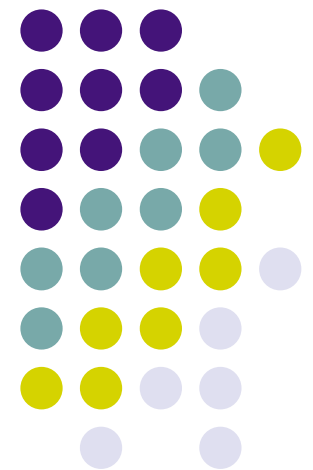
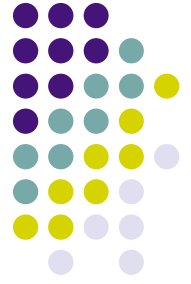


Agile Development and Extreme Programming

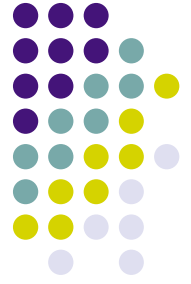
CSCI 5828: Foundations of
Software Engineering
Lecture 5: Supplement
Kenneth M. Anderson





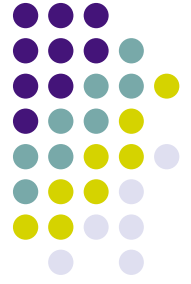
Credit where Credit is Due

- The material for this lecture is based on content from “Agile Software Development: Principles, Patterns, and Practices” by Robert C. Martin
- As such, some of this material is copyright © Prentice Hall, 2003



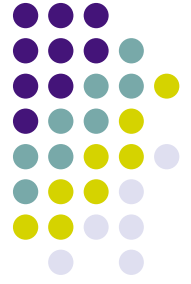
Goals for this lecture

- (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



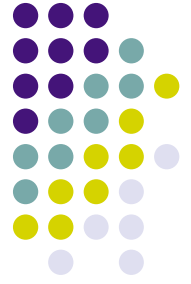
Outline

- **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



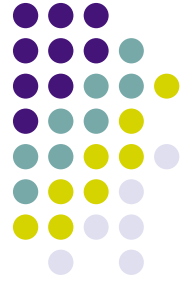
Agile Development (II)

- 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



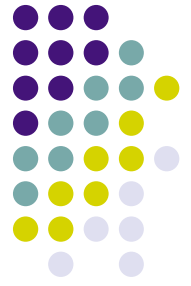
Deliver Early and Often to Satisfy Customer

- 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



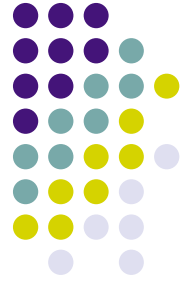
Welcome Changing Requirements

- 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



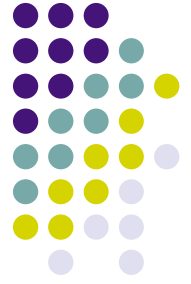
Measure Progress against Working Software

- 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



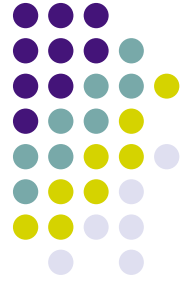
Simplicity is Essential

- 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



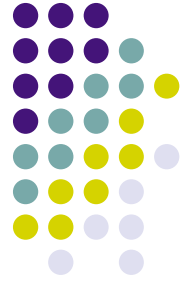
The Other Seven

- 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

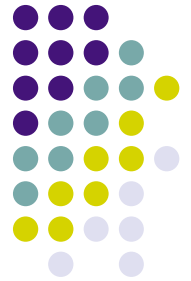
- Background on Agile Methods
- **Extreme Programming**



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 stories 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

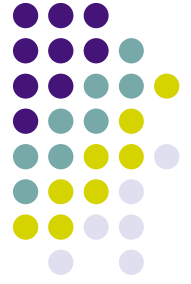
- An XP team makes their designs as simple and expressive as they can be
 - They narrow focus to current set of stories and build the simplest system that can handle those stories
- Mantras
 - Consider the Simplest Thing That Could Possibly Work
 - You Aren't Going to Need It
 - Once and Only Once (aka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