Create Test Cases with Ease Using Combination Tools

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So many tests, so little time

- Class exercise in finding defects caused by variables combinations
  - Insert defect into product
  - Begin the bug hunt!

So many tests, so little time (cont.)

- Exhaustive testing is overkill. The goal of testing is to find bugs (Jenkins)
- Most bugs only require one, two, or three features to be used together (Jenkins)

Case Study Using Combinations

- Challenge – verify that medical claim benefits are determined based on the specified parameters
- 500+ parameters can be used within formulas to calculate payment of claim benefits
- Time to test each parameter separately exceeded time allowed on project

Case Study Using Combinations (cont.)

- Possible Solutions
  - Manually test each parameter as separate formula
  - Manually test several parameters together in fewer formulas
  - Give up!
  - Use AllPairs or jenny to create combinations

Pairswise Testing (Bach)

- ALLPAIRS explained
  - ALLPAIRS is a freeware Perl script that generates a pairwise set of test cases that covers all pairs of N parameters on the practical theory that all cases of exact combinations are rarely needed to find defects/bugs in the test domain. Besides, it would take too many test cases to try all combinations for large numbers of variables or parameters.
  - Coverage of all the combinations of pairs is a lot easier to achieve than all combinations. For instance, if you want to test with ten parameters of 26 values each, all combinations leads to (26^{10}) = 141,167,095,653,376 test cases.
  - The ALLPAIRS combination tool does it in 1094 cases.

Pairswise Testing (cont.)

- Allpairs demo
  - The ALLPAIRS script runs from the command prompt:
    - Prompt>allpairs
  - Start by preparing a tab delimited text file from (Excel* or Notepad) with your parameters arranged in columns with column titles. Extra tabs will cause errors!
  - Save the text file in a location where you can type the path or store in the ALLPAIRS directory until finished

*Excel is a trademark of Microsoft Corporation

Pairswise Testing (cont.)

- Run your input text file with ALLPAIRS:
  - Prompt>allpairs *(input filename.txt)* > *(output filename.txt)*
- Using Excel, open and parse the output file from ALLPAIRS into test case rows
- Save the file with Excel for automated or manual testing

Pairswise Testing (cont.)

- Note that ALLPAIRS reports redundant (“don’t care”) pairs with a tilde marker (~). This means that the parameter has already been tested for all pairs but has fewer dimensions than the other parameters. (Bach)

- When a value is “don’t care”, you may want to choose a value which either maximizes the probability of a failure, or maximizes the impact of the failure, should one occur. (Bach)

N-Tuples Testing with jenny (Jenkins)

- Pairs, Triples, Quads….N-Tuples!
- **jenny** is tool for generating regression tests. Any time exhaustive testing looks painful due to the combinatorial explosion of features interactions to be tested, consider using **jenny**. It will cover most of the interactions with far fewer test cases. It can guarantee pairwise testing of all features that can be used together, and it can avoid those feature combinations that cannot.

N-Tuples Testing with jenny (cont.)

- **jenny** has **exhaustive testing** as its limit. Exhaustive testing is to run one test case for every combination in the Cartesian product of all dimensions. For example, exhaustive testing of 12 dimensions with 2 features each (for example 12 flags that can each be on or off) requires $2^{12} = 4096$ test cases, and that's what **jenny** produces:

  - Prompt>jenny -n12 2 2 2 2 2 2 2 2 2 2 2 2 | wc 4096 49152 167936

N-Tuples Testing with jenny (cont.)

- To view jenny output on screen, use the following command line syntax:
  - Prompt>jenny –n3 x x x x x x
- To send the same jenny output to a text file, use the following syntax:
  - Prompt>jenny –n3 x x x x x x > (filename.txt)

Back to our Case Study Using Combinations

- Combination tool approach
  - Analyze parameters and determine values for creating test cases
  - Run AllPairs or jenny tool to determine the combinations that will be used for testing

Test Data Analysis

- Results from AllPairs and jenny need to be analyzed
  - AllPairs > Ready to use!
  - jenny > need to convert to test data
    - Use Excel Macro to convert
    - Use Excel Lookup Function to convert
    - Manually convert
  - Data created as text files from the tool
  - Import into Excel spreadsheet

jenny Output imported into Excel

1a	2c	3b	4h	5b
1b	2a	3d	4c	5a
1c	2b	3a	4b	5a
1d	2c	3e	4e	5a
1e	2a	3f	4g	5b
1f	2b	3c	4f	5b
1g	2a	3a	4a	5b
1h	2c	3d	4d	5b
1i	2c	3f	4a	5a
1j	2b	3b	4d	5a
1k	2b	3e	4c	5b
1l	2b	3f	4e	5b
1m	2a	3c	4h	5a
1n	2c	3a	4g	5a
1o	2a	3b	4f	5a
1p	2a	3e	4b	5a
1q	2c	3c	4e	5a
1r	2c	3b	4b	5b
1s	2b	3d	4g	5a
1a	2b	3e	4a	5a
1a	2c	3f	4c	5a

Test Data Analysis

- Mapping with Excel Macro
  - Create a spreadsheet containing the values of all parameters
  - Run a macro to convert tool output to data into test cases
  - Macro converts from cryptic output to useable test cases in seconds (like magic!)

Test Data Analysis

- Mapping tool output using spreadsheet functions
  - Use Microsoft Excel spreadsheet functions
  - Convert jenny output with Excel's VLookup function

jenny Output

1a	2c	3b	4h	5b
1b	2a	3d	4c	5a
1c	2b	3a	4b	5a
1d	2c	3e	4e	5a
1e	2a	3f	4g	5b
1f	2b	3c	4f	5b
1g	2a	3a	4a	5b
1h	2c	3d	4d	5b
1i	2c	3f	4a	5a
1j	2b	3b	4d	5a
1k	2b	3e	4c	5b
1l	2b	3f	4e	5b
1m	2a	3c	4h	5a
1n	2c	3a	4g	5a
1o	2a	3b	4f	5a
1p	2a	3e	4b	5a
1q	2c	3c	4e	5a
1r	2c	3b	4b	5b
1s	2b	3d	4g	5a
1a	2b	3e	4a	5a

VLookup Conversion

Lookup	Level	Coverage	Weekday	Fruit	Binary
a	STRC1	Single	Mon	Orange	Yes
b	STRC2	Spouse	Tue	Pear	No
c	STRC3	Family	Wed	Apple	
d	STRC4		Thur	Grape	
e	STRC5		Fri	Tangerine	
f	STRC6		Sat	Kiwi	
g	STRC7			Tomato	
h	STRC8			Banana	
i	STRC9				
j	STRC10				
k	STRC11				
l	STRC12				
m	STRC13				
n	STRC14				
o	STRC15				
p	STRC16				
q	STRC17				
r	STRC18				
s	STRC19				

Resulting Test Cases

STRC1	Family	Tue	Banana	No
STRC2	Single	Thur	Apple	Yes
STRC3	Spouse	Mon	Pear	Yes
STRC4	Family	Fri	Tangerine	Yes
STRC5	Single	Sat	Tomato	No
STRC6	Spouse	Wed	Kiwi	No
STRC7	Single	Mon	Orange	No
STRC8	Family	Thur	Grape	No
STRC9	Family	Sat	Orange	Yes
STRC10	Spouse	Tue	Grape	Yes
STRC11	Spouse	Fri	Apple	No
STRC12	Spouse	Sat	Tangerine	No
STRC13	Single	Wed	Banana	Yes
STRC14	Family	Mon	Tomato	Yes
STRC15	Single	Tue	Kiwi	Yes
STRC16	Single	Fri	Pear	Yes
STRC17	Family	Wed	Tangerine	Yes
STRC18	Family	Tue	Pear	No
STRC19	Spouse	Thur	Tomato	Yes
STRC1	Spouse	Fri	Orange	Yes

Using the Created Test Cases

- Manual testing
  - Test cases with data are ready to be used by test team
- Automated testing
  - Modern record and playback tools accept test data directly from Excel spreadsheets (or csv files)
  - The newly created spreadsheet can be used by these tools for data-driven testing
  - Data ready to be used by automated tools without further manipulation, except….
    - Warning – create a copy of the spreadsheet and do not use the one with the macro attached

Additional Techniques

- Exclusions
  - Some combinations may not be supported or possible with the application under test (AUT)
  - Use jenny command line switch “w” to turn off those combinations or edit manually
- Redundancy
  - Edit out repeated test cases; revisit input variables setup
- Equivalence classes
  - Repeating tests with equivalent variables (same datatype, length, non-boundary, etc.) wastes time.
  - Analyze required test classes per Kaner*
    - Valid
    - Invalid
    - Absence / Nulls

References

- Web sites
  - *ALLPAIRS* (James Bach)
    - http://www.satisfice.com
    - http://tejasconsulting.com/open-testware/feature/allpairs.html
  - *jenny* (Bob Jenkins)
    - http://www.burtleburtle.net/bob/math/jenny.html
  - Variables Testing Methodologies (Cem Kaner)
    - http://www.kaner.com

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  - Lessons Learned in Software Testing (Kaner - Bach – Pettichord
- Periodicals
  - Software Test & Performance [Feb 2006]
    - http://www.stpmag.com/issues/stp-2006-02.pdf