Collaborative programming: Pair programming, bug reporting, and reviews

CSE 403

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  - take turns “driving”
  - rotate pairs often
  - pair people of different experience levels

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- cons:

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- pros:
  - Can produce better code; notice problems faster
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- cons:
  - Distracting (can’t get into flow; but better documentation)
  - Can impede design work
  - Straightforward work doesn’t require two people

Bug reporting

Do your homework first

- Is there an answer in the manual or an online forum?
- Has the bug already been reported?

A bug report should include:

- environment: version number of the software, any relevant libraries, and the OS; configuration settings (e.g., environment variables)
- a recipe to reproduce the problem. Two common forms of this are:
  - command lines that can be cut-and-pasted into a command shell (preferably starting with `git clone`), or
  - a list of UI events (mouse clicks, etc.) that can be followed
- inputs (such as files) used by the commands
  - it's helpful to minimize this
- outputs (as text, not a screenshot; complete, not just a snippet)
- why you think the output is incorrect

Stick to the facts; do not make assumptions

Reviews

- **Review**: Other team member(s) read an artifact (design, specification, code) and suggest improvements
  - documentation
  - defects in program logic
  - program structure
  - coding standards & uniformity with codebase
  - enforce subjective rules
  - … everything is fair game
- Feedback → refactoring → reviews → … → approval
- Can occur before or after code is committed

Analogy: writing a newspaper article

What is the effectiveness of…

- Spell-check/grammar check
- Reviewing your own article
- Others reviewing your article

To Get Results Advertise Your Wants In the Daily Globe

The Boston Daily Globe.

Advertise Your April 19th Sales In The Daily Globe

VOL. LXXXI—NO 107. BOSTON, TUESDAY MORNING, APRIL 16, 1912—TWENTY PAGES. PRICE TWO CENTS

TITANIC SINKS, 1500 DIE

Carpathia Picks Up 675 Out of 2200---Races for New York---Survivors Mostly Women and Children.

POLICE ORDER DORR'S ARREST

Lynn Chief Accuses Him of the Murder of George E. Marsh.

Suspect Said to Have Left Boston Thursday Night--Auto Found Here.

Giant Steamer Goes Down Before Help Arrives.

Virginian or Parisian May Have Some Survivors

White Star Officials Ad... "Horrible Loss of Life".

Greatest Sea Tragedy in History Off Newfoundland Coast.

Motivation for reviews

- Can catch most bugs, design flaws early
- > 1 person has seen every piece of code
  - Insurance against author's disappearance ("bus number")
  - Accountability (both author and reviewers are accountable)
- Forcing function for documentation and code improvements
  - Authors must articulate their decisions
  - Authors participate in the discovery of flaws
  - Prospect of a review raises your quality threshold
- Inexperienced personnel get experience without hurting code quality
  - Pairing them up with experienced developers
  - Can learn by being a reviewer as well
- Bonding experience
- Explicit non-purpose:
  - Assessment of individuals for promotion, pay, ranking, etc.
  - Management is usually not permitted at reviews

Motivation by the numbers

- Average defect detection rates
  - Unit testing: 25%
  - Function testing: 35%
  - Integration testing: 45%
  - **Design and code inspections: 55% and 60%**.
- 11 programs developed by the same group of people
  - 5 without reviews: average 4.5 errors per 100 lines of code
  - 6 with reviews: average 0.82 errors per 100 lines of code
  - Errors reduced by **> 80%**.
- IBM's Orbit project: 500,000 lines, 11 levels of inspections. **Delivered early** with **1% of the predicted errors**.
- After **AT&T** introduced reviews, **14% increase in productivity** and a **90% decrease in defects**.

(From Steve McConnell's Code Complete)

Code Reviews at Google

"All code that gets submitted needs to be reviewed by at least one other person, and either the code writer or the reviewer needs to have readability in that language. Most people use Mondrian [now Critique] to do code reviews, and obviously, we spend a good chunk of our time reviewing code."

-- Amanda Camp, Software Engineer, Google

Also see: https://google.github.io/eng-practices/review/

Code reviews at Yelp

“At Yelp we use review-board. An engineer works on a branch and commits the code to their own branch. The reviewer then goes through the diff, adds inline comments on review board and sends them back. The reviews are meant to be a dialogue, so typically comment threads result from the feedback. Once the reviewer's questions and concerns are all addressed they'll click "Ship It!" and the author will merge it with the main branch for deployment the same day.”

-- Alan Fineberg, Software Engineer, Yelp

Code reviews at WotC

"At Wizards we use Perforce for SCM. I work with stuff that manages rules and content, so we try to commit changes at the granularity of one bug at a time or one card at a time. Our team is small enough that you can designate one other person on team as a code reviewer. Usually you look at code sometime that week, but it depends on priority. It's impossible to write sufficient test harnesses for the bulk of our game code, so code reviews are absolutely critical."

-- Jake Englund, Software Engineer, MtGO

Code reviews at Facebook

"At Facebook, we have an internally-developed web-based tool to aid the code review process. Once an engineer has prepared a change, she submits it to this tool, which will notify the person or people she has asked to review the change, along with others that may be interested in the change – such as people who have worked on a function that got changed.

At this point, the reviewers can make comments, ask questions, request changes, or accept the changes. If changes are requested, the submitter must submit a new version of the change to be reviewed. All versions submitted are retained, so reviewers can compare the change to the original, or just changes from the last version they reviewed. Once a change has been submitted, the engineer can merge her change into the main source tree for deployment to the site during the next weekly push, or earlier if the change warrants quicker release."

- Ryan McElroy, Software Engineer, Facebook

Logistics of the code review

- What is reviewed:
  - A document (requirements, specification, …)
  - A coherent module (sometimes called an “inspection”)
  - A single checkin or code commit (incremental review)
- Who participates:
  - One other developer
  - A group of developers
- Where:
  - Email/electronic
  - In-person meeting
    - Best to prepare beforehand: artifact is distributed in advance
    - Preparation usually identifies more defects than the meeting

Review goals

- Outcomes:
  - Only identify defects, or also brainstorm fixes?

Code review variations

- **walkthrough**: playing computer, trace values of sample data
- **group reading**: as a group, read whole artifact line-by-line
- **presentation**: author presents/explains artifact to the group
- **offline preparation**: reviewers look at artifact by themselves (possibly with no actual meeting)

Common open source approach: incremental code review

- Each small change is reviewed *before* it is committed
- No change is accepted without signoff by a "committer"
  - Assumed to know the whole codebase well
  - Sometimes committers are excepted
- Code review can (d)evolve into a design discussion
- The most common type of code review

Another approach: holistic group code review

- Review an entire component
  - Documentation is required (as is good style)
  - *No* extra overview from developer
- Each reviewer focuses where he/she sees fit
  - Mark up with lots of comments
  - Identify 5 most important issues
- At meeting, go around the table raising one issue
  - Discuss the reasons for the current design, and possible improvements
- Author addresses all issues in comments
  - Not just those raised in the meeting
- Better for discussing design, for training, for establishing norms

Human code reviews

How to Do Code Reviews Like a Human
by Michael Lynch

If you prefer text:
https://mtlynch.io/human-code-reviews-1/
If you prefer video:
https://www.youtube.com/watch?v=0t4_MfHgb_A

1. Settle style arguments with a style guide
2. Let computers do the boring parts: linters/formatters (and CI)
3. Give code examples (build trust)
4. Never say “you” (focus on the code, not the coder!); “we” = team ownership
5. Requests and questions, not commands and criticism … frame it as an in-person conversation
6. Offer sincere praise
7. Incremental improvements instead of perfection
8. Handle stalemates proactively

Software quality assurance (review)

- What are we assuring?
- Why are we assuring it?
- How do we assure it?
- How do we know we have assured it?

What are we assuring?

- Validation: building the right system?
- Verification: building the system right?

- Presence of good properties?
- Absence of bad properties?

- Identifying errors?
- Confidence in the absence of errors?

- Robust? Safe? Secure? Available? Reliable? Understandable? Modifiable? Cost-effective? Usable? …

Review checklists

May divide checks
into categories, such as:

- Coding style
- Comments
- Logic
- Error handling
- Design decisions

Sometimes, each person is asked to focus on one aspect (security, performance, previously discovered problems, etc.)

This happens in interviews too!

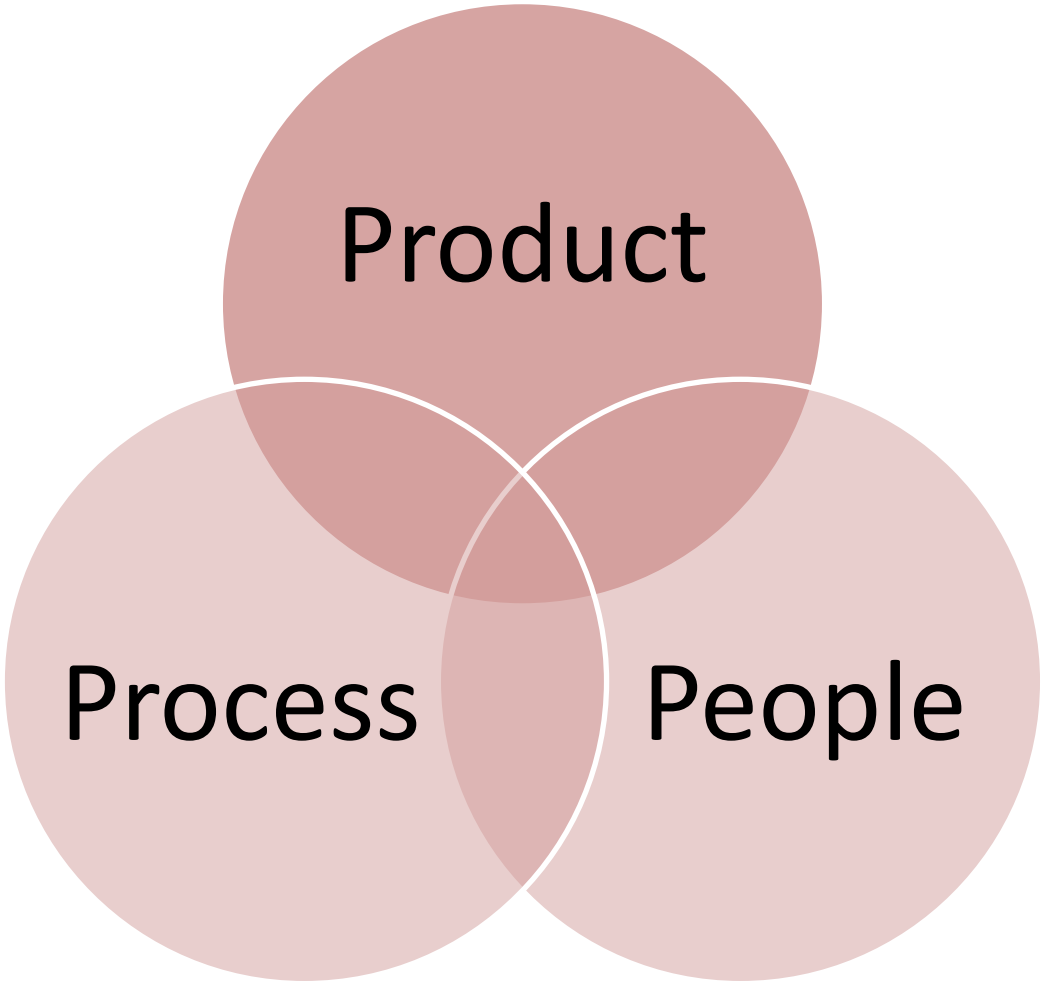
Example:
https://google.github.io/eng-practices/review/reviewer/looking-for.html

- The code is well-designed.
- The functionality is good for the users of the code.
- Any UI changes are sensible and look good.
- Any parallel programming is done safely.
- The code isn't more complex than it needs to be.
- The developer isn't implementing things they *might* need in the future but don't know they need now.
- Code has appropriate unit tests.
- Tests are well-designed.
- The developer used clear names for everything.
- Comments are clear and useful, and mostly explain *why* instead of *what*.
- Code is appropriately documented (generally in g3doc).
- The code conforms to our style guides.

Why are we assuring it?

- Business reasons
- Ethical reasons
- Professional reasons
- Personal satisfaction
- Legal reasons
- Social reasons
- Economic reasons
- …

How do we assure it?



How do we know we have assured it?

- Depends on “it”
- Depends on what we mean by “assurance”
- …

Code review exercise

What feedback would you give the author? What changes would you request before merging?

```
public class Account {
   double principal,rate;    int daysActive,accountType;

   public static final int STANDARD=0, BUDGET=1,
   PREMIUM=2, PREMIUM_PLUS=3;
}

...

public static double calculateFee(Account[] accounts)
{
   double totalFee = 0.0;
   Account account;
   for (int i=0;i<accounts.length;i++) {
      account=accounts[i];
      if ( account.accountType == Account.PREMIUM ||
           account.accountType == Account.PREMIUM_PLUS )
         totalFee += .0125 * (        // 1.25% broker's fee
             account.principal * Math.pow(account.rate,
             (account.daysActive/365.25))
             - account.principal);   // interest
   }
   return totalFee;
}
```

Possible code changes

- Comment.
- Make fields private.
- Replace magic values (e.g. 365.25) with constants.
- Use an enum for account types.
- Use consistent whitespace, line breaks, etc.

Improved code (page 1)

```
/** An individual account.  Also see CorporateAccount. */
public class Account {
   private double principal;
   /** The yearly, compounded rate (at 365.25 days per year). */
   private double rate;
   /** Days since last interest payout. */
   private int daysActive;
   private Type type;

   /** The varieties of account our bank offers. */
   public enum Type {STANDARD, BUDGET, PREMIUM, PREMIUM_PLUS}

   /** Compute interest. **/
   public double interest() {
      double years = daysActive / 365.25;
      double compoundInterest = principal * Math.pow(rate, years);
      return compoundInterest - principal;
   }

   /** Return true if this is a premium account. **/
   public boolean isPremium() {
      return accountType == Type.PREMIUM ||
             accountType == Type.PREMIUM_PLUS;
   }
```

Improved code (page 2)

```
    /** The portion of the interest that goes to the broker. **/
    public static final double BROKER_FEE_PERCENT = 0.0125;

    /** Return the sum of the broker fees for all the given
    accounts. **/
    public static double calculateFee(Account[] accounts) {
        double totalFee = 0.0;
        for (Account account : accounts) {
            if (account.isPremium()) {
                totalFee += BROKER_FEE_PERCENT * account.interest();
            }
        }
        return totalFee;
    }

}
```