



# Efficient Test Suite Management

## cont ...

Prof. Durga Prasad Mohapatra  
Professor  
Dept. of CSE, NIT Rourkela

# Overview of last class

- Discussed a technique for prioritizing system test cases based on requirements, proposed by **Srikanth et. al.**
- This technique is known as PORT (prioritization of requirements for test).
- They have considered the following four factors for analyzing and measuring the criticality of requirements.

# Overview of last class cont ...

- **Customer-assigned priority of requirements:** Based on priority, the customer assigns a weight (on scale of 1 to 10) to each requirement.
- **Requirement volatility:** This is a rating based on the frequency of change of a requirement.
- **Developer-perceived implementation complexity:** The developer gives more weight to a requirement which he thinks is more difficult to implement.
- **Fault proneness of requirements:** This factor is identified based on the previous versions of system. If a requirement in an earlier version of the system has more bugs, i.e. it is error-prone, then this requirement in the current version is given more weight. This factor cannot be considered for a new software.

## Overview of last class cont ...

- Based on these four factor values, a prioritization factor value (PFV) is computed as given below.

$$PFV_i = \sum (FV_{ij} \times FW_j)$$

where  $FV_{ij}$  = Factor value is the value of factor  $j$  corresponding to requirement  $i$ , and  $FW_j$  = Factor weight is the weight given to factor  $j$ .

- PFV is then used to produce a prioritized list of system test cases.



# An Approach for Prioritization of Regression Test Cases

Kavitha & Kumar proposed an approach for prioritization of regression test cases by considering the following factors:

1. Customer-assigned priority of requirements
2. Changes in requirements
3. Developer-perceived code implementation complexity
4. Fault impact of requirements
5. Completeness
6. Traceability
7. Execution time

Based on these factors, a weightage is assigned to each test case and the test cases are prioritized according to the weightages.



## Another Approach for Test Case Prioritization Based on Requirements

Kumar & Chauhan proposed a hierarchical test case prioritization approach, where prioritization is performed at three levels:

- Prioritize the requirements on the basis of 12 factors by assigning a weightage to each requirement.
- Map the prioritized requirements to their corresponding modules to get the prioritized modules.
- Rank (prioritize) the test cases of the prioritized modules for execution.



# Prioritization of requirements

- The process of prioritization of requirements is performed on the basis of 12 factors.
- These factors are in accordance with every phase of SDLC.
- All these factors have been assigned a priority value between 0 and 10.
- These priority values are assigned by various stakeholders of the project.
- Table in next slide shows these factors.

# Factors considered for requirement prioritization

S.NO	Factors	Phase of SDLC	Priority Value Assigned by
1	Requirement volatility	Requirement analysis	Customer
2	Customer assigned priority	Requirement analysis	Customer
3	Implementation complexity	Design	Developer
4	Fault proneness of requirements	Design	Developer
5	Developer assigned priority	Requirement analysis	Developer
6	Show stopper requirements	Design	Developer
7	Frequency of execution of requirements	Requirement analysis	Developer
8	Expected faults	Coding	Developer
9	Cost	Requirement analysis	Analyst
10	Time	Requirement analysis	Analyst
11	Penalty	Requirement analysis	Customer
12	Traceability	Testing	Tester



# Requirement Prioritization Factor Value

- For each requirement, based on these 12 factors, a Requirement Prioritization Factor Value (RPFV) is calculated using below Eq.

$$RPFV = \sum_{j=1}^n (pfvalue_{ij} \times pfweight_j)$$

- i represents the number of requirements, & j represents the number of factors
- RPFV represents the prioritization factor value for a requirement which is the summation of the product of priority value of a factor and the project factor weight.

# Requirement Prioritization Factor Value

cont ...

- pfvalue is the value of factor for the  $i^{\text{th}}$  requirement
- pfweight is the factor weight for the  $j^{\text{th}}$  factor for a particular project.
- By using the previous Eq. the weight prioritization factor RPFV for every requirement can be calculated.
- The table in next slide shows the prioritization of 4 sample requirements on the basis of RPFV for each requirement.

# Requirements prioritization

Factor	R1	R2	R3	R4	Weight factor
Customer assigned priority	8	10	9	9	0.02
Developer assigned priority	8	9	9	8	0.08
Requirements volatility	3	0	0	2	0.1
Fault proneness	0	0	0	0	0.15
Expected faults	2	3	4	2	0.10
Implementation complexity	3	4	5	3	0.10
Execution frequency	5	10	9	6	0.05
Traceability	0	0	0	0	0.05
Show stopper requirements	0	9	6	0	0.2
Penalty	1	4	3	3	0.05
Time	3	6	5	4	0.05
Cost	4	7	6	6	0.05
RPFV	2.25	4.77	4.15	2.47	1.0

# Inference

- In this table, R2 has the highest RPFV among all requirements.
- So, the prioritization order of these requirements is R2, R3, R4, and R1.
- The value of RPFV depends on the values of pfvalue and pfweight.



# Prioritization of modules

- It is a process of mapping between prioritized requirements and their corresponding modules.
- If there is more than one module then the modules are prioritized.
- It uses criteria like Cyclometric complexity and non-dc path.

## Prioritization of modules cont ...

- Definition-clear path (dc-path): A dc-path with respect to a variable  $v$  is a path between the definition node and the usage node s.t. no other node in the path is a defining node of variable  $v$ . Non-dc paths are more error prone.
- The test cases of higher priority modules are prioritized first and executed.
- For each module, a module prioritize value (MPV) is calculated by adding cyclometric complexity and the number of non-dc paths.

# Example

Factors	M1	M2	M3	M4
Cyclomatic complexity	8	4	4	5
Non-dc path	7	5	6	3
MPV	15	9	10	8

# Example

- The table shows the prioritization of 4 sample modules on the basis of MPV for each module.
- The order of prioritization of modules on the basis of MPV is M1, M3, M2 and M4.



# Test case prioritization process

- It is used to prioritize and schedule the test cases corresponding to prioritized modules.
- Some weight factors are used for test case prioritization such as
  - test case complexity,
  - requirements coverage,
  - dependency of the test cases and
  - test impact.

# Test Case Complexity

- It shows how difficult it is to execute a test case.
- It also shows how much effort is required to execute the test case.
- This factor is assigned a value between 1 and 10.



# Requirements Coverage

- It shows how many requirements are covered by executing the test case.
- This factor is scaled between 1 to 10.
- A higher value shows maximum requirements are covered by the test case.
- Higher the number of requirements coverage, higher is the priority of the test case to be executed first.

# Dependency

- It shows the dependency of test cases on some pre-requisites.
- It shows how many pre-requisites are required for each test case before execution of the test case.
- This factor is assigned a value between 1 and 10.

# Test Impact

- It is the most critical factor in test case prioritization.
- It shows the impact of test case on a system if it is not executed.
- This factor assesses importance of the test case.
- This factor is assigned a value between 1 and 10.

# Test Case Weight Prioritization

- TCWP is calculated as follows

$$TCWP = \sum_{j=1}^n (fvalue_{ij} \times fweight_j)$$

where,

- TCWP = weight prioritization for each test case calculated from the four factors.
- fvalue = value assigned to each test case.
- fweight = weight assigned to each factor.

## Test Case Weight Prioritization cont ...

- After calculating the value of each test case, test cases are ordered by TCWP such that maximum TCWP gives a test case the highest priority and executed.
- Suppose, a set of four test cases TC1,TC2,TC3, and TC4 are to be prioritized. For these test cases TCWP is calculated by using the above equation and are prioritized on the basis of values of TCWP.

# Example

S. No.	Factor	TC1	TC2	TC3	TC4	Weight
1	Test impact	4	8	7	9	0.4
2	Test case complexity	8	7	5	9	0.3
3	Requirement coverage	6	2	4	4	0.2
4	Dependency	7	6	6	8	0.1
	TCWP	5.90	6.30	5.70	7.90	1.0

So, the final prioritized order of test cases is TC4,TC2,TC1,TC3



# Reference

1. Naresh Chauhan, Software Testing: Principles and Practices, Second Edition, (Chapter 12), Oxford Univerity Press, 2018.



Thank you