A Taxonomy of Testing Types
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A Taxonomy of Testing Types

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Topics

Relevant Testing Challenges
Goals of Presentation
What is Testing?
Presentation Scope
Testing Types
Conclusion
Relevant Testing Challenges
Relevant Testing Challenges

Many testers are only aware of a minority of types of testing, let alone know how to perform them.
Test managers and developers are aware of even fewer testing types.
The test strategies, project test plans, and test sections of system/software development plans tend to identify only a very small number of types of testing (e.g., unit, integration, system, and acceptance testing).
• Not planned → Not performed
Goals of the Presentation
Goals of the Presentation

Make it clear that:

- There are *many* different types of testing.
- Testing is a complex discipline with its own technical jargon.
- There is a lot of overlap between different classes of testing types.
  - Think multiple classification (object-oriented design)
    or multiple inheritance (object-oriented programming).

Get you to take a look at your:

- Test strategies and test plans and ask yourselves “Are they sufficiently complete?”
- Testers and other testing stakeholders and ask yourselves “Do they need additional training in testing types.”
Polling Question 1

How many different types of testing do you typically use on a project?

O 1-5
O 6-10
O 11-15
O 16+
What is Testing?
What is Testing?

Testing

The **execution** of an Object Under Test (OUT) under specific **preconditions** with specific **stimuli** so that its **actual behavior** can be compared with its **expected or required behavior**

- **Preconditions**: pretest mode, states, stored data, or external conditions
- **Stimuli**:
  - Calls, commands, and messages (control flows)
  - Data inputs (data flows)
  - Trigger events such as state changes and temporal events
- **Actual Behavior**:
  - **During Test**:
    - Calls, commands, and messages (control flows)
    - Data outputs (data flows)
  - **Postconditions**: post-test mode, states, stored data, or external conditions
Presentation Scope
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Presentation Scope

Verification and Validation (V&V) Methods
Quality Control (QC)

Legend

[Diagram showing various testing methods:
- Test
- Evaluation
- Analysis
- Demonstration
- "Inspection"
- Certification
- Reuse
- Warantee
- Static
- Dynamic]

In Scope

T&E

Static Analysis
Dynamic Analysis
Desk Checking
Inspection
Review
Walk-Through
Peer Review
Formal Review
The Taxonomy of Testing Types
Types of Testing

A type of testing is:
- A specific way to perform testing
- A class or subclass of testing
- Much narrower in scope than a testing paradigm

There are relationships between the various types of testing.

Most testers know:
- A lot about a few types of testing
- A little about some additional types of testing
- Very little about a sizable number of testing types
Polling Question 2

Have you ever seen a taxonomy of testing types (i.e., a hierarchical categorization of different ways to test)?

O Yes
O No
O Not Sure
Types of Testing

16 Categories of Testing Types
Answering the 5W+2H Questions:

- What?
- When?
- Where?
- Who?
- Why?
- How?
- How Well?

These supertypes are not disjoint (think multiple inheritance)!
Types of Testing

WHAT is Tested
What: by Object Under Test (OUT)

- What-Based Testing
  - OUT-Based Testing
    - Model Testing
    - Hardware Testing
    - Software Testing
    - System Testing
    - Data Center Testing
    - Tool/Environment Testing
What: by Object Under Test (OUT) – Model Testing

- Testing
  - What-Based Testing
    - OUT-Based Testing
    - Model Testing
      - Requirements Model Testing
      - Architecture Model Testing
      - Design Model Testing
What: by Object Under Test (OUT) – Hardware Testing

- Hardware Testing
  - Continuity Testing
  - Hardware Stress Testing
  - Highly Accelerated Life Testing (HALT)
  - HW Qualification Testing
  - Power-off Testing
What: by Object Under Test (OUT) – Software Testing

Testing

What-Based Testing

OUT-Based Testing

Software Testing

SW Unit [Component] Testing
SW Integration Testing
SW Application Testing
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What: by Object Under Test (OUT) – System Testing

OUT-Based Testing

- Subsystem Testing
- System Integration Testing
- System Testing
- SoS Integration Testing
- SoS Testing

System Testing

Hardware-in-the-Loop (HIL) Testing
- Human-in-the-Loop (HIL) Testing
- Processor-in-the-Loop (PIL) Testing
- Software-in-the-Loop (SIL) Testing
What: by Object Under Test (OUT) – Data Center Testing

- Testing
  - What-Based Testing
    - OUT-Based Testing
      - Data Center Testing
        - Configuration Testing
        - Failover and Restore Testing
        - Integrated System Testing (IST)
        - Network Traffic Testing
What: by Object Under Test (OUT) – Tool / Environment Testing

- What-Based Testing
  - OUT-Based Testing
    - Tool/Environment Testing
      - Development Tool Testing
      - Development Environment Testing
      - Test Tool Testing
      - Test Environment Testing
What: by Domain

Domain-Based Testing

Domain-Independent Testing

- Many Types of Domain-Independent Testing

Domain-Specific Testing

- Crash Testing
- Exhaust Emissions Testing
- Flight Testing
- Live Fire Testing
- Sea Trials
- Wind Tunnel Testing
Types of Testing

WHEN Testing Occurs
When: by Temporal Order

[Diagram showing the hierarchy of testing types]

- Testing
  - When-Based Testing
    - Order-Based Testing
      - Order-By-Direction Testing
        - Bottom-Up Testing
        - Top-Down Testing
        - Outside-In Testing
      - Order-By-Component Testing
        - Feature-Based Testing
        - Layer-Based Testing
        - Subsystem-Based Testing
When: by Lifecycle

Testing

When-Based Testing

Lifecycle-Based Testing

Waterfall Testing

Incremental Testing

Continuous Testing (CT)

At-The-End Testing

V-Model Testing

Agile Testing

DevOps Testing
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When: by Phase

Beware of Synonyms and Almost Synonyms!
When: by BIT Execution Time

Built-In Testing (BIT)

- Power-Up Built-In Testing (PupBIT)
- Interrupt-driven Built-In Testing (IBIT)
- User-initiated Built-In Testing (UBIT)

Ongoing Built-In Testing (OBIT)

- Self-Testing via Assertion Checking
- Self-Testing via Prognostics and Health Management (PHM) Subsystem
- Self-Testing via Heartbeat

Periodic Built-In Testing (PBIT)

Shutdown Built-In Testing (SBIT)
Types of Testing

WHY Testing is Being Performed
Why: by Driver

Testing

Why-Based Testing

Driver-Based Testing

Regulatory-Compliance Testing (tests compliance)
- Validates
- System Complies with Laws or Regulations

Needs-Driven Testing (tests why)
- Verifies
- System Meets Stakeholder Needs

Requirements-Driven Testing (tests what + how-well)
- Verifies
- System Meets System Requirements

Architecture-Driven Testing (tests how)
- Verifies
- System Conforms to Architecture

Design-Driven Testing (tests how)
- Verifies
- System Conforms to Design

System Meets System Requirements

System Conforms to Architecture

System Conforms to Design

System Complies with Laws or Regulations

System Meets Stakeholder Needs

System Meets System Requirements

System Conforms to Architecture

System Conforms to Design
Why: by Reason

Testing

Why-Based Testing

Reason-Based Testing

- Smoke Testing
  - COTS Testing
- Reuse Testing
  - Open Source Testing
- Initial Testing
- Retesting
  - Legacy Testing
  - Partial Regression Testing
- Regression Testing
- Error Seeding
  - Complete Regression Testing
Types of Testing

WHO Performs Testing
Who: by Collaboration

Who-Based Testing

Collaboration-Based Testing

Individual Testing

Group Testing

Buddy Testing

Flash Mob Testing

Pair Testing
Who: by Organization

Who-Based Testing

Organization-Based Testing

- Development Organization Testing
  - Prime Contractor Testing
  - Subcontractor Testing
- Acquisition Organization Testing
  - COTS Vendor Testing
- Independent Test Organization Testing
  - DT Organization Testing
- Operations Organization Testing
  - OT Organization Testing
- User Organization Testing
Polling Question 3

Who performs testing on your projects? Check all that apply.

☐ Project-internal Testers
☐ Independent Testers
☐ Developers
☐ Specialty Engineers (e.g., performance, reliability, safety, security, human factors)
☐ Quality Engineers
☐ Others
Who: by Role

Role-Based Testing

Who-Based Testing

Testing

Developer Testing
- Requirements Engineer Testing
- Architect Testing
- Programmer Testing
- Human Factors Engineer Testing
- Safety Engineer Testing
- Security Engineer Testing

Tester Testing
- Alpha Tester Testing
- Embedded Tester Testing
- Independent Tester Testing

Operator Testing
- Buddy Testing
- Pair Testing

User Testing
- Database Admin Testing
- Network Admin Testing
- Sys Admin Testing

User as Tester
- Closed Beta Testing
- Open Beta Testing

Developer Testing

Tester Testing

Operator Testing

User Testing
Types of Testing

WHERE Testing is Performed
Where: by Organizational Location

Testing

Where-Based Testing

Organizational-Location-Based Testing

Insourced Testing

Outsourced Testing
Where: by Physical Location

Where-Based Testing

Physical-Location-Based Testing

Cloud Testing  Distributed Testing  Local Testing
Types of Testing

HOW Testing is Performed
How: by Level of Automation

- Manual Testing
  - Test Script Generation
  - Test Data Generation
  - Test Script Execution
  - Test Report Generation

- Automated Testing
  - Test Script Generation
  - Test Data Generation
  - Test Script Execution
  - Test Report Generation

- Record-Playback Testing
- Script-Based Testing
- Data-Driven Testing
- Action-Keyword Testing
- Model-Based Testing
How: by Level of Scripting

Testing → How-Based Testing

Level-of-Scripting-Based Testing

Scripted Testing

Unscripted Testing

Exploratory Testing

Monkey Testing
How: by Technique

- Blackbox Testing
- Graybox Testing
- Whitebox Testing
- Patterns-Based Testing
- Experience-Based Testing
- Random Testing (Cat on the Keyboard)
How: by Technique

- Blackbox Testing

Relevance

Test-Technique-Based Testing

Blackbox Testing

- Cause and Effect Testing
- Combinatorial Testing
- End-to-End Testing
- Requirements Testing
- Scenario Testing
- Syntax Testing
- Classification Tree Testing
- Decision Table Testing
- Manual Procedure Testing
- Risk-Based Testing
- State-Based Testing
- User Interface Navigation Testing
How: by Technique
- Graybox Testing

Test-Technique-Based Testing

Graybox Testing

- Boundary Value Testing
- Equivalence Class Testing
How: by Technique
- Whitebox Testing
How: by Technique - Experience-Based Testing

- Experience-Based Testing
  - Bug Hunt Testing
  - Error Guessing Testing
  - Exploratory Testing
  - Galumphing

Test-Technique-Based Testing

How-Based Testing

Testing
How: by Technique
- Random Testing

Test-Technique-Based Testing

Random Testing
(Cat on the Keyboard)

- Fuzz Testing
- Monkey Testing
- Shoe Testing
- Stuck Key Testing
Types of Testing

HOW WELL Object Under Test Functions
How Well: by Quality Characteristic

Based on the associated quality characteristic and its associated quality attributes:
- Uncover related defects
- Determine level of quality
How Well: by Quality – Capacity Testing

- Load Testing
- Stress Testing
- Volume Testing
How Well: by Quality
– Reliability Testing

Testing

How-Well-Based Testing

Quality-Characteristic-Based Testing

Reliability Testing

Endurance (Stability) Testing

Reliability Enhancement Testing

Reliability Growth Testing

Reliability Mechanism Testing
How Well: by Quality – Robustness Testing

Robustness Testing

Error Tolerance Testing
Fault Tolerance Testing
Failure Tolerance Testing
Environmental Tolerance Testing

Quality-Characteristic-Based Testing

How-Well-Based Testing

Communication Error Testing
Hardware Error Testing
Human Error Testing
Software Error Testing
System Error Testing
Fault Injection Testing
Failover and Recovery Testing

Environmental Tolerance Testing

Acceleration Tolerance Testing
Acoustic Tolerance Testing
Electromagnetic Compatibility (EMC) Tolerance Testing
Pressure/Leakage Tolerance Testing
Radiation Tolerance Testing
Shock/Drop Tolerance Testing
Temperature Tolerance Testing
Vacuum Tolerance Testing

Pressure Cycling Tolerance Testing
Temperature Cycling Tolerance Testing
How Well: by Quality – Security Testing
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Conclusion
Conclusion

Most systems require quite a few different types of testing. Most testers are not aware of the majority of the different types of testing.

- If you are not aware that it exists, then you don’t know whether you need it.

These types of testing can be organized into a taxonomy by the 5W + 2H questions. This taxonomy has several uses:

- Ensure the test strategy is sufficiently complete with no important type of testing overlooked.
- Organize testing types to make them and their relationships more understandable.
- Augment test training materials.
- Help categorize and understand limitations of testing tools.