Software Inspection

Administrivia

- Assignment 0 due now
- Assignment 1 due Tuesday
- Crystal help sessions (SCRG 265)
  - Friday 12:30-2
  - Monday 1:30-3
(Informal) Inspection Exercise: Find that Bug!

- Mozilla bug report handout
- Code handout
  - Read in groups of 3-5
- Let me know if or when:
  - you need to read other code (why?)
  - you have identified the problem
    - what is it?
    - what is the principle behind a fix?

Quality: testing, inspection, and analysis

1. Testing is the **most widely used** approach to manage software quality

2. Testing and inspection typically account for **more resource use** than actual design and coding

3. Testing and inspection **cannot find** all defects

4. Testing and inspection **do not create quality**. Development practices create quality

5. Choices regarding testing and inspection are influenced by quality **metrics visible to management**

6. There are **emerging assurance techniques** that complement test and inspection
Inspection – The Big Questions

1. What is inspection?
   • And what are the benefits?

2. When are inspections better than testing?
   • What kind of attributes?
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3. Are there different kinds of inspections?
   • What are the relative benefits of each?

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   • What are summary guidelines for the meetings?

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Software Inspections

1. What are software inspections (reviews)?
   • Meetings (real or virtual) during which designs and code are reviewed by people other than the original developer.

   • What are the benefits of inspections?
     • New perspective
       • Finding defects may be easier for people who haven't seen the artifact before and don't have preconceived ideas about its correctness

     • Knowledge sharing
       • Regarding designs and specific software artifacts
       • Regarding defect detection practices

     • Find flaws early
       • Can dramatically reduce cost of fixing them
       • During detail design – even before code is written
       • Or code that does not yet have a test harness
       • Or code in which testing has found flaws but root causes are not understood

     • Reduce rework and testing effort
       • Can reduce overall development effort
Inspections vs. Testing

2. What attributes are well-handled by inspections but not testing?

- “Fuzzy” non-functional properties
  - Maintainability, evolvability, reusability

- Other properties tough to test
  - Scalability, efficiency
  - Security, integrity
  - Robustness, reliability, exception handling

- Requirements, architecture, design documents
  - Cannot "execute" these as a test

Experience with inspection

- Raytheon
  - Reduced "rework" from 41% of cost to 20% of cost
  - Reduced effort to fix integration problems by 80%

- Paulk et al.: cost to fix a defect in space shuttle software
  - $3 if found in inspection
  - $13 during system test
  - $92 after delivery

- IBM
  - 1 hour of inspection saved 20 hours of testing
  - Saved 82 hours of rework if defects in released product

- IBM Santa Teresa Lab
  - 3.5 hours to find bug with inspection, 15-25 through testing

- C. Jones
  - Design/code inspections remove 50-70% of defects
  - Testing removes 35%

- R. Grady, efficiency data from HP
  - System use 0.21 defects/hour
  - Black box 0.28 defects/hour
  - White box 0.32 defects/hour
  - Reading/inspect 1.06 defects/hour

- Your mileage may vary
  - Studies give different answers
  - These results show what is possible
Kinds of Inspections

3. Are there different kinds of inspections?

Inspections / Formal Technical Reviews
- Participation defined by policy
  - Developers
  - Designated key individuals – peers, QA team, Review Board, etc.
- Advance preparation by participants
  - Typically based on checklists
- Formal meeting to discuss artifact
  - Led by moderator, not author
  - Documented process followed
  - May be virtual or conferenced
- Formal follow-up process
  - Written deliverable from review
  - Appraise product

Other review approaches
- Pass-around – preparation part of an inspection
- Peer desk check – examination by a single reviewer (like pair programming)
- Ad-hoc – informal feedback from a team member

Walkthroughs
- No advance preparation
- Author leads discussion in meeting
- No formal follow-up
- Low cost, valuable for education

There are tradeoffs among the techniques
- Formal technical reviews will find more bugs
  - Ford Motor: 50% more bugs with formal process
- But they also cost more

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**Review Roles**

4. Who are the stakeholders in inspection?

**Moderator**

- Organizes review
  - Keeps discussion on track
  - Ensures follow-up happens

- Key characteristics
  - Good facilitator
  - Knowledgeable
  - Impartial and respected
  - Can hold participants accountable and correct inappropriate behavior

- Separate role from **Recorder**
  - Who captures a log of the inspection process

**Review Roles: Reader**

**Reader** (different from author)

- Presents material
  - Provides points of comparison for author and other team members
  - Differences in interpretation provoke discussion
  - Reveals ambiguities
    - If author were to present, others might not mention that their interpretation is different

- Alternative
  - Get comments section by section
  - Faster, but does not capture differing perspectives as effectively
Review Roles: **Author**

**Author**

- Describes rationale for work
- **Not moderator or reader**
  - Conflict between objectivity required of moderator-reader and advocacy for the author’s own work
  - Others raise issues more comfortably
- **Not recorder**
  - Temptation to not write down issues the author disagrees with
- **Significant benefits to attending**
  - Gain insight from others’ perspectives
  - Can answer questions
  - Can contribute to discussion based on knowledge of artifact
  - Potential downside: meeting may be confrontational

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Process: Planning

5. How is the inspection process accomplished?

Planning
• Determine objectives
• Choose moderator
• Identify inspectors
  • Good to involve people with connection to artifact
    • e.g. depends on, interfaces with
• Schedule meeting(s)
  • General guideline: 150-200 SLOC/hour, or 3-4 pages/hour
• Prepare and distribute inspection package
  • Deliverable, supporting docs, checklists
  • Cross-reference specs, standards

Process

Overview meeting
• Informal meeting
• Goal: go over features, assumptions, background, context
• Optional stage
  • May be able to use paper overview or shared context

Preparation
• Inspectors examine deliverable
  • Defects: cause an error in the product
  • Non-defects: improvements, clarification, style, questions
    • May want to list typos/spelling/format/style separately and not discuss during the meeting
  • Conformance to standards & specification
  • Often use checklist
• General guideline
  • prep time ~ meeting time
Process: Meeting

The Meeting

- **Reader** describes one segment at a time
  - Inspectors respond: defects, questions, suggestions
- **Recorder** writes down each defect, suggestion, issue
  - This is the primary deliverable
- **Moderator**
  - Avoid problem solving, inappropriate behavior, lack of participation
  - At conclusion: prepares report with appraisal and data
- **Outcomes: Appraisal of product**
  - Accepted (minor changes, no follow up)
  - Accepted conditionally (minor changes, verification)
  - Reinspect following rework (major changes)
  - Inspection not completed
- **Outcomes: Input on improving inspection process**

- **Variant**: reviewers make comments on electronic bulletin board
  - Cost is lower
  - Lose benefits of direct meeting (face to face, telephone)
    - Synergy - new bugs found (4%? 25%?)
    - Learning by participants
    - Communication about product

Process: Rework and Follow-up

Follow-up by author

- **Author** addresses each item
  - Ensure understanding of issue
    - Is it a defect or not? Is it a feature request or requirement change?
  - Fixes defects and makes improvements
    - Uncorrected/unverified defects go into defect tracking system
- **Deliverables**
  - Corrected work product
  - Response to each issue and rationale for action
- **Moderator (or verifier) meets with author**
  - Check resolution of issues
  - Examine corrected deliverable
- **Author checks in code**
Process: Analysis

Analysis

- Causal analysis
  - Analyze root causes of defects
- Make improvements to development and QA processes
  - Add issue to checklist
  - Change testing approach
  - Develop or purchase new static analysis
- Measuring effectiveness
  - Percentage of bugs found during inspection
    - vs. found by other means or afterwards (test, customer)
- Measuring efficiency
  - “Defects per hour”
  - Will decrease as your process improves

Meetings: Review Guidelines

- Build reviews into your schedule
  - Otherwise unexpected and viewed as intrusion
  - Recognize that reviews can accelerate schedule by reducing other V&V activities
- Keep review team small
  - General guidelines: 3-7 participants
    - 3 is minimum for formal process to work
    - Below 3, too few perspectives besides author
    - Above 7, work may be slowed by process, scheduling
  - Smaller groups for code, larger groups for other documents
    - Knowledge is spread around more, more stakeholders
    - Particular for requirements
- Find problems, but don't try to solve them
  - Typically less expensive to address 1-on-1
  - Guideline: halt solution discussion after 1-3 minutes
- Limit meetings to 2 hours maximum
  - Attention span gets lost beyond this
- Require advance preparation
  - Provides much of the value of a (formal) review
Meetings: Checklists

- **Benefits**
  - Focus on likely sources of error
  - Form quality standard that aids preparers
  - Can bring up issues specific to a product

- **Should be short**
  - About seven items
  - If more, group and do multiple passes

- **Focus**
  - Priority issues
  - Issues unlikely to be found other ways
  - Historical problems
  - Issues specific to the document

- **Start with checklist from well-known source**
  - Refine based on experience

People: Social Aspects of Reviews

- **Reviews are challenging**
  - Authors invest self-worth in product
  - Encourages you to avoid letting others find errors

- **For Authors**
  - Recognize value of feedback
  - Place value in making code easy to understand
  - Don’t take criticism of code personally

- **For reviewers**
  - Don’t show off how much better/smarter you are
  - Be sensitive to colleagues
    - Bad: “you didn’t initialize this variable”
    - Good: “I didn’t see where this variable was initialized”
Review Pitfalls

- Letting reviewers lead the quality process
  - Attitude: "why fix this, the reviewers will find it"
  - Responsibility for quality is with author, not reviewers
    - Reviewers help

- Insisting on perfection/completion before review
  - Makes harder to accept suggestions for change

- Using review statistics for HR evaluation
  - Real world example:
    - Manager decides "finding more than 5 bugs during an inspection would count against the author" [Weigers '02]
  - Negative effects
    - Avoid submitting for inspection
    - Submit small pieces at a time
    - Avoid pointing out defects in reviews (thus missing them)
    - Holding "pre-reviews" that waste time and skew metrics

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What to Inspect

6. What do inspectors inspect?

- **Requirements, design documents**
  - Difficult to validate in other ways
  - May have high associated risk
  - Especially important to get right
  - Cheaper to fix earlier on in process
  - Many different perspectives are helpful
  - Need involvement of multiple stakeholders

- **Critical or uncertain pieces of code**
  - Security-critical code
  - Safety-critical code

- **Start inspections at the earliest stages of process**
  - Catch mistakes early, when easy to fix
  - Allow rest of system to be built with knowledge gained

- **Sample segments when there is a large body of work**
  - Consider what are good “coverage” criteria

End