# IT314 Lab 8

# Functional Testing (Black-Box)

sunay revad
202201370

**Q.1. Consider a program for determining the previous date. Its input is triple of day, month and year with the following ranges 1 <= month <= 12, 1 <= day <= 31, 1900 <= year <= 2015.The possible output dates would be previous date or invalid date. Design the equivalence class test cases?**

## Equivalence class

1. Valid input for a previous date:
   - Equivalence class 1: Day, month, and year that corresponds to a valid date that is not the lowest boundary (day = 2, month = 3, year = 2010).
   - Equivalence class 2: Day = 1, month > 1 (day = 1, month = 4, year = 2005).
   - Equivalence class 3: Day > 1, month = 1 (day = 15, month = 1, year = 1999).
2. Valid input for the lowest boundary:
   - Equivalence class 4: Day = 1, month = 1 (day = 1, month = 1, year = 1900).
3. Valid input for the highest boundary:
   - Equivalence class 5: Day = 31, month = 12, year = 2015 (day = 31, month = 12, year = 2015).
4. Invalid inputs:
   - Equivalence class 6: Day < 1 (day = 0, month = 6, year = 2000).
   - Equivalence class 7: Day > 31 (day = 32, month = 7, year = 1995).
   - Equivalence class 8: Month < 1 (day = 20, month = 0, year = 2012).
   - Equivalence class 9: Month > 12 (day = 10, month = 13, year = 2008).
   - Equivalence class 10: Year < 1900 (day = 5, month = 9, year = 1899).
   - Equivalence class 11: Year > 2015 (day = 3, month = 11, year = 2016).
5. Special cases:
   - Equivalence class 12: Leap year (day = 29, month = 2, year = 2000).
   - Equivalence class 13: Non-leap year (day = 29, month = 2, year = 1900).

# Equivalence Class Test Cases

| Test ID | Tester Action and Input Data (Day, Month, Year) | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Day = 2, Month = 3, Year = 2010 | Previous Date: 01/03/2010 | EP1: Valid date (Day > 1, Month > 1, Year in range) |
| TC2 | Day = 1, Month = 4, Year = 2005 | Previous Date: 31/03/2005 | EP2: Valid (First day of month, Month > 1) |
| TC3 | Day = 15, Month = 1, Year = 1999 | Previous Date: 14/01/1999 | EP3: Valid (Day > 1, Month = 1) |
| TC4 | Day = 1, Month = 1, Year = 1900 | Previous Date: Invalid (No previous date before 01/01/1900) | EP4: Valid lowest boundary (Day = 1, Month = 1, Year = 1900) |
| TC5 | Day = 31, Month = 12, Year = 2015 | Previous Date: 30/12/2015 | EP5: Valid highest boundary (Day = 31, Month = 12, Year = 2015) |
| TC6 | Day = 0, Month = 6, Year = 2000 | Error: Invalid date | EP6: Invalid (Day < 1) |
| TC7 | Day = 32, Month = 7, Year = 1995 | Error: Invalid date | EP7: Invalid (Day > 31) |
| TC8 | Day = 20, Month = 0, Year = 2012 | Error: Invalid date | EP8: Invalid (Month < 1) |
| TC9 | Day = 10, Month = 13, Year = 2008 | Error: Invalid date | EP9: Invalid (Month > 12) |
| TC10 | Day = 5, Month = 9, Year = 1899 | Error: Invalid date | EP10: Invalid (Year < 1900) |
| TC11 | Day = 3, Month = 11, Year = 2016 | Error: Invalid date | EP11: Invalid (Year > 2015) |
| TC12 | Day = 29, Month = 2, Year = 2000 | Previous Date: 28/02/2000 | EP12: Leap year valid (Day = 29, Month = 2, Year = Leap Year) |
| TC13 | Day = 29, Month = 2, Year = 1900 | Error: Invalid date | EP13: Non-leap year (Feb 29 does not exist in 1900) |
| TC14 | Day = 1, Month = 2, Year = 1900 | Previous Date: 31/01/1900 | BVA: Boundary value at Day = 1 and Month > 1 |
| TC15 | Day = 1, Month = 1, Year = 2015 | Previous Date: 31/12/2014 | BVA: Boundary value at Day = 1 and Year > 1900 |

| | | | |
|---|---|---|---|
| TC16 | Day = 1, Month = 1, Year = 1901 | Previous Date: 31/12/1900 | BVA: Boundary value at Day = 1, Month = 1, and Year = 1901 |

**Q.2. Programs:**

**P1. The function linearSearch searches for a value v in an array of integers a. If v appears in the array a, then the function returns the first index i, such that a[i] == v; otherwise, -1 is returned.**

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

## P1. linearSearch(v, a[])

Description: This function searches for the first occurrence of a value 'v' in the array 'a'. It returns the index of the first occurrence or -1 if the value is not found.

### Equivalence Classes (EP):

- EP1: v is present in the array a.

- EP2: v is not present in the array a.

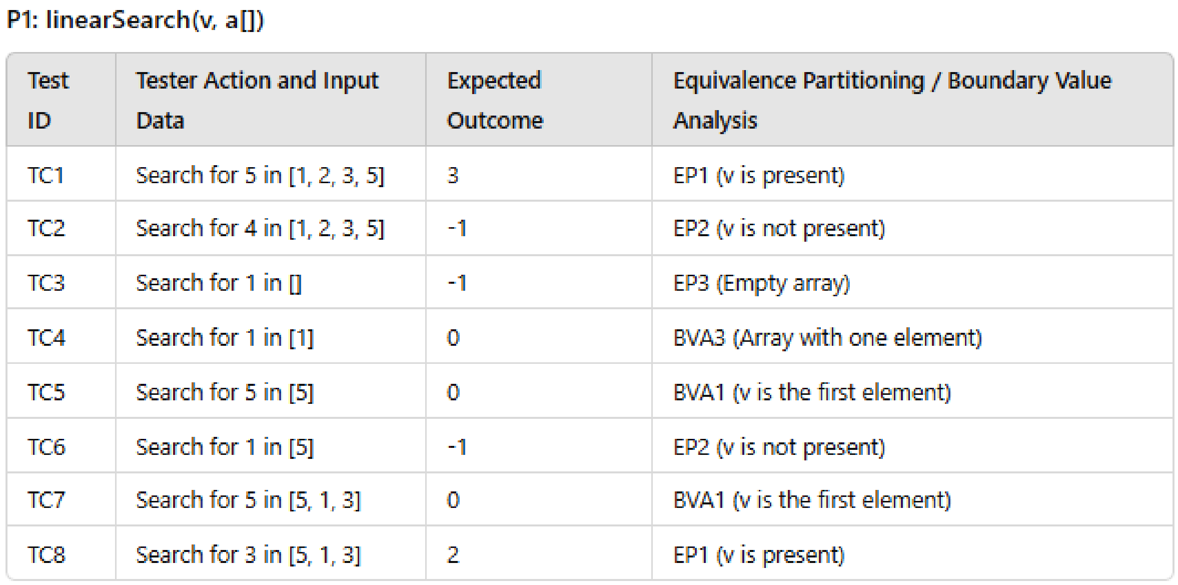
- EP3: Empty array (a.length = 0).

### Boundary Value Analysis (BVA):

- BVA1: v is the first element of the array (a[0]).

- BVA2: v is the last element of the array (a[length-1]).

- BVA3: Array with one element (a.length = 1).



**P1: linearSearch(v, a[])**

| Test ID | Tester Action and Input Data | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Search for 5 in [1, 2, 3, 5] | 3 | EP1 (v is present) |
| TC2 | Search for 4 in [1, 2, 3, 5] | -1 | EP2 (v is not present) |
| TC3 | Search for 1 in [] | -1 | EP3 (Empty array) |
| TC4 | Search for 1 in [1] | 0 | BVA3 (Array with one element) |
| TC5 | Search for 5 in [5] | 0 | BVA1 (v is the first element) |
| TC6 | Search for 1 in [5] | -1 | EP2 (v is not present) |
| TC7 | Search for 5 in [5, 1, 3] | 0 | BVA1 (v is the first element) |
| TC8 | Search for 3 in [5, 1, 3] | 2 | EP1 (v is present) |

**P2 . The function countItem returns the number of times a value v appears in an array of integers a.**

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

}
return (count);
```

## P2. countItem(v, a[])

Description: This function returns the number of times a value 'v' appears in an array 'a'.

### Equivalence Classes (EP):

- EP1: v appears in the array a multiple times.

- EP2: v appears in the array a once.

- EP3: v does not appear in the array a.

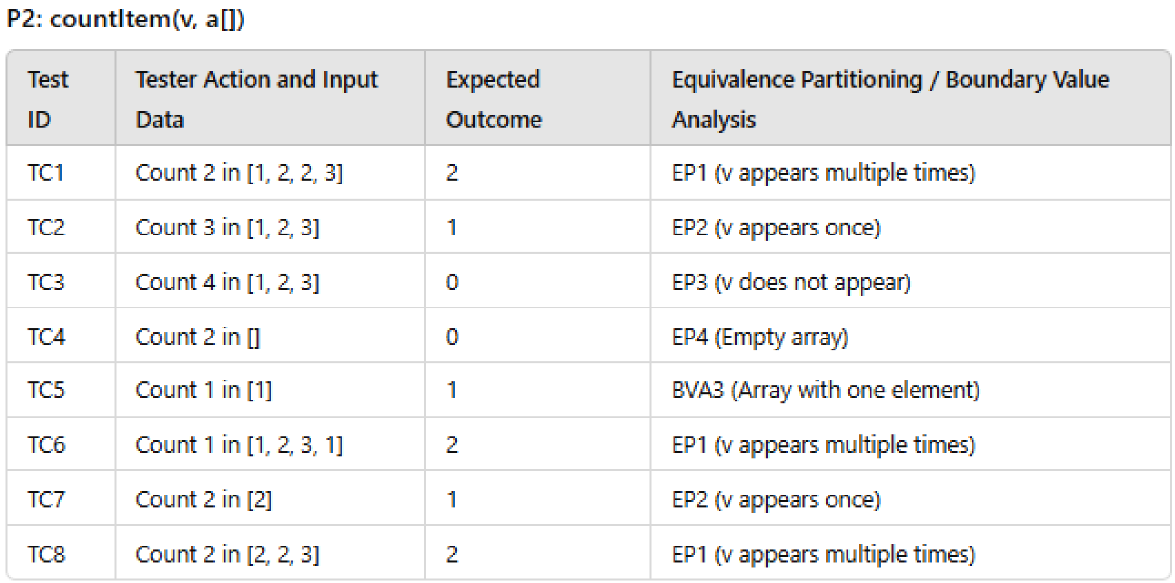
- EP4: Empty array (a.length = 0).

### Boundary Value Analysis (BVA):

- BVA1: v appears at the start of the array.

- BVA2: v appears at the end of the array.

- BVA3: Array with one element.



P2: countItem(v, a[])

| Test ID | Tester Action and Input Data | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Count 2 in [1, 2, 2, 3] | 2 | EP1 (v appears multiple times) |
| TC2 | Count 3 in [1, 2, 3] | 1 | EP2 (v appears once) |
| TC3 | Count 4 in [1, 2, 3] | 0 | EP3 (v does not appear) |
| TC4 | Count 2 in [] | 0 | EP4 (Empty array) |
| TC5 | Count 1 in [1] | 1 | BVA3 (Array with one element) |
| TC6 | Count 1 in [1, 2, 3, 1] | 2 | EP1 (v appears multiple times) |
| TC7 | Count 2 in [2] | 1 | EP2 (v appears once) |
| TC8 | Count 2 in [2, 2, 3] | 2 | EP1 (v appears multiple times) |

P3 . **The function binarySearch searches for a value v in an ordered array of integers a. If v appears in the array a, then the function returns an index i, such that a[i] == v; otherwise, -1 is returned.**

```
 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);
}
```

## P3. binarySearch(v, a[])

Description: This function performs a binary search on a sorted array of integers 'a' for the value 'v'. Returns an index of 'v' or -1 if not found.

### Equivalence Classes (EP):

- EP1: v is present in the array a.

- EP2: v is not present in the array a.

- EP3: Empty array (a.length = 0).

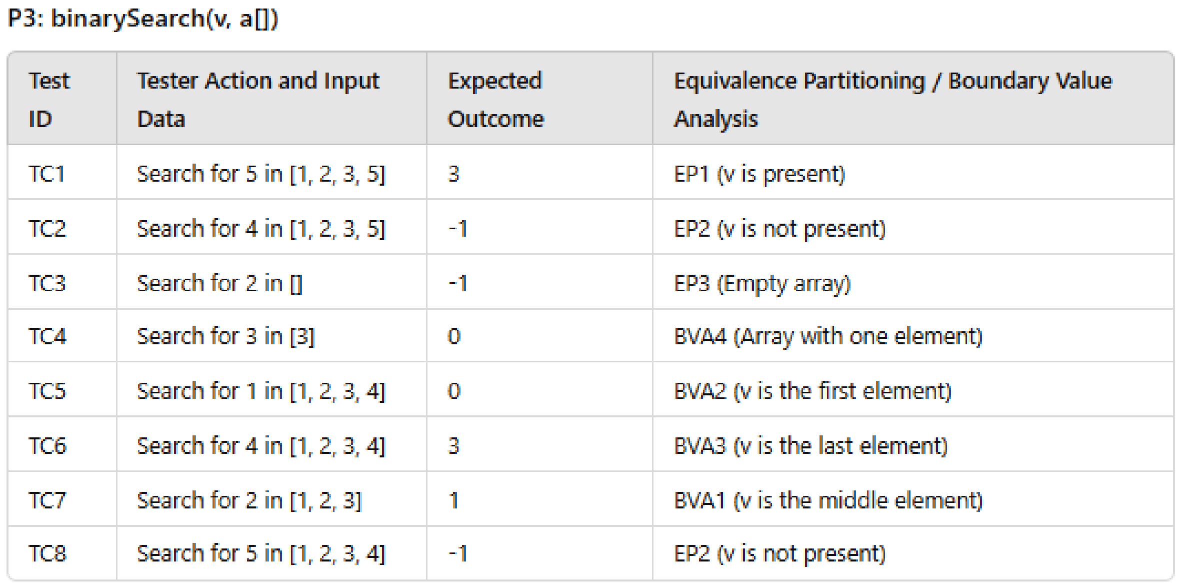
### Boundary Value Analysis (BVA):

- BVA1: v is the middle element of the array.

- BVA2: v is the first element of the array.

- BVA3: v is the last element of the array.

- BVA4: Array with one element (a.length = 1).



**P3: binarySearch(v, a[])**

| Test ID | Tester Action and Input Data | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Search for 5 in [1, 2, 3, 5] | 3 | EP1 (v is present) |
| TC2 | Search for 4 in [1, 2, 3, 5] | -1 | EP2 (v is not present) |
| TC3 | Search for 2 in [] | -1 | EP3 (Empty array) |
| TC4 | Search for 3 in [3] | 0 | BVA4 (Array with one element) |
| TC5 | Search for 1 in [1, 2, 3, 4] | 0 | BVA2 (v is the first element) |
| TC6 | Search for 4 in [1, 2, 3, 4] | 3 | BVA3 (v is the last element) |
| TC7 | Search for 2 in [1, 2, 3] | 1 | BVA1 (v is the middle element) |
| TC8 | Search for 5 in [1, 2, 3, 4] | -1 | EP2 (v is not present) |

**P4. The following problem has been adapted from The Art of Software Testing, by G. Myers (1979). The function triangle takes three integer parameters that are interpreted as the lengths of the sides of a triangle. It returns whether the triangle is equilateral (three lengths equal), isosceles (two lengths equal), scalene (no lengths equal), or invalid (impossible lengths).**

```
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);

}
```

## P4. triangle(a, b, c)

Description: This function takes three integer parameters (a, b, c) representing the lengths of the sides of a triangle. It returns whether the triangle is equilateral, isosceles, scalene, or invalid.

### Equivalence Classes (EP):

- EP1: Equilateral triangle (a = b = c).

- EP2: Isosceles triangle (a = b, a ≠ c).

- EP3: Scalene triangle (a ≠ b ≠ c).

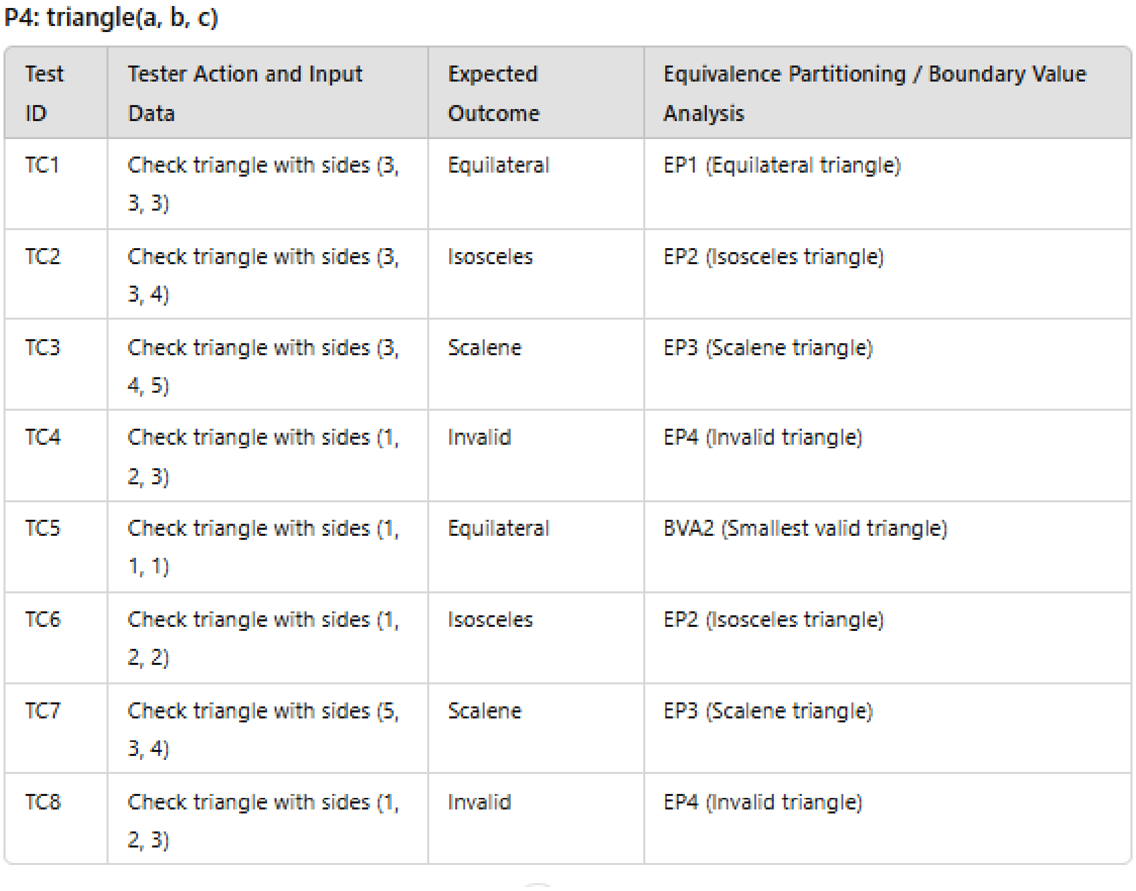
- EP4: Invalid triangle (a + b <= c or a + c <= b or b + c <= a).

### Boundary Value Analysis (BVA):

- BVA1: a + b = c (Invalid boundary case).

- BVA2: a = b = c = 1 (Smallest valid triangle).

- BVA3: a + b > c (Valid boundary case).



### P4: triangle(a, b, c)

| Test ID | Tester Action and Input Data | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Check triangle with sides (3, 3, 3) | Equilateral | EP1 (Equilateral triangle) |
| TC2 | Check triangle with sides (3, 3, 4) | Isosceles | EP2 (Isosceles triangle) |
| TC3 | Check triangle with sides (3, 4, 5) | Scalene | EP3 (Scalene triangle) |
| TC4 | Check triangle with sides (1, 2, 3) | Invalid | EP4 (Invalid triangle) |
| TC5 | Check triangle with sides (1, 1, 1) | Equilateral | BVA2 (Smallest valid triangle) |
| TC6 | Check triangle with sides (1, 2, 2) | Isosceles | EP2 (Isosceles triangle) |
| TC7 | Check triangle with sides (5, 3, 4) | Scalene | EP3 (Scalene triangle) |
| TC8 | Check triangle with sides (1, 2, 3) | Invalid | EP4 (Invalid triangle) |

**P5. The function prefix (String s1, String s2) returns whether or not the string s1 is a prefix of string s2 (you may assume that neither s1 nor s2 is null).**

```
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;

}
```

## P5. prefix(s1, s2)

Description: This function returns whether or not the string s1 is a prefix of string s2.

### Equivalence Classes (EP):

- EP1: s1 is a prefix of s2.

- EP2: s1 is not a prefix of s2.

- EP3: s1 has the same length as s2 but is not a prefix.

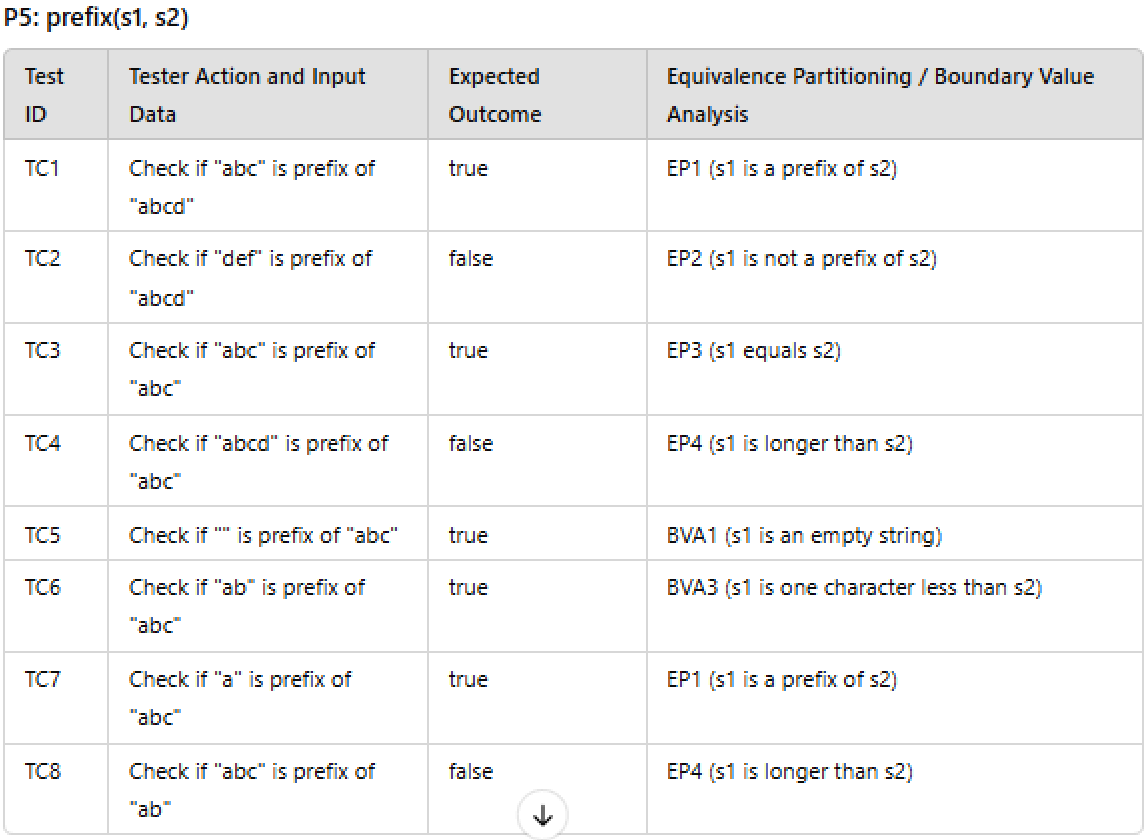
- EP4: s1 has a greater length than s2.

### Boundary Value Analysis (BVA):

- BVA1: s1 is an empty string.

- BVA2: s1 equals s2 (both strings are the same).

- BVA3: s1 is one character less than s2.



### P5: prefix(s1, s2)

| Test ID | Tester Action and Input Data | Expected Outcome | Equivalence Partitioning / Boundary Value Analysis |
|---|---|---|---|
| TC1 | Check if "abc" is prefix of "abcd" | true | EP1 (s1 is a prefix of s2) |
| TC2 | Check if "def" is prefix of "abcd" | false | EP2 (s1 is not a prefix of s2) |
| TC3 | Check if "abc" is prefix of "abc" | true | EP3 (s1 equals s2) |
| TC4 | Check if "abcd" is prefix of "abc" | false | EP4 (s1 is longer than s2) |
| TC5 | Check if "" is prefix of "abc" | true | BVA1 (s1 is an empty string) |
| TC6 | Check if "ab" is prefix of "abc" | true | BVA3 (s1 is one character less than s2) |
| TC7 | Check if "a" is prefix of "abc" | true | EP1 (s1 is a prefix of s2) |
| TC8 | Check if "abc" is prefix of "ab" | false | EP4 (s1 is longer than s2) |

## Answer to P6

a) Equivalence Classes:

(a) Equilateral Triangle: All sides are equal ($A = B = C$).

(b) Isosceles Triangle: Two sides are equal, and the third is different ($A = B \neq C$, $A \neq B = C$, $A = C \neq B$).

(c Scalene Triangle: All sides are different ($A \neq B \neq C$).

(d Right-Angled Triangle: Satisfies the Pythagorean theorem ($A^2 + B^2 = C^2$).

(e Non-Triangle: It cannot form a triangle ($A + B \leq C$, $B + C \leq A$, $C + A \leq B$).

b) Extensive Test Cases:

(a) Equivalence Class: Equilateral Triangle

- Test Case 1: $A = 1, B = 1, C = 1$ (Minimum positive values)
- Test Case 2: $A = 10, B = 10, C = 10$ (Larger positive values)

(b) Equivalence Class: Isosceles Triangle

- Test Case 3: $A = 3, B = 3, C = 4$ ($A = B \neq C$)
- Test Case 4: $A = 4, B = 3, C = 3$ ($A \neq B = C$)
- Test Case 5: $A = 3, B = 4, C = 3$ ($A = C \neq B$)

(c) Equivalence Class: Scalene Triangle

- Test Case 6: $A = 3, B = 4, C = 5$ (Regular scalene triangle)
- Test Case 7: $A = 1, B = 2, C = 3$ (Smallest positive values)

(d) Equivalence Class: Right-Angled Triangle

- Test Case 8: $A = 3, B = 4, C = 5$ ($A^2 + B^2 = 9 + 16 = 25 = C^2$)
- Test Case 9: $A = 5, B = 12, C = 13$ (Another right-angled triangle)

(e) Equivalence Class: Non-Triangle

- Test Case 10: $A = 1, B = 2, C = 6$ ($A + B = 3 < C$)
- Test Case 11: $A = 0, B = 0, C = 0$ (All sides are zero)
- Test Case 12: $A = 1, B = 1, C = 2$ ($A + B = 2 = C$)

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

(a) Test Case 13: $A = 3, B = 4, C = 6$ ($A + B = 7 > C$)

(b) Test Case 14: $A = 1, B = 1, C = 2$ ($A + B = 2 < C$)

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

(a) Test Case 15: $A = 5, B = 4, C = 5$ ($A = C$)

(b) Test Case 16: $A = 1, B = 1, C = 2$ ($A \neq C$)

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

(a) Test Case 17: $A = 4, B = 4, C = 4$ ($A = B = C$)

(b) Test Case 18: $A = 1, B = 2, C = 3$ ($A \neq B \neq C$)

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

(a) Test Case 19: $A = 3, B = 4, C = 5$ ($A^2 + B^2 = 9 + 16 = 25 = C^2$)

(b) Test Case 20: $A = 7, B = 24, C = 25$ (Another right-angled triangle)or Non-Triangle Case (Boundary Exploration):

(c) Test Case 21: $A = 1, B = 2, C = 3$ ($A + B = 3 < C$)

(d) Test Case 22: $A = 0, B = 0, C = 1$ (A and B are zero, $A + B = 0 < C$)

(e) Test Case 23: $A = 1, B = 1, C = 3$ ($A + B = 2 < C$)

g) For Non-Positive Input (Boundary Exploration):

(a) Test Case 24: $A = -1, B = 2, C = 3$ (A is non-positive)

(b) Test Case 25: $A = 1, B = -2, C = 3$ (B is non-positive)

(c) Test Case 26: $A = 1, B = 2, C = -3$ (C is non-positive)

(d) Test Case 27: $A = 0, B = 2, C = 3$ (A is zero)

(e) Test Case 28: $A = 1, B = 0, C = 3$ (B is zero)

(f) Test Case 29: $A = 1, B = 2, C = 0$ (C is zero)