Software Testing and Reliability

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Lecture 12

Quiz on May 21

Reliability

Definition of Software Reliability

J. D. Musa, A. Iannino and K. Okumoto:

“It is the probability of failure-free operation of a computer program for a specified time in a specified environment.”

Example: A system has a reliability of 0.96 for 12 hours when used by the average user.

Levels of Failure Severity

US Military Standard

(1) Minor – not causing injury

(2) Marginal – minor injury, mission degradation

(3) Critical – severe injury, mission loss

(4) Catastrophic – death

Basic Definitions

- MTTF – mean time to failure
- MTTR – mean time to repair
- MTBF – mean time between failures

$$MTBF = MTTF + MTTR$$

Failure Occurrences

- Time of failure
- Time interval between failures
- Cumulative failures experienced up to a give time
- Failures experienced in a time interval

Example

- Suppose failures occur at the following times (in seconds):

  11, 17, 22, 39, 51, 66, 78, 93, 123, 145, 167, 196,

  234, 265, 293, 303, 335, 389, …

Time-Based Failure Specification

11, 17, 22, 39, 51, 66, 78, 93, 123, 145, 167, 196, 234, 265, 293, 303, 335, 389, …

Failure Number	1	2	3	4	5	6	7	8	9
Failure Time (in sec)	11	17	22	39	51	66	78	93	123
Failure Interval (in sec)	11	6	5	17	12	15	12	15	30

Failure Number	10	11	12	13	14	15	16	17	18
Failure Time (in sec)	145	167	196	234	265	293	303	335	389
Failure Interval (in sec)	22	22	29	38	31	28	10	32	54

Failure-Based Failure Specification

11, 17, 22, 39, 51, 66, 78, 93, 123, 145, 167, 196, 234, 265, 293, 303, 335, 389, …

Time (in sec)	30	60	90	120	150	180	210	240	270	300	330	360	390
Number of Failures in interval	3	2	2	1	2	1	1	1	1	1	1	1	1
Cumulative Failures	3	5	7	8	10	11	12	13	14	15	16	17	18

Prediction of the Number of Software Errors

Various models to predict the number of software errors

- error seeding model
- independent testing model

Error Seeding Model

- N denotes the total number of errors (N is fixed but unknown)
- Suppose M errors are seeded into the program
- n denotes the number of indigenous errors detected
- m denotes the number of seeded errors detected

Error Seeding Model (continued)

- Assumption – original indigenous and seeded errors are of the same chance of being detected

$$N = (nM) / m$$