Testing Software Quality Characteristics – Part 2

Reliability Testing

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Objective

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Apply operational profile testing to assess software reliability

Reliability Definition (from John Musa)

- “The probability that a system or a capability functions without failure for a specified time or number of natural units in a specified environment"

- Natural units correspond to the processing performed such as the number of calls or transactions completed (e.g. one transaction lost per 50,000)

- Probabilities have a range of 0 to 1

Availability Definition from John Musa

> “The probability at any given time that a system or capability of a system functions satisfactorily in a specified environment"

Software Availability Calculation

- **Availability can also be performed as the percent of time the system performs satisfactorily**

$$\text{availability} = \frac{\text{MTTF}}{\text{MTTF} + \text{MTTR}} \times 100\%$$

5NINES Availability Requirement

- **The system shall be available 99.999% of the time, i.e. the probability the system functions satisfactorily at any point in time is 99.999**

- **In terms of service to a customer over a year, this translates into approximately 5 minutes of allowable down time per year**
  - There are 525,600 minutes per year
  - 5NINES implies one minute of down time per 100,000 minutes

Achieving High Reliability and Availability

Achieving high reliability and availability in a cost effective manner requires the prudent application of Software Reliability Engineering techniques

Appropriate development techniques must be applied for:

- Fault prevention
- Fault tolerance

Achieving High Reliability and Availability (cont'd)

Appropriate testing techniques must be applied along with models for assessing whether reliability and availability objectives are being met.

- Operational profile testing
- Error detection and recovery testing
- Serviceability testing

Introduction to Operational Profiles

- An operational profile describes how users utilize a product
- An operational profile consists of a set of major functions performed by the system and their occurrence probabilities
- An operational profile is essential for reliability prediction

Basic Operational Profile Construction Steps

1. **Identify the major functions performed by the system**
   - Identify different types of users / external entities
   - Use-cases are good candidates for basing the operational profile
2. **Identify the occurrence rates**
   - Historical data
   - Marketing
3. **Calculate the occurrence probability**

ATM Example

Use-Cases	Occurrence Rate (xact / hr)	Occurrence Probability
Deposit	95	0.095
Withdraw	900	0.9
Transfer	5	0.005

Development of Tests

- Tests are developed based on the operational profile
- Test generation is modified to incorporate critical functions with low occurrence probabilities
- Number of tests to execute is based on the reliability objectives

Interpreting Failure Data

Development Testing

- Goal: To remove faults that have causes failures

Certification Testing

- Goal: To determine whether a software component or system should be accepted or rejected

Other Uses of Operational Profiles

Operational profiles may also be used to:

- Guide development priorities
- Assist in performance analysis

Summary