Agile Development and Extreme Programming

CSCI 5828: Foundations of Software Engineering

Lecture 5: Supplement

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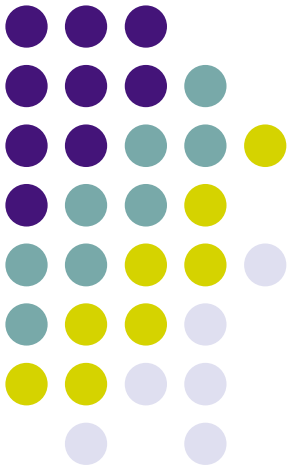
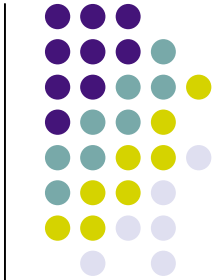


Credit where Credit is Due



- The material for this lecture is based on content from “Agile Software Development: Principles, Patterns, and Practices” by Robert C. Martin
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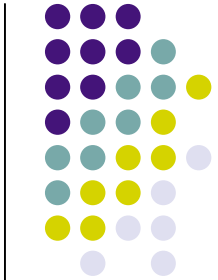
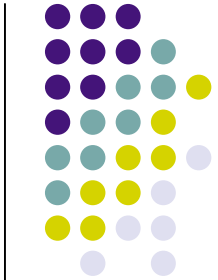
Goals for this lecture



- (Very) Briefly introduce the concepts of Agile Design and Extreme Programming
- Agile Design is a design framework
- Extreme Programming is one way to "implement" agile design
  - Other agile life cycles include SCRUM, Crystal, feature-driven development, and adaptive software development
  - See http://www.agilealliance.org/ for pointers

Outline

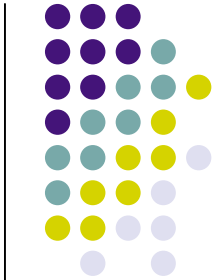


- **Background on Agile Methods**
- Extreme Programming

Agile Development (I)

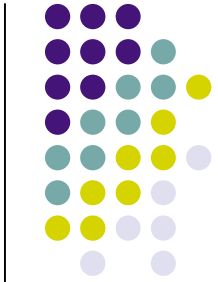
- Agile development is a response to the problems of traditional “heavyweight” software development processes
  - too many artifacts
  - too much documentation
  - inflexible plans
  - late, over budget, and buggy software

Agile Development (II)



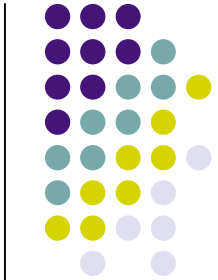
- A manifesto (from the Agile Alliance)
  - “We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value
    - individuals and interactions over processes and tools
    - working software over comprehensive documentation
    - customer collaboration over contract negotiation
    - responding to change over following a plan
  - That is, while there is value in the items on the right, we value the items on the left more

Agile Development (III)



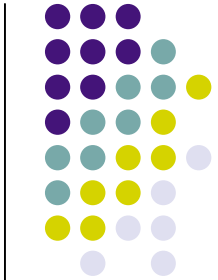
- From this statement of values, agile development has identified twelve principles that distinguish agile practices from traditional software life cycles
- Lets look at five of them
  - Deliver Early and Often to Satisfy Customer
  - Welcome Changing Requirements
  - Face to Face Communication is Best
  - Measure Progress against Working Software
  - Simplicity is Essential

Deliver Early and Often to Satisfy Customer



- MIT Sloan Management Review published an analysis of software development practices in 2001
  - Strong correlation between quality of software system and the early delivery of a partially functioning system
    - the less functional the initial delivery the higher the quality of the final delivery!
  - Strong correlation between final quality of software system and frequent deliveries of increasing functionality
    - the more frequent the deliveries, the higher the final quality!
- Customers may choose to put initial/intermediate systems into production use; or they may simply review functionality and provide feedback

Welcome Changing Requirements

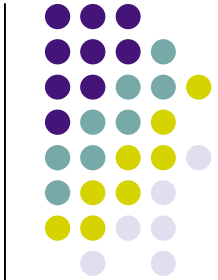


- Welcome change, even late in the project!
- Statement of Attitude
  - Developers in agile projects are not afraid of change; changes are good since it means our understanding of the target domain has increased
  - Plus, agile development practices (such as refactoring) produce systems that are flexible and thus easy to change

Face to Face Communication is Best

- In an agile project, people talk to each other!
  - The primary mode of communication is conversation
    - there is no attempt to capture all project information in writing
  - artifacts are still created but only if there is an immediate and significant need that they satisfy
    - they may be discarded, after the need has passed

Measure Progress against Working Software

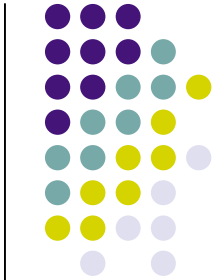


- Agile projects measure progress by the amount of software that is currently meeting customer needs
  - They are 30% done when 30% of required functionality is working AND deployed
- Progress is not measured in terms of phases or creating documents

Simplicity is Essential

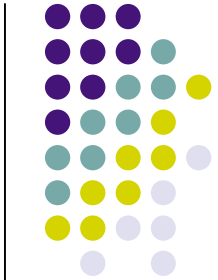
- This refers to the art of maximizing the amount of work NOT done
  - Agile projects always take the simplest path consistent with their current goals
  - They do not try to anticipate tomorrow's problems; they only solve today's problems
  - High-quality work today should provide a simple and flexible system that will be easy to change tomorrow if the need arises

The Other Seven



- The other seven principles are
  - Deliver working software frequently
  - Stakeholders and developers work together daily
  - Build projects around motivated individuals
  - Agile processes promote sustainable development
  - Continuous attention to technical excellence and good design enhances agility
  - Agile team members work on all aspects of the project
  - At regular intervals, the team reflects on how to become more effective

Outline

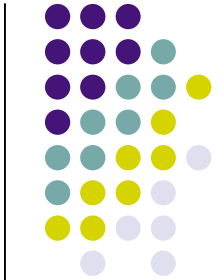


- Background on Agile Methods
- **Extreme Programming**

Extreme Programming

- Extreme Programming (XP) takes commonsense software engineering principles and practices to extreme levels
  - For instance
    - “Testing is good?”
    - then
    - “We will test every day” and “We will write test cases before we code”
- As Kent Beck says extreme programming takes certain practices and “sets them at 11 (on a scale of 1 to 10)”

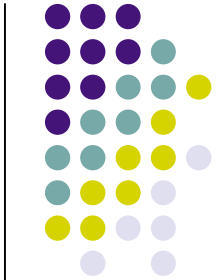
XP Practices



- The best way to describe XP is by looking at some of its practices
  - There are fourteen standard practices

Customer Team Member
User Stories
Short Cycles
Acceptance Tests
Pair Programming
Test-Driven Development
Collective Ownership
Continuous Integration
Sustainable Pace
Open Workspace
The Planning Game
Simple Design
Refactoring
Metaphor

Customer Team Member

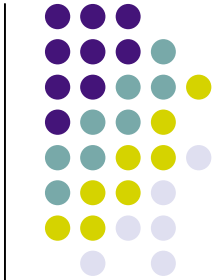


- The “customer” is made a member of the development team
  - The customer is the person or group who defines and prioritizes features
  - A customer representative should be “in the same room” or at most 100 feet away from the developers
  - “Release early; Release Often” delivers a working system to the client organization; in between, the customer representative provides continuous feedback to the developers

User Stories (I)

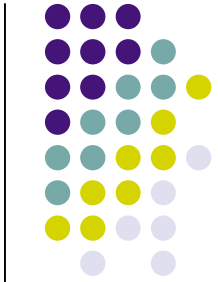
- We need to have requirements
- XP requirements come in the form of “user stories” or scenarios
  - We need just enough detail to estimate how long it might take to support this story
    - avoid too much detail, since the requirement will most likely change; start at a high level, deliver working functionality and iterate based on explicit feedback

User Stories (II)



- User stories are not documented in detail
  - we work out the scenario with the customer “face-to-face”; we give this scenario a name
  - the name is written on an index card
    - developers then write an estimate on the card based on the detail they got during their conversation with the customer
- The index card becomes a “token” which is then used to drive the implementation of a requirement based on its priority and estimated cost

Short Cycles (I)



- An XP project delivers working software every two weeks that addresses some of the needs of the customer
  - At the end of each iteration, the system is demonstrated to the customer in order to get feedback

Short Cycles (II)

- Iteration Plan
  - The collection of user stores that will be implemented during this iteration
  - determined by a “budget” of points
  - the budget is determined by the progress made on the previous iteration
- Release Plan
  - A plan that maps out the next six iterations or so (3 months)
  - A release is a version of the system that can be put into production use

Acceptance Tests

- Details of a user story are captured in the form of acceptance tests specified by the customer
  - The tests are written before a user story is implemented
  - They are written in a scripting language or testing framework that allows them to be run automatically and repeatedly
  - Once a test passes, it is never allowed to fail again (at least for very long)
  - These tests are run several times a day each time the system is built

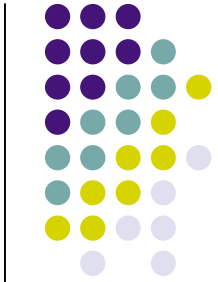
Pair Programming

- All production code is written by pairs of programmers working together at the same workstation
  - One member drives the keyboard and writes code and test cases; the second watches the code, looking for errors and possible improvements
  - The roles will switch between the two frequently
  - Pair membership changes once per day; so that each programmer works in two pairs each day
    - this facilitates distribution of knowledge about the state of the code throughout the entire team
- Studies indicate that pair programming does not impact efficiency of the team, yet it significantly reduces the defect rate!
  - [Laurie Williams, 2000] [Alistair Cockburn, 2001] [J. Nosek, 1998]

Test-Driven Development

- All production code is written in order to make failing test cases pass
  - First, we write a test case that fails since the required functionality has not yet been implemented
  - Then, we write the code that makes that test case pass
  - Iteration between writing tests and writing code is very short; on the order of minutes
- As a result, a very complete set of test cases is written for the system; not developed after the fact

Collective Ownership

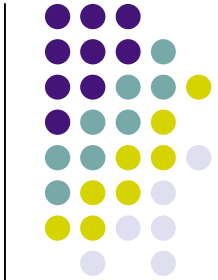


- A pair has the right to check out ANY module and improve it
  - Developers are never individually responsible for a particular module or technology
- Contrast this with Fred Brook's conceptual integrity and the need for a small set of "minds" controlling a system's design
  - Apparent contradiction is resolved when you note that XP is designed for use by small programming teams; I haven't seen work that tries to scale XP to situations that require 100s or 1000s of developers

Continuous Integration

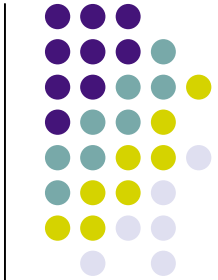
- Developers check in code and integrate it into the larger system several times a day
- Simple Rule: first one to check-in “wins”; everyone else merges
- Entire system is built every day; if the final result of a system is a CD, a CD is burned every day; if the final result is a web site, they deploy the web site on a test server, etc.
  - This avoids the problem of cutting integration testing to “save time and money”

Sustainable Pace



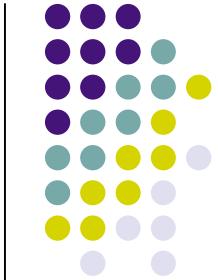
- A software project is not a sprint; it's a marathon
  - A team that leaps off the starting line and races as fast as it can will burn out long before the finish line
  - The team must instead "run" at a sustainable pace
- An XP rule is that a team is not *allowed* to work overtime
  - This is also stated as "40 hour work week"

Open Workspace



- The team works together in an open room
  - There are tables with workstations
  - There are whiteboards on the walls for the team members to use for status charts, task tracking, UML diagrams, etc.
- Each pair of programmers are within earshot of each other; information is communicated among the team quickly
  - “War room” environments can double productivity
    - http://www.sciencedaily.com/releases/2000/12/001206144705.htm
- Joel on Software disagrees
  - http://www.joelonsoftware.com/items/2006/07/30.html

The Planning Game

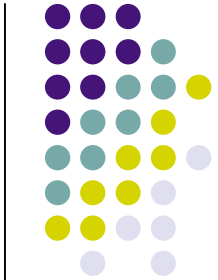


- Customer decides how important a feature is
- Developers decide how much that feature costs
- At the beginning of each release and/or iteration, developers give customers a budget based on productivity of previous iteration
- Customers choose user stories whose costs total up to but do not exceed the budget
  - The claim is that it won't take long for customer and developers to get used to the system
  - and then the pace can be used to estimate cost and schedule

Simple Design

- An XP team makes their designs as simple and expressive as they can be
  - They narrow focus to current set of stories and build the simplest system that can handle those stories
- Mantras
  - Consider the Simplest Thing That Could Possibly Work
  - You Aren't Going to Need It
  - Once and Only Once (aka Don't Repeat Yourself)

Refactoring

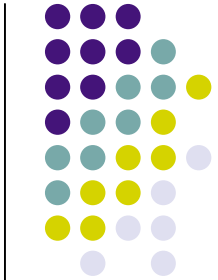


- XP teams fight “code rot” by employing refactoring techniques constantly
  - They have the confidence to do this because they also use test-driven design
  - By “constantly” we mean every few hours versus “at the end of the project”, “at the end of the release”, or “at the end of the iteration”

Metaphor (I)

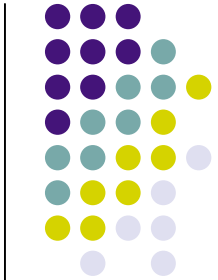
- The big picture that ties the whole system together
  - Vocabulary that crystallizes the design in a team member's head

Metaphor (II)



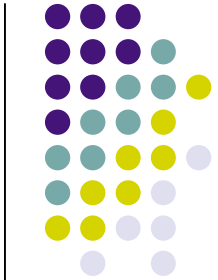
- Example
  - A system that transmits text to a screen at 60 chars per second; programs write to buffer, when buffer full, programs are suspended, when buffer empty, programs are activated
    - Metaphor: Dump Trucks Hauling Garbage
    - Screen = “Garbage Dump”, Buffer = “Dump Truck”, Programs = “Garbage Producer”

Metaphor (III)



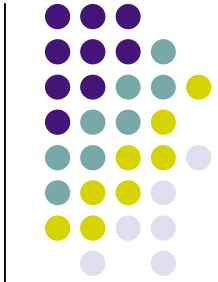
- Example
  - network traffic analyzer, every 30 minutes, system polled dozends of network adapters and acquired monitoring data; Each adaptor provides block of data composed of several variables
    - Metaphor: A toaster toasting bread
    - Data Block = “Slices”
    - Variables = “Crumbs”
    - Network analyzer = “The Toaster”
    - Slices are raw data “cooked” by the toaster

Benefits of XP



- Customer Focus
- Emphasis on teamwork and communication
- Programmer estimates before implementation
- Emphasis on responsibility for quality
- Continuous measurement
- Incremental development
- Simple design
- Frequent redesign via refactoring
- Frequent testing
- Continuous reviews via pair programming

Criticisms of XP



- Code centered vs. Design centered
  - Hurts when developing large systems
- Lack of design documentation
  - Limits XP to small systems
- Producing readable code is hard
- Code not good as serving as documentation (listings can run to 1000s of pages)
- Lack of structured inspection process (can miss defects)
- Limited to narrow segment of software application domains
- Methods are only briefly described
- Difficult to obtain management support
- Lack of transition support (how do you switch from waterfall or other process?)