Announcements

- Lab 3 is due on Monday (by 11:59 PM)
- Midterm is on Monday March 2nd

Today's Topics

- Midterm
- Software Engineering
- Group Activity

Midterm – Monday March 2nd

- **Half of the exam based on Software Engineering Slides**
- **Allowed one 8.5x11in cheat sheet with HAND WRITTEN notes**
- **The other half on Objective C and iPhone SDK**
- **Question Formats:**
  - Multiple choice
  - True/False
  - Short Answer

Midterm Software Engineering

- **Be familiar with (able to list and/or define) the following:**
  - Software engineering myths/realities
  - Software Design Models
    - Waterfall
    - Rapid Application
    - Evolutionary
      - Spiral
      - Prototyping
    - Agile Development
      - Extreme Programming
    - Copyright
    - Engineering Ethics

Midterm –Objective C

- Understand the following concepts:
  - Objects
  - Memory Management
  - Model/View/Control
  - View Controllers
- Be able to explain the following commands
  - synthesize
  - -(id) myMethod vs +(id) myMethod
- Syntax covered in class (slides)

Questions on Midterm?

What is Software Engineering?

Software engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of ***software***, and the study of these approaches; that is, the application of ***engineering*** to software.

"Guide to Software Engineering Body of Knowledge" – Bourque

Software Engineering ≠ Software Programming

- **Software programming**
  - Single developer
  - "Toy" applications
  - Short lifespan
  - Single or few stakeholders
    - Architect = Developer = Manager = Tester = Customer = User
  - One-of-a-kind systems
  - Built from scratch
  - Minimal maintenance

Software Engineering ≠ Software Programming

- **Software engineering**
  - Teams of developers with multiple roles
  - Complex systems
  - Indefinite lifespan
  - Numerous stakeholders
    - Architect ≠ Developer ≠ Manager ≠ Tester ≠ Customer ≠ User
  - System families
  - Reuse to amortize costs
  - Maintenance accounts for over 60% of overall development costs

Software Engineers' Myths

- ***Once the program is written, I'm done***
  - Between 60-80% of effort expended *after* delivery
- ***Until the program is written, quality is uncertain***
  - Formal design reviews
  - Formal code reviews
  - Test-first approaches
  - Prototyping to verify design and structure
  - Prototyping to validate requirements
- ***The only deliverable is the program itself***
  - Lots of documentation: installation guides, usage guides, maintenance guides, API definitions and examples

Software Engineers' Myths

- ***Documentation is Software-Engineering busy work***
  - Focus is on quality, not quantity
  - Documentation can be hard for engineers to write, just as C++ may be difficult for poets.
  - Conserve energy: documented code can serve as a basis for useful documentation
    - JavaDoc
    - Doxygen
- ***Literate Programming***
  - You write code for other people to read

Software Engineering "Axioms"

- **Adding developers to a project will likely result in further delays and accumulated costs**
- **Basic tension of software engineering**
  - better, cheaper, faster — pick any two!
  - functionality, scalability, performance — pick any two!
- **The longer a fault exists in software**
  - the more costly it is to detect and correct
  - the less likely it is to be properly corrected
- **Up to 70% of all faults detected in large-scale software projects are introduced in requirements and design**
  - detecting the causes of those faults early may reduce their resulting costs by a factor of 100 or more

Software Design Models

Software Production Process

- **Phases and Actions to Build, Deliver, Evolve Product**
- **Objectives**
  - Construct Programs from Idea to Completion
  - Produce Reliable, Predictable, and Efficient SW
- **Difficult to Automate**
  - Software Production is a Highly Intellectual Activity
  - Interactions of Individuals from Various Backgrounds
  - Interface to OS, Hardware, Databases, etc.
- **Production Models Focus on the Software Lifecycle Emphasizing the Process from Start to Finish**

Motivation

- **Increase in Application Complexity and Requirements**
  - Led to Separation Between Developers and Users
- **Software Now Targets Users without "Computer Expertise"**
  - Higher Level of Quality and Reliability Needed
  - Software Development as Group Activity
- **Software Development Needs to:**
  - Manage Complexity in Modern Applications
  - Provide Detailed Careful Analysis of User Requirements
- **Goals of a Model are:**
  - Determine Appropriate Stages
  - Establish Transition Criteria for Progressing from One Stage to Another

Different Models

- **Waterfall Model**
- **Rapid Application Model**
- **Evolutionary Models**
  - Spiral
  - Prototyping
- **Agile Model**

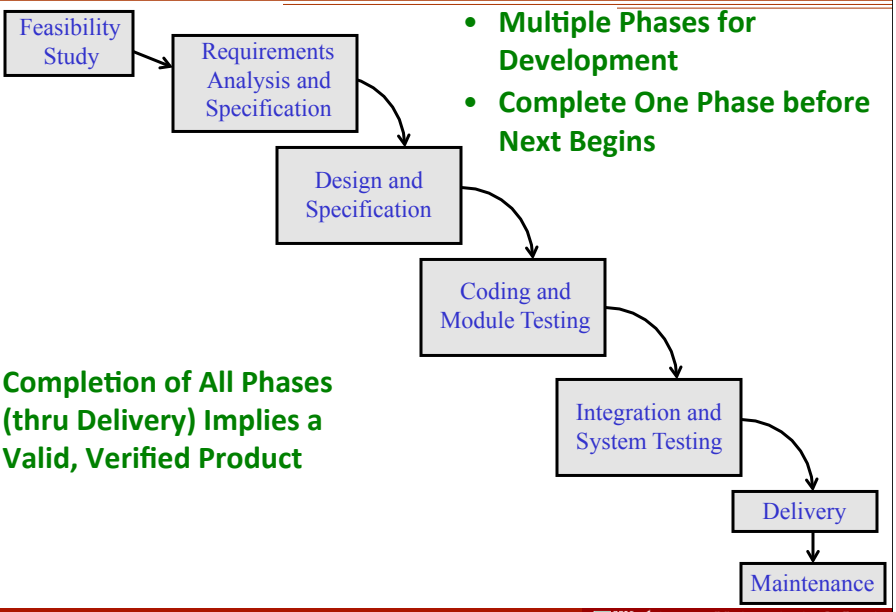
Waterfall Model

- Also called classic life cycle, proposed by Winston Royce in 1970
- Original proposal allowed for feedback and loops
- In practice, strictly linear
- Called a "prescriptive" process model

Waterfall Model

- Communication
  - Initiation, requirements gathering
- Planning
  - Estimating, scheduling, tracking mechanisms
- Modeling
  - Analysis and design
- Construction
  - Code and test
- Deployment
  - Delivery, support, feedback

Waterfall Model – Classic Approach



- **Multiple Phases for Development**
- **Complete One Phase before Next Begins**
- **Completion of All Phases (thru Delivery) Implies a Valid, Verified Product**

Waterfall Model - Evaluation

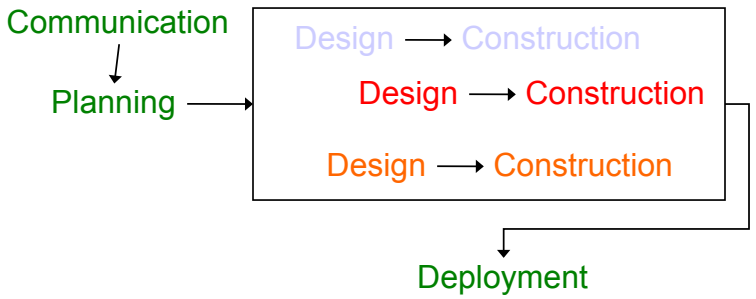
- **Contributions to Understanding Software Processes**
  - Software Development Must be Disciplined, Planned, and Managed
  - Implementation Delayed Until Objectives Clearly Understood
- **Characteristics of Waterfall Model**
  - Linear: From Beginning to End w/o Backtracking
  - Rigid
  - Monolithic: All Planning is Oriented to Single Delivery Date
- **What are the Problems with this Process?**

Waterfall Model – Problems

- **Problems with Waterfall Model**
  - Forces Cost Estimation and Project Planning to Occur After Limited Analysis Performed
  - Unrealistic to Assume all Requirements Frozen before Development Starts
    - User's Often Don't Know Exact Requirements
    - Particularly Early in the Process
  - Does not Stress Anticipating Changes
  - Enforces Standards Based on Producing Particular Documents at Specific Times

RAD–Rapid Application Deployment

- **Breaks problem into pieces**
- **Utilizes concurrent design and construction**
- **Huge integration exercise at the end**
- **Alleged 60-90 day time span**



Problems with RAD?

- **Requires sufficient human resources**
- **Must commit to rapid development process**
  - Vision of design must remain consistent among teams
  - Tends to fade or become chaotic over time
- **Requires a project that can be componentized**
- **Levels of abstraction and insulation between teams can cause performance issues**
- **Use of cutting-edge technology in one team can sink the whole project if it fails**

Evolutionary Model

- **Fred Brooks Advocates Producing a Product Twice**
  - First Version is Throwaway to Provide Means for Users to Offer Feedback on Exact Requirements
  - Second Version Developed using Waterfall
- **Evolutionary or Incremental Approach**
  - Emphasizes Stepwise Development
  - Flexible and Non-Monolithic
  - Postpones Parts of Some Stages

Evolutionary Models

- **Examples**
  - Spiral
  - Prototyping
- **Iterative approaches**
- **Increasingly more complete versions of the product are generated**
- **Articulated deliveries can help planning**
  - Revising design delivers a more on-target product
  - Revisiting implementation can remedy a bad initial approach

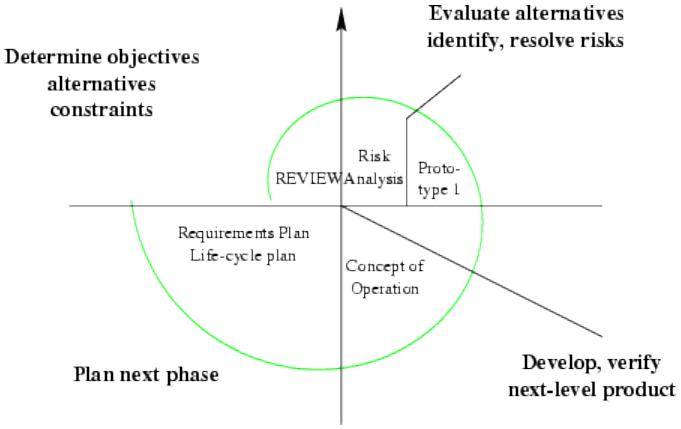
Spiral Model

- **Purpose:**
  - Provide a Framework for Design Production Process Guided by Risk Levels
- **Guiding Principles:**
  - Level of Risk (Potential Adverse Circumstance)
- **Risk Management :**
  - Barry Boehm (created Spiral Model) states :"Discipline whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive software rework."
- **Focus on Identifying and Eliminating High Risk Problems by Careful Process Design/Assessment**

Spiral Model

- **Cyclical Model is Four Stages:**
  1. Identify Objectives and Design Alternatives
  2. Evaluate Alternatives and Identify/Deal with Potential Risks
  3. Develop and Verify Next Level Product
  4. Review Results and Plan for Next Iteration
- **Allows Unstated Requirements to Become Part of Specification of Next Cycle**
  - Robustness Approximates Correctness More Closely

The Spiral Model



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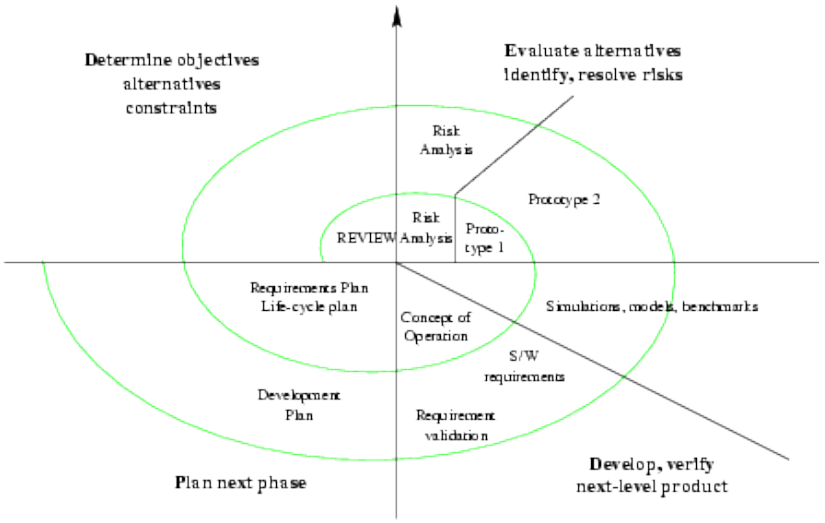
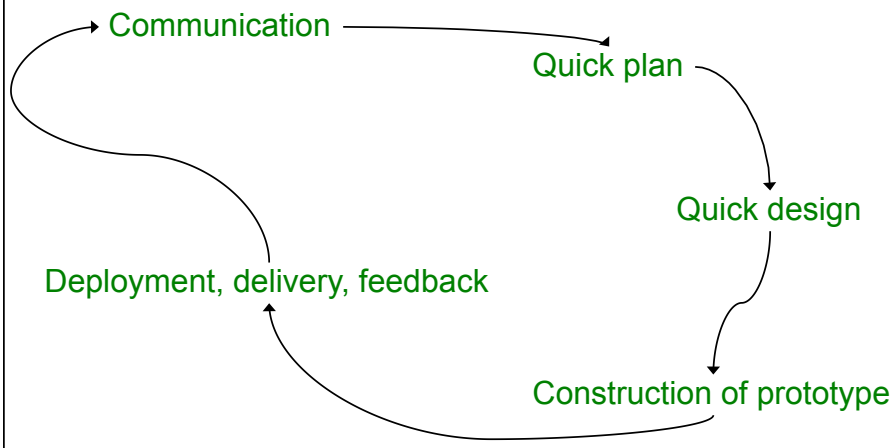


Prototyping Model



Prototyping Model

- **Useful when**
  - Insufficient requirements exist at start
  - Behavior of some components unknown
    - New or strange OS
    - Hardware "in progress"
    - HCI (Human-Computer Interface) factors not yet firm
    - Algorithmic uncertainties: speed, space
- **Potential Problems or Issues?**
  - Testing may be minimal
  - Not intended for ultimate delivery of longevity
  - Little or no documentation is produced
- **Customer and team must agree on this approach up-front**
- **Expectations should not be overly high on either side**

Problems in Evolutionary Models

- **Potential Problems:**
  - Large Time Gap Between Requirements Specification and Delivery
  - Emphasis on User Interface and Not Product
    - May Miss Functional Requirement
    - May Underestimate DB Complexity/Interactions

Advantages in Evolutionary Models

- Product May Closely Follow User Requirements
- Supports Anticipation of Change
- More Flexible Than Just Waterfall Approach

Agile Progamming

- Iterative and evolutionary development
- Timeboxing
  - Set amount of time for iteration
  - Adapt future iteration based on the realities
- Adaptive planning
- Incremental delivery
- More focused on success than sticking with a plan
- Working software is valued and considered measure of progress

Agile Programming

- **Learn enough to start**
- **Work together in the same space**
- **Express solution in features**
- **Maintain working system, fully tested, ready to ship**
- **Deliver features consistently**
- **Evolve the design as you learn**

Extreme Programming?

- 2am, marathon, Cheetos,
- Hacking
- undocumented, brilliant,
- tests?, mysterious,
- Jolt Cola, protective,
- ad-hoc, brittle, cubicle,
- fear change, cowboy,
- overly elegant, code ego,
- real soon now, stress
- difficult to talk to

Extreme Programming!

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8-5, teamwork,
code reviews,
communication,
coding standards,
snacks, communal code
tests, tests, tests,
maintainable,
documented
predictable,
copes with change

Extreme Programming

- **Code is written in response to a user story**
  - 4x6 card describing requirements
- **Start with the smallest set of features**
  - Release early and often
- **Simple Design**
  - Use simplest possible design that gets job done

Extreme Programming

- **Continuous Testing**
  - Tests are written before programming
  - When tests are passed, job is done
- **Continuous Integration**
  - New code is added daily
    - All test must be passed though
- **Pair Programming**
  - Two programmers at one machine

Pair Programming

- **Two programmers share one computer**
  - One is the driver
    - Does all the writing of code
  - Other is observer
    - Watches and guides
    - Focuses on strategic issues
      - How this module fits with others
    - Typically the more experienced programmer
- **Claim:**
  - Pair programming is more productive than having two separate programmers
- **NYtimes article:**
  - http://www.nytimes.com/2009/09/20/jobs/20pre.html?_r=1&scp=1&sq=computer%20programming&st=cse

Group Activity