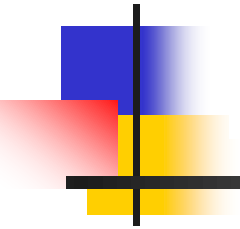
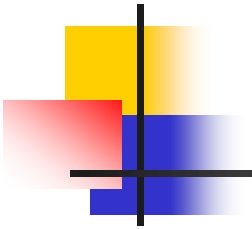
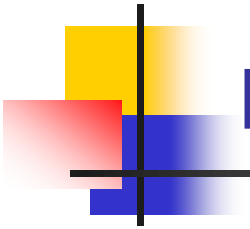


Software Project Management

Software Quality Management

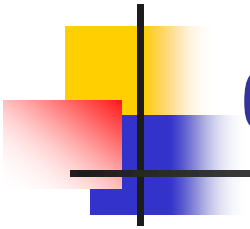


- Software quality assurance (SQA)
- Mark C. Paulk et al. , ISO 9001



Basic Concepts

- What is quality?
  - IEEE Glossary: Degree to which a system, component, or process meets (1) specified requirements, and (2) customer or user needs or expectations
  - ISO: the totality of features and characteristics of a product or service that bear on its ability to satisfy specified or implied needs



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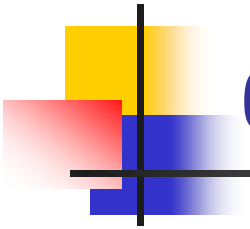
- An alternate view of Quality:
  - has aspects that are not easy to measure
  - is not absolute
  - assessment is subject to constraints (e.g., cost)
  - is about acceptable compromises
  - criteria are not independent, can conflict
- Quality Criteria include
  - Correctness , efficiency, flexibility, integrity, interoperability, maintainability, portability, reliability, reusability, testability, usability

Cost of Quality

- Cost of quality includes all costs incurred in the pursuit of quality or perform quality related work
- Quality cost includes:
  - Prevention cost - arise from efforts to keep defects from occurring at all
    - Quality planning
    - Investment in quality related information system
    - testing equipment
    - Quality training and workforce development



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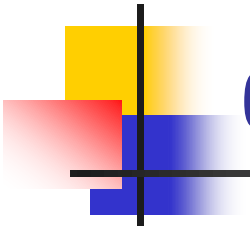
- Appraisal Cost - arise from detecting defects via inspection, test, audit
  - in-process and inter-process inspection
  - equipment calibration and maintenance
  - Test and inspection of purchased materials
  - Inspection
  - Testing
  - Quality audits



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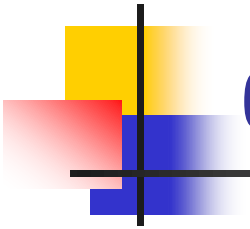
- Failure cost:
  - Internal failure cost - arise from defects caught internally and dealt with by discarding or repairing the defective items
    - rework, repair, and failure mode analysis
  - External failure cost – arise from defects that actually reach customers
    - complaint resolution, product return and replacement, help line support, warranty work



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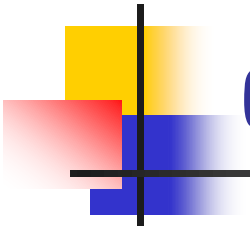
- Software Quality Assurance (SQA)
  - Consists of a means of monitoring the software engineering processes and methods used to ensure quality.
  - It does this by means of audits of the quality management system under which the software system is created.
  - These audits are backed by one or more standards, usually ISO 9000 or CMMI.
- It is practically impossible to iron out every single bug before releasing it both from a difficulty point of view and due to time constraints.

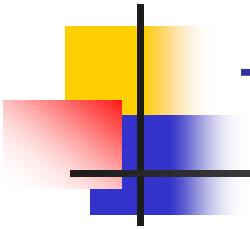


Quality Assurance (QA)

- Measures the quality of processes used to create a quality product
  - A set of activities designed to ensure that the development and/or maintenance process is adequate to ensure a system will meet its objectives.
  - QA activities ensure that the process is defined and appropriate.
  - Methodology and standards development are examples of QA activities.
  - A QA review would focus on the process elements of a project

Quality Control (QC)

- Measures the quality of a product
  - A set of activities (inspections, reviews, and test) designed to evaluate a developed work product.
  - QC activities focus on finding defects in specific deliverables
- Two types of quality control:
  - Quality design - the characteristics that designers specify for an item.
    - includes: requirements, specifications, and the design of the system.
  - Quality of conformance - the degree to which the design specification are followed.
    - It focuses on implementation based on the design.
- Generally, QC compare the work products with the specified and measurable standards



Testing

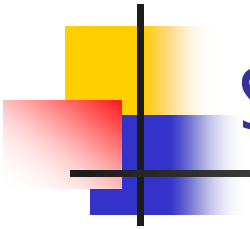
- Testing - Quality control
  - The process of executing a system with the intent of finding defects.
  - includes test planning prior to the execution of the test cases.
  - Testing is one example of a QC activity, but there are others such as inspections.

Quality Assurance Vs. Quality Control

- Both QA and QC activities are generally required for successful software development
- Software quality control is a control of products
- Software quality assurance is a control of processes
  - Related to the practice of quality assurance in product manufacturing
- Software vs. manufactured product
  - Manufactured product is physical and can be seen, Software product is not visible
  - Manufactured product rolls off the assembly line, it is essentially a complete, finished product , Software is never finished
- The processes and methods to manage, monitor, and measure software ongoing quality are as fluid and sometimes elusive as are the defects that they are meant to keep in check

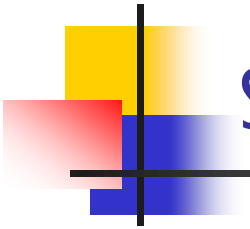
Software Quality Assurance Jobs

- includes:
  - Reviewing requirements documents
  - Software testing
- It also encompasses the entire software development process
  - Software design
  - Coding
  - Source code control
  - Code reviews
  - Change management
  - Configuration management , Release management.



Software Quality Assurance Jobs

- SQA encompasses:
  - a quality management approach
  - effective software engineering technology
  - formal technical reviews
  - a multi-tiered testing strategy
  - document change control
  - software development standard and its control procedure
  - measurement and reporting mechanism

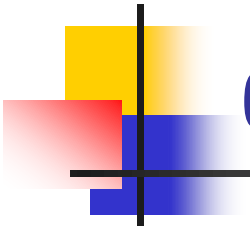


Software Quality Assurance Methodology

- PPQA audits:
  - Process and Product Quality Assurance
  - the activity of ensuring that the process and work product conform to the agreed upon process.

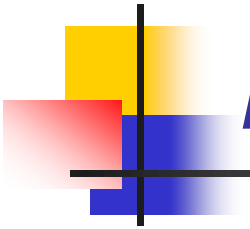
Quality Control Activities

- Peer Reviews:
  - Peer reviews of a project's work products are the most efficient defect removal (quality control) activity.
- Validation testing
  - the act of entering data that the tester knows to be erroneous into an application.
    - Example, typing "Hello" into an edit box that is expecting to receive a numeric entry.
- Data comparison
  - Comparing the output of an application with specific parameters to a previously created set of data with the same parameters that is known to be accurate.



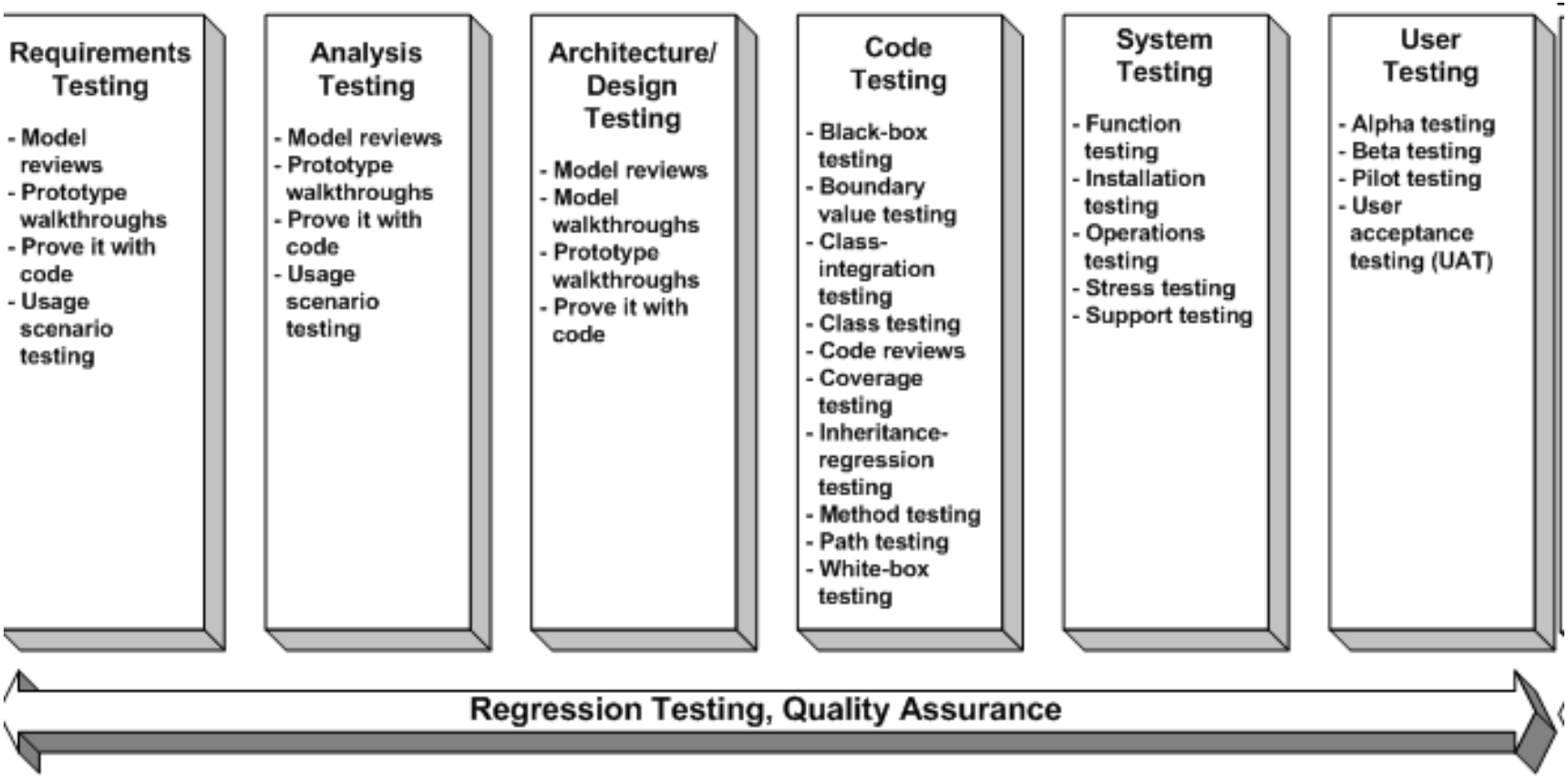
Cont…

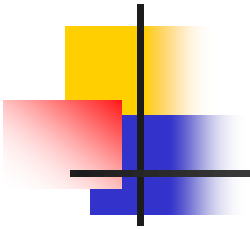
- Stress testing:
  - A stress test is when the software is used as heavily as possible for a period of time to see whether it copes with high levels of load.
  - Often used for server software that will have multiple users connected to it simultaneously.
  - Also known as Destruction testing.
- Usability testing
  - Sometimes getting users who are unfamiliar with the software to try it for a while and offer feedback to the developers about what they found difficult to do is the best way of making improvements to a user interface



Advantages Software Quality Assurance

- Improved customer satisfaction
- Reduced cost of development
- Reduced cost of maintenance





Testing lifecycle and phases

- Test Requirements
- Test Planning
- Test Environment Setup
- Test Design
- Test Automation
- Test Execution and Defect Tracking
- Test Reports and Acceptance

Cont…

Test Requirements

- Requirement Specification documents
- Functional Specification documents
- Design Specification documents (use cases, etc)
- Use case Documents
- Test Trace-ability Matrix for identifying Test Coverage

Test Planning

- Test Scope, Test Environment
- Different Test phase and Test Methodologies
- Manual and Automation Testing
- Defect Mgmt, Configuration Mgmt, Risk Mgmt. Etc
- Evaluation & identification – Test, Defect tracking tools

Test Environment Setup

- Test Bed installation and configuration
- Network connectivity's
- All the Software/ tools Installation and configuration
- Coordination with Vendors and others

Cont…

Test Design

- Test Traceability Matrix and Test coverage
- Test Scenarios Identification & Test Case preparation
- Test data and Test scripts preparation
- Test case reviews and Approval
- Base lining under Configuration Management

Test Automation

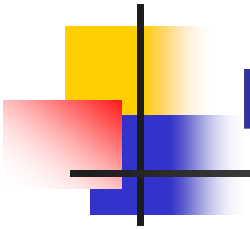
- Automation requirement identification
- Tool Evaluation and Identification.
- Designing or identifying Framework and scripting
- Script Integration, Review and Approval
- Base lining under Configuration Management

Test Execution and Defect Tracking

- Executing Test cases
- Testing Test Scripts
- Capture, review and analyze Test Results
- Raised the defects and tracking for its closure

Test Reports and Acceptance

- Test summary reports
- Test Metrics and process Improvements made
- Build release
- Receiving acceptance

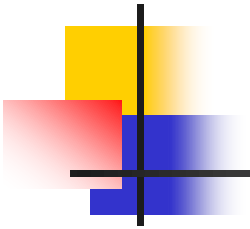


Positive and Negative Testing

- Positive testing:
  - Doing something it was supposed to do
- Negative testing:
  - Doing something it was not supposed to do
  - The simple testing the application beyond and below of its limits
  - Examples: the password where it should be minimum of 8 characters so testing it using 6 characters is negative testing

Capability Maturity Model - CMM

- A model of the maturity of the capability of certain business processes.
  - A maturity model can be described as a structured collection of elements that describe certain aspects of maturity in an organization
  - Aids in the definition and understanding of an organization's processes
- Level 1 - Ad hoc (Chaotic)
  - Are (typically) undocumented and in a state of dynamic change, tending to be driven in an ad hoc, uncontrolled and reactive manner by users or events
- Level 2 – Repeatable
  - Some processes are repeatable, possibly with consistent results.



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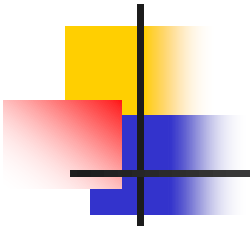
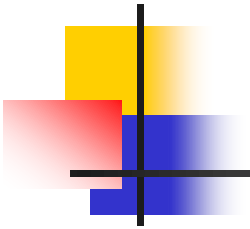
- Level 3 - Defined
  - Sets of defined and documented standard processes established and subject to some degree of improvement over time.
- Level 4 - Managed
  - Using process metrics, management can effectively control the AS-IS process (e.g., for software development)
- Level 5 - Optimized
  - The focus is on continually improving process performance through both incremental and innovative technological changes/improvements.



Test case methodologies

- Testing Methodologies are different from Test case Methodologies
- Decision Tables
  - like if-then-else and switch-case statements, associate conditions with actions to perform
- Cause Effect Graphs,
  - a directed graph that maps a set of causes to a set of effects. The causes may be thought of as the input to the program, and the effects may be thought of as the output.



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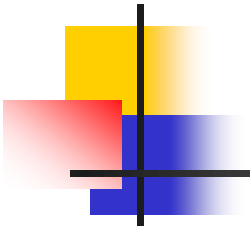
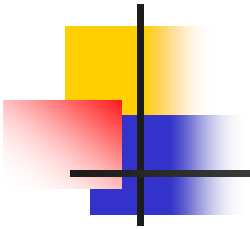
- Equivalence Class Partitioning ECP
  - Approach divides the input domain of a software to be tested into the finite number of partitions or equivalence classes.
  - This method can be used to partition the output domain as well, but it is not commonly used
- Boundary value testing BVA
  - find whether the application is accepting the expected range of values and rejecting the values which falls out of range
- Error Guessing
  - design technique based on the ability of the tester to draw on his past experience, knowledge and intuition to predict where bugs will be found in the software under test



Verification Vs. Validation

- The process of checking that a product, service, or system meets specifications and that it fulfils its intended purpose
- Validation - Are you building the right thing?
  - The process of establishing documented evidence that provides a high degree of assurance that a product, service, or system accomplishes its intended requirements.
  - This often involves acceptance and suitability with external customers
  - High level activity: correctness of the final software product



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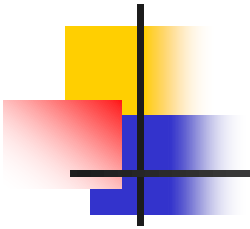
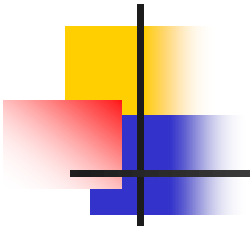
- Verification - Are you building the thing right?
  - A quality process that is used to evaluate whether or not a product, service, or system complies with a regulation, specification, or conditions imposed at the start of a development phase.
  - Verification can be in development, scale-up, or production.
  - This is often an internal process
  - Low level activity: consistency, completeness, and correctness of the software at each stage



Black / white / Gray box testing

- Gray-box
  - Test designed based on the knowledge of algorithm, internal states, architectures, or other high-level descriptions of the program behavior
  - involves having access to internal data structures and algorithms for purposes of designing the test cases, but testing at the user, or black-box level.
  - Is particularly important when conducting integration testing between two modules of code written by two different developers
- White box testing
  - Uses an internal perspective of the system to design test cases based on internal structure.



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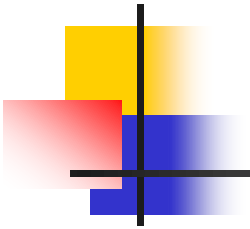
- It requires programming skills to identify all paths through the software.
- Applicable at the unit, integration and system levels of the software testing process

- Black box testing
  - An external perspective of the test object to derive test cases.
  - These tests can be functional or non-functional.
  - The test designer selects valid and invalid input and determines the correct output.
  - There is no knowledge of the test object's internal structure

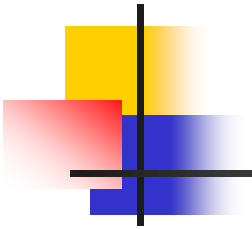
Non Functional Software Testing

- Performance testing
  - checks to see if the software can handle large quantities of data or users.
  - This is generally referred to as software scalability.
- Usability testing
  - needed to check if the user interface is easy to use and understand.
- Security testing
  - essential for software which processes confidential data and to prevent system intrusion by hackers.
- Internationalization and localization
  - needed to test these aspects of software, for which a pseudolocalization method can be used



Regression testing

- After modifying software, either for a change in functionality or to fix defects, a regression test re-runs previously passing tests on the modified software to ensure that the modifications haven't unintentionally caused a *regression* of previous functionality.
- Regression testing can be performed at any or all of the above test levels.
- These regression tests are often automated.
  - More specific forms of regression testing are known as sanity testing, when quickly checking for bizarre behavior, and smoke testing when testing for basic functionality.
  - Benchmarks may be employed during regression testing to ensure that the performance of the newly modified software will be at least as acceptable as the earlier version or, in the case of code optimization, that some real improvement has been achieved.

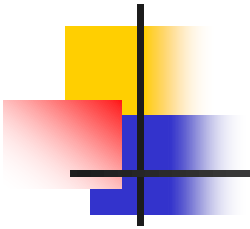


System Testing

- Software or hardware is testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements
- Black box testing
- To detect any inconsistencies
  - between the software units that are integrated together (called assemblages)
  - between any of the assemblages and the hardware

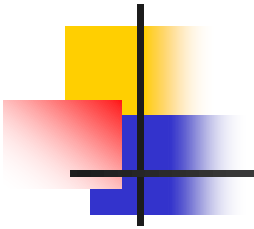
Test strategy Vs. Test plan

- Test strategy
  - a company level document and which says the approach for testing.
  - The test strategy doc also says that the scope, business issues, test deliverables, tools used, risk analysis etc,
- Test plan
  - document which says what to test, when to test ,how to test and who to test.
  - the test plan document was prepared by the test lead



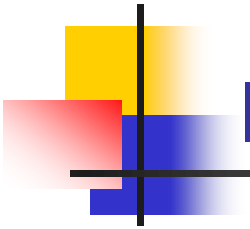
Automated Testing

- The use of software to control the execution of tests, the comparison of actual outcomes to predicted outcomes, the setting up of test preconditions, and other test control and test reporting functions



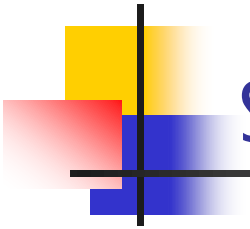
IEEE 829

- 829 Standard for Software Test Documentation
  - a set of documents for use in eight defined stages of software testing, each stage potentially producing its own separate type of document
  - Test Plan: a management planning document
  - Test Design Specification
  - Test Case Specification
  - Test Procedure Specification
  - Test Item Transmittal Report
  - Test Log
  - Test Incident Report
  - Test Summary Report



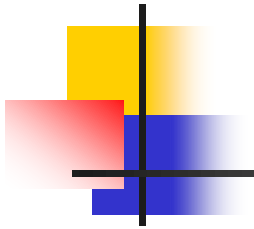
ISO 9003

- A quality assurance model for final inspections and testing

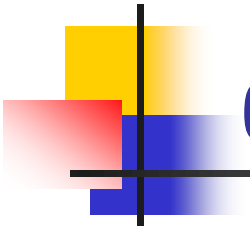


Software walkthrough

- a form of software peer review
  - A designer or programmer leads members of the development team and other interested parties through a software product
  - And the participants ask questions and make comments about possible errors, violation of development standards, and other problems

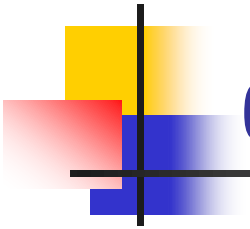


- Quality Assurance and Process Improvement



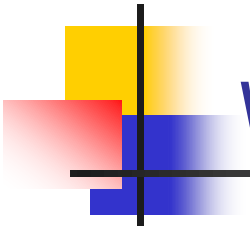
Change Management

- the process of requesting, determining attainability, planning, implementing and evaluation of changes to a system
- Changes in the IT infrastructure may arise reactively in response to problems or externally imposed requirements



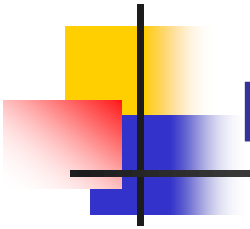
Configuration Management

- a field of management that focuses on establishing and maintaining consistency of a product's performance and its functional and physical attributes with its requirements, design, and operational information throughout its life
  - Configuration identification
  - Configuration control
  - Configuration status accounting
  - Configuration authentication



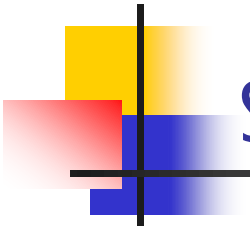
Version Control

- The management of multiple revisions of the same unit of information
  - application source code



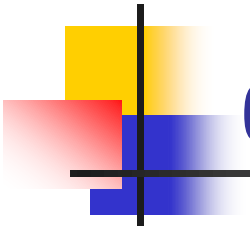
Defect Tracking

- the process of finding defects in a product (by inspection, testing, or recording feedback from customers), and making new versions of the product that fix the defects.



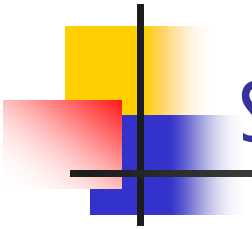
SQA Group

- Who involves quality assurance activities?
  - Software engineers, project managers, customers, sale people, SQA group
- Engineers involved the quality assurance work:
  - apply technical methods and measures
  - conduct formal technical review
  - perform well-planned software testing
- The SQA group's role
  - serves as the customer's in-house representative
  - assist the software engineering team in achieving high-quality



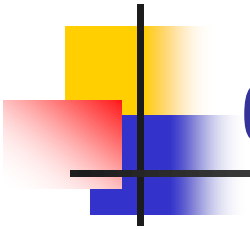
Cont…

- The SQA group's responsibility:
  - quality assurance planning oversight, record keeping, analysis and reporting
- The SQA group's tasks:
  - Prepare a SQA plan for a project
  - Participate in the development of the project's software process description
  - Review engineering activities to verify compliance with the defined process
  - Audits designated software work products to verify compliance the defined process
  - Ensure the deviations in software work and products according to a documented procedure
  - Records any noncompliance and reports to senior management



SQA plan

- The SQA plan provides a road map for instituting software quality assurance.
- Below presents an outline for SQA plans by IEEE [IEEE94].
- Basic items:
  - purpose of plan and its scope
  - management
    - organization structure, SQA tasks, their placement in the process
    - roles and responsibilities related to product quality
  - Documentation
    - project documents, models, technical documents, user documents.



Cont…

- standards, practices, and conventions
- reviews and audits
- test -
  - test plan and procedure
- problem reporting, and correction actions
- Tools
- code control
- media control
- supplier control
- records collection, maintenance, and retention
- Training
- risk management