

IT 314 - Software Engineering

Lab 8 - Black Box Testing

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QUESTION-1:

Equivalence Class Partitioning (EP):

Input Condition	Valid Partition	Invalid Partitions
Day	$1 \leq \text{day} \leq 31$ for valid months	- Day < 1 (e.g., 0, -5)
		- Day > 31 (e.g., 32, 45)
		- Invalid day for a specific month (e.g., 31st in April)
Month	$1 \leq \text{month} \leq 12$	- Month < 1 (e.g., 0, -2)
		- Month > 12 (e.g., 13, 15)
Year	$1900 \leq \text{year} \leq 2015$	- Year < 1900 (e.g., 1899)
		- Year > 2015 (e.g., 2020, 2025)

Test Cases Based on Equivalence Class Partitions:

Day	Month	Year	Expected Outcome	Reason
15	5	2000	Previous date: 14/5/2000	Valid input (middle of valid partitions)
0	5	2000	Error: Invalid day	Invalid day (Day < 1)
32	5	2000	Error: Invalid day	Invalid day (Day > 31)
30	2	2001	Error: Invalid day	Invalid day for February (non-leap year)
12	13	2000	Error: Invalid month	Invalid month (Month > 12)
12	0	2000	Error: Invalid month	Invalid month (Month < 1)
12	5	1899	Error: Invalid year	Invalid year (Year < 1900)
12	5	2020	Error: Invalid year	Invalid year (Year > 2015)
1	3	2000	Previous date: 29/2/2000	Valid leap year for February
31	12	2015	Previous date: 30/12/2015	Valid input (end of the upper boundary for year)

Boundary Value Analysis Test Cases:

Day:

- Lower boundary: Day = 1
- Upper boundary: Day = 31

Special boundary cases:

- February 28/29 (depends on whether it is a leap year).
- 30th day for months like April, June, September, and November.

Month:

- Lower boundary: Month = 1 (January)
- Upper boundary: Month = 12 (December)

Year:

- Lower boundary: Year = 1900 (minimum valid year)
- Upper boundary: Year = 2015 (maximum valid year)

Day	Month	Year	Expected Outcome	Boundary Condition
1	1	1900	Previous date: 31/12/1899	Lower boundary for day, month, and year
31	12	2015	Previous date: 30/12/2015	Upper boundary for day, month, and year
1	3	2000	Previous date: 29/2/2000	Leap year boundary for February
1	3	2001	Previous date: 28/2/2001	Non-leap year boundary for February
30	4	2001	Previous date: 29/4/2001	Boundary for months with 30 days
31	3	2000	Previous date: 30/3/2000	Boundary for months with 31 days
1	1	2000	Previous date: 31/12/1999	Lower boundary for year 2000
31	1	2000	Previous date: 30/1/2000	Upper boundary for January

QUESTION - 2:

Program 1: Linear Search

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

Test Case	Expected Outcome	Remarks
v = 3, a = [1, 2, 3, 4, 5]	2	Value found at index 2 (basic test case)
v = 6, a = [1, 2, 3, 4, 5]	-1	Value not present in the array (non existant value)
v = 1, a = [1, 2, 3, 4, 5]	0	First element matches (left boundary)
v = 5, a = [1, 2, 3, 4, 5]	4	Last element matches (right boundary)
v = 1, a = []	-1	Empty array, no elements to search.
v = 2, a = [1, 2, 2, 3, 4]	1	Multiple occurrences, first found at index 1.
v = -1, a = [-5, -4, -3, -2, -1]	4	Negative number search, found at index 4.
v = 0, a = [-1, -2, -3, 0, 1]	3	Searching for zero, found at index 3.

Program 2: Frequency of a value

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

Test Case	Expected Outcome	Remarks
v = 2, a = [1, 2, 3, 2, 4]	2	Value 2 appears twice in the array (basic)
v = 5, a = [1, 2, 3, 4]	0	Value 5 is not present in the array.
v = 0, a = []	0	Empty array, no elements to count.
v = -1, a = [-1, -1, 0, 1]	2	Value -1 appears twice in the array (left boundary)
v = 5, a = [1, 2, 3, 4, 5]	1	Value 1 appears once in the array (right boundary)
v = 10, a = [10, 10, 10, 10]	4	Value 10 appears four times in the array.

Program 3: Binary Search

```
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);
}
```

Test Case	Expected Outcome	Remarks
v = 3, a = [1, 2, 3, 4, 5]	2	Value 3 found at index 2.
v = 6, a = [1, 2, 3, 4, 5]	-1	Value 6 not present in the array.
v = 1, a = [1, 2, 3, 4, 5]	0	Value 1 found at index 0 (left boundary)
v = 5, a = [1, 2, 3, 4, 5]	4	Value 5 found at index 4 (right boundary)
v = 1, a = []	-1	Empty array, no elements to search.
v = -1, a = [-5, -4, -3, -2, -1]	4	Value -1 found at index 4 (for negatives)

Program 4: Valid Triangle

```
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);
}
```

Test Case	Expected Outcome	Remarks
a = 3, b = 3, c = 3	0	Equilateral triangle, all sides equal.
a = 5, b = 5, c = 3	1	Isosceles triangle, two sides equal.
a = 4, b = 5, c = 6	2	Scalene triangle, all sides different.
a = 1, b = 2, c = 3	3	Invalid triangle, lengths do not form a triangle.
a = 0, b = 1, c = 1	3	Invalid triangle, side length cannot be zero.

Program 5: Is string 1 a prefix of string 2?

```
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;
}
```

Test Case	Expected Outcome	Remarks
s1 = "pre", s2 = "prefix"	true	"pre" is a prefix of "prefix".
s1 = "prefix", s2 = "pre"	false	"prefix" is longer than "pre".
s1 = "def", s2 = "abcdef"	false	"def" is not a prefix of "abcdef".
s1 = "", s2 = "hello"	true	An empty string is a prefix of any string.
s1 = "hello", s2 = ""	false	"hello" cannot be a prefix of an empty string.

Program 6: Valid Triangle (Part 2)

Equivalence Classes for Triangle Classification

Equivalence Class	Description
Valid Equilateral Triangle	All sides are equal ($A = B = C$)
Valid Isosceles Triangle	Exactly two sides are equal ($A = B$ or $A = C$ or $B = C$)
Valid Scalene Triangle	All sides are different ($A \neq B, B \neq C, A \neq C$)
Valid Right-Angled Triangle	Follows Pythagorean theorem ($A^2 + B^2 = C^2$)
Invalid Triangle	Non-Triangle: $A + B \leq C$ or $A + C \leq B$ or $B + C \leq A$
Non-Positive Input	Any side length is less than or equal to zero ($A \leq 0.0, B \leq 0.0, C \leq 0.0$)

Test Cases Covering Identified Equivalence Classes

Input (A, B, C)	Equivalence Class	Expected Output
(5.5, 5.5, 5.5)	Valid Equilateral Triangle	"Equilateral"
(5.5, 5.5, 4.4)	Valid Isosceles Triangle	"Isosceles"

Input (A, B, C)	Equivalence Class	Expected Output
(4.5, 5.5, 6.7)	Valid Scalene Triangle	"Scalene"
(3.0, 4.0, 5.0)	Valid Right-Angled Triangle	"Right-Angled"
(1.0, 2.0, 3.0)	Invalid Triangle (Non-Triangle)	"Invalid"
(0.0, 4.4, 5.5)	Non-Positive Input	"Invalid"
(5.5, 0.0, 7.2)	Non-Positive Input	"Invalid"
(8.0, 15.5, 17.0)	Valid Right-Angled Triangle	"Right-Angled"
(-3.0, 4.4, 5.5)	Non-Positive Input	"Invalid"
(10.5, 5.5, 5.5)	Valid Isosceles Triangle	"Isosceles"

Boundary Condition: $A + B > C$ (Scalene Triangle)

Input (A, B, C)	Description	Expected Output
(1.5, 1.5, 2.5)	All sides equal, becomes equilateral	"Equilateral"
(2.2, 2.2, 3.0)	Exactly two sides equal, becomes isosceles	"Isosceles"

Input (A, B, C)	Description	Expected Output
(2.5, 3.5, 4.5)	Valid scalene triangle, $A + B > C$	"Scalene"
(5.5, 4.4, 10.0)	Invalid triangle ($A + B \leq C$)	"Invalid"

Boundary Condition: $A = C$ (Isosceles Triangle)

Input (A, B, C)	Description	Expected Output
(2.5, 3.0, 2.5)	Two sides are equal, valid isosceles triangle	"Isosceles"
(5.5, 5.5, 5.5)	All sides equal, becomes equilateral	"Equilateral"
(4.4, 2.2, 4.4)	Two sides equal, valid isosceles triangle	"Isosceles"
(10.5, 5.5, 10.5)	Valid isosceles triangle	"Isosceles"

Boundary Condition: $A = B = C$ (Equilateral Triangle)

Input (A, B, C)	Description	Expected Output
(3.3, 3.3, 3.3)	All sides equal, valid equilateral triangle	"Equilateral"

Input (A, B, C)	Description	Expected Output
(5.5, 5.5, 5.5)	All sides equal, valid equilateral triangle	"Equilateral"
(0.0, 0.0, 0.0)	Invalid triangle (non-positive input)	"Invalid"

Boundary Condition: $A^2 + B^2 = C^2$ (Right-Angled Triangle)

Input (A, B, C)	Description	Expected Output
(3.0, 4.0, 5.0)	Valid right-angled triangle ($3.0^2 + 4.0^2 = 5.0^2$)	"Right-Angled"
(5.0, 12.0, 13.0)	Valid right-angled triangle ($5.0^2 + 12.0^2 = 13.0^2$)	"Right-Angled"
(1.5, 1.5, 2.1)	Invalid triangle (not a right-angled triangle)	"Invalid"
(8.0, 15.0, 17.0)	Valid right-angled triangle ($8.0^2 + 15.0^2 = 17.0^2$)	"Right-Angled"

Non-Triangle Case (Exploring Boundary)

Input (A, B, C)	Description	Expected Output
(1.5, 2.5, 4.0)	Invalid triangle ($1.5 + 2.5 \leq 4.0$)	"Invalid"

Input (A, B, C)	Description	Expected Output
(3.0, 5.0, 9.0)	Invalid triangle ($3.0 + 5.0 \leq 9.0$)	"Invalid"
(0.0, 0.0, 1.0)	Invalid triangle (non-positive input)	"Invalid"
(10.5, 5.5, 5.5)	Valid isosceles triangle, check boundary conditions	"Isosceles"

Non-Positive Input Test Points

Input (A, B, C)	Description	Expected Output
(0.0, 5.5, 5.5)	Invalid triangle ($A \leq 0.0$)	"Invalid"
(3.0, 0.0, 4.5)	Invalid triangle ($B \leq 0.0$)	"Invalid"
(-1.5, 5.5, 5.5)	Invalid triangle ($A \leq 0.0$)	"Invalid"