Static Testing

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Drawbacks of Dynamic Testing

- Uncovers the bug at a later stage of SDLC
  - Costly to debug
- It is expensive and time consuming, as it needs to create, run, validate and maintain test cases.

Drawbacks of Dynamic Testing cont…

- The efficiency of code coverage decreases with the increase in size of the system.
- It provides information about the bugs-
  - It is difficult and time-consuming to trace a failure from a test case back to its root cause.
- Dynamic testing cannot detect all the potential bugs.

Static Testing

- Static testing is a complimentary to dynamic testing technique to acquire high quality software.
- Static testing techniques do not execute the software and do not require the bulk of test cases.
- Static testing reveals the errors which are not shown by dynamic testing.
- This type of testing is also known as non-computer based testing or human testing.

Static Testing cont…

- Static testing can be applied for most of the verification activities.
- They check the software product at each SDLC stage for conformance with the required specification or standards.

Static Testing cont…

- Requirements, design specifications, test plans, source code, user's manuals, maintenance procedures are some of the items that can be statically tested.
- Static testing has proved to be a cost-effective technique of error detection.
  - 60% of errors in a program can be detected

Benefits of Static Testing

- As defects are found and fixed, the quality of the product increases.
- A more technically correct base is available for each new phase of development.
- Overall software life cycle cost becomes lower.
- Effectiveness of dynamic test activity is increased & less time needs to be devoted for testing the product.
- Immediate evaluation and feedback about quality improvement is available.

Objectives of Static Testing

- To identify errors in any phase of SDLC as early as possible.
- To verify that the components of software are in conformance with its requirements.
- To provide information for project monitoring.
- To improve the software quality and increase productivity.

Types of Static Testing

- Software Inspections
- Walkthroughs
- Technical reviews

Types of Static Testing cont …

- After a module has been coded:
  - code inspection and code walk through are carried out
  - ensures that coding standards are followed
  - helps detect as many errors as possible before testing.

Types of Static Testing cont …

- Detect as many errors as possible during inspection & walkthrough:
  - detected errors require less effort for correction
    - much higher effort needed if errors were to be detected during integration or system testing.

Inspections

- Software inspections were first introduced at IBM by Fagan in the early 1970s.
- These can be used to tackle software quality problems because they allow the detection and removal of defects after each phase of SDLC.

Inspection

- Code inspection aims mainly at discovery of commonly made errors.
- During code inspection:
  - the code is examined for the presence of certain kinds of errors.

Inspection

- For instance, consider:
  - classical error of writing a procedure that modifies a formal parameter
  - while the calling routine calls the procedure with a constant actual parameter.
- It is more likely that such an error will be discovered:
  - by looking for this kind of mistakes in the code,
  - rather than by simply hand simulating execution of the procedure.

Inspection

- Good software development companies:
  - collect statistics of errors committed by their engineers
  - identify the types of errors most frequently committed.
- A list of common errors:
  - can be used during code inspection to look out for possible errors.

Commonly made errors

- Use of uninitialized variables.
- Nonterminating loops.
- Array indices out of bounds.
- Incompatible assignments.
- Improper storage allocation and deallocation.
- Actual and formal parameter mismatch in procedure calls.
- Jumps into loops.

Inspections cont…

- Inspection process is an in-process manual examination of an item to detect bugs.
- It may be applied to any product or partial product of the software development process.
- These are done in the early stages of each product development.

Inspections cont…

- This process does not require executable code or test cases
  - With inspection, bugs can be found on infrequently executed paths that are not likely to be included in test cases.
- It does not execute the code, so
  - It is machine independent
  - Requires no target system resources
  - Does not require to change program's operational behavior.

Inspections cont…

- The inspection process is carried out by a group of peers.
- The group first inspects the product at individual level.
- After this, they discuss the potential defects of the product observed in a formal meeting.

Inspections cont…

- The second important thing about inspection process is that it is a formal process of verifying a software product.
- The documents which can be inspected are SRS, SDD, Code, and test plan.

Inspections cont…

- An inspection process involves the interaction of the following elements:
  - Inspection steps,
  - Role for participants,
  - Item being inspected.

Inspections cont…

- The entry and exit criteria are used to determine whether an item is ready to be inspected.
  - Entry criteria mean that the item to be inspected is matured enough to be used.
  - Exit criterion is that once the item has been given for inspection, it should not be updated,
    - Otherwise it will not know how many bugs have been reported and corrected and the whole purpose of inspection is lost.

Inspection team

- For the inspection process, a minimum of the following four team members are required:
  - Author/Owner/Producer
    - Is a programmer or designer responsible for producing the program or documents.
    - He is also responsible for fixing defects discovered during the inspection process.

Inspection team cont…

- Inspector
  - A peer member of the team.
  - He is not directly related to the product under inspection and may be concerned with some other products.
  - He finds errors, omissions, and inconsistencies in programs and documents.

Inspection team cont…

- Moderator
  - A team member who manages the whole inspection process.
  - He schedules, leads and controls the inspection session.
  - He is the key person with the responsibility of planning and successful execution of the inspection.

Inspection team cont…

- Recorder

  Who records all the results of the inspection meeting.

Inspection process

- A general inspection process has the following stages:
  - Planning
  - Overview
  - Individual preparation
  - Inspection meeting
  - Rework
  - Follow-up

Inspection process cont…

- Planning:

  During this phase the following is executed:
  - The product to be inspected is identified.
  - A moderator is assigned
  - The objective of the inspection is stated.

Inspection process cont…

During planning the moderator performs the following activities

- Assures that the product is ready for inspection
- Selects the inspection team and assigns their roles.
- Schedules the meeting venue and time.
- Distributes the inspection materials like the item to be inspected, check lists, etc.

Inspection process cont…

- Overview:
  - The inspection team is provided with the background information for inspection.
  - The author presents the rationale for the product, its relationship to the rest of the product being developed, its function and intended use, and the approach used to develop it.
  - The opening meeting may also be called by the moderator to explain the objective of inspection to the team members

Inspection process cont…

- Individual preparation:
  - After the overview, the reviewers individually prepare themselves for the inspection.
  - They point out potential errors or problems found and record them in a log.
  - The moderator compiles the logs of different members and gives a copy to the author of the inspected team.
  - The inspector reviews the product for general problems as well as specific problems.

Inspection process cont…

- The product being inspected is also checked against standard documents to assure correctness.
- After reviewing, the inspector records the defects found and the time spent for preparation.
- Completed preparation logs are then submitted to the moderator prior to the inspection meeting.

Inspection process cont…

- The moderator reviews the logs to determine whether the team is adequately prepared.
- Moderator also checks for trouble spots and the areas of major concern that may require extra attention .
- If the team is not adequately prepared then the meeting is rescheduled.
- After this, the compiled log file is submitted to the author.

Inspection process cont…

- Inspection meeting:
  - The inspection meeting starts with the author of the inspected team.
  - Author discusses every issue raised by different members in the compiled log file.
  - They arrive at a consensus to accept the concerns as errors or not.
  - If a new error is found during the meeting then it is also recorded and discussed.

Inspection process cont…

- During the meeting effort is put only to identify the bug and not to fix them.
- The author later fixes the identified bugs.
- It is the duty of the moderator that the meeting remains focused towards its objective and the author is not discouraged in any way.
- At the end the moderator concludes the meeting and produces the summary of the inspection meeting.

Inspection process cont…

- Rework:
  - The summary list of the bugs that arise during the inspection meeting needs to be reworked by the author.
  - The author fixes all these bugs and reports back to the moderator.

Inspection process cont…

- Follow-up:
  - Moderator checks that all the bugs found have been addressed and fixed.
  - He prepares a report, the document is then approved for release.
  - If this is not the case, then the unresolved issues are mentioned in a report and another inspection meeting is called.

Benefits of Inspection process

- Bug reduction
- Bug prevention
- Productivity
- Real-time feedback to software engineers
- Reduction in development resource
- Quality improvement
- Project management
- Checking coupling and cohesion
- Learning through inspection
- Process improvement
  - Finding most error prone modules
  - Distribution of error types

Effectiveness of inspection process

- The effectiveness of the inspection process lies in the rate of inspection
- Refers to how much evaluation of an item has been done.
  - Rate is high
    - Coverage of item to be evaluated is high.
  - Rate is slow
    - Means coverage is not much.
- Rate should be considered in the perspective of detection of errors
  - Too high means less errors detected, and too slow increases the cost of project.

Effectiveness of inspection process cont…

- It may be calculated as the error detection efficiency of the inspection process, as given below:

  Error detection efficiency =

$$\frac{Errorfoundbyaninspection}{totalerror\sin theitembeforeinspection}\times 100$$

- It also depends on the experience of the team, programming language and the application domain.

Cost of Inspection

- With at least four members involved the cost of inspecting 100 lines of code is roughly equivalent to one person-day of effort.
  - Assuming that inspection takes 1 hr &
  - Each member spends1-2hrs preparation
- Testing costs are variable and depend on number of faults in the software.
- Effort required for inspection is half the effort that would be required for dynamic testing.
- It is estimated that, the cost of inspection can be 5-10%of the total cost of the project.

Thank You