Advanced Software Testing

Pairwise Testing Techniques

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Advanced Software Testing

- A series of webinars excerpted from *Advanced Software Testing: Volume 1,* a book for test analysts and test engineers
- Equivalence partitioning and boundary value analysis are useful for testing input field validation
- In some cases, we need to consider what can happen when supposedly independent options might interact
- This fourth webinar covers use case testing

Pairwise Techniques

- Concept: test unconstrained combinations of options for factors, each option tested equally
- Model: tabular representation of factors and the combination of options for each factor
- Test derivation: generate table of option combinations across the factors
- Coverage criteria: at least one test per row
- Bug hypothesis: singletons and pairs of options most likely to misbehave, with higher-order combinational problems less likely

Orthogonal Arrays and All-Pairs Tables

- You can use orthogonal arrays
  - Library of orthogonal arrays at www.research.att.com/~njas/oadir
- You can use tools to build all-pairs tables
  - Freeware and commercial all pairs tools at www.pairwise.org
- Orthogonal arrays and all-pairs tables differ in the number of times each pair of options is represented, which is usually not important

A Simple Orthogonal Array

- Two factors
- Two options per factor
- Each pair of options across the two factors is represented in one (and only one) row

	Factor	
Test	**1**	**2**
1	0	0
2	0	1
3	1	0
4	1	1

A Larger Orthogonal Array

- Three factors
- Two options per factor
- Each pair of options across the three pairs of factors is represented in one (and only one) row
- I added a factor without increasing the number of test configurations

	Factor		
Test	**1**	**2**	**3**
1	0	0	0
2	0	1	1
3	1	0	1
4	1	1	0

Selecting an Orthogonal Array

- At least as many columns as factors
  - If there are too many columns, you can drop the extra(s)
- At least enough numbers in the columns to hold the options for each factor
  - Spare numbers that don't map to any option can be replaced by any valid option for that factor (so-called "tester's choice")
- At least as many rows as the product of the two largest numbers of options
  - If there are too many rows, you cannot drop them if interesting pairs exist in the row

Mapping onto the Orthogonal Array

1. Drop extra column(s)
2. Map factors to columns (add column headings)
3. Map options in each column (search and replace)
4. Drop any extra rows with no interesting singletons or pairs
5. Fill in spare cells with easy tests, popular configurations, and so forth, either now or during test execution

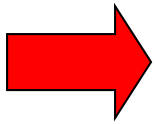
Example: Pairwise Techniques

- Testing compatibility of www.rbcs-us.com
- Four factors, two, three, or four options
  - Connection speed: dial up and broadband
  - Operating system: Mac, Linux, Windows XP, Windows Vista
  - Security: OS only, Symantec, Trend Micro, McAfee
  - Browser: Firefox, Internet Explorer, Opera
- Need an array with four columns, four numbers per column, and sixteen rows

Example: Select and Map

- Here's an array from the AT&T site
- In less than five minutes, the mapping is done
- It's a perfect fit, so we can skip dropping rows

00000
01111
02222
03333
10123
11032
12301
13210
20231
21320
22013
23102
30312
31203
32130
33021



	Factor			
Test	**Speed**	**OS**	**Security**	**Browser**
1	DU	Mac	OS	Firefox
2	DU	Linux	Symantec	IE
3	DU	XP	Trend	Opera
4	DU	Vista	McAfee	~
5	BB	Mac	Symantec	Opera
6	BB	Linux	OS	~
7	BB	XP	McAfee	Firefox
8	BB	Vista	Trend	IE
9	~	Mac	Trend	~
10	~	Linux	McAfee	Opera
11	~	XP	OS	IE
12	~	Vista	Symantec	Firefox
13	~	Mac	McAfee	IE
14	~	Linux	Trend	Firefox
15	~	XP	Symantec	~
16	~	Vista	OS	Opera

Conclusion

- In this webinar, we've seen how to apply pairwise testing in situations where supposedly independent options might interact
- In our previous webinars, decision tables, state based methods, and use cases
- Pairwise techniques allow us to cover combinations in a manageable way
- These advanced three techniques allow you to perform a wide range of important tests

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