

IT 314 : Software Engineering
Lab 8
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Question 1

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
15, 6, 2000	Yes (14/6/2000)
1, 7, 2000	Yes (30/6/2000)
31, 12, 2000	Yes (30/12/2000)
0, 6, 2000	Error
32, 6, 2000	Error
15, 0, 2000	Error
29, 2, 2000	Yes (28/2/2000)
31, 3, 2000	Yes (30/3/2000)
30, 4, 2000	Yes (29/4/2000)

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
1, 6, 2000	Yes (31/5/2000)
31, 12, 2000	Yes (30/12/2000)
0, 6, 2000	Error
15, 12, 2000	Yes (14/12/2000)
15, 0, 2000	Error
15, 13, 2000	Error
15, 6, 1900	Yes (14/6/1900)
28, 2, 2000	Yes (27/2/2000)

Modified Program :

```
#include <iostream>
#include <string>
#include <vector>
#include <tuple>
using namespace std;

class DateValidator {
private:
    const int daysInMonth[12] = {31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31};

    bool isLeapYear(int year) {
        return (year % 4 == 0 && year % 100 != 0) || (year % 400 == 0);
    }

    bool isValidDate(int day, int month, int year) {
        if (year < 1900 || year > 2015) return false;
        if (month < 1 || month > 12) return false;
        if (day < 1 || day > 31) return false;

        if (month == 2) {
            if (isLeapYear(year)) return day <= 29;
```

```

        return day <= 28;
    }

    return day <= daysInMonth[month - 1];
}

public:
    string getPreviousDate(int day, int month, int year) {
        if (!isValidDate(day, month, year)) {
            return "Invalid date";
        }

        if (day == 1) {
            if (month == 1) {
                // First day of year
                if (year == 1900) {
                    return "Invalid date";
                }
                return to_string(31) + "/" + to_string(12) + "/" + to_string(year - 1);
            }
            int prevMonth = month - 1;
            int lastDay = (prevMonth == 2 && isLeapYear(year)) ? 29 : daysInMonth[prevMonth - 1];
            return to_string(lastDay) + "/" + to_string(prevMonth) + "/" + to_string(year);
        }

        // Normal case
        return to_string(day - 1) + "/" + to_string(month) + "/" + to_string(year);
    }
};

```

```

class TestRunner {
private:
    DateValidator validator;

    void runTestCase(int day, int month, int year, string expectedOutcome,
                     string testType, string description) {
        string result = validator.getPreviousDate(day, month, year);
        string actualOutcome = (result != "Invalid date") ? "Yes" : "Error";
        string status = (actualOutcome == expectedOutcome) ? "PASS" : "FAIL";

        cout << testType << ": " << description << endl;
        cout << "Input: " << day << "/" << month << "/" << year << endl;
        cout << "Expected: " << expectedOutcome << endl;
        cout << "Actual: " << actualOutcome << endl;
    }
};

```

```

    cout << "Status: " << status << endl;
    cout << "Output: " << result << endl;
    cout << string(50, '-') << endl;
}

```

public:

```

void runEquivalencePartitioningTests() {
    cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;
    cout << string(50, '=') << endl;

    // Vector of test cases: {day, month, year, expected outcome, description}
    vector<tuple<int, int, int, string, string>> testCases = {
        // Valid Dates
        {15, 6, 2000, "Yes", "Valid middle date"},
        {1, 7, 2000, "Yes", "First day of month"},
        {31, 12, 2000, "Yes", "Last day of year"},

        // Invalid Dates
        {0, 6, 2000, "Error", "Invalid day - below range"},
        {32, 6, 2000, "Error", "Invalid day - above range"},
        {15, 0, 2000, "Error", "Invalid month - below range"},
        {15, 13, 2000, "Error", "Invalid month - above range"},
        {15, 6, 1899, "Error", "Invalid year - below range"},
        {15, 6, 2016, "Error", "Invalid year - above range"},
        {31, 4, 2000, "Error", "Invalid day for month"},
        {29, 2, 2001, "Error", "Invalid day for February non-leap year"}
    };

    for (const auto& test : testCases) {
        runTestCase(get<0>(test), get<1>(test), get<2>(test),
            get<3>(test), "EP", get<4>(test));
    }
}

```

```

void runBoundaryValueTests() {
    cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;
    cout << string(50, '=') << endl;

    vector<tuple<int, int, int, string, string>> testCases = {
        // Day boundaries
        {1, 6, 2000, "Yes", "Minimum valid day"},
        {31, 12, 2000, "Yes", "Maximum valid day"},
        {0, 6, 2000, "Error", "Day below minimum"},
        {32, 6, 2000, "Error", "Day above maximum"},
    };
}

```

```

        // Month boundaries
        {15, 1, 2000, "Yes", "Minimum valid month"},
        {15, 12, 2000, "Yes", "Maximum valid month"},
        {15, 0, 2000, "Error", "Month below minimum"},
        {15, 13, 2000, "Error", "Month above maximum"},

        // Year boundaries
        {15, 6, 1900, "Yes", "Minimum valid year"},
        {15, 6, 2015, "Yes", "Maximum valid year"},
        {15, 6, 1899, "Error", "Year below minimum"},
        {15, 6, 2016, "Error", "Year above maximum"}
    };

    for (const auto& test : testCases) {
        runTestCase(get<0>(test), get<1>(test), get<2>(test),
                    get<3>(test), "BVA", get<4>(test));
    }
};

int main() {
    TestRunner runner;
    runner.runEquivalencePartitioningTests();
    runner.runBoundaryValueTests();
    return 0;
}

```

Outputs :

EQUIVALENCE PARTITIONING TEST CASES

=====

EP: Valid middle date

Input: 15/6/2000

Expected: Yes

Actual: Yes

Status: PASS

Output: 14/6/2000

EP: First day of month

Input: 1/7/2000

Expected: Yes

Actual: Yes

Status: PASS

Output: 30/6/2000

EP: Last day of year

Input: 31/12/2000

Expected: Yes

Actual: Yes

Status: PASS

Output: 30/12/2000

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Minimum valid day

Input: 1/6/2000

Expected: Yes

Actual: Yes

Status: PASS

Output: 31/5/2000

BVA: Maximum valid day

Input: 31/12/2000

Expected: Yes

Actual: Yes

Status: PASS

Output: 30/12/2000

BVA: Day below minimum

Input: 0/6/2000

Expected: An Error message

Actual: An Error message

Status: PASS

Output: Invalid date

Question 2

P1. Linear Search Test Cases

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
------------------------------	------------------

v=5, a=[5,2,8,1,9]	0
v=8, a=[5,2,8,1,9]	2
v=3, a=[5,2,8,1,9]	-1
v=5, a=[]	-1

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
v=5, a=[5]	0
v=5, a=[1,5]	1
v=5, a=[5,5,5]	0
v=1, a=[1]	0
v=1, a=[]	-1

Modified Program :

```

#include <iostream>

#include <string>

#include <vector>

#include <tuple>

using namespace std;

class LinearSearch {

```



```

public:

int search(int v, int a[], int length) {

int i = 0;

while (i < length) {

if (a[i] == v) return

i; i++;

}

return -1;

}

};

class TestRunner {

private:

LinearSearch searcher;

void runTestCase(int value, int arr[], int length, int expectedOutcome,

string testType, string description) {

int result = searcher.search(value, arr, length);

string status = (result == expectedOutcome) ? "PASS" : "FAIL";

cout << testType << ": " << description << endl;

cout << "Input: value=" << value << ", array=";

for(int i = 0; i < length; i++) {

cout << arr[i];

if(i < length-1) cout << ",";

}

cout << "]" << endl;

```

```

cout << "Expected: " << expectedOutcome << endl;

cout << "Actual: " << result << endl;

cout << "Status: " << status << endl;

cout << string(50, '-') << endl;

}

public:

void runEquivalencePartitioningTests() {

cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;

cout << string(50, '=') << endl;

int test1[] = {5,2,8,1,9};

int test2[] = {1};

int test3[] = {1,1,1,1,1};

runTestCase(5, test1, 5, 0, "EP", "Value at start");

runTestCase(8, test1, 5, 2, "EP", "Value in middle");

runTestCase(9, test1, 5, 4, "EP", "Value at end");

runTestCase(3, test1, 5, -1, "EP", "Value not present");

runTestCase(1, test2, 1, 0, "EP", "Single element array - value present");

runTestCase(2, test2, 1, -1, "EP", "Single element array - value not present");

runTestCase(1, test3, 5, 0, "EP", "All elements same - value present");

}

void runBoundaryValueTests() {

cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;

cout << string(50, '=') << endl;

int test1[] = {5};

```

```
int test2[] = {5,5};  
int test3[] = {1,2,3,4,5};  
  
runTestCase(5, test1, 1, 0, "BVA", "Single element - found");  
runTestCase(1, test1, 1, -1, "BVA", "Single element - not found");  
  
runTestCase(5, test2, 2, 0, "BVA", "Two identical elements");  
  
runTestCase(1, test3, 5, 0, "BVA", "First element");  
runTestCase(5, test3, 5, 4, "BVA", "Last element");  
  
}  
};  
  
int main() {  
  
    TestRunner runner;  
  
    runner.runEquivalencePartitioningTests();  
  
    runner.runBoundaryValueTests();  
  
    return 0;  
  
}
```

Output :

EQUIVALENCE PARTITIONING TEST CASES

=====

EP: Value at start

Input: value=5, array=[5,2,8,1,9]

Expected: 0

Actual: 0

Status: PASS

EP: Value in middle

Input: value=8, array=[5,2,8,1,9]

Expected: 2

Actual: 2

Status: PASS

EP: Value at end

Input: value=9, array=[5,2,8,1,9]

Expected: 4

Actual: 4

Status: PASS

EP: Value not present

Input: value=3, array=[5,2,8,1,9]

Expected: -1

Actual: -1

Status: PASS

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Single element - found

Input: value=5, array=[5]

Expected: 0

Actual: 0

Status: PASS

BVA: Single element - not found

Input: value=1, array=[5]

Expected: -1

Actual: -1

Status: PASS

BVA: Two identical elements

Input: value=5, array=[5,5]

Expected: 0

Actual: 0

Status: PASS

P2. Count Item Test Cases

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
v=5, a=[5,2,5,1,5]	3
v=2, a=[5,2,5,1,5]	1
v=3, a=[5,2,5,1,5]	0

v=5, a=[]	0
------------------	----------

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
v=5, a=[5]	1
v=5, a=[5,5]	2
v=5, a=[5,5,5]	3
v=1, a=[1]	1
v=1, a=[]	0

Modified Program :

```
#include <iostream>

#include <string>

#include <vector>

#include <tuple>

using namespace std;

class CountItem {

public:

int count(int v, int a[], int length) {

int count = 0;

for (int i = 0; i < length; i++) {

if (a[i] == v) count++;
```

```

}

return count;

}

};

class TestRunner {

private:

    CountItem counter;

    void runTestCase(int value, int arr[], int length, int expectedOutcome,
        string testType, string description) {

        int result = counter.count(value, arr, length);

        string status = (result == expectedOutcome) ? "PASS" : "FAIL";

        cout << testType << ": " << description << endl;

        cout << "Input: value=" << value << ", array=[";

        for(int i = 0; i < length; i++) {

            cout << arr[i];

            if(i < length-1) cout << ",";

        }

        cout << "]" << endl;

        cout << "Expected: " << expectedOutcome << endl;

        cout << "Actual: " << result << endl;

        cout << "Status: " << status << endl;

        cout << string(50, '-') << endl;

    }

public:

```

```

void runEquivalencePartitioningTests() {

cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;

cout << string(50, '=') << endl;

int test1[] = {5,2,5,1,5};

int test2[] = {1};

int test3[] = {1,1,1,1,1};

runTestCase(5, test1, 5, 3, "EP", "Multiple occurrences");

runTestCase(2, test1, 5, 1, "EP", "Single occurrence");

runTestCase(3, test1, 5, 0, "EP", "No occurrence");

runTestCase(1, test2, 1, 1, "EP", "Single element array - value present");

runTestCase(2, test2, 1, 0, "EP", "Single element array - value not present");

runTestCase(1, test3, 5, 5, "EP", "All elements same - value present");

}

void runBoundaryValueTests() {

cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;

cout << string(50, '=') << endl;

int test1[] = {5};

int test2[] = {5,5};

int test3[] = {1,2,3,4,5};

runTestCase(5, test1, 1, 1, "BVA", "Single element - found");

runTestCase(1, test1, 1, 0, "BVA", "Single element - not found");

runTestCase(5, test2, 2, 2, "BVA", "Two identical elements");

runTestCase(1, test3, 5, 1, "BVA", "Single occurrence at start");

runTestCase(5, test3, 5, 1, "BVA", "Single occurrence at end");

```



```
}  
};  
  
int main() {  
  
    TestRunner runner;  
  
    runner.runEquivalencePartitioningTests();  
  
    runner.runBoundaryValueTests();  
  
    return 0;  
}
```

EQUIVALENCE PARTITIONING TEST CASES

=====

EP: Multiple occurrences

Input: value=5, array=[5,2,5,1,5]

Expected: 3

Actual: 3

Status: PASS

EP: Single occurrence

Input: value=2, array=[5,2,5,1,5]

Expected: 1

Actual: 1

Status: PASS

EP: No occurrence

Input: value=3, array=[5,2,5,1,5]

Expected: 0

Actual: 0

Status: PASS

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Single element - found

Input: value=5, array=[5]

Expected: 1

Actual: 1

Status: PASS

BVA: Single element - not found

Input: value=1, array=[5]

Expected: 0

Actual: 0

Status: PASS

BVA: Two identical elements

Input: value=5, array=[5,5]

Expected: 2

Actual: 2

Status: PASS

P3. Binary Search Test Cases

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
v=5, a=[1,3,5,7,9]	2
v=1, a=[1,3,5,7,9]	0

v=9, a=[1,3,5,7,9]	4
v=4, a=[1,3,5,7,9]	-1
v=5, a=[]	-1

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
v=1, a=[1]	0
v=5, a=[5]	0
v=1, a=[1,3]	0
v=3, a=[1,3]	1
v=0, a=[1]	-1

Modified Program :

```
#include <iostream>
#include <string>
using namespace std;
```

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

```
};
```

```
class TestRunner {
```

```
private:
```

```
    BinarySearch searcher;
```

```
    void runTestCase(int value, int arr[], int length, int expectedOutcome,  
        string testType, string description) {  
        int result = searcher.search(value, arr, length);  
        string status = (result == expectedOutcome) ? "PASS" : "FAIL";
```

```
        cout << testType << ": " << description << endl;  
        cout << "Input: value=" << value << ", array=[";  
        for(int i = 0; i < length; i++) {  
            cout << arr[i];  
            if(i < length-1) cout << ",";  
        }  
        cout << "]" << endl;  
        cout << "Expected: " << expectedOutcome << endl;  
        cout << "Actual: " << result << endl;  
        cout << "Status: " << status << endl;  
        cout << string(50, '-') << endl;  
    }
```

```
public:
```

```
    void runEquivalencePartitioningTests() {  
        cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;  
        cout << string(50, '=') << endl;  
  
        int test1[] = {1,3,5,7,9};  
        int test2[] = {1};  
        int test3[] = {1,1,1,1,1};  
  
        runTestCase(5, test1, 5, 2, "EP", "Value in middle");  
        runTestCase(1, test1, 5, 0, "EP", "Value at start");  
        runTestCase(9, test1, 5, 4, "EP", "Value at end"); runTestCase(4,  
        test1, 5, -1, "EP", "Value not present"); runTestCase(1, test2, 1,  
        0, "EP", "Single element array - found");  
        runTestCase(2, test2, 1, -1, "EP", "Single element array - not found");  
    }
```

```
    void runBoundaryValueTests() {  
        cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;  
        cout << string(50, '=') << endl;
```

```
int test1[] = {1};
int test2[] = {1,2};
int test3[] = {1,2,3,4,5};

runTestCase(1, test1, 1, 0, "BVA", "Single element - found");
runTestCase(0, test1, 1, -1, "BVA", "Single element - not found");
runTestCase(1, test2, 2, 0, "BVA", "Two elements - found first");
runTestCase(2, test2, 2, 1, "BVA", "Two elements - found second");
runTestCase(1, test3, 5, 0, "BVA", "Found at first position");
runTestCase(5, test3, 5, 4, "BVA", "Found at last position");
}
};

int main() {
    TestRunner runner;
    runner.runEquivalencePartitioningTests();
    runner.runBoundaryValueTests();
    return 0;
}
```

EQUIVALENCE PARTITIONING TEST CASES

=====

EP: Value in middle

Input: value=5, array=[1,3,5,7,9]

Expected: 2

Actual: 2

Status: PASS

EP: Value at start

Input: value=1, array=[1,3,5,7,9]

Expected: 0

Actual: 0

Status: PASS

EP: Value at end

Input: value=9, array=[1,3,5,7,9]

Expected: 4

Actual: 4

Status: PASS

EP: Value not present

Input: value=4, array=[1,3,5,7,9]

Expected: -1

Actual: -1

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Single element - found

Input: value=1, array=[1]

Expected: 0

Actual: 0

Status: PASS

BVA: Single element - not found

Input: value=0, array=[1]

Expected: -1

Actual: -1

Status: PASS

BVA: Two elements - found first

Input: value=1, array=[1,2]

Expected: 0

Actual: 0

Status: PASS

BVA: Two elements - found second

Input: value=2, array=[1,2]

Expected: 1

Actual: 1

Status: PASS

P4. Triangle Test Cases

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
------------------------------	------------------

a=3, b=3, c=3	EQUILATERAL
a=3, b=3, c=4	ISOSCELES
a=3, b=4, c=5	SCALENE
a=1, b=1, c=3	INVALID
a=0, b=0, c=0	INVALID

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
a=1, b=1, c=1	EQUILATERAL
a=2, b=2, c=3	ISOSCELES
a=3, b=4, c=5	SCALENE
a=1, b=2, c=3	INVALID
a=0, b=1, c=1	INVALID

Modified Program :

```
#include <iostream>
#include <string>
using namespace std;

class Triangle {
public:
    static const int EQUILATERAL = 0;
    static const int ISOSCELES = 1;
    static const int SCALENE = 2;
    static const int INVALID = 3;
```



```

int classify(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;
}
};

class TestRunner {
private:
    Triangle triangle;

    void runTestCase(int a, int b, int c, int expectedOutcome,
                     string testType, string description) {
        int result = triangle.classify(a, b, c);
        string status = (result == expectedOutcome) ? "PASS" : "FAIL";

        cout << testType << ": " << description << endl;
        cout << "Input: a=" << a << ", b=" << b << ", c=" << c << endl;
        cout << "Expected: " << expectedOutcome << endl;
        cout << "Actual: " << result << endl;
        cout << "Status: " << status << endl;
        cout << string(50, '-') << endl;
    }

public:
    void runEquivalencePartitioningTests() {
        cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;
        cout << string(50, '=') << endl;

        runTestCase(5, 5, 5, Triangle::EQUILATERAL, "EP", "Equilateral triangle");
        runTestCase(5, 5, 3, Triangle::ISOSCELES, "EP", "Isosceles triangle");
        runTestCase(3, 4, 5, Triangle::SCALENE, "EP", "Scalene triangle");
        runTestCase(1, 1, 3, Triangle::INVALID, "EP", "Invalid triangle");
        runTestCase(0, 0, 0, Triangle::INVALID, "EP", "Zero sides");
    }

    void runBoundaryValueTests() {
        cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;
        cout << string(50, '=') << endl;
    }
};

```

```
runTestCase(1, 1, 1, Triangle::EQUILATERAL, "BVA", "Minimum equilateral");
runTestCase(2, 2, 3, Triangle::ISOSCELES, "BVA", "Minimum isosceles");
runTestCase(3, 4, 5, Triangle::SCALENE, "BVA", "Minimum scalene");
runTestCase(1, 2, 3, Triangle::INVALID, "BVA", "Just invalid (sum)");
runTestCase(1, 1, 2, Triangle::INVALID, "BVA", "Boundary of invalid");
}
};
```

```
int main() {
    TestRunner runner;
    runner.runEquivalencePartitioningTests();
    runner.runBoundaryValueTests();
    return 0;
}
```

EQUIVALENCE PARTITIONING TEST CASES

EP: Equilateral triangle

Input: a=5, b=5, c=5

Expected: 0

Actual: 0

Status: PASS

EP: Isosceles triangle

Input: a=5, b=5, c=3

Expected: 1

Actual: 1

Status: PASS

EP: Scalene triangle

Input: a=3, b=4, c=5

Expected: 2

Actual: 2

Status: PASS

EP: Invalid triangle

Input: a=1, b=1, c=3

Expected: 3

Actual: 3

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Minimum equilateral

Input: a=1, b=1, c=1

Expected: 0

Actual: 0

Status: PASS

BVA: Minimum isosceles

Input: a=2, b=2, c=3

Expected: 1

Actual: 1

Status: PASS

BVA: Minimum scalene

Input: a=3, b=4, c=5

Expected: 2

Actual: 2

Status: PASS

BVA: Just invalid (sum)

Input: a=1, b=2, c=3

Expected: 3

Actual: 3

Status: PASS

P5. Prefix Test Cases

Equivalence Partitioning

Tester Action and Input Data	Expected Outcome
s1="he", s2="hello"	true
s1="hi", s2="hello"	false
s1="", s2="hello"	true
s1="hello", s2="he"	false
s1="hello", s2="hello"	true

Boundary Value Analysis

Tester Action and Input Data	Expected Outcome
s1="", s2=""	true
s1="a", s2="a"	true
s1="a", s2="ab"	true
s1="ab", s2="a"	false
s1="abc", s2="abcd"	true

Modified Program :

```
#include <iostream>
#include <string>
using namespace std;

class Prefix {
public:
    bool isPrefix(string s1, string s2) {
        if (s1.length() > s2.length())
```

```

        return false;
    for (int i = 0; i < s1.length(); i++) {
        if (s1[i] != s2[i])
            return false;
    }
    return true;
}
};

```

```

class TestRunner {

```

```

private:

```

```

    Prefix prefix;

```

```

    void runTestCase(string s1, string s2, bool expectedOutcome,
                     string testType, string description) {
        bool result = prefix.isPrefix(s1, s2);
        string status = (result == expectedOutcome) ? "PASS" : "FAIL";

```

```

        cout << testType << ": " << description << endl;
        cout << "Input: s1=\"\" << s1 << "\", s2=\"\" << s2 << "\"\" << endl;
        cout << "Expected: " << (expectedOutcome ? "true" : "false") << endl;
        cout << "Actual: " << (result ? "true" : "false") << endl;
        cout << "Status: " << status << endl;
        cout << string(50, '-') << endl;
    }

```

```

public:

```

```

    void runEquivalencePartitioningTests() {
        cout << "\nEQUIVALENCE PARTITIONING TEST CASES" << endl;
        cout << string(50, '=') << endl;

```

```

        runTestCase("", "abc", true, "EP", "Empty string prefix");
        runTestCase("abc", "abc", true, "EP", "Equal strings");
        runTestCase("ab", "abc", true, "EP", "Proper prefix");
        runTestCase("abc", "ab", false, "EP", "First longer than second");
        runTestCase("abc", "def", false, "EP", "No match");
    }

```

```

    void runBoundaryValueTests() {
        cout << "\nBOUNDARY VALUE ANALYSIS TEST CASES" << endl;
        cout << string(50, '=') << endl;

```

```

        runTestCase("", "", true, "BVA", "Both empty strings");
        runTestCase("a", "a", true, "BVA", "Single character - match");

```

```
        runTestCase("a", "b", false, "BVA", "Single character - no match");
        runTestCase("a", "ab", true, "BVA", "Single char prefix");
        runTestCase("ab", "abc", true, "BVA", "All but last char");
    }
};

int main() {
    TestRunner runner;
    runner.runEquivalencePartitioningTests();
    runner.runBoundaryValueTests();
    return 0;
}
```

EQUIVALENCE PARTITIONING TEST CASES

=====

EP: Empty string prefix

Input: s1="", s2="abc"

Expected: true

Actual: true

Status: PASS

EP: Equal strings

Input: s1="abc", s2="abc"

Expected: true

Actual: true

Status: PASS

EP: Proper prefix

Input: s1="ab", s2="abc"

Expected: true

Actual: true

Status: PASS

EP: First longer than second

Input: s1="abc", s2="ab"

Expected: false

Actual: false

BOUNDARY VALUE ANALYSIS TEST CASES

=====

BVA: Both empty strings

Input: s1="", s2=""

Expected: true

Actual: true

Status: PASS

BVA: Single character - match

Input: s1="a", s2="a"

Expected: true

Actual: true

Status: PASS

BVA: Single character - no match

Input: s1="a", s2="b"

Expected: false

Actual: false

Status: PASS

BVA: Single char prefix

Input: s1="a", s2="ab"

Expected: true

Actual: true

Status: PASS

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. Determine the following for the above program:

a) Identify the equivalence classes for the system:

1. Valid Triangle Classes:
 - EC1: Equilateral triangles (all sides equal)
 - EC2: Isosceles triangles (exactly two sides equal)
 - EC3: Scalene triangles (no sides equal)
 - EC4: Right-angled triangles ($a^2 + b^2 = c^2$)
2. Invalid Triangle Classes:
 - EC5: Non-triangle (sum of any two sides \leq third side)
 - EC6: Negative numbers for any side
 - EC7: Zero value for any side
 - EC8: Numbers too large for float representation

b) Test cases covering identified equivalence classes:

1. EC1 (Equilateral):
 - Test case: (5.0, 5.0, 5.0)
 - Test case: (10.0, 10.0, 10.0)
2. EC2 (Isosceles):
 - Test case: (5.0, 5.0, 3.0)
 - Test case: (4.0, 3.0, 4.0)
 - Test case: (3.0, 4.0, 4.0)
3. EC3 (Scalene):
 - Test case: (3.0, 4.0, 6.0)
 - Test case: (5.0, 7.0, 9.0)
4. EC4 (Right-angled):
 - Test case: (3.0, 4.0, 5.0)
 - Test case: (6.0, 8.0, 10.0)
5. EC5 (Invalid - sum):
 - Test case: (1.0, 1.0, 3.0)
 - Test case: (2.0, 3.0, 6.0)
6. EC6 (Negative):
 - Test case: (-1.0, 2.0, 3.0)
 - Test case: (1.0, -2.0, 3.0)

7. EC7 (Zero):

- Test case: (0.0, 2.0, 3.0)
- Test case: (1.0, 0.0, 3.0)

c) Boundary test cases for $A + B > C$ (scalene triangle):

1. Just below boundary (invalid):
 - Test case: (3.0, 4.0, 7.001)
 - Test case: (5.0, 6.0, 11.001)
2. On boundary (invalid):
 - Test case: (3.0, 4.0, 7.0)
 - Test case: (5.0, 6.0, 11.0)
3. Just above boundary (valid):
 - Test case: (3.0, 4.0, 6.999)
 - Test case: (5.0, 6.0, 10.999)

d) Boundary test cases for $A = C$ (isosceles triangle):

1. Just below equality:
 - Test case: (5.0, 3.0, 4.999)
2. Exact equality:
 - Test case: (5.0, 3.0, 5.0)
3. Just above equality:
 - Test case: (5.0, 3.0, 5.001)

e) Boundary test cases for $A = B = C$ (equilateral triangle):

1. Just below equality:
 - Test case: (5.0, 4.999, 5.0)
2. Exact equality:
 - Test case: (5.0, 5.0, 5.0)
3. Just above equality:
 - Test case: (5.0, 5.001, 5.0)

f) Boundary test cases for $A^2 + B^2 = C^2$ (right-angle triangle):

1. Just below right angle:
 - Test case: (3.0, 4.0, 4.999)
2. Exact right angle:
 - Test case: (3.0, 4.0, 5.0)
3. Just above right angle:
 - Test case: (3.0, 4.0, 5.001)

g) Boundary test cases for non-triangle:

1. Just below triangle inequality:

- Test case: (2.0, 3.0, 5.001)
- 2. On triangle inequality:
 - Test case: (2.0, 3.0, 5.0)
- 3. Just above triangle inequality:
 - Test case: (2.0, 3.0, 4.999)

h) Test points for non-positive input:

- 1. Zero values:
 - Test case: (0.0, 4.0, 5.0)
 - Test case: (3.0, 0.0, 5.0)
 - Test case: (3.0, 4.0, 0.0)
- 2. Negative values:
 - Test case: (-0.001, 4.0, 5.0)
 - Test case: (3.0, -0.001, 5.0)
 - Test case: (3.0, 4.0, -0.001)
- 3. Just above zero:
 - Test case: (0.001, 4.0, 5.0)
 - Test case: (3.0, 0.001, 5.0)
 - Test case: (3.0, 4.0, 0.001)