Slide Notes(其实就是抄课件)

Week 1 Introduction

Greenfield vs Brownfield Development

- Greenfiled development
  - Creating a software system from scratch
- Brownfield development
  - Adding functionality to an existing(network of) computer systems
  - Fixing bugs
  - Adding small features
  - Adding whole sub-systems or systems

Week 2 Building and Testing Open Source Software

Build Automation

- All this points to the need for the build process to be automated
- Build automation tools:
  - Maven, Ant, Gradle, make, Rake, MSBuild, NAnt, ...
- Aim: make build:
  - Painless to initiate
  - Completely repeatable
  - Quick!

Run the tests

- Release pipeline gateways:
  - Code review
  - Coding standards/documentation procedures
  - Automated tests

Link to the Exam

Could be questions on any aspect of the build and test process.

Week 3 Code comprehension

Learning Unfamiliar Codebases

Code reading

- Goal: build a mental model of the codebase by acquiring
  - Application domain knowledge
  - General programming knowledge
- Use systematic reading strategies
  - Top-down
  - Bottom-up
- Tip: assume previous coders were sensible and honest

Comprehending Marauroa

Omitted

Learning unfamiliar codebases

- Acquire knowledge gradually through the top-down reading strategy
- Packages and classes are hierarchical
- Location is indicator of relevance
- Extract meaning from names
- Open files and skim
- Use different sources
- Don't read everything
- Trust the previous developer

Unit testing overview

Unit testing: what, why & when?

- Replicating problems is key to bug fixing
- However, Marauroa is a game engine, even if we build a toy game it could take ages to replicate bug
- Unit testing is an elegant and maintainable way of executing pieces of code
- Test-driven development lifecycle: test->implement->refactor

Unit testing: terminology

- terminology
    - test fixture
    - code under test
    - unit test
    - test coverage
    - integration test
- Organization
    - Where deploy tests?
    - Which part of the code to test?

JUnit annotations

Annotation	Usage
@Test	in dicates the method as a test method
@Before	to execute a method before a test
@BeforeClass	to execute a method before all tests
@After	to execute a method after a test
@AfterClass	to execute a method after all test

JUnit statements

Statement	Usage

assertTure(String message, boolean condition)	Checks that the boolean condition is true
assertFalse(String message, boolean condition)	Checks that the boolean condition is false
assertEquals(String message, expected, actual)	Tests that two values are the same
assertNull(String message, object)	Checks that the object is null
assertNotNull(String message, object)	Checks that the object is not null

Unit test reading & writing

What can we learn from unit test reading?

- Unit test indicate trace of
  - Critical and key pieces of code
  - Tricky parts of the code
  - Sensitive excerpts
  - Bugs that were repaired in the past
- Marauroa has a dedicated package with tests
- Check marauroa.common.RPObjectTest.java
- What can we learn about the class being tested?
  - Start reading the method under the @Before clause
  - How is it structured and which are its dependencies?
  - Which is the main data structure?

Testing worlds, zones and objects

就是个课上老师带着做的练习，不清楚考不考啊，如果觉得有必要自己稍微过一下源码吧

- There is one world which can contain N zones and zones contain objects
- Find the classes in Marauroa
  - Object: marauroa.common.game.RPObject
  - Zone: marauroa.server.game.rp.MarauroaRPZone
  - World: marauroa.server.game.rp.RPWorld
- Let's test whether
  a. There is only one instance of World
  b. If Zones are actually added to Worlds
  c. If Objects are actually added to Zones
  d. If Objects are destroyed when removed from Zones

1. Test there is only one instance of World
   a. Get two instances of World
   b. Use a JUnit a statement to compare the two instances
2. Test if Zones are actually added to Worlds
   a. Get an instance of the world
   b. Create a new Zone
   c. Add the new Zone to the World
   d. Use a method from the World class to check if our Zone belongs to the World
   e. Use a JUnit a statement to check the above
3. Test Objects are actually added to Zones
   a. Create a Zone and create an Object
   b. Set an identifier to the Object

    c. Add the object to Zone
    d. Use a method from the Zone class to check if our Object belongs to the Zone
    e. Use a JUnit a statement to check the above
4. Test Objects are destroyed once they are removed
    a. Same as above until step e
    b. Remove object from zone
    c. Use a method rom the Zone class to check if our Object belongs to the Zone. Use JUnit.

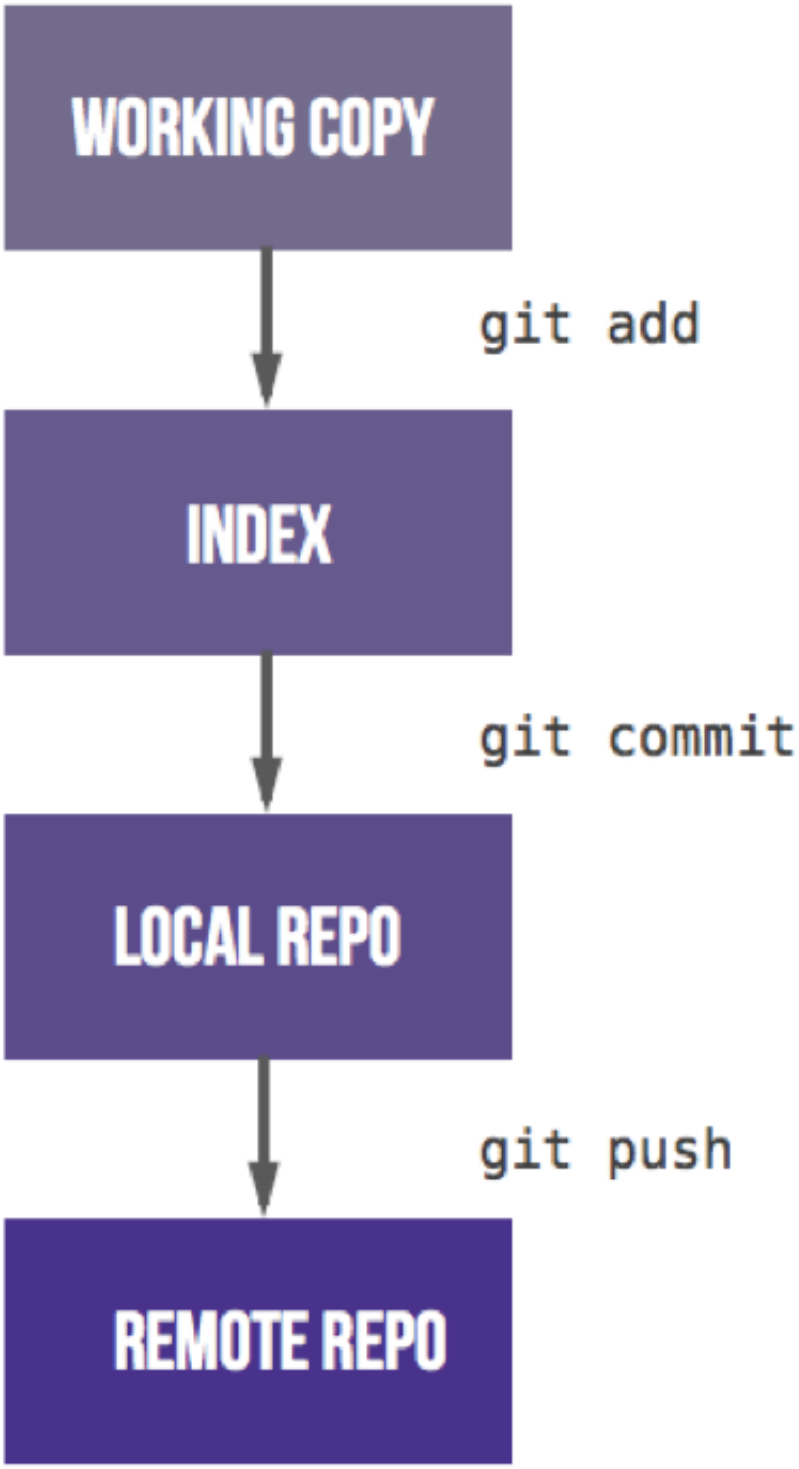
Week4 Git workflows and Code reviews

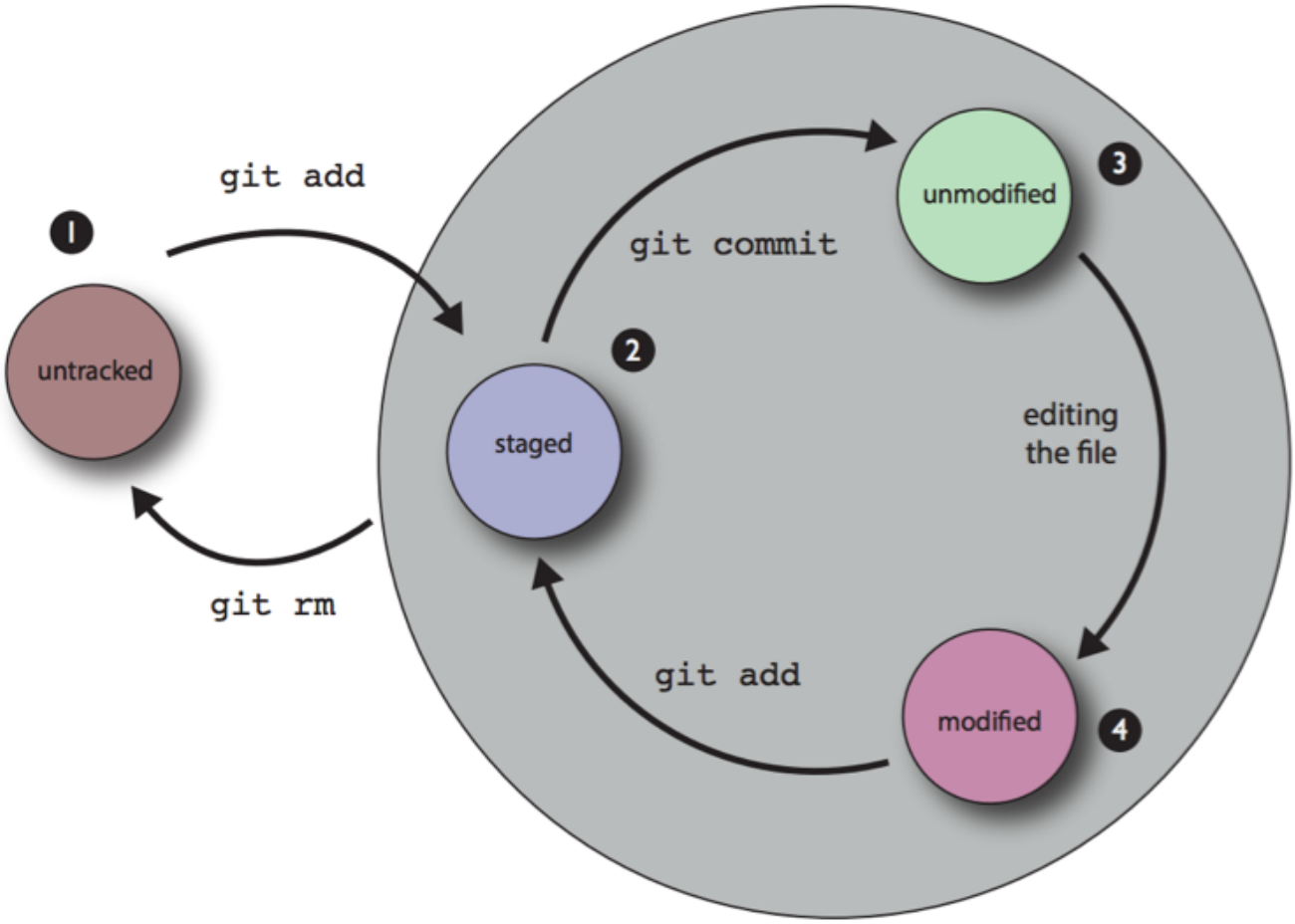
Git workflows

Basic Git

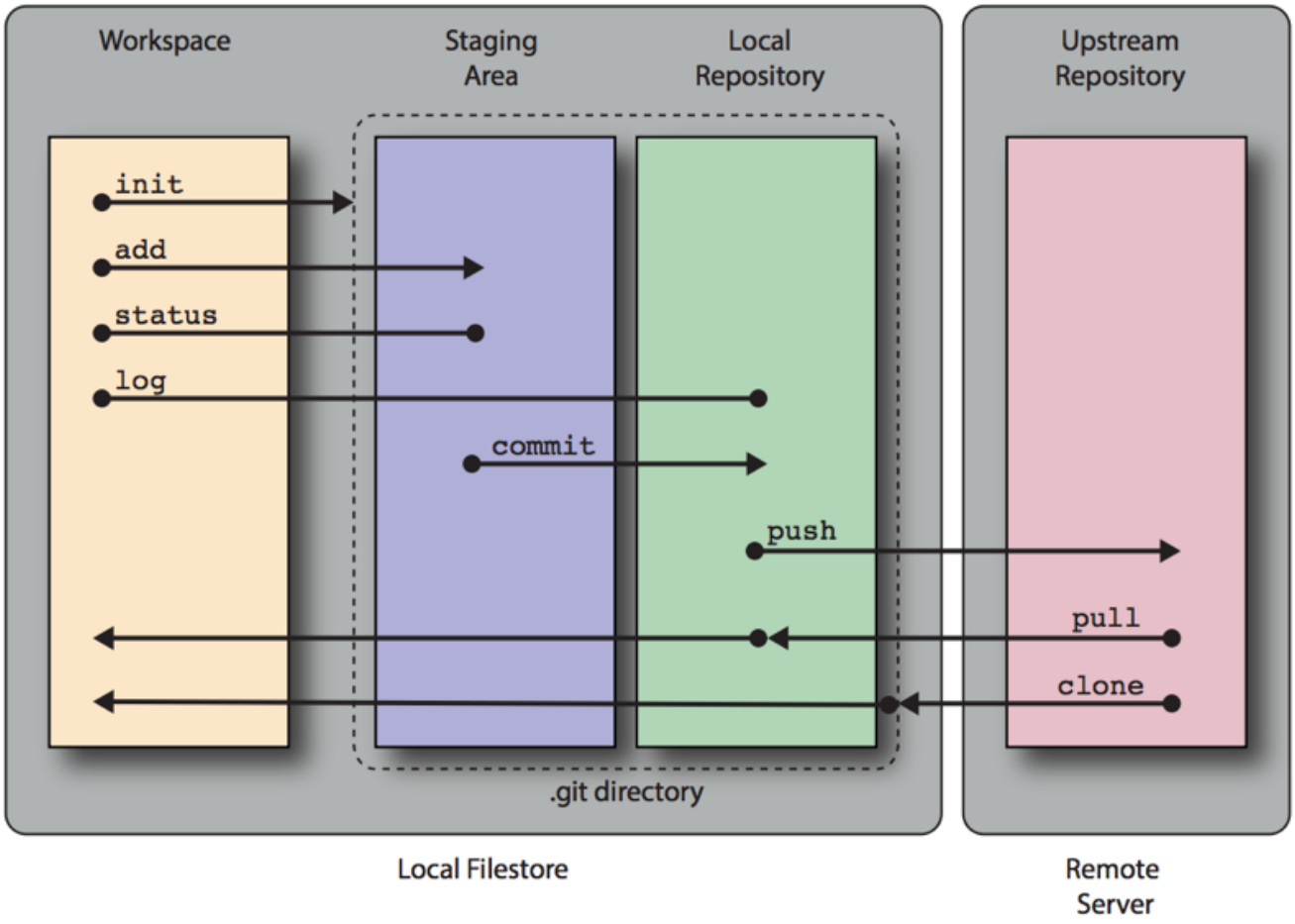
Git is a distributed version control system

The life cycle of a file under git's control:


WORKING COPY
git add
INDEX
git commit
LOCAL REPO
git push
REMOTE REPO



Basic git commands and their interaction with various repositories:



Git Commit

- A commit should represent one conceptual change to your work
  - Expressed in one sentence
  - One commit per bug
- Do commit frequently
- Do not comit unfinished things
- Write meaningful messages

Git Branching

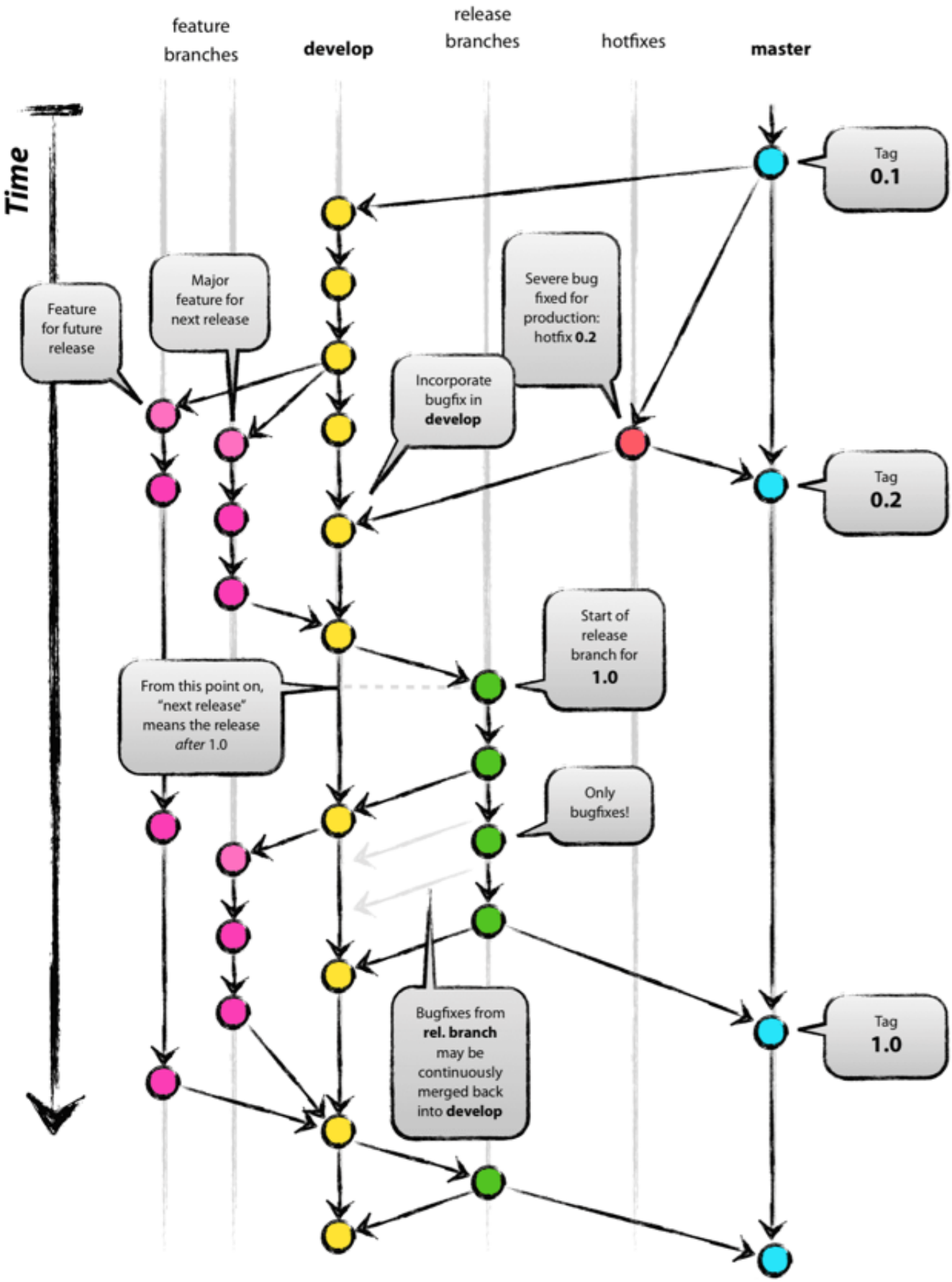
- Branches are used to develop freatures isolated from each other.
- The master branch is the "default" branch when you create a repository
- Use other branches for development and merge them back to the master branch upon completion.

Git workflows

- Branching allows a wide variety of strategies
- This flexibility can result in complex, intertwined and messy ways of developing code
- Using Git stops being efficient
- A 'code of conduct' or protocal or conventions are needed
- Patterns for Git use: Git workflows

Git workflows(2)

The GitFlow model:



- Two main branches
  - Master: production code
  - Develop: latest development
- Supporting branches
  - Feature branches
  - Hotfix branches

    - Release branch
- Positive aspects
    - Popular workflow
- Negative aspects
    - Still complex!

Git workflows(3)

- The GitHub Flow model as a reaction
    - Master branch
    - Feature branches
- GitHub Flow assumes you are able to deploy every time you merge a feature branch
- Simplification and reduction of branch types
- GitLab Flow simplifies this even more
- Confusion: different repository managers use different terminology for merging!
    - Gitlab and Gitorious: merge request
    - GitHub and BitBucket: pull request

Code reviews

- Having the coder reviewed by somebody else is good
- It can be done in several ways:
    - Formal meeting with a projector and code is checked line by line
    - 'Over the shoulder'
    - Email
    - Pair programming
    - Tool based
- It improves the quality, readability and maintain ability of software
- It has an average of 60% of defect removal rate (even 85%) vs. 25% of unit testing

Code review: what to report

- Code review rates should be between 200 and 400 lines of code per hour
- What sort of issues?
    - Design issues
    - Possible errors
    - Coding style issues
    - Testing issues
    - Rewards: positive comments
- How to do the reviews?
    - Be nice
    - Be constructive (somebody else will look at yours!)
- It's good for your own soft skills

Code reviews in the GitLab workflows

- GitLab provides a online platform to discuss the code
- Code reviews on merge requests
    a. Assign the request to somebody else
    b. This person will verify(through code reviews)
        i. If happy with request they accept the merge
        ii. If not they may require further work

Week5 Cost Estimation and Planning

Cost Estimation

Definition

Cost estimation: Estimating the effort, resources and schedule for software projects.

Building a plane!!!!!!!!!!!!!!!!!!!!!!!!

omitted.....

Things that make estimating hard

- Process
  - Poor management
  - Which units should we use?
  - Deadlines
  - Bigger teams need more communication
- Unknowns
  - Lack of experience
  - Unforeseen problems
  - Unfamiliar tools
  - Complexity
  - Variable quality of materials
- External issues over which we have no control
  - Distractions
  - Relying on other people / services
- Different opinions
- Over optimism or pessimism

Things that can help you estimate

- Having a clear view of your objectives
  - Focused scope
- Experience
  - Removing uncertainty
  - Shared experience
  - Familiarity with
    - Process
    - Team members
    - Tools
    - Resources
    - Code/application (estimating gets easier as project goes on)
- Interest
  - Easier to estimate if you are engaged
- Reuse of resources
  - Templates
  - Designs
  - Components
- Honesty

Chaos Report (Standish Group)

- Successful projects:
  - Large companies 9%
  - Medium companies 16%
  - Small companies 28%
- Cost overruns
- Time overruns
- Content deficiencies
- Around half of IT Executives think there are more project failures now than there used to be.

Week 6 Design for Testability

Design for Testability?

- What is Design for Testability?
  - Making sure that we can test what we build
- Why Design for Testability?
  - So that we can test what we build in isolation
- What prevents testability
  - Complexity
  - Non-deterministic code (different every time)
  - Hard coding implementation in the wrong place
  - Not allowing inheritance
  - Breaking the Law of Demeter

Be careful of new

- Avoid new unil you really have to use it
  - The most common form of hardcoding
  - Nails down the exact implementation of an object
- Methods should only instantiate objects we don't want to substitute

Test doubles (测试替身这个翻译不错)

- "Pretend" objects used in place of real objects for testing purposes
- Dummy objects
  - Passed around but never actually used. Often used to fill parameter lists
- Fake objects
  - Have working implementations. Usually take shortcuts which makes them unsuitable for use in production
- Stubs
  - Provide canned answers to calls made during the test, sually not responding anything outside the test
- Mocks
  - Pre-programmed with expectations which form a specification of the calls they are expected to receive

Mocks

- When "mocking" we create a special subclass of something to help us test something else
- With this subclass (a mock) we can

        - Control certain aspects of a class's behavior
            - Fix return values
        - Verify that certain behaviours occur
            - Methods called the correct number of times

Week7 Design Patterns, Offensive and Defensive Coding

Patterns

- Reusable solutions to recurring problems that occur during software development
    - Not necessarily the same code
    - Same structure
- Can be used in discussions among programmers who know them
    - Know that we're talking about the same thing
    - More effectively collaborate
- Mark Grand, "Patterns in Java"

Common patterns: Singleton and Factory (这里课件上没啥内容，补充材料里至少要看第五章的这两个设计模式，至少)

- Can you find any instances of the Singleton and Factory Method patterns in the Marauroa code?
    - Use Mark Grand Chapter 5 (in moodle) as a reference
        - Forces and Consequences
    - In which situations are they used?
    - Why?
- Can you spot any problems with some uses of Singleton in the code?
- How might use of the Factory pattern relate to testability?

UI patterns(这里自己要补充么？)

omitted

Coding styles: Defensive programming

- A blanket term for various practices to increase code stability once it is in production
- Pros
    - "Defend against the impossible, because the impossible will happen"
    - Systems will not fail, but try as hard as possible to continue
        - Even in the face of unexpected user input or actions
    - Aids maintenance
        - Higher quality code: readable and comprehensible
- Cons
    - The impossible cannot happen so why defend against it?
        - New people join the team, new features, etc
    - Hurts maintenance
        - Hides bugs, bad for testability
    - Defensive coding often degenerates into paranoid programming

A note on assert

- assert is used to verify the correctness of an invariant in the code
- Should never trigger in production code
    - Turned off by default

        - Should be on during testing
        - Turn on with -ea option on the java command
- Do not use assert to check public method parameters!
    - Use Exceptions
- Do use assert to check post-conditions

Paranoid programming vs testability

omitted (自己看图，不代表不重要)

Code styles: Offensive programming

- "The best defence is a good offence" - Anon
- Pros
    - Don't silently ignore errors, let them happen!
    - Force bugs to be detected and fixed as soon as possible
    - Simpler code(less error checking)
    - Errors shipped to the customer will be obvious
        - Easier to get management buy-in to fix them?
        - No results better than wrong results?
    - Cons
        - Errors shipped to the customer will be obvious
            - Low quality more obvious
            - Errors visible to everyone
    - More crashes
        - Real-time life-critical systems won't try to recover

Week8 Refactoring and code migration

What is refactoring?

- "Refactoring changes structure, not behaviour"
- What do we mean by "behaviour"?
    - The function that is performed by the code
    - The interface that the code presents to the world
        - API
        - More obvious in object-oriented programming

Testing and refactoring

- "Refactoring changes structure, not behaviour"
    - Behaviour must be exactly the same after refactoring
- Good tests are essential for refactoring
    - Must start and finish in known good state
- Refactoring workflow:
    - Runtests (start from known good state)
    - Refactor
    - Run tests (finish in the same known good state)

Changing interfaces vs refactoring

- "What if I split a complex method up into smaller private methods?"
    - This is a refactor; the interface is not changed

            - Run tests to ensure they pass
            - Refactor
            - Re-run entire test suite to check for regressions
- "What if I combine similar functionality from two private methods into a single one?"
    - This is a refactor; the interface is not changed
        - Run tests to ensure they pass
        - Refactor
        - Re-run entire test suite to check for regressions
- "What if I am removing a public method, and no longer need the test?"
    - Not a refactor; you are changing the interface
        - Run tests to ensure they pass
        - Remove the test
        - Remove the method
        - Re-run entire test suite to check for regressions
- "What if I am moving a public method between two classes?"
    - Not a refactor; you are changing the interface
        - Run tests to ensure they pass
        - Change the test so that it tests the code in its new location
        - Move the code to the new class
        - Re-run entire test suite to check for regressions

How do I know when to refactor?

- Look out for
    - Complexity
        - Assignments, branches, calls (ABC)
        - Cyclometric complexity
        - Consider refactoring high scoring methods
    - Structural similarity
        - Consider refactoring similar code
    - Don't search by hand, use tools

Refactoring with your IDE

Omitted

Refactor operations

Simple tasks

- Rename...; Move...
    - Fields, local variables, types, packages, etc
- Changemethod signature...
    - Keep originalas delegate
    - Deprecate original
- Encapsulate field...
    - Replaces all references to a field with getter and setter methods

Super-type/sub-type operations

- Use super-type where possible...
    - Replace occurrences of a type with one of its super-types where possible.

- Pull up...
    - Move a field/method to a superclass
    - Declare the method abstract in the superclass
        - Methods only
- Push down...
    - Move a set of methods and fields from a class to its subclasses

Extracting structure

- Extract local variable
    - Creates a new variable assigned to the current selection
    - Replaces the selection with a reference to the new variable
- Extract method
    - Creates a new method containing the current selection
    - Replaces the selection with a reference to the new method
    - Useful for refactoring lengthy, cluttered, or overly-complex methods
- Extract superclass...
    - Extracts a common superclass from a set of sibling types
    - The selected sibling types become direct subclasses of the extracted superclass
    - Maybe re-run "Use super-type where possible..."
- Extract interface...
    - Creates a new interface with a set of methods
    - Makes the selected class implement the interface

Week10 Domain Specific Languages (DSL)

What is a domain?

- Area of interest
- Scientific specialty

- Bounded
- Overlapping

- Examples
    - Computer Science
        - Software Engineering
        - Human Computer Interaction

Domain Specific Languages

- Domain Specific Languages are very common
    - They underpin many key technologies
- Also known as
    - Little languages
    - Minilanguages
- Mostly textual
    - Ideally more natural looking than general code

DSL examples

- Web
    - HTML, CSS, JavaScript, XSLT

- Development tools
    - make, rake, ant, lex, yacc, Emacs Lisp
- Databases
    - SQL, HQL, Object/Relational Mapping in general
- Tyesetting utilities
    - TeX, LaTeX troff, groff, PostScript
- Unix tools
    - sed, awk, bc, m4
- Other
    - Regular expressions, Office macros, MATLAB

DSLs vs general-purpose languages

- Design goals contrast those of general languages
- Less complex/comprehensive
    - Smaller syntex (fewer opportunities for bugs?)
    - Focussed on a particular domain
- More expressive
    - Optimized for tasks within a domain
- Both of the above mean a DSL in unlikely to be of general use outside their domain

Why use a DSL?

- Allow domain experts to develop systems
    - Express solutions in the problem domain
- Run time configurations of complex systems
    - Emacs, Stendhal
- Simplified recipe scripts
    - Build systems, installers
- Connect two or more different languages or services
    - ColdFusion Markup Language
- Generate models and services in multiple languages
    - One source multiple targets(e.g. Ruby on Rails)

DSL implementation styles

- Internal
    - Uses the syntax of a host language
        - Already have a parser and run time
    - Easier in flexible, low ceremony languages
        - Ruby, Groovy, Lisp
- External
    - Custom syntax
        - Need to write code to parse and run it
    - Typical example: XML-style configuration files
- Interpreted
    - Read the DSL script and execute it at run time
        - More natural in interpreted languages
    - Good for configuration at run time
- Code generation
    - Read the DSL script and generate code
        - In a general purpose language

        - Often C, C++, Java
    - May then also need to be compiled
- Not suitablefor run time configuration tasks