incremental Development
    - Reuse-Oriented SW Engineering

Waterfall

- Cascading from one phase to the next
- Each phase ends with a “gate”
  - Signoff is required before a phase can be considered complete
  - Increases the likelihood of true completion
  - Makes it difficult to estimate completion time
- In practice, any engineering effort follows this general approach, but also involves iteration
  - Iterations facilitate learning
  - It is difficult to estimate the required number of iterations


Requirements definition
System and software design
Implementation and unit testing
Integration and system testing
Operation and maintenance

Iterative Development

- Achieve a defined “sub-objective” with each iteration
- The product is evolved methodically
- The focus is on answering questions and resolving challenges
- Often used to bridge the project team-customer gap
  - Produce a prototype and solicit feedback
  - Quickly and cheaply achieve critical understanding

Reuse-Oriented SW Engineering

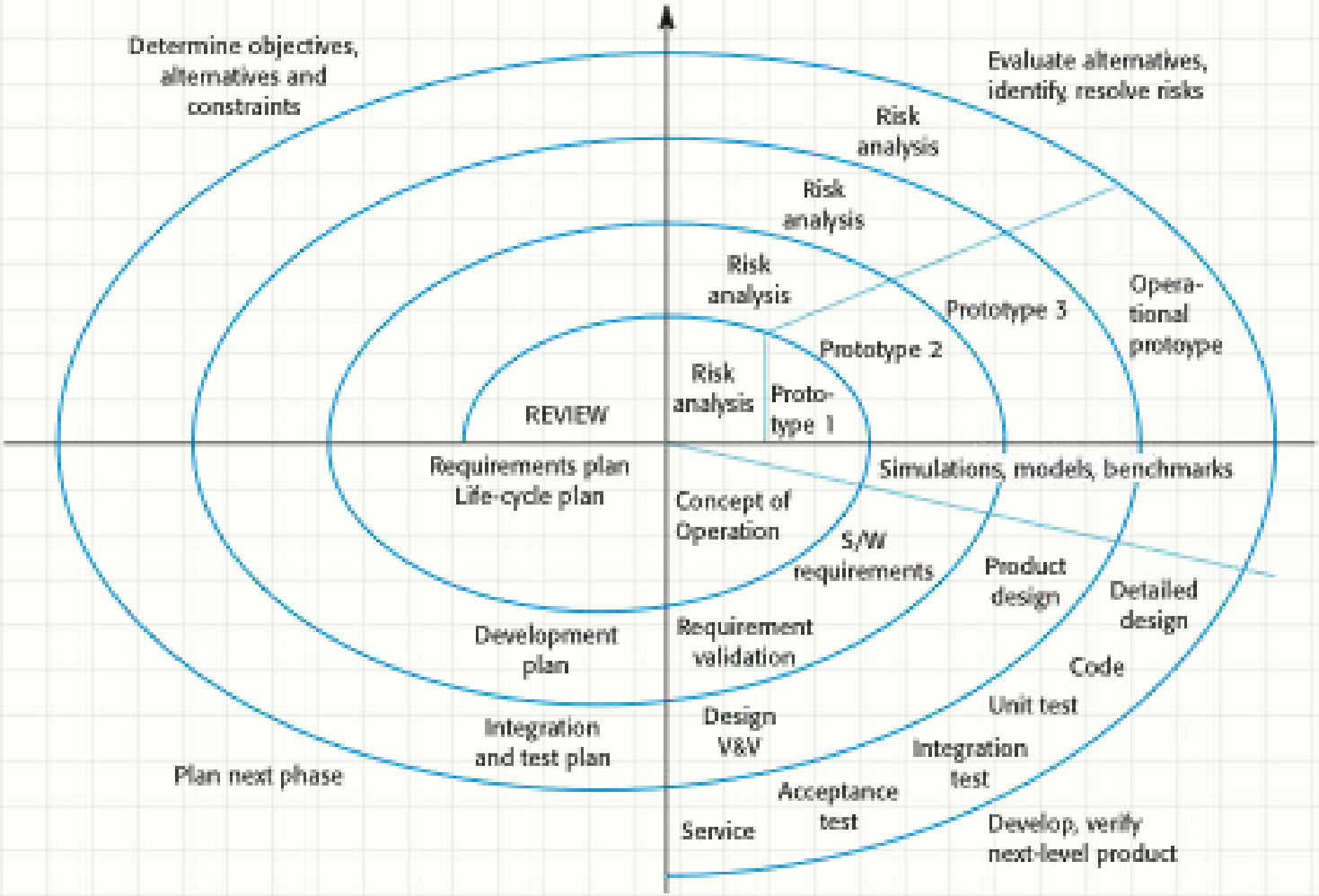
- Focus is on reusing previously created system elements
  - Clearly faster
  - Defects are limited to points of integration and “inappropriately” applied components
- Tradeoffs may be necessary
  - Existing components may not exactly match requirements
- Requires disciplined management of reusable components
  - Documentation
  - Testing
  - Version control, etc.

Development Process Objectives

- Each of these models addresses the following needs:
  - Specification of requirements
    - Identifying services to be provided and environmental constraints
  - Design and implementation
    - Transforming specification into working system
  - Verification and validation
    - Showing that the system satisfies requirements and meets customer expectations
  - Evolution
    - Growing the system over time to accommodate environmental changes and new requirements

The Spiral Model

- Iterative, risk-driven approach developed by Barry Boehm
- Four phases executed repeatedly
  - Objective setting
  - Risk assessment and reduction
  - Development and validation
  - Planning for the next iteration


Determine objectives, alternatives and constraints
Evaluate alternatives, identify, resolve risks
Risk analysis
Risk analysis
Risk analysis
Prototype 3
Opera-tional prototype
Prototype 2
Risk analysis
Proto-type 1
REVIEW
Requirements plan
Life-cycle plan
Concept of Operation
Simulations, models, benchmarks
S/W requirements
Product design
Detailed design
Development plan
Requirement validation
Code
Unit test
Integration and test plan
Design V&V
Integration test
Acceptance test
Plan next phase
Service
Develop, verify next-level product

The Rational Unified Process

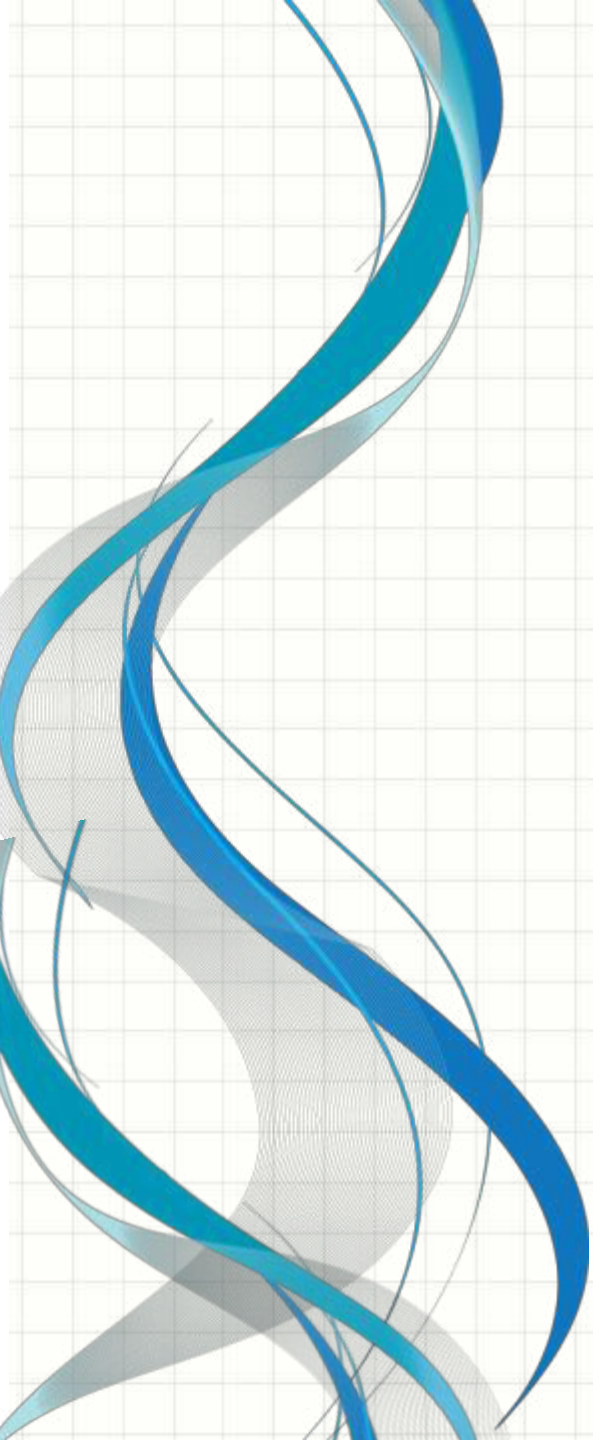
- Hybrid model incorporating prototyping and incremental delivery
  - Based on UML and the Unified Software Development Process
- Described from multiple perspectives
  - Dynamic: phases of the model over time
  - Static: process activities that are enacted
  - Practice: suggests good practices to be used during the process
- RUP phases:
  - Inception, elaboration, construction, and transition

RUP Best Practices

- Develop software iteratively
- Manage requirements
- Use component-based architectures
- Visually model software
- Verify software quality
- Control changes to software

Change Happens

- An iterative approach is beneficial because change is likely
  - Technology evolves rapidly
  - Competition drives customers to change requirements
  - Changes to economic conditions can affect strategic approaches
- Minimizing time and scope also minimizes opportunity for change
  - Plan for relatively short, well-defined iterations
  - Customers can utilize incrementally delivered systems



Agile Methods

Agile Methods

- Software development evolving to keep up with the dynamic world it serves
  - Speed up delivery to hit the moving target
  - Involve users significantly and early
  - Extreme flexibility
- Agile characteristics
  - Interleaving of phases
  - Documentation effort is minimized (focus on essentials)
  - Frequent delivery of versions
  - Visual development tools to facilitate rapid, interactive UI development

The Agile Approach

- Flow
  - Get a basic idea, then jump into design and implementation cycles
    - Requirements gathering and V&V are pulled into design and implementation
  - Frequently "surface" the evolving product
  - Growth is more organic than planned
- Pros and Cons
  - The benefit is that progress drives discovery which drives more progress
  - The risk is the discovery is influenced by the working prototype and presence of the customer

Extreme Programming

- Best practices pushed to the extreme
  - Extremely rapid development and deployment
  - Extremely small teams
  - Extremely close user involvement
  - Extremely tight iterations
- Requirements come as simple customer stories (scenarios)
- Change is handled by frequently coding, testing and releasing
- Simplicity is a goal to help manage the rapid pace

XP Testing

- The lack of a system specification makes it difficult to “hand off” testing to an independent verification team
- Focus is on only bringing “clean” code into the current version
  - Develop the tests first, then the code
  - In some ways developing the tests is very similar to specifying functionality, designing the interface, etc.
  - Especially if the user writes the tests
  - Rely on automation

Agile Project Management

- Project management has a generally bureaucratic feel to it
- Agile methods require more flexibility and speed than what is normally associated with project management
- The Scrum approach is an example of PM principles applied to short, tight iterations
  - Short, fixed timeframes (2-4 weeks)
  - Focus on prioritized, outstanding work
  - Frequent communication and assessment
  - Commitment to iterations

Scaling Agile Methods

- Agile methods seem naturally suited for small development efforts
- That would be disappointingly limiting
- Scaling to larger development is possible with:
  - Focus on up-front analysis and design
  - Cross-team communication mechanisms
  - Continuous integration including whole-system builds every time anything is changed/added
  - PMs with experience with Agile methods
  - Organizations with a certain degree of flexibility