Advanced Software Design
Agile Development Methodologies

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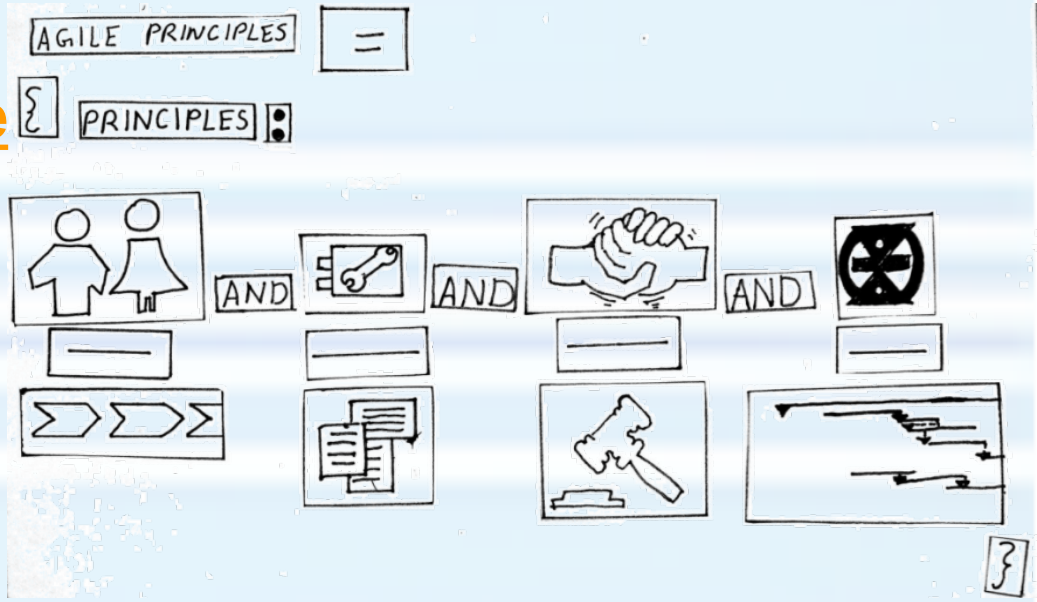
slides and materials taken from prof edwin blake & melissa densmore

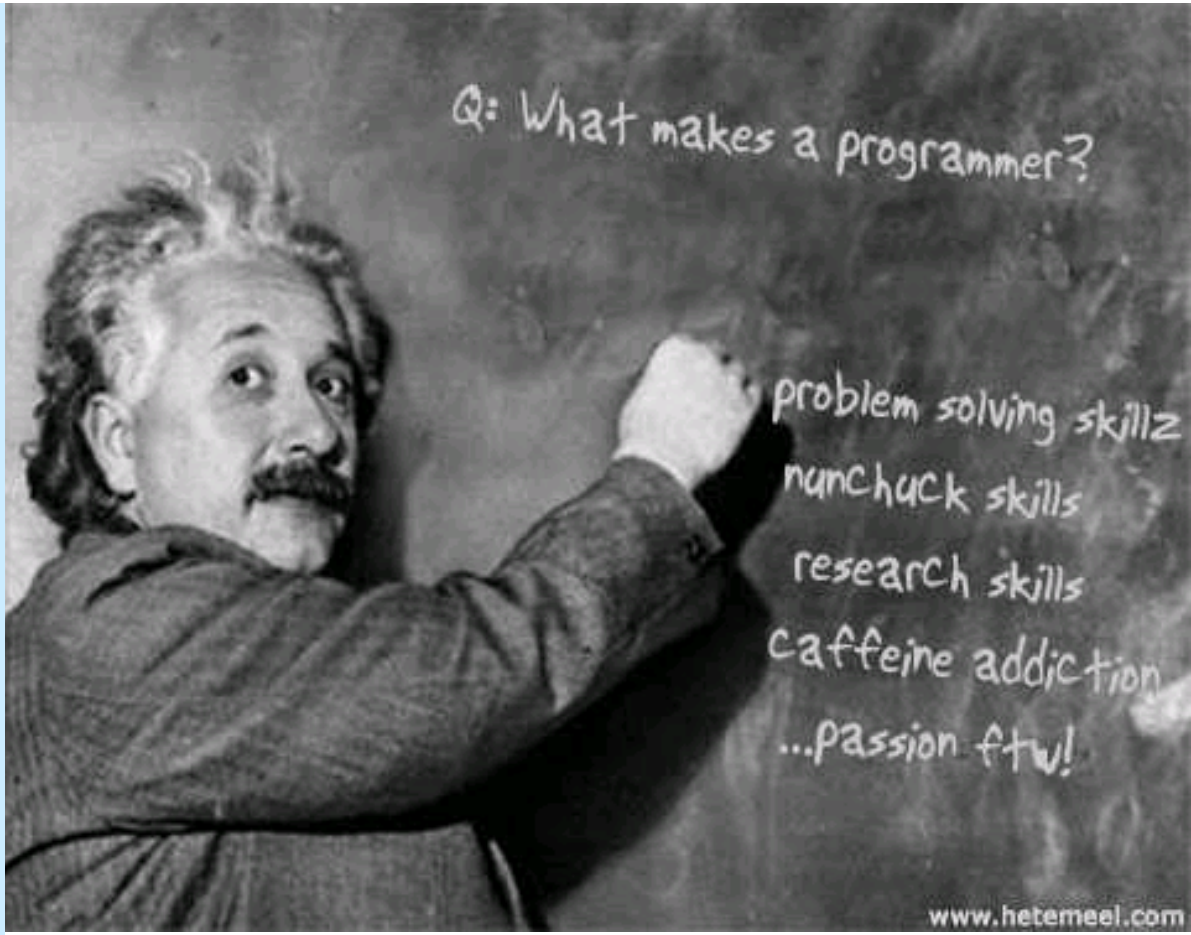
PRINCIPLES OF AGILE METHODS

Principles of Agile Methods



Programming

“It's not the strongest of the species that survive, but those most able to adapt.” — Charles Darwin



What is Agile Software Development?

- Put the software being developed first
- Acknowledge that user requirements change
- It is *agile* because it can respond quickly to the users' changing needs
- Advocates frequent and regular, software releases.
  - Users can respond quickly to these releases, changing requirements
    - "that's not what we meant!"

Principles of Agile Methods

Principle	Description
Customer involvement	Customers should be closely involved throughout the development process. Their role is to provide and prioritize new system requirements and to evaluate the iterations of the system.
Incremental delivery	The software is developed in increments with the customer specifying the requirements to be included in each increment.
People not process	The skills of the development team should be recognized and exploited. Team members should be left to develop their own ways of working without prescriptive processes.
Embrace change	Expect the system requirements to change and so design the system to accommodate these changes.
Maintain simplicity	Focus on simplicity in both the software being developed and in the development process. Wherever possible, actively work to eliminate complexity from the system.

Teams Must be Empowered

- The project team must have sole responsibility to deliver the product.
- Any interference with the project team is disruptive and reduces their motivation to deliver.
- The team must together
  - **establish and clarify the requirements**,
  - prioritise them together,
  - agree to the tasks required to deliver them,
  - estimate the effort involved.
- It ensures the buy-in and commitment from the entire project team from the outset;
- When challenges arise, the team feels a real sense of ownership.

Agile Manifesto

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

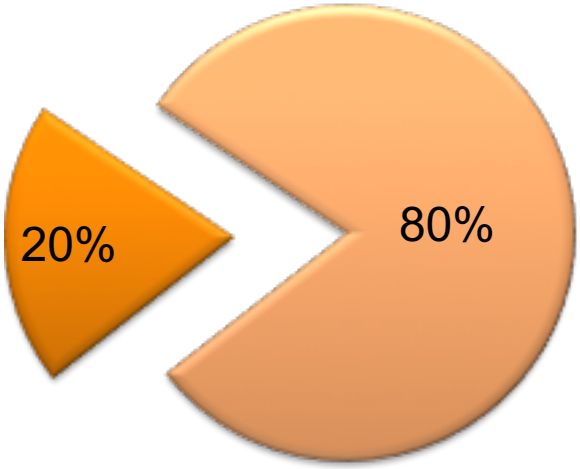
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

Pareto's Law — 80/20 rule

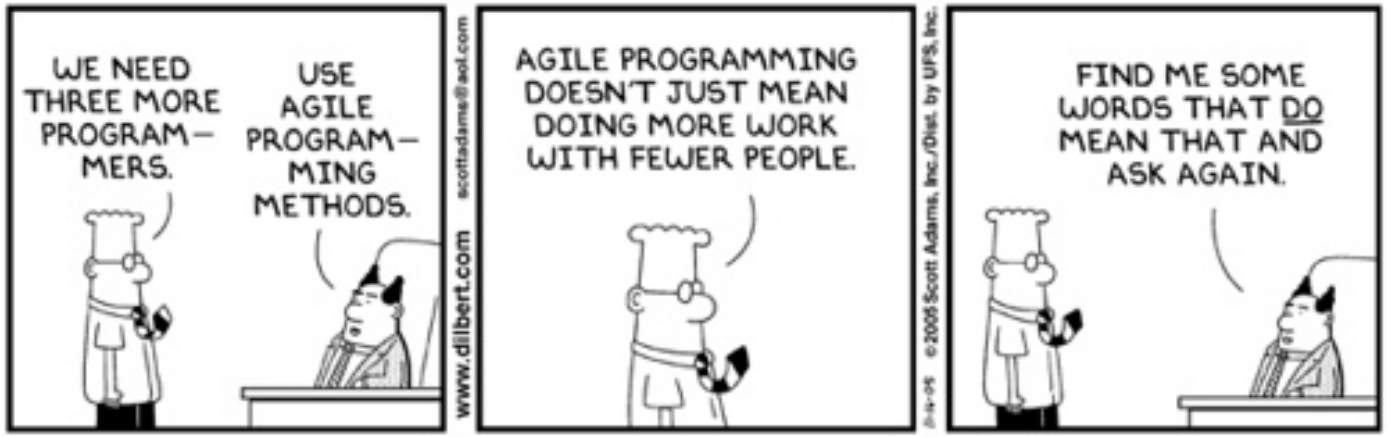
- *Typically* 80% of your results may actually come from only 20% of your efforts!
  - try to apply the 80/20 rule, and focus on the important 20% of effort that gets the majority of the results.
- The difficult question is can you see *initially which* 20% is the *important* 20%?
  - the 20% that will deliver 80% of the results.
  - In very many cases, the answer is **NO**.

- https://www.youtube.com/watch?v=zPoA6dzKmtg



Vilfredo Pareto
1848–1923

FIXED TIMESCALE



Time Waits for No-one I

- In Agile Development, requirements evolve, but timescales are fixed.
- Contrast to traditional development:
  - capture all known requirements
  - changes are subject to change control.
  - users are told it's much more expensive to change or add requirements during or after the software is built.
    - It becomes imperative to include everything they can think of, everything they ever dreamed of!

Time Waits for No-one II

- Normally
  - Users may actually use only 20% or less of the product
  - Many projects start with a bloated scope.
    - No-one is sure at the outset which 20% they will use.
  - It is impossible to think of everything, things change, and things are understood differently.
- Agile Development assumes that requirements emerge and evolve
  - however much analysis and design you do, you cannot really know what you want until you see and use the software.
  - in the time spent analysing and reviewing requirements and designing a solution, external conditions could change

Fixed Budget

- What does business expect from development teams?
  - deliver the agreed business requirements
  - on time and within budget
  - to an acceptable quality.
    - In Agile Development, it is the scope that is variable, not the cost and timescale.
- For this to work, it's imperative to start development with the core, highest priority features
  - delivered in the earliest iterations
- As a result
  - business has a fixed budget,
  - based on affordable resources and
  - can make plans based on a certain launch date.

BARE REQUIREMENTS

Agile Requirements are Barely Sufficient

- Capture requirements at a high level and on a piecemeal basis
  - just-in-time for each feature to be developed.
  - barely sufficient
    - The minimum to enable development and testing
      - minimise the time spent on anything not part of product.
- Understand enough to determine the scope and for high level budgetary estimates.
- Captured in collaborative workshops so that all team members understand the requirements.
  - allows everyone to contribute, challenge and understand what's needed and why.

User Stories

- Most Agile teams represent each requirement as a user story.
  - similar to Use Cases but lightweight and simpler;
  - a simple statement about what a user wants to do with a feature;

Form of the User Stories

- Should focus on the who, what and why of a feature, ***not how***.
  - on a job site, two high-level User Stories might be:
    - As a **job seeker**, I want to **search for a job**, so I can **advance my career**.
    - As a **recruiter**, I want to **post a job vacancy**, so I can **find a new team member**.
- The general form can be:
  - As a [**user role**], I want to [**goal**], so I can [**reason**].

Capture User Stories at the Start

- At the start of a project, capture an initial list of User Stories up-front
  - **useful for estimating and planning**.
- **Defer capturing the details** until the story is prioritised and due to be developed.
- Users often tell stories
  - about the failings of their current system.
  - how they see things working better in future.
  - **Capture these stories as User Stories**. As they are told.
- In traditional development projects, these stories are captured in a lengthy analysis process and available in a lengthy document;
  - Not user friendly.

Recording User Stories

- Written on postcard size cards in 3 parts:
  - Heading,
    - name/description of the user story, reference numbers, estimated size, etc.
  - Conversation (on the front of the card)
    - information about the user story + what system is meant to do
      - a **sketch or diagram** of the feature,
      - notes about how it should function.
  - Confirmation (on the back of the card)
    - test cases to help identify scenarios that users, developers and/or analysts may not have thought of.
- Writing User Stories on a card ensures requirements are broken into small, manageable pieces of functionality
  - individual features.

Agile Requirements are Barely Sufficient

- Cards can be supported by documentation, but keep it to the bare minimum to allow a feature to be developed, and always in very small units.
- Requirements should be broken into tasks of no more than 16 hours or preferably 8 hours, so progress can be measured daily.
- All items are deliverables not activities or tasks.
  - You can see a deliverable to judge its quality and completeness.
  - A task you cannot.

Incremental Design

- As *opposed* to Fred Brooks ("No Silver Bullet") Agile does not follow a top-down design method.
  - Top-down design says: time in design is worth it to save cost of reworking the design many times.
- Agile design is always the same size as the system.
  - "you can't possibly anticipate the problems and alternatives that will arise once you start coding".
- If a new feature comes along that requires major changes then that is the trade-off for the flexibility it allows.
  - … perhaps this feature was not even known at the beginning anyway!
  - or it might have gone away if we knew of it at the start!!

AGILE DEVELOPMENT CYCLE

Agile Development Cycle

- The cycle is Analyse, Develop, Test; Analyse, Develop, Test; and so on
  - doing each step for each feature, one feature at a time.
- Advantages of this approach include:
  - **Reduced risk**
  - **Increased value:** delivering some benefits early
  - **More flexibility/agility**
  - **Better cost management**
- Each feature must be fully developed, to the extent it can be shipped.
- Develop features in *priority* order.

How Frequent is Frequent?

- Competitors won't wait.
- Speed-to-market: a significant competitive edge
- The value of first-mover advantage is enormous.
  - research shows 80% of first to market end up market leaders.
- So how frequent is *frequent enough?*

So how Frequent is Frequent Enough?

- There is no right or wrong answer.
  - decide what's appropriate; stick to a regular release cycle
    - allows you to plan.
    - allows your infrastructure and ops teams to plan.
    - allows your business colleagues to plan.
    - allows launch events, marketing campaigns, etc to be planned.
- **BUT**: Frequent releases of buggy software can *really* irritate customers!

Done Means Done

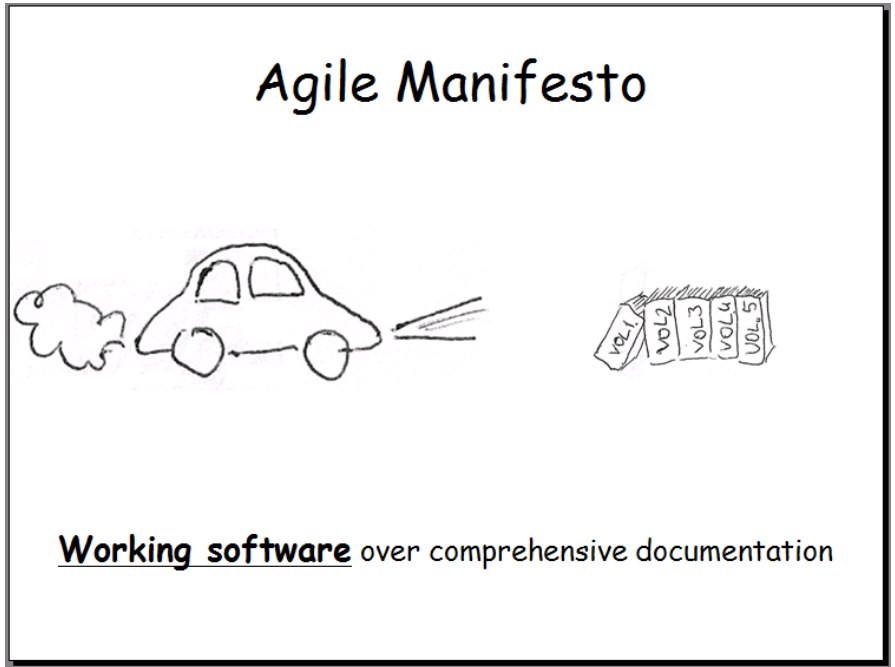
- Features developed in an iteration, should be 100% complete by the end of the iteration.
  - Ideally, each iteration results in a release.
- In Agile development, “DONE!” means shippable.
  - In practice a feature may rely on other features being completed before the product could really be shipped.
    - But the feature on its own merit should be shippable.
- Completing each feature before moving on to the next ensures the system is not in a state where multiple features are 90% complete or untested, as in traditional developments.

Working Product at All Times I

- Meaning 1
  - A software product should always be in a working state.
    - Not always functionally complete, just that it works and has high quality.
- Meaning 2
  - The emphasis is on producing a working product and shipping it
  - Not on producing documentation that might lead to a product.

Working Product at All Times II

- The best way to get user feedback is to give a product even if it is only work in progress.
- Prototypes are better than a document.
- Effort spent getting the product back to a working state is a missed opportunity to be doing valuable work.



Working Product at All Times — Prototypes

- Prototype solutions to *risky* problems helps to increase the chance of having a working product.
- Prototypes: an inexpensive way to try out ideas so that as many issues as possible are understood before the real implementation
- Two main classes of prototypes
  - the true prototype,
    - test implementation to understand a problem before it is implemented for real.
  - “tracer bullets”
    - prototype that is intended to gradually turn into the final solution

Working Product at All Times — Continuous Integration

- An important discipline is to continuously integrate changes.
  - **Frequent integration helps to ensure that modules will fit together**;
  - And also that the product continues to work with all the changes.
- Developers have the bad habit of checking out a number of files and not checking them in again until their work is done.
  - Developers should integrate their work daily.
  - This gradual introduction of changes ensures that integration problems or regressions are caught early.

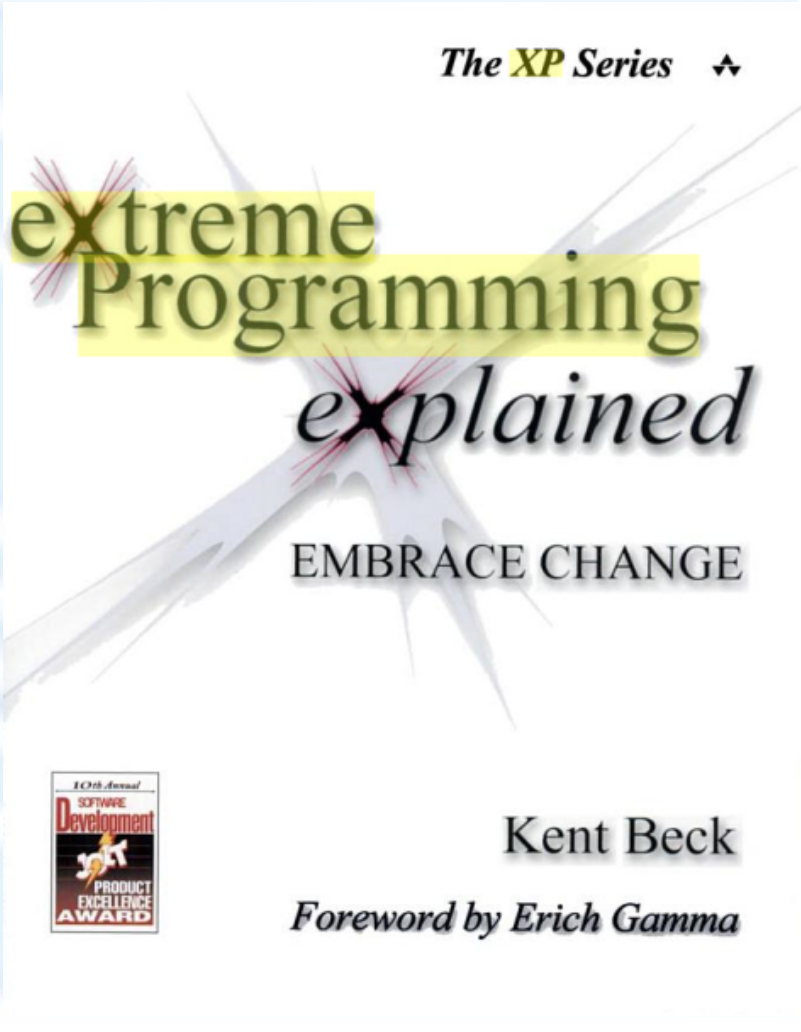
Working Product at All Times — Nightly Builds

- Software should be completely rebuilt from scratch daily.
  - the result of the build should be an installable product image.
- The build should include as many automated tests as possible to catch integration problems early.
  - If the build or tests fail, fix the problems first thing
  - Don't let anyone integrate any additional work until after the build succeeds again
  - There is a risk of multiple bad changes accumulating that will jeopardize the quality of the product.

Working Product at All Times — Performance

- *Don't Neglect Performance*!
  - Performance is a topic that generates passionate discussions in software development.
  - Some people feel that code clarity is more important and that you should get the code clarity right first and then optimize the 1% to 3% of code that needs it.
  - Others feel that you should code for performance first, because if you don't, your code will always be slow.

EXTREME PROGRAMMING



Extreme Programming Principles I

Principle	Description
Incremental planning	Requirements are recorded on story cards and the stories to be included in a release are determined by the time available and their relative priority. The developers break these stories into development 'Tasks'.
Small releases	The minimal useful set of functionality that provides business value is developed first. Releases of the system are frequent and incrementally add functionality to the first release.
Simple design	Enough design is carried out to meet the current requirements and no more.
Test-first development	An automated unit test framework is used to write tests for a new piece of functionality before that functionality itself is implemented.
Refactoring	All developers are expected to refactor the code continuously as soon as possible code improvements are found. This keeps the code simple and maintainable.

Extreme Programming Principles II

Principle	Description
Pair programming	Developers work in pairs, checking each other's work and providing the support to always do a good job.
Collective ownership	The pairs of developers work on all areas of the system, so no islands of expertise develop and all the developers take responsibility for all of the code: anyone can change anything.
Continuous integration	As soon as the work on a task is complete, it is integrated into the whole system. After any such integration, all the unit tests in the system must pass.
Sustainable pace	Large amounts of overtime are not acceptable as the net effect is often to reduce code quality & medium term productivity
On-site customer	A representative of the end-user of the system (the customer) should be available full time for the use of the XP team. In an extreme programming process, the customer is a member of the development team and is responsible for bringing system requirements to the team for implementation.

System Metaphor in Extreme Programming

- System metaphor is a mental model that everyone shares about the system and it shapes the ***architecture*** of the system.
  - Frequently misunderstood and neglected part of XP
  - Difficult to find such a metaphor.
- Example: “Payroll System is an Assembly Line” metaphor used for Chrysler Corp
  - paycheque is a combination of *parts (e.g. basic gross pay)*
  - parts move down the assembly line and are processed in a sequence of debiting or crediting further amounts to the initial amount
- Beck: “*The metaphor just helps everyone on the project understand the basic elements and their relationships. Words chosen to identify technical entities should be consistently taken from the chosen metaphor. As development proceeds and the metaphor matures, the whole team will find new inspiration from examining the metaphor.*”

System Metaphor continued

- Metaphor is something you start using when your mother asks what you are working on and you try to explain her the details.
- Use your common sense or find the person on your team who is good at explaining technical things to customers in a way that is easy to understand.

- Jonjon: show metaphor for zero-knowledge proof

XP Planning Game Stages I

Release Planning: requirements for near-term release (months)

- Customers & Developers

Iteration Planning: next increment (1–4 weeks work for the team)

- Only Developers

XP Planning Game Stages II

Phases of:	Release Planning	Iteration Planning
Exploration	Customer provides high-value requirements written as user stories.	Requirement translated into different tasks recorded on task cards.
Commitment	Developers commit to the functionality and date for next release.	Tasks assigned to programmers and time to complete estimated.
Steering	• Plan can be adjusted • New requirements added • Existing requirements changed or removed	Tasks are performed and the result is matched with the user story.

XP Planning Game: Release Planning

- Customer or user is part of XP team and is responsible for making decisions on requirements.
  - User requirements are expressed as scenarios or user stories.
- Team read and discuss the stories, and rank them in order of
  - Value to customer
  - Risk
  - Amount of time they think it will take to implement the story; measured as *velocity*.
- Choose scope: customer selects stories with the features to be implemented in the next release based on these estimates.

A ‘prescribing medication’ story

Prescribing medication

The record of the patient must be open for input. Click on the medication field and select either ‘current medication’, ‘new medication’ or ‘formulary’.

If you select ‘current medication’, you will be asked to check the dose; If you wish to change the dose, enter the new dose then confirm the prescription.

If you choose, ‘new medication’, the system assumes that you know which medication you wish to prescribe. Type the first few letters of the drug name. You will then see a list of possible drugs starting with these letters. Choose the required medication. You will then be asked to check that the medication you have selected is correct. Enter the dose then confirm the prescription.

If you choose ‘formulary’, you will be presented with a search box for the approved formulary. Search for the drug required then select it. You will then be asked to check that the medication you have selected is correct. Enter the dose then confirm the prescription.

In all cases, the system will check that the dose is within the approved range and will ask you to change it if it is outside the range of recommended doses.

After you have confirmed the prescription, it will be displayed for checking. Either click ‘OK’ or ‘Change’. If you click ‘OK’, you prescription will be recorded on the audit database. If you click ‘Change’, you re-enter the ‘Prescribing medication’ process.

Examples of task cards for prescribing medication

Task 1: Change dose of prescribed drug

Task 2: Formulary selection

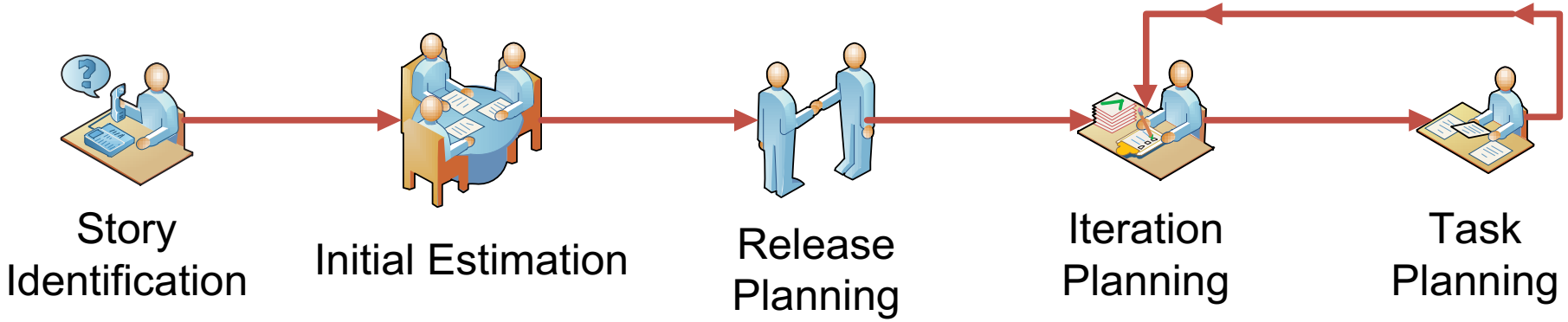
Task 3: Dose Checking

Dose checking is a safety precaution to check that the doctor has not prescribed a dangerously small or large dose.

Using the formulary id for the generic drug name, lookup the formulary and retrieve the recommended maximum and minimum dose.

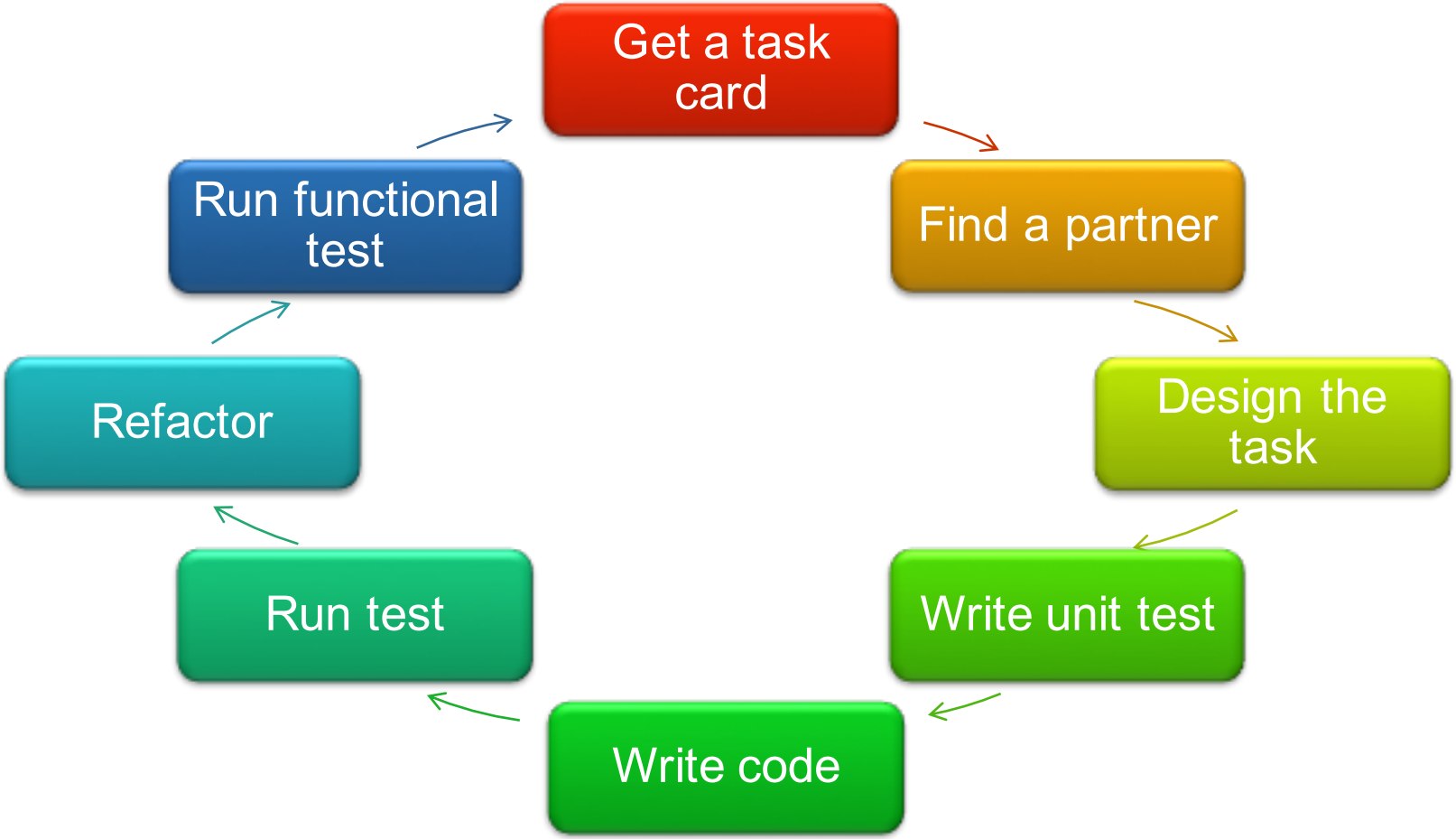
Check the prescribed dose against the minimum and maximum. If outside the range, issue an error message saying that the dose is too high or too low. If within the range, enable the 'Confirm' button.

XP Planning Game: Iteration Planning



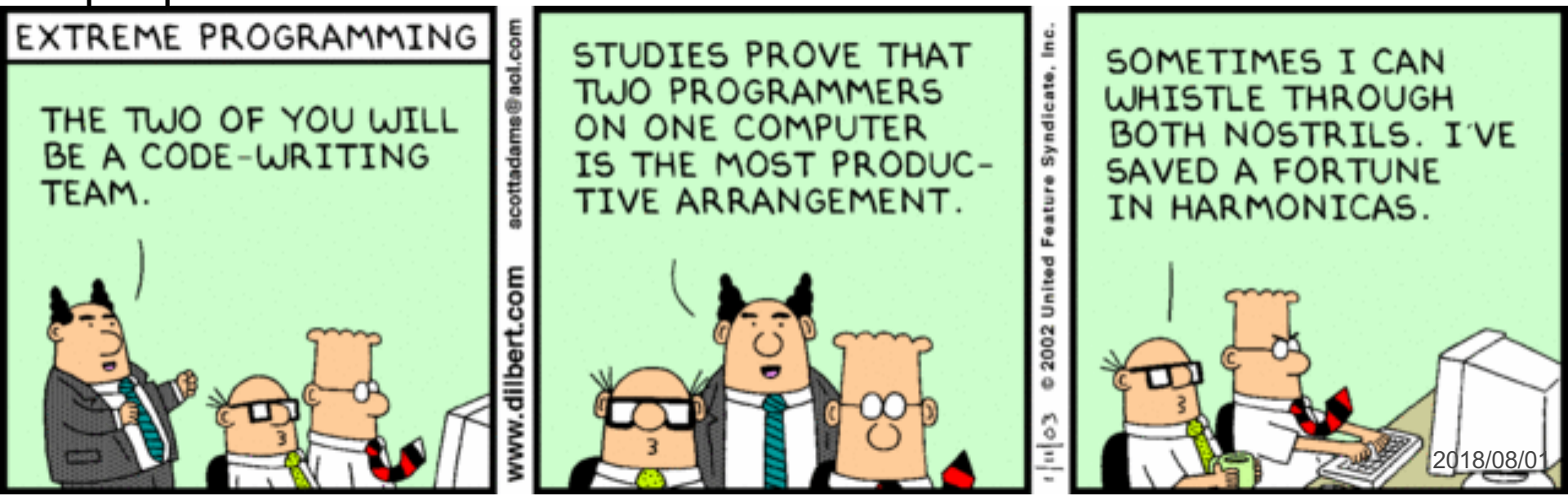
- Stories to be implemented in an iteration are chosen.
- Development team break them down into implementation tasks.
  - Written on task cards.
  - These tasks are the basis of schedule estimates.
- Programmers then accept tasks and the load is balanced between the team members.

XP Planning Game: Iteration Steering



Pair Programming in XP

- Programmers work in pairs, sit together to write every line of code.
  - 2 programmers + 1 computer = atomic unit of XP code development.
  - One person at the keyboard, other supporting.
  - Pairs are created dynamically
  - Egoless development
- Informal review process: each line of code is looked at by at least two people.



Pair Programming in XP II

- Productivity is similar to that of two people working independently …
- Common ownership of code
  - Individuals are not held responsible for problems with the code.
- Collective responsibility for the system.
  - Team has collective responsibility for resolving problems.
- Spreads knowledge across the team.
  - Reduces risk if someone leaves
- Motivates refactoring as the whole team will benefit from it.

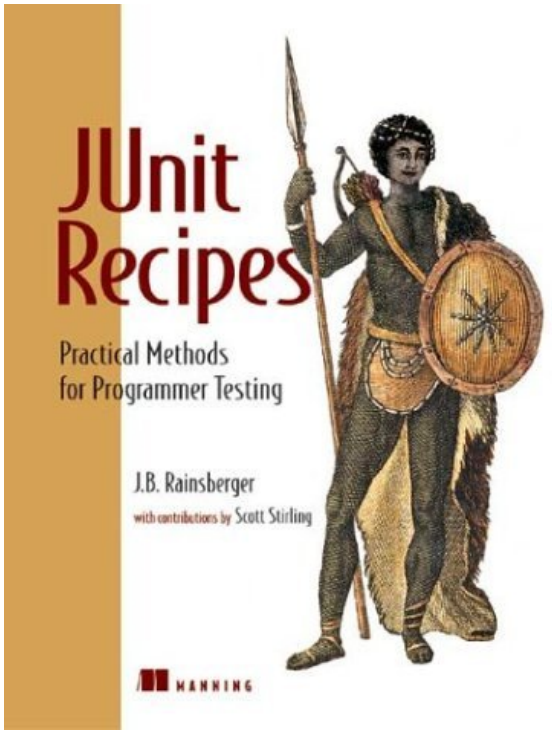
TESTING

Testing in Agile Development

- Testing is integrated throughout the lifecycle;
  - testing the software continuously throughout development
- Agile development does not have a separate test phase.
- Developers write automated repeatable unit tests.
  - Testing done as part of the build
  - Ensures all features are working each time a build is produced.
    - builds should be regular, at least daily
  - integration is done as you go too.
- These actions keep the software in a releasable condition throughout the development,
  - can be shipped whenever appropriate.

Testing in XP

- The XP (e**X**treme **P**rogramming) agile methodology recommends test driven development
  - writing tests *before* writing code
- Testing can still be done by professional testers
  - In Agile development testing is more quality assurance than purely testing.
- But what to you test against?



Testing in XP II

- Testing is central to XP and XP has developed an approach where the program is tested after every change has been made.
- XP testing features:
  - Test-first development.
  - Incremental test development from scenarios.
  - User involvement in test development and validation.
  - Automated test harnesses are used to run all component tests each time that a new release is built.

Test-First Development

- **Writing tests before code clarifies the requirements to be implemented.**
- Tests are programs rather than data
  - Executed automatically
  - Usually with a testing framework such as **JUnit**.
    - www.junit.org & junit.sourceforge.net
- All previous and new tests are run automatically when new functionality is added, thus checking that the new functionality has not introduced errors.

Customer Involvement

- Role of the customer in testing is to help develop acceptance tests for the stories implemented in the next release of the system.
- All new code is therefore validated to ensure that it is what the customer needs.
- Customers have limited time available
  - Cannot work full-time with the development team.
  - May feel that providing requirements was enough of a contribution
  - May be reluctant to get involved in the testing process.

Test Case Description for Dose Checking

Test 4: Dose checking

Input:

1. A number in mg representing a single dose of the drug.
2. A number representing the number of single doses per day.

Tests:

1. Test for inputs where the single dose is correct but the frequency is too high.
2. Test for inputs where the single dose is too high and too low.
3. Test for inputs where the single dose * frequency is too high and too low.
4. Test for inputs where single dose * frequency is in the permitted range.

Output:

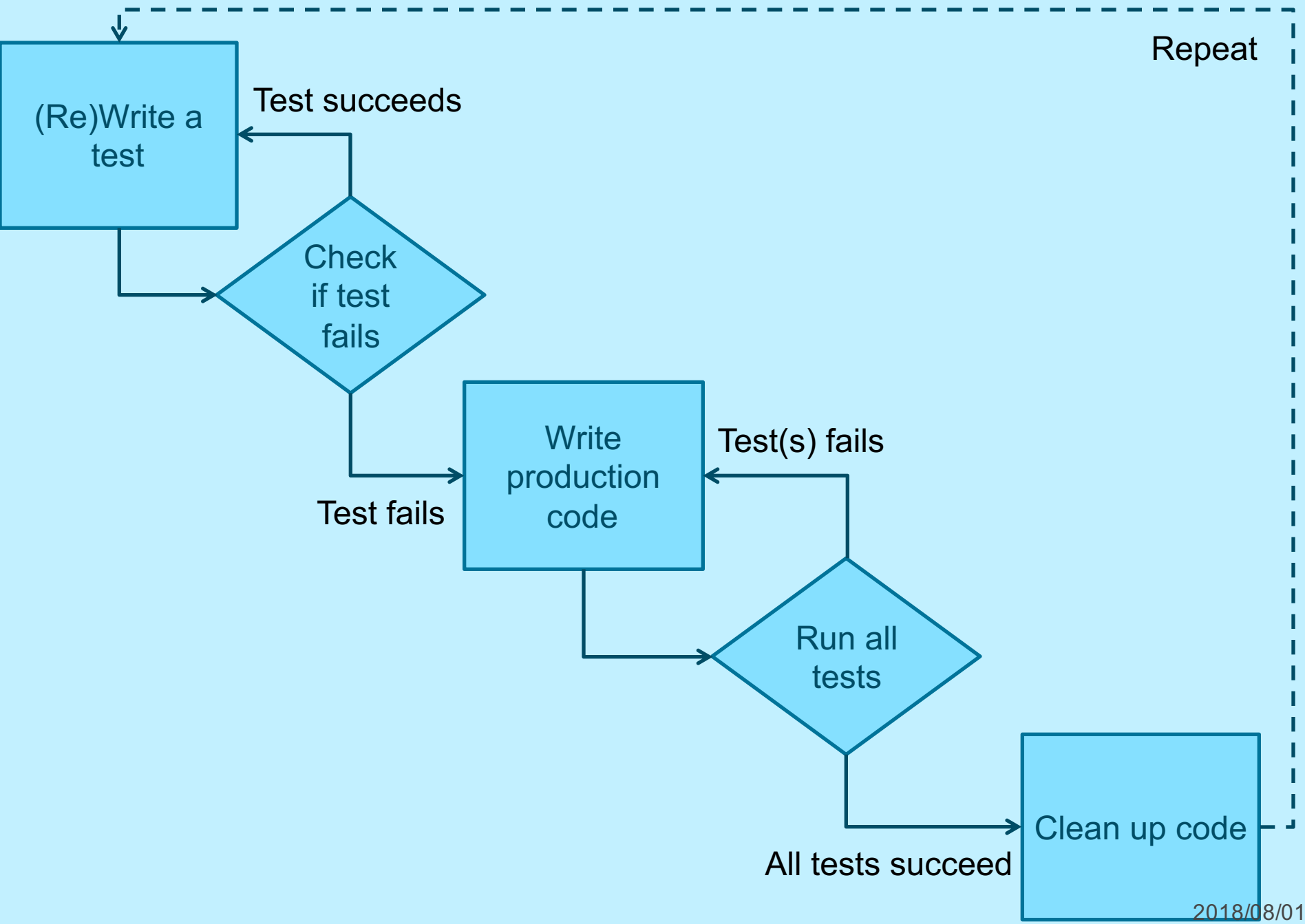
OK or error message indicating that the dose is outside the safe range.

XP Testing Difficulties I

- Programmers prefer programming to testing
  - Sometimes they take short cuts when writing tests.
    - For example, they may write incomplete tests that do not check for all possible exceptions that may occur.
- Some tests can be very difficult to write incrementally.
  - In a complex user interface, it is often difficult to write unit tests for the code that implements the 'display logic' and workflow between screens.
- It difficult to judge the completeness of a set of tests.
  - You may have a lot of system tests but your test set may not provide complete coverage.

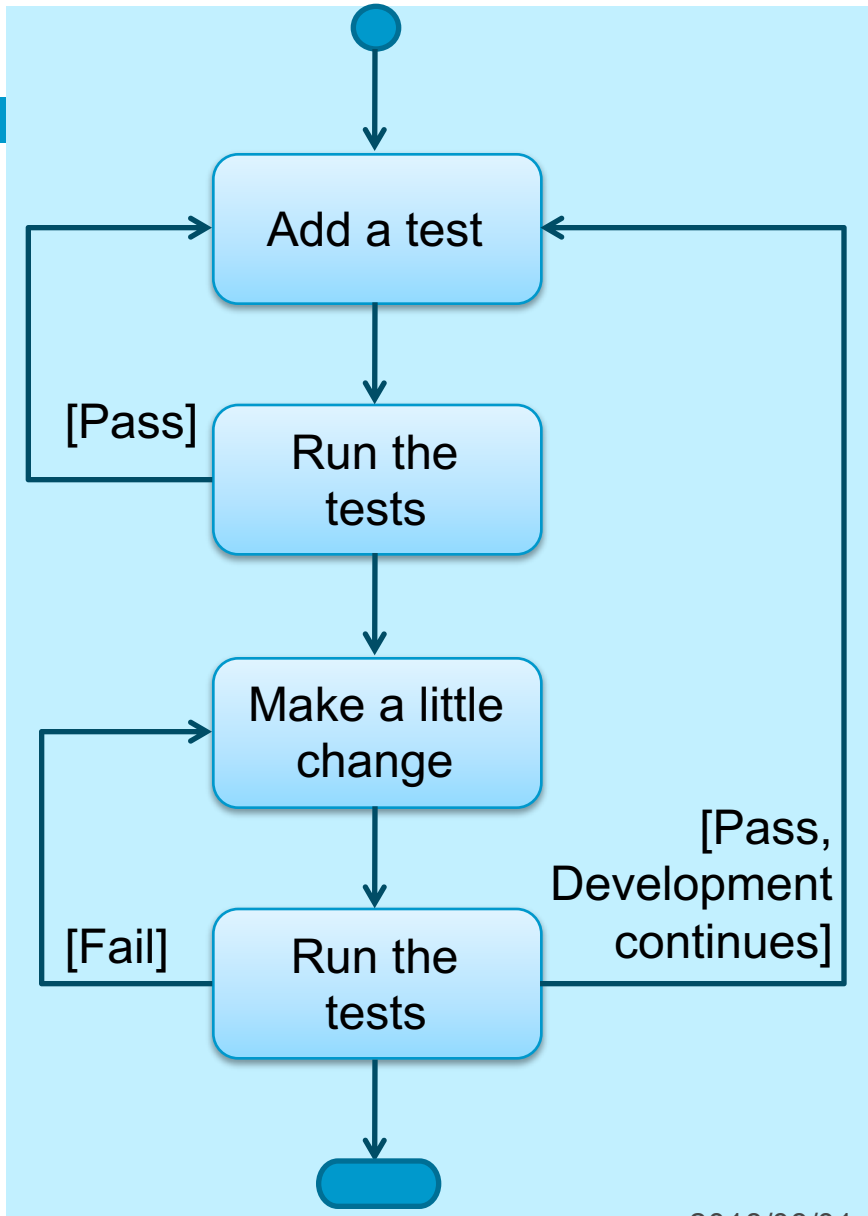
XP Testing Difficulties II

- What are XP/Agile Programmers testing for?
  - They don't have a detailed spec to test against, so how can they possibly test it?
- Agile testing therefore calls for more judgment from a tester
  - not just a case of following a test script
  - “testathon” — collaborative programmer brainstorm to write software tests


Repeat
(Re)Write a test
Test succeeds
Check if test fails
Test fails
Write production code
Test(s) fails
Run all tests
All tests succeed
Clean up code

Test First Development

1. Quickly add test for new feature
   - just enough code to fail.
2. run your tests
   - the complete test suite or
   - (for speed) a subset, to ensure that new test does in fact fail
3. update the functional code to make it pass the new tests.
4. run the tests again
   - If they fail update the functional code and retest
5. once the tests pass start over
   - possibly refactoring any duplication out of the design

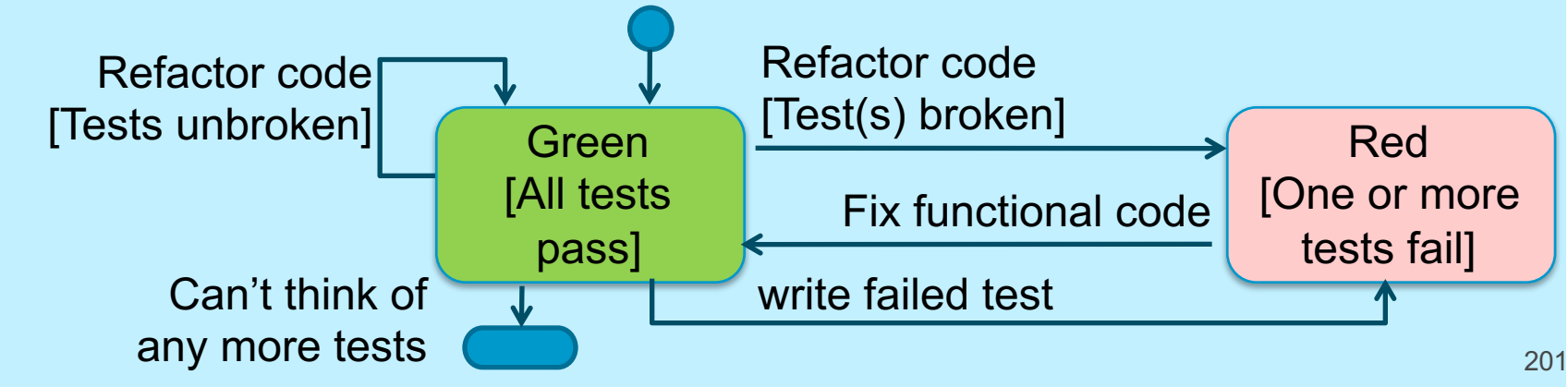


Test Driven Development I

- TDD can be described as:
  - TDD = TFD + **refactoring**
- TDD turns traditional development around.
  - Instead of writing functional code first and then your testing code as an afterthought
  - you ***first*** write your test code ***before*** your functional code.
- Also you do so in very small steps
  - one test and a small bit of code at a time.
- With TDD a developer refuses to write a new function unless there is a test that fails because that function isn't present.
  - Refuse to add even a single line of code until a test exists for it.

Test Driven Development II

- Once the test is in place do the work required to ensure that the test suite now passes.
- Once your code works, refactor it to ensure that it's remains of high quality.
- The diagram shows how you perform test driven development:



Test Driven Development: The Rules

1. Write new code **only** when an automated test fails
2. Eliminate any duplication.

Generates complex individual and group behaviour. Some technical implications are:

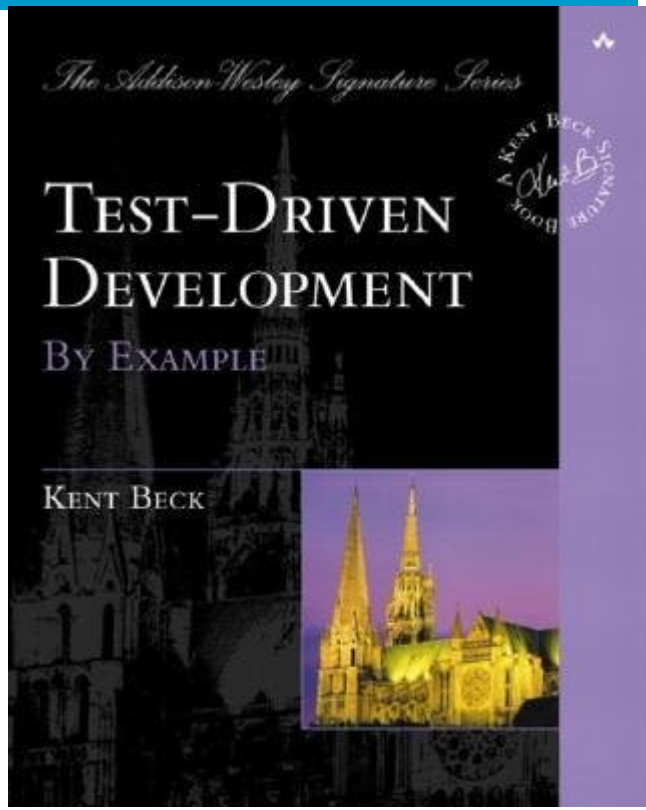
- You design organically, with the running code providing feedback between decisions.
- You write your own tests because you can't wait 20 times per day for someone else to write a test.
- Your development environment must provide rapid response to small changes
- Your designs must consist of highly cohesive, loosely coupled components
  - this makes evolution and maintenance of the system easier

Test Driven Development: Unit Tests

- Implication: developers need to learn how to write effective unit tests
- Experience is that good unit tests:
  - Run fast
    - they have short setups, run times, and break downs
  - Run in isolation
    - you should be able to reorder them.
  - Use data to make them easy to read and understand
  - Use real data when they need to
    - copies of production data.
  - Represent one step towards your overall goal

Test Driven Development VI

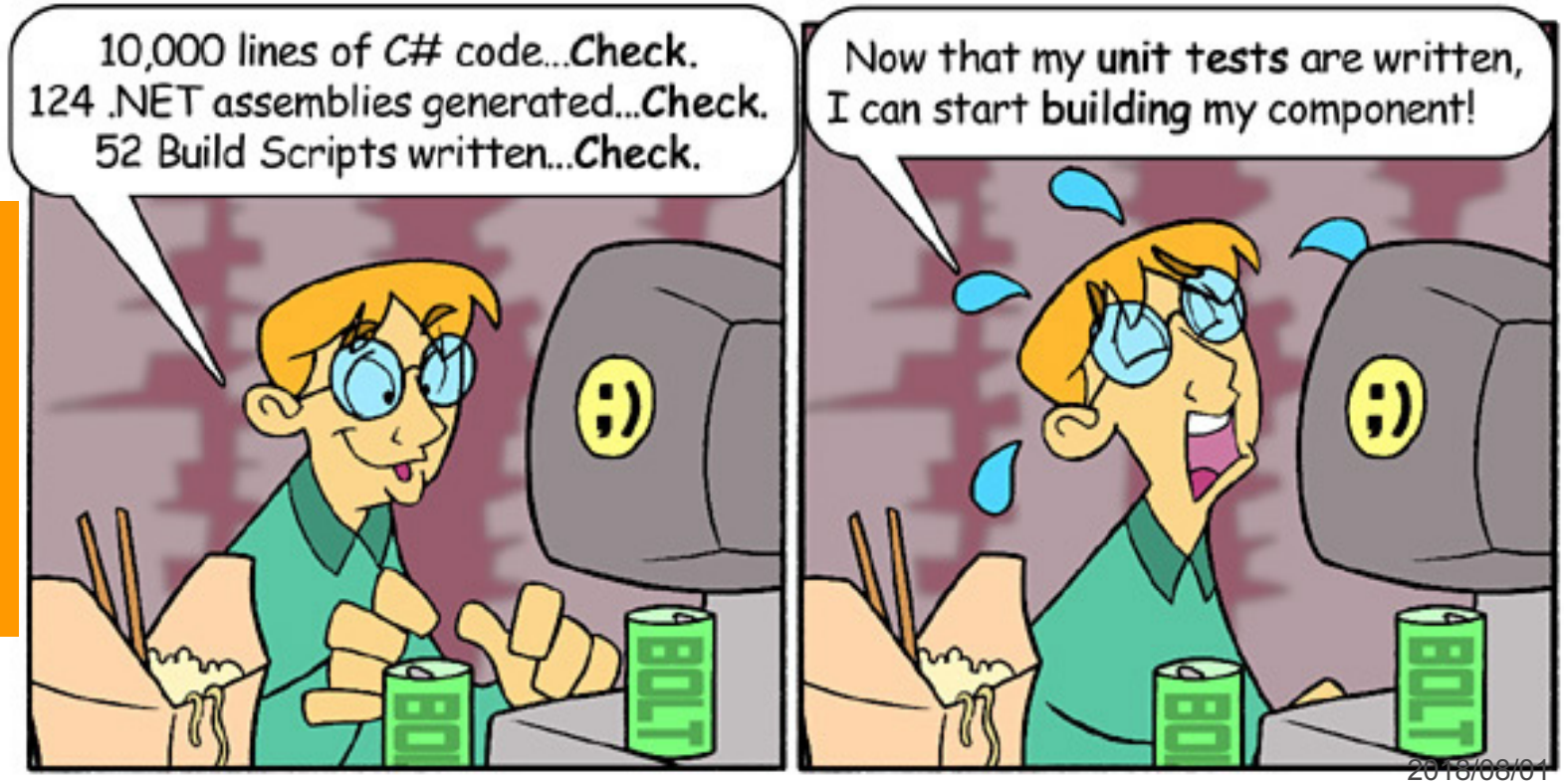
- Most programmers don't read the written documentation for a system
  - instead they prefer to work with the code.
- When trying to understand a class or operation most programmers will look for sample code that invokes it.
- Unit tests provide a working specification of the functional code
- Unit tests become a significant portion of the technical documentation.



Test Driven Development: Conclusion

- Test-driven development is a development technique where you must first write a test that fails before you write new functional code.

What's wrong with this picture?



REFACTORING

XP and change

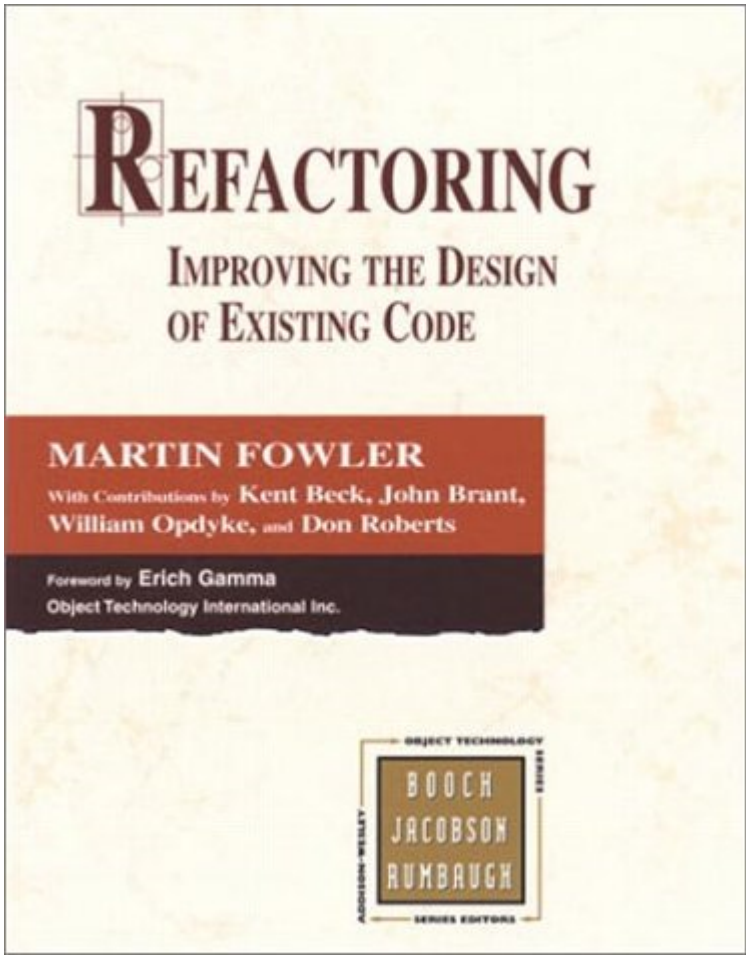
- Conventional wisdom in software engineering is to design for change. It is worth spending time and effort anticipating changes as this reduces costs later in the life cycle.
- XP, however, maintains that this is not worthwhile as changes cannot be reliably anticipated.
- Rather, it proposes constant code improvement (refactoring) to make changes easier when they have to be implemented.

What is Refactoring?

- Refactoring is defined as
  - *a change made to the internal structure of software to make it easier to understand and cheaper to modify without changing its observable behaviour*
- *Adding functionality* does not change existing code, it only adds new capabilities
  - measure progress by adding tests and getting the tests to work.
- *Refactoring* does not add functionality, you only restructure the code.
  - don't even add any tests — only restructure the code
- These software improvements are made *before* there is an immediate need for them.

Refactoring when Developing Software

- Try to add a new function
  - (oops) realize this would be much easier if the code were structured differently
- Refactor for a while
  - the code is better structured
- Add the new function
  - get the new function working
    - it is coded in a way that's awkward to understand
    - so refactor.

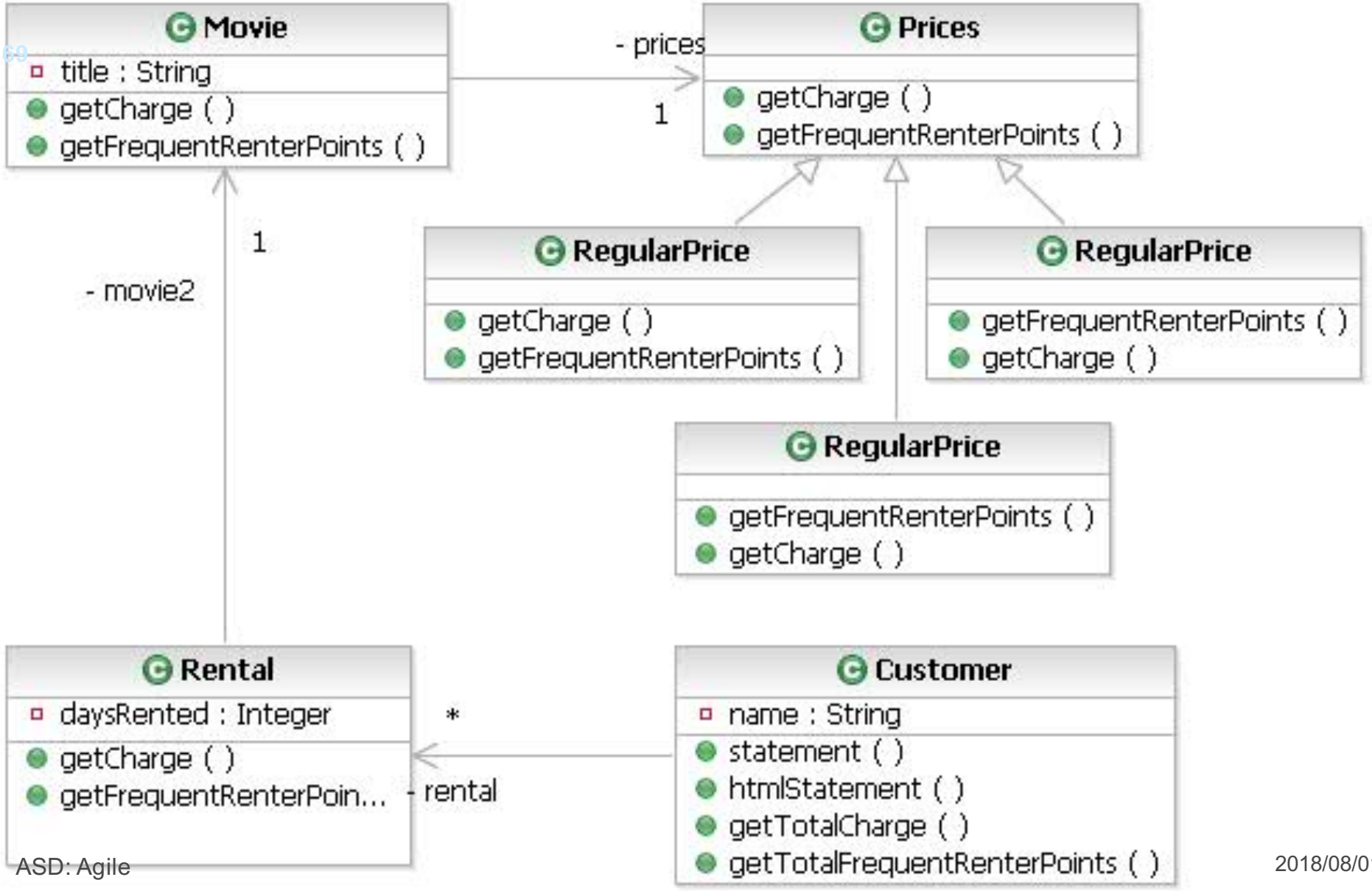


Examples of Refactoring

- Re-organization of a class hierarchy to remove duplicate code.
- Tidying up and renaming attributes and methods to make them easier to understand.
- The replacement of inline code with calls to methods that have been included in a program library.

Example: Initial Classes Video Rental

Example: Refactored Classes Video Rental



Why Refactor?
Improves the Design of Software

- Deal with Software rot, decay and loss of structure.
- Refactoring is like tidying up the code.
  - Regular refactoring helps code retain its shape.
  - You refactor code that works but is not ideally structured.
- An important aspect of improving design is to eliminate duplicate code.
  - Ensure the code says everything once and only once
  - more code ⇔ harder to modify correctly ⇔ more code to understand
  - change this bit of code here, but the system doesn't do what is expected because you didn't change that bit over there that does much the same thing in a slightly different context.
- Changes are easier to make because the code is well-structured and clear.

Why Refactor?
Makes Software Easier to Understand

- Improve the understandability and readability of the software
  - reduces the need for documentation.
  - Good programmers write code understandable by human beings!
- After code is written it has to be maintained
  - Someone will try to read the code to make changes.
  - It matters if it takes a programmer a week to make a change that would have taken an hour if she had understood your code.
- When you are trying to get the program to work, you are not thinking about that future developer.
  - It takes a change of rhythm to make changes that make code easier to understand.
  - Refactoring leads to higher levels of understanding that would otherwise be missed during development

Why Refactor?
Helps Find Bugs

- By clarifying the structure of the program, you clarify certain assumptions you've made
  - to the point at which even you can't avoid spotting the bugs.
- Kent Beck often says about himself:
  "I'm not a great programmer; I'm just a good programmer with great habits."
  - Refactoring helps me be much more effective at writing robust code.

Why Refactor?
Helps You Program Faster

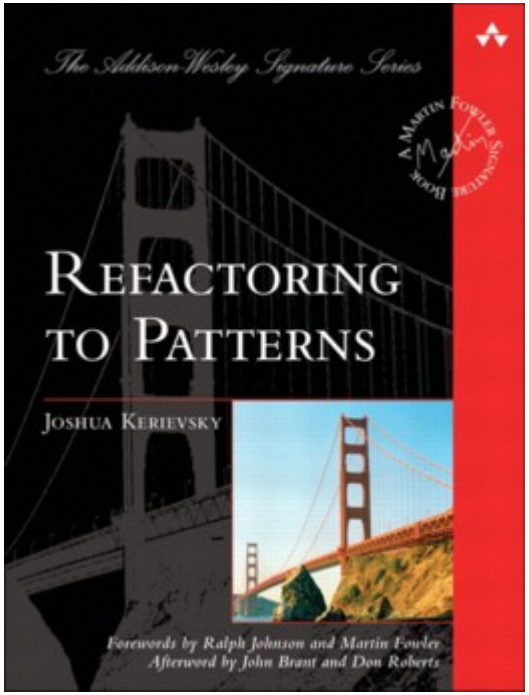
- Good design is essential for rapid software development.
- Changes take longer as you try to understand the system and find the duplicate code
- New features need more coding as you patch over a patch that patches a patch on the original code base.
- Refactoring helps you develop software more rapidly, because it stops the design of the system from decaying.
- It can even improve a design.

Refactoring Categories

1. *Composing methods.*
   - These refactorings serve restructurings at the method level.
2. *Moving features between objects.*
   - These refactorings support the moving of methods and fields between classes.
3. *Organizing data.*
   - These refactorings restructure the data organization.
4. *Simplifying conditional expressions.*
   - These refactorings simplify conditional expressions
5. *Making method calls simpler.*
   - These refactorings simplify method calls
6. *Dealing with generalization.*
   - These refactorings help to organize inheritance hierarchies

Refactoring to Patterns

- Refactoring to Patterns is the marriage of refactoring with patterns
  - Patterns ≡ classic solution to recurring design problems.
- Use patterns to improve an existing design
  - Better than using patterns early in a new design.
- This is compatible with XP's desire to avoid too much upfront design



CONCLUSION

Principles of Agile Programming

Fixed Timescale

Bare Requirements

Agile Development Cycle

Extreme Programming

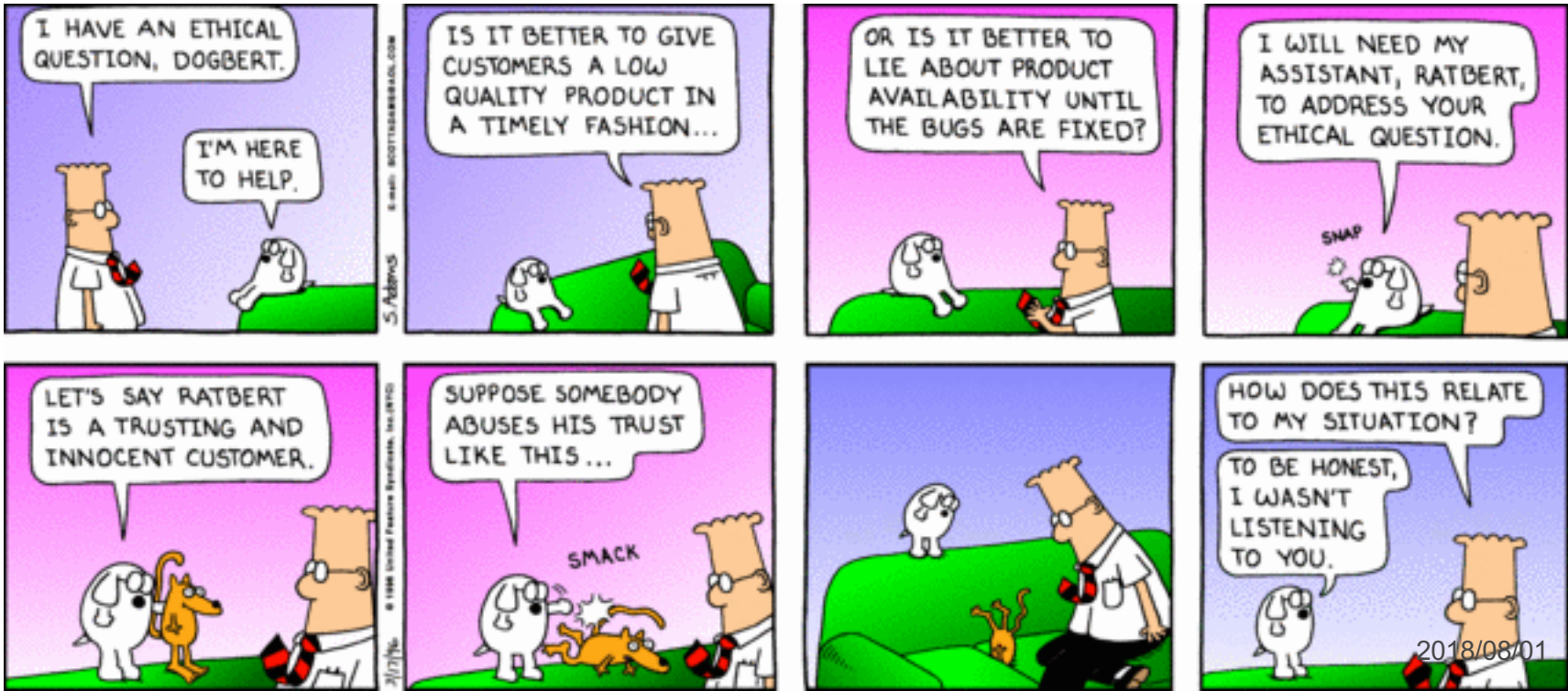
Testing

Refactoring

Conclusion

Conclusion

- The traditional view is that refactoring is a waste of resources.
- What is the business advantage of refactoring?
- Is it an overhead?
- Is it a necessary result of change?
- One option is refactoring to an acceptable pattern.



Collaboration with Users

- Agile development relies on close cooperation and collaboration between all team members and stakeholders.
  - keep requirements and documentation lightweight
  - acknowledge that change is a normal and acceptable reality in software development.
  - required to clarify requirements just-in-time
  - keep all team members on the same page throughout the development.
- You can't do away with a big spec up-front *and* not have close collaboration.

Agile method applicability

- Product development where a software company is developing (medium-sized) product for sale.
- Custom system development within an organization, where there is a clear commitment from the customer to become involved in the development process and where there are not a lot of external rules and regulations that affect the software.

Problems with agile methods

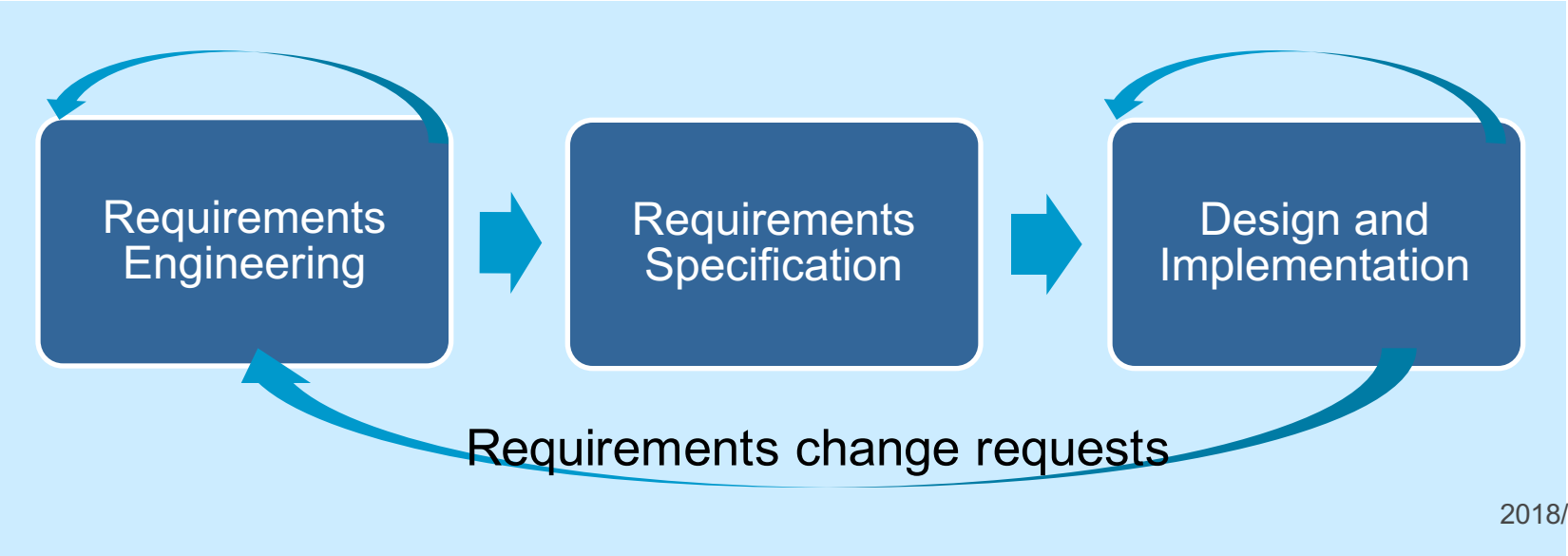
- It can be difficult to keep the interest of customers who are involved in the process.
- Team members may be unsuited to the intense involvement that characterizes agile methods.
- Prioritizing changes can be difficult where there are multiple stakeholders.
- Maintaining simplicity requires extra work.
- Contracts may be a problem as with other approaches to iterative development.
- Because of their focus on small, tightly-integrated teams, there are problems in scaling agile methods to large systems.

Agile methods and software maintenance

- Most organizations spend more on maintaining existing software than they do on new software development.
  - So agile methods have to support maintenance as well as original development.
- Two key issues:
  - Are systems that are developed using an agile approach maintainable, given the emphasis in the development process of minimizing formal documentation?
  - Can agile methods be used effectively for evolving a system in response to customer change requests?
- Problems may arise if original development team cannot be maintained.

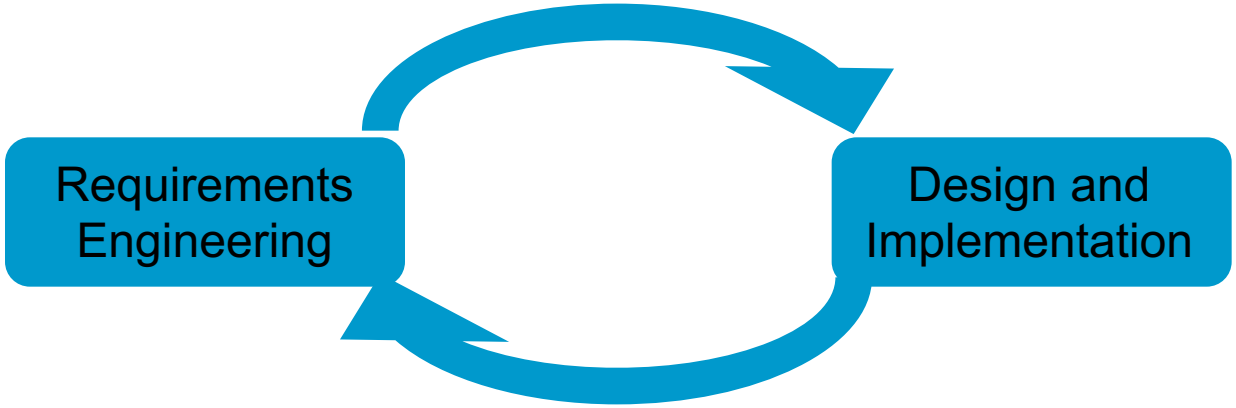
Plan-driven specification and development

- A plan-driven approach to software engineering is based around separate development stages with the outputs to be produced at each of these stages planned in advance.
- Not necessarily waterfall model – plan-driven, incremental development is possible
- Iteration occurs within activities.



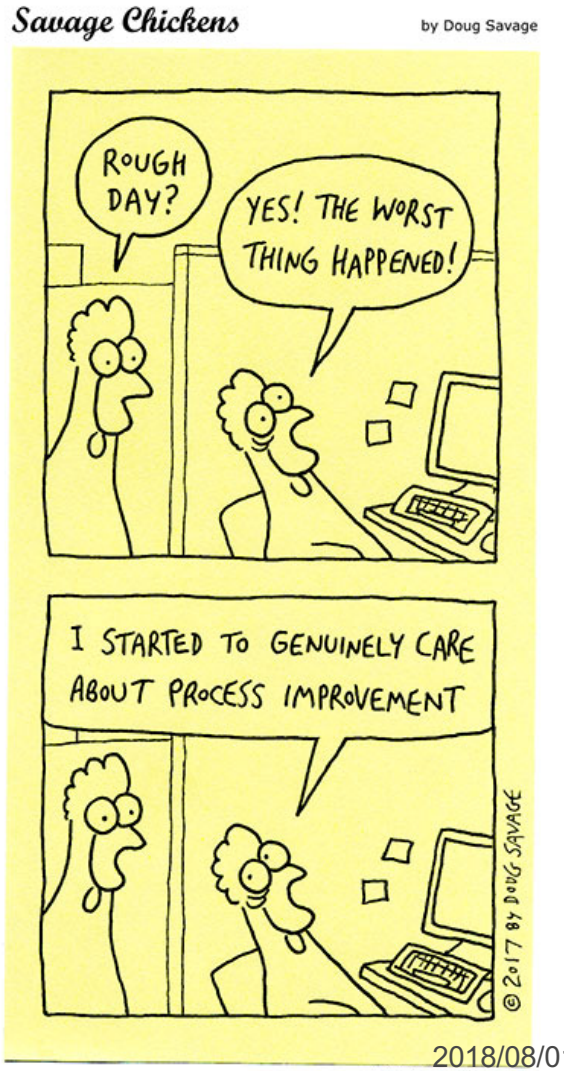
Agile specification and development

- Specification, design, implementation and testing are inter-leaved
- Outputs from the development process are decided through a process of negotiation *during* the software development process.



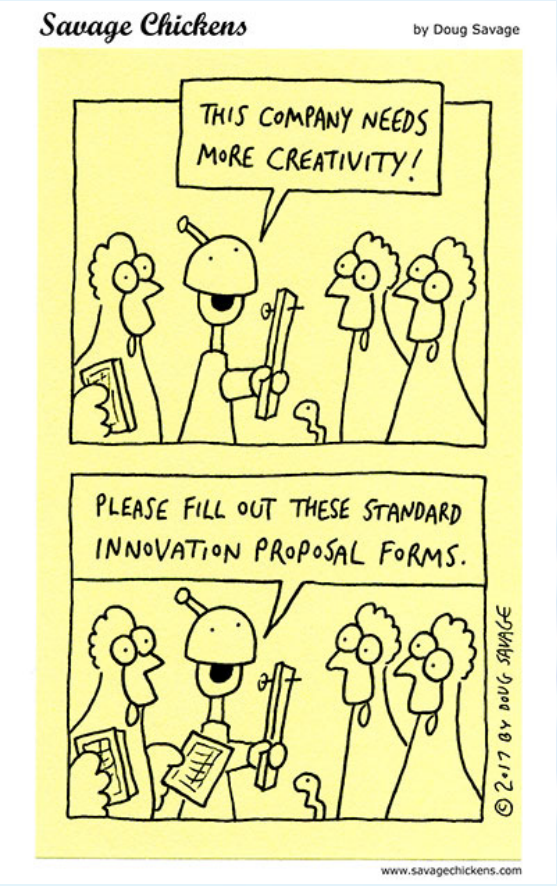
Architecture Change and Refactoring

- Changes that require architecture refactoring is very expensive.
- It is hard to do.
- It has consequences for the code and implies code refactoring



SUMMARY

Not comprehensive: points to consider



Principles of Agile Methods

1. Active user involvement is imperative
2. The team must be empowered to make decisions
3. Requirements evolve but the timescale is fixed
4. Capture requirements at a high level; lightweight & visual
5. Develop small, incremental releases and iterate
6. Focus on frequent delivery of products
7. Complete each feature before moving on to the next
8. Apply the 80/20 rule
9. Testing is integrated throughout the project lifecycle – test early and often
10. A collaborative & cooperative approach between all stakeholders is essential

Active User Involvement I

- Requirements are clearly communicated and understood at the outset
- Requirements are prioritized appropriately, based on the needs of the user and market
- Requirements can be clarified daily with the project team, not from lengthy documents that aren't read or are misunderstood
- Emerging requirements can be factored into the development schedule with the impact and trade-off decisions understood
- The right product is delivered
- As iterations are delivered, check they meet user expectations
- The product is more intuitive and easy to use
- The user is seen to be interested in the development .

Active User Involvement II

- The user/business sees the commitment of the team
- Developers are accountable, share progress openly every day
- There is complete transparency as there is nothing to hide
- The user shares responsibility for issues arising; it's not a customer-supplier relationship but a joint team effort
- Timely decisions can be made, about features, priorities, issues, and when the product is ready
- Responsibility is shared; the team is responsible together for delivery of the product
- When the going gets tough, the *whole* team - business and technical - work *together*!

Fixed Timescale

- No-one knows what the right solution is at the outset

  ⇒its practically impossible to build the right solution initially
- Traditional projects fight change, with change control processes
  - minimise and resist change wherever possible.
- Agile Development embraces and expects change
  - the only thing that's certain in life is change.
  - requirements are allowed to evolve, but the timescale is fixed
    - to include a new requirement, or to change a requirement, the user must remove a comparable amount of work
  - assumes there are enough non-mandatory features included in the original timeframes

Agile Requirements are Barely Sufficient

- Contrast this to the traditional situation
  - User still has new and changed requirements
    - Expects the new and existing features to be delivered in the original timeframes.
- Teams that don't control changes can end up with **scope creep**
  - one of the most common reasons for projects to fail.
- Agile teams accept change and even expect it.

Agile Development Cycle: Frequent Delivery

- Agile development is about frequent delivery of products.
  - gone are 12 months project.
  - a 3-6 month project is strategic!
- Consider the Web
  - products are released early with basic features.
  - in the Web 2.0 world, it's a perpetual beta.
    - derive some benefits early
    - get real user/customer feedback
    - look at your web metrics, see what works/ doesn't
    - before building 'everything'

Agile Development Cycle: Regular Release Cycles

- Allows you to learn more effectively.
- Estimates might be good or bad but they should be consistent.
  - estimate features at a granularity of less than 1 day and track your performance
  - you'll begin to understand your delivery rate
  - you'll be surprised how predictable you can be.
- Managing expectations is about predictability.
  - If people know what to expect, they're generally happy.
  - If they don't, they're not happy.
- Focus on frequent delivery of products.
- Even more importantly, focus on *consistent* delivery.

Practices of eXtreme Programming (XP)

1. Whole Team: remove barrier between customer and the rest of the development team.
2. Metaphor: Common analogy for the system.
3. The Planning Game: planning specifies the next step.
   - As the project progresses get a better and better picture of what will be accomplished.
   - Client expresses goals through user stories: overall behaviours of the software.
   - Development takes stories and estimates costs
   - Client prioritises stories.
4. Simple Design: as simple as the current level of functionality allows. No extraneous complexity allowed.
   - When the code becomes too unwieldy its time for *refactoring.*
   - Design only extend to the next iterations new features.

Practices of XP 5–8

5. Small Releases: XP development teams release tested, working code, very frequently.
   - Each iteration — 2 weeks — the client gets new code.
   - Client evaluates it and dictates the next delivery.
6. Consumer Tests: The customer develops acceptance tests to see if software meets user stories.
   - Tests are automated and used frequently by the developers.
7. Pair Programming: see later.
8. Test Driven Development: see later.

Practices of XP

9. Design Improvement: Refactor code whenever deficiencies are noticed = improving the design of existing code.
10. Collective Code Ownership: Immaterial who wrote the code; anyone can modify it at any time.
    - Whoever notices a problem, fixes it.
11. Continuous Integration: At all times the system compiles, runs and passes all tests.
12. Sustainable Pace: Same amount of work and effort in every iteration.
    - Overtime leads to burnout, mistakes and more burnout.
13. Coding Standard: Adopt some coding standard that is consistently adhered to.

TDD: Test Driven Development

- Programming technique ensuring that code is thoroughly unit tested
- If a test fails then progress has been made: you know what to fix.
  - clear measure of success when the test no longer fails.
- TDD increases confidence that the system meets the requirements
- Side effect of TDD is you achieve 100% coverage test
  - every single line of code is tested
  - not guaranteed with traditional testing
- Does not replace traditional testing: just effective unit testing.
- Side effect of TDD: the resulting tests are working examples for invoking the code ⇒ provides a working spec for the code.