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Software Quality

Part5

(Software Testing)

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Software Testing

- *Testing is the process of detecting errors by running the actual software and verifying that it works as it should*
  - *Test cases, Expected results, Actual results*
- *Testing is by far the most popular QA activity (but not the most effective)*
- *Formal technical reviews are cheaper and more effective than testing, but are often ignored*
- *Research has shown that all forms of testing combined usually find less than 60% of the errors present*
- *A typical project might expend 50% of its resources on testing*

Software Testing

- *Exhaustively testing software is not feasible*
  - *The number of possible input combinations, sequences, and timings is effectively infinite*
  - *The number of unique paths through the code is effectively infinite*
  - *You wouldn't live long enough to exhaustively test a non-trivial software system*

- *We must do partial testing because we only have enough resources (time and money) to run relatively few test cases*

- *Partial testing can never prove the absence of defects*
  - *If the system passes all your test cases, there could still be defects, you just need more or better test cases to find them*

Software Testing

- *Effective testing lies in intelligently choosing the relatively few test cases that will actually be executed*
  - *Test all requirements and features defined in the requirements spec. and functional spec.*
  - *Focus on scenarios that users are likely to encounter in practice*
  - *Test cases should not be redundant (i.e., each one should follow a different path through the code)*
  - *Analyze the program's design and code to find potential weak areas*
  - *Analyze all points at which data enters the system and look for ways to attack it*
  - *Take inspiration from defects found in previous systems*

Software Testing

- *Approaches for test case design are generally divided into two broad categories: Black Box Testing and White Box Testing*

- *Black Box Testing*
  - *The tester has limited knowledge of the inner workings of the item being tested*
  - *Test cases are based on the specification of the item's external behavior*

- *White Box Testing*
  - *The tester has knowledge of the inner workings of the item being tested*
  - *Test cases are based on the specification of the item's external behavior AND knowledge of its internal implementation*

Software Testing

- *Testing is unlike other software development activities because the goal is to break the software rather than to create it*
- *Effective testing requires the assumption that you will find defects*
- *Effective testing requires that you want to find defects*
- *If you think you won't find defects, or you don't want to, you will have set up a self-fulfilling prophecy*
- *Testing by both developers and an independent testing group are essential*
  - *They have different perspectives and motivation*
  - *They do different kinds of tests (developer does white box, test team does black box), which tend to discover different types of defects*

Software Testing

- *Defects are not evenly distributed (i.e., they tend to cluster)*
- *Research has shown that:*
  - *80% of a system's defects are found in 20% of its code*
  - *50% of a system's defects are found in 5% of its code*

- *There is a high correlation between bugs and complex code.*
  - *Use tools to measure code complexity, and focus testing on those modules with the most complex code*
- *One goal of testing is to identify the most problematic modules*
  - *Redesign may be needed if there is an inherent design flaw*
  - *Replace buggy module with a third-party product*

Software Testing

- *How many defects should you expect to find?*
  - *It depends on your development process*
  - *Most projects experience between 1 and 25 errors per 1000 LOC*
  - *The Applications Division at Microsoft reports 10 to 20 errors per 1000 LOC, with 0.5 errors per 1000 LOC in released products*

Software Testing

- *Automation of test cases is essential to make frequent re-running of test cases feasible*
- *A lot of the interesting testing work is found in inventing and creating ways to automate test cases (i.e., create programs whose purpose is to test other programs)*
- *Automation requires a lot of software design and implementation (sometimes called "Test Engineering")*
- *Some tests are difficult to automate and have to be run manually*