SWE 637 Software Testing Activities, week 5

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(Dr. B for short)

https://go.gmu.edu/SWE637

Adapted from slides by Jeff Offutt and Bob Kurtz

Class Activity #5A

Consider the intersection() method

```
public static Set  intersection (Set s1, Set s2)
/**
 * @param  s1, s2 : compute intersection of these two sets
 * @return a (non null) Set equal to the intersection of sets s1 and s2
 * @throws NullPointerException if s1 or s2 is null
*/
```

And the following domain model

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	$s1 \subset s2$ (s1 is a subset of s2)	$s1 \supset s2$ (s2 is a subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)

Class Activity #5a

1. If the **base choice** (BCC) criterion were applied to the two partitions *as they are shown*, how many test requirements would result? Give a test set.

2. If the **pair-wise** (PWC) criterion were applied, how many test requirements would result? Give a test set.

3. Is the partitioning for characteristic A *complete* and *disjoint*? Explain why or why not and propose a fix if necessary.

4. Is the partitioning for characteristic B *complete* and *disjoint*? Explain why or why not and propose a fix if necessary.

Class Activity #5a

1. If the **base choice** (BCC) criterion were applied to the two partitions *as they are shown*, how many test requirements would result? Give a test set.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

Class Activity #5a

2. If the **pair-wise** (PWC) criterion were applied, how many test requirements would result? Give a test set.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	$s1 = s2$ (same set)	$s1 \subset s2$ (s1 is a subset of s2)	$s1 \supset s2$ (s2 is a subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)

Class Activity #5a

3. Is the partitioning for characteristic A *complete* and *disjoint* ?

   Explain why or why not and propose a fix if necessary.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

Class Activity #5a

4. Is the partitioning for characteristic B *complete* and *disjoint* ?

Explain why or why not and propose a fix if necessary.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	$s1 = s2$ (same set)	$s1 \subset s2$ (s1 is a subset of s2)	$s1 \supset s2$ (s2 is a subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)

Class Activity #5B

Consider constraints between the characteristics. For example, if block Ab_1 is chosen for characteristic A, then what values can be chosen for characteristic B?

- Identify all constraints between characteristics
- Update the domain model if needed so that each block of each characteristic is consistent with at least one block of the other characteristic(s). That is, there should be no cases where choosing a block for characteristic A means that there are no possible blocks to choose for characteristic B.

Class Activity #5B

Consider constraints between the characteristics.

Characteristic	b_1	b_2	b_3	b_4	b_5
A: type of s1	Null	Empty set	≥1 element	--	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 $\subsetneq$ s2 (s1 is a proper subset of s2)	s2 $\subsetneq$ s1 (s2 is a proper subset of s1)	s1 ∩ s2 = Ø ∧ s1≠Ø ∧ s2≠Ø (disjoint non-empty sets)	s1 ⊄ s2 ∧ s1 ⊅ s2 ∧ s1 ∩ s2 ≠ Ø (overlap)

Class Activity #5b

How many **base choice** tests are there now?

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Example Answers

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Class Activity #5a

1. If the **base choice** (BCC) criterion were applied to the two partitions *as they are shown*, how many test requirements would result? Give a test set.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

1 for the base test, plus 2 for the other blocks of characteristic A, plus 3 for the other blocks of characteristic B = 6 tests

Example: (Ab_3, Bb_4), // base choice

(Ab_1, Bb_4), (Ab_2, Bb_4), // others from A

(Ab_3, Bb_1), (Ab_3, Bb_2), (Ab_3, Bb_3) // others from B

Class Activity #5A

2. If the **pair-wise** (PWC) criterion were applied, how many test requirements would result? Give a test set.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

3 x 4 = 12

Example: (Ab_1, Bb_1), (Ab_1, Bb_2), (Ab_1, Bb_3), (Ab_1, Bb_4),
(Ab_2, Bb_1), (Ab_2, Bb_2), (Ab_2, Bb_3), (Ab_2, Bb_4),
(Ab_3, Bb_1), (Ab_3, Bb_2), (Ab_3, Bb_3), (Ab_3, Bb_4)

Note that since there are only 2 characteristics, pair-wise is the same as all-combinations

Class Activity #5a

3. Is the partitioning for characteristic A *complete* and *disjoint* ?

Explain why or why not and propose a fix if necessary.

A is complete because there are no other possible values for a set. It is disjoint because no possible value for a set can match two blocks.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	$s1 = s2$ (same set)	$s1 \subset s2$ (s1 is a subset of s2)	$s1 \supset s2$ (s2 is a subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)

Class Activity #5a

4. Is the partitioning for characteristic B *complete* and *disjoint* ?

Explain why or why not and propose a fix if necessary.

B is not complete because it does not handle the possibility of partially overlapping sets.
B is not disjoint because identical sets are also subsets of each other (Bb1, Bb2, Bb3), and the empty set matches all partitions.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

Class Activity #5a

Revise the characteristics to eliminate any problems.

Characteristic	b_1	b_2	b_3	b_4
A: type of s1	Null	Empty set	≥1 element	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊂ s2 (s1 is a subset of s2)	s1 ⊃ s2 (s2 is a subset of s1)	s1 ∩ s2 = Ø (disjoint)

5. Fix the *completeness* problem to allow overlapping sets (add a new block)

Class Activity #5a

Revise the characteristics to eliminate any problems.

Characteristic	b_1	b_2	b_3	b_4	b_5
A: type of s1	Null	Empty set	≥1 element	--	--
B: relation between s1 and s2	$s1 = s2$ (same set)	$s1 \subset s2$ (s1 is a subset of s2)	$s2 \subset s1$ (s2 is a subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)	$s1 \not\subset s2 \wedge s1 \not\supset s2 \wedge s1 \cap s2 \neq \emptyset$ (overlap)

Class Activity #5a

Revise the characteristics to eliminate any problems.

PASSED

Characteristic	b_1	b_2	b_3	b_4	b_5
A: type of s1	Null	Empty set	≥1 element	--	--
B: relation between s1 and s2	$s1 = s2$ (same set)	$s1 \subsetneq s2$ (s1 is a proper subset of s2)	$s2 \subsetneq s1$ (s2 is a proper subset of s1)	$s1 \cap s2 = \emptyset$ (disjoint)	$s1 \not\subset s2 \land s1 \not\supset s2 \land s1 \cap s2 \neq \emptyset$ (overlap)

Fix the *disjointness* problem caused by equal sets also being subsets/supersets

Class Activity #5a

Revise the characteristics to eliminate any problems.

PASSED

Characteristic	b_1	b_2	b_3	b_4	b_5
A: type of s1	Null	Empty set	≥1 element	--	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 ⊊ s2 (s1 is a proper subset of s2)	s2 ⊊ s1 (s2 is a proper subset of s1)	s1 ∩ s2 = Ø ∧ s1≠∅ ∧ s2≠∅ (disjoint non-empty sets)	s1 ⊄ s2 ∧ s1 ⊅ s2 ∧ s1 ∩ s2 ≠ ∅ (overlap)

Fix the *disjointness* problem caused by s1=s2=Ø matching Bb_1 and Bb_4

Class Activity #5a

Revise the characteristics to eliminate any problems.

Characteristic	b_1	b_2	b_3	b_4	b_5
A: type of s1	Null	Empty set	≥1 element	--	--
B: relation between s1 and s2	s1 = s2 (same set)	s1 $\subsetneq$ s2 (s1 is a proper subset of s2)	s2 $\subsetneq$ s1 (s2 is a proper subset of s1)	s1 ∩ s2 = Ø ∧ s1≠Ø ∧ s2≠Ø (disjoint non-empty sets)	s1 $\not\subset$ s2 ∧ s1 $\not\supset$ s2 ∧ s1 ∩ s2 ≠ Ø (overlap)

AB1 ➡ … none of these choices? Let's fix that.

Class Activity #5a

Characteristic	b_1	b_2	b_3	b_4	b_5	b_6
A: type of s1	Null	Empty set	≥1 element	--	--	--
B: relation between s1 and s2	s1 = null ∨ s2 = null (one or more sets are null)	s1 = s2 (same set)	s1 ⊊ s2 (s1 is a proper subset of s2)	s2 ⊊ s1 (s2 is a proper subset of s1)	s1 ∩ s2 = Ø ∧ s1≠Ø ∧ s2≠Ø (disjoint non-empty sets)	s1 ⊄ s2 ∧ s1 ⊅ s2 ∧ s1 ∩ s2 ≠ Ø (overlap)

Ab_1 --> Bb_1, Ab_2 --> $!Bb_4$, Ab_2 --> $!Bb_6$

Bb_2 --> $!Ab_1$, Bb_3 --> $!Ab_1$, Bb_4 --> $!Ab_1$, Bb_4 --> $!Ab_3$, Bb_5 --> $!Ab_1$, Bb_6 --> $!Ab_1$

Class Activity #5B

How many **base choice** tests are there now?

Characteristic	b_1	b_2	b_3	b_4	b_5	b_6
A: type of s1	Null	Empty set	≥1 element	--	--	--
B: relation between s1 and s2	s1 = null ∨ s2 = null (one or more sets are null)	s1 = s2 (same set)	s1 ⊊ s2 (s1 is a proper subset of s2)	s2 ⊊ s1 (s2 is a proper subset of s1)	s1 ∩ s2 = Ø ∧ s1≠Ø ∧ s2≠Ø (disjoint non-empty sets)	s1 ⊄ s2 ∧ s1 ⊅ s2 ∧ s1 ∩ s2 ≠ Ø (overlap)

8 – 1 base test plus 2 alternate values for A plus 5 alternate values for B