

IT314 Lab 8

Software Testing

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Note : for all the below questions Equivalence Partitioning is represented as “EP” and Boundary value Analysis is represented as “BV”.

Question - 1:

1. Equivalence Class Partitioning:

Equivalence partitioning divides the input domain into several classes that are expected to behave similarly.

Valid Equivalence Classes:

- Day: ($1 \leq \text{day} \leq 31$)
- Month: ($1 \leq \text{month} \leq 12$)
- Year: ($1900 \leq \text{year} \leq 2015$)

Invalid Equivalence Classes:

- Day < 1 or Day > 31
- Month < 1 or Month > 12
- Year < 1900 or Year > 2015

2. Boundary Value Analysis:

BVA tests values at the boundaries between partitions.

Boundaries for Day:

- Minimum value: 1
- Maximum value: 31

Boundaries for Month:

- Minimum value: 1
- Maximum value: 12

Boundaries for Year:

- Minimum value: 1900
- Maximum value: 2015

- **Test Cases:**

Input Data	Expected Outcome	Type
2, 5, 2000	Previous date: 01/05/2000	EP
1, 3, 2015	Previous date: 28/02/2015	EP
32, 5, 2000	error	EP
15, 13, 2000	error	EP
15, 10, 1899	error	EP
1, 1, 1900	error	BV
1, 2, 1900	Previous date: 31/01/1900	BV
1, 1, 2015	Previous date: 31/12/2014	BV
31, 12, 2015	Previous date: 30/12/2015	BV

Question - 2:

P1:

```
int linearSearch(int v, int a[])
{
    int i = 0;
    while (i < a.length)
    {
        if (a[i] == v)
            return(i);
        i++;
    }
    return (-1);
}
```

1. Equivalence Class Partitioning:

We can divide the inputs into valid and invalid equivalence classes.

- **Valid Equivalence Classes:**

- v is present in the array a.
- v is not present in the array a.
- The array a contains one or more elements.

- **Invalid Equivalence Classes:**
 - The array a is empty.

2. Boundary Value Analysis:

Test boundary values for the size of the array a:

- Empty array (a with size 0).
- Array with one element.
- Array with two elements (minimum non-trivial size).
- Array with a large number of elements.

Boundary for the element v to be found:

- v is at the first index (index 0).
- v is at the last index (index a.length-1).

● Test Cases:

Input Data	Expected Outcome	Type
[1, 2, 3, 4, 5], 3	Return index: 2	EP
[10, 20, 30, 40], 10	Return index: 0	EP
[9, 8, 7, 6], 5	error (not found)	EP
[], 5	error (array is empty)	EP
[3], 3	0	BV
[1, 2], 2	1	BV
[4, 5, 6], 6	2	BV

[10, 20, 30, ..., 1000], 1000	999	BV
[10, 20, 30, ..., 1000], 1	error (not found)	BV

P2:

```
int countItem(int v, int a[])
{
    int count = 0;
    for (int i = 0; i < a.length; i++)
    {
        if (a[i] == v)
            count++;
    }
    return (count);
}
```

1. Equivalence Class Partitioning:

We can divide the inputs into valid and invalid equivalence classes.

- **Valid Equivalence Classes:**
 - v appears one or more times in the array a.
 - v does not appear in the array a.
 - The array a contains one or more elements.
- **Invalid Equivalence Classes:**
 - The array a is empty.

2. Boundary Value Analysis:

Test boundary values for the size of the array a:

- Empty array (a with size 0).
- Array with one element.
- Array with two elements.
- Array with a large number of elements.

Boundary for the element **v** occurrence:

- v appears once.
- v appears multiple times.
- v does not appear at all.

• Test Cases:

Input Data	Expected Outcome	Type
[1, 2, 3, 4, 5], 3	Return count: 1	EP
[10, 20, 30, 40], 10	Return count: 1	EP
[9, 8, 7, 6], 5	error (not found)	EP
[], 5	error (EMPTY)	EP
[3], 3	Return count: 1	BV
[1, 2], 2	Return count: 1	BV
[1, 2, 2, 2, 3], 2	Return count: 3	BV
[10, 20, 30, ..., 1000], 1000	Return count: 1	BV
[10, 20, 30, ..., 1000], 1	error (not found)	BV

P3:

```
int binarySearch(int v, int a[])
{
    int lo, mid, hi;
    lo = 0;
    hi = a.length-1;
    while (lo <= hi)
    {
        mid = (lo+hi)/2;
        if (v == a[mid])
            return (mid);
        else if (v < a[mid])
            hi = mid-1;
        else
            lo = mid+1;
    }
    return(-1);
}
```

1. Equivalence Class Partitioning:

We can divide the inputs into valid and invalid equivalence classes.

- **Valid Equivalence Classes:**
 - **v** is present in the array a.

- **v** is not present in the array a.
- The array a contains one or more elements, and is sorted.

- **Invalid Equivalence Classes:**

- The array a is empty.
- The array a is unsorted.

2. Boundary Value Analysis:

Test boundary values for the size of the array a:

- Empty array (a with size 0).
- Array with one element.
- Array with two elements.
- Array with a large number of elements.

Boundary for the element v to be found:

- v is at the first index (index 0).
- v is at the last index (index a.length-1).
- v is not in the array at all.

- **Test Cases:**

Input Data	Expected Outcome	Type
[1, 2, 3, 4, 5], 3	Return index: 2	EP
[10, 20, 30, 40], 10	Return index: 0	EP
[9, 8, 7, 6], 5	error (array is unsorted)	EP

[5, 10, 15, 20], 25	error (not found)	EP
[], 5	error (empty)	EP
[3], 3	Return index: 0	BV
[1, 2], 2	Return index: 1	BV
[4, 5, 6], 6	Return count: 2	BV
[10, 20, 30, ..., 1000], 1000	Return index: 999	BV
[10, 20, 30, ..., 1000], 1	error (not found)	BV

P4:

```

final int EQUILATERAL = 0;
final int ISOSCELES = 1;
final int SCALENE = 2;
final int INVALID = 3;
int triangle(int a, int b, int c)
{
    if (a >= b+c || b >= a+c || c >= a+b)
        return(INVALID);
    if (a == b && b == c)
        return(EQUILATERAL);
    if (a == b || a == c || b == c)
        return(ISOSCELES);
    return(SCALENE);
}

```

}

1. Equivalence Class Partitioning:

We can divide the inputs into valid and invalid equivalence classes.

Valid Equivalence Classes:

- Equilateral triangle (all three sides are equal).
- Isosceles triangle (two sides are equal).
- Scalene triangle (all sides are different).

Invalid Equivalence Classes:

- The side lengths do not satisfy the triangle inequality:
 - $a \geq b + c$
 - $b \geq a + c$
 - $c \geq a + b$
- One or more sides are non-positive (i.e., $a \leq 0$, $b \leq 0$, $c \leq 0$).

2. Boundary Value Analysis:

Test boundary values for the lengths of the sides of the triangle:

- Minimal positive length (1).
- Equal side lengths for equilateral and isosceles.
- Slight variations in side lengths for scalene and invalid cases.
- Triangle inequality boundary conditions.

- **Test Cases:**

Input Data	Expected Outcome	Type
(3, 3, 3)	Return: Equilateral(0)	EP
(5, 5, 8)	Return: Isosceles(1)	EP
(4, 5, 6)	Return: Scalene(2)	EP
(10, 5, 3)	error (triangle inequality)(3)	EP
(0, 5, 5)	error (non-positive side)(3)	EP
(1, 1, 1)	Return: Equilateral(0)	BV
(2, 2, 3)	Return: Isosceles(1)	BV
(3, 4, 5)	Return: Scalene(2)	BV
(1, 2, 3)	error (triangle inequality)(3)	BV
(-1, 2, 3)	error (invalid coordinates)(3)	BV

P5:

```

public static boolean prefix(String s1, String s2)
{
    if (s1.length() > s2.length())
    {
        return false;
    }
    for (int i = 0; i < s1.length(); i++)
    {
        if (s1.charAt(i) != s2.charAt(i))
        {
            return false;
        }
    }
}

```

```
    }  
  }  
  return true;  
}
```

1. Equivalence Class Partitioning:

We can divide the inputs into valid and invalid equivalence classes.

- **Valid Equivalence Classes:**
 - s1 is a valid prefix of s2.
 - s1 is not a prefix of s2.
 - s1 is an empty string (an empty string is a prefix of any string).
 - s1 is longer than s2.

2. Boundary Value Analysis:

Test boundary values for the lengths of s1 and s2:

- s1 and s2 are both empty strings.
- s1 is an empty string and s2 is non-empty.
- s1 has one character and s2 has the same character at the start.
- s1 and s2 have the same length and are equal.
- s1 is longer than s2.

- **Test Cases:**

Input Data	Expected Outcome	Type
("pre", "prefix")	Return: true	EP

("fix", "prefix")	Return: false	EP
("longer", "short")	Return: false	EP
("prefix", "prefix")	Return: true	EP
("a", "abc")	Return: true	BV
("abc", "abc")	Return: true	BV
("abcdef", "abc")	Return: false	BV
("abc", "abx")	Return: false	BV

P6: Consider again the triangle classification program (P4) with a slightly different specification: The program reads floating values from the standard input. The three values A, B, and C are interpreted as representing the lengths of the sides of a triangle. The program then prints a message to the standard output that states whether the triangle, if it can be formed, is scalene, isosceles, equilateral, or right angled.

a) Identify the equivalence classes for the system:

Equivalence Classes:

We can identify different equivalence classes based on the properties of a triangle.

- **Valid Equivalence Classes:**
 - Equilateral Triangle: All sides are equal ($A = B = C$).

- Isosceles Triangle: Two sides are equal ($A = B$ or $A = C$ or $B = C$).
- Scalene Triangle: No sides are equal ($A \neq B \neq C$).
- Right-Angled Triangle: The sides satisfy the Pythagorean theorem ($A^2 + B^2 = C^2$).

- **Invalid Equivalence Classes:**

- The sides do not satisfy the triangle inequality ($A + B \leq C$ or $A + C \leq B$ or $B + C \leq A$).
- One or more sides are non-positive ($A \leq 0$ or $B \leq 0$ or $C \leq 0$).

b) Identify test cases to cover the identified equivalence classes. Also, explicitly mention which test case would cover which equivalence class.

- **Test Cases:**

Input Data	Expected Outcome	Equivalence Class
(3.0, 3.0, 3.0)	Equilateral	Equilateral ($A=B=C$)
(5.0, 5.0, 8.0)	Isosceles	Isosceles ($A=B, A \neq C$)
(3.0, 4.0, 5.0)	Right-Angled	Right-Angled ($A^2 + B^2 = C^2$)
(7.0, 8.0, 9.0)	Scalene	Scalene ($A \neq B \neq C$)
(1.0, 2.0, 3.0)	error	invalid
(0.0, 4.0, 5.0)	error	invalid
(-1.0, 2.0, 2.0)	error	invalid

(4.0, 4.0, 7.0)	error	invalid
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c) For the boundary condition $A + B > C$ case (scalene triangle), identify test cases to verify the boundary.

This condition ensures that the sum of two sides is greater than the third.

Test Case 1:

- Input: (3.0, 4.0, 7.0) (Boundary value where $A + B = C$)
- Expected Outcome: Invalid Triangle (fails triangle inequality).

Test Case 2:

- Input: (4.0, 4.0, 7.0) (Boundary value where $A + B = C$)
- Expected Outcome: Isosceles Triangle.

d) For the boundary condition $A = C$ case (isosceles triangle), identify test cases to verify the boundary.

This condition checks whether two sides of the triangle are equal.

Test Case:

- Input: (5.0, 7.0, 5.0) (Two sides are equal at the boundary).
- Expected Outcome: Isosceles Triangle.

e) For the boundary condition $A = B = C$ case (equilateral triangle), identify test cases to verify the boundary.

This checks for cases where all three sides are equal.

Test Case 1:

- Input: (6.0, 6.0, 6.0) (All sides are equal at the boundary).
- Expected Outcome: Equilateral Triangle.

Test Case 2:

- Input: (7.0, 6.0, 6.0).
- Expected Outcome: Not an Equilateral Triangle.

f) For the boundary condition $A^2 + B^2 = C^2$ case (right-angle triangle), identify test cases to verify the boundary.

This checks if the triangle satisfies the Pythagorean theorem.

Test Case:

- Input: (3.0, 4.0, 5.0) (Classic Pythagorean triplet).
- Expected Outcome: Right-Angled Triangle.

g) For the non-triangle case, identify test cases to explore the boundary.

This tests the triangle inequality where the sum of two sides is not greater than the third side.

Test Case:

- Input: (1.0, 2.0, 3.0) (Boundary value where $A + B = C$).
- Expected Outcome: Invalid Triangle.

h) For non-positive input, identify test points.

This tests cases where one or more sides are non-positive.

Test Case 1:

- Input: (0.0, 3.0, 4.0) (Zero side length).
- Expected Outcome: Invalid Triangle.

Test Case 2:

- Input: (-1.0, 3.0, 3.0) (Negative side length).
- Expected Outcome: Invalid Triangle.