SOFTWARETESTINGLABORATORY

Subject Code:	15ISL76		**Credits:**	2
Course Type:	L		**CIE Marks:**	25
Hours/week: L – T – P	0-0-3		**SEE Marks:**	25
Total Hours:	40		**SEE Duration:**	3 Hours

PART-A

1 Design and develop a program in a language of your choice to solve the **triangle problem** defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on **decision-table** approach, execute the test cases and discuss the results.

2 Design and develop a program in a language of your choice to solve the **triangle problem** defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on **boundary-value analysis**, execute the test cases and discuss the results.

3 Design and develop a program in a language of your choice to solve the **triangle problem** defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on **equivalence class** partitioning, execute the test cases and discuss the results.

4 Design, develop, code and run the program in any suitable language to solve the **commission problem**. Analyze it from the perspective of **data flow testing**, derive different test cases, execute these test cases and discuss the test results..

5 Design, develop, code and run the program in any suitable language to solve the **commission problem**. Analyze it from the perspective of **decision table-based testing**, derive different test cases, execute these test cases and discuss the test results.

PART-B

6 Design, develop, code and run the program in any suitable language to implement the **binary search algorithm**. Determine the **basis paths** and using them derive different test cases, execute these test cases and discuss the test results.

7 Design, develop, code and run the program in any suitable language to implement the **quicksort algorithm**. Determine the **basis paths** and using them derive different test cases, execute these test cases and discuss the test results

8 Design, develop, code and run the program in any suitable language to

implement an absolute **letter grading procedure**, making suitable assumptions. Determine the **basis paths** and using them derive different test cases, execute these test cases and discuss the test results.

9 Design, develop, code and run the program in any suitable language to implement the **NextDate function**. Analyze it from the perspective of **equivalence class value testing**, derive different test cases, execute these test cases and discuss the test results.

10 Demonstration of test case developments based on boundary values analysis or equivalence class using the software testing tools like 'SELENIUM'.

1. Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on decision-table approach, execute the test cases and discuss the results.

1.1 REQUIREMENTS:

R1. The system should accept 3 positive integer numbers (a, b, c) which represents 3 sides of the triangle. Based on the input it should determine if a triangle can be formed or not.

R2. If the requirement R1 is satisfied then the system should determine the type of the triangle, which can be

- Equilateral (i.e. all the three sides are equal)
- Isosceles (i.e Two sides are equal)
- Scalene (i.e All the three sides are unequal)

else suitable error message should be displayed. Here we assume that user gives three positive integer numbers as input.

1.2 DESIGN:

Form the given requirements we can draw the following conditions: C1:
a<b+c?
C2: b<a+c?
C3: c<a+b?
C4: a=b?
C5: a=c?
C6: b=c?

According to the property of the triangle, if any one of the three conditions C1, C2 and C3 are not satisfied then triangle cannot be constructed. So only when C1, C2 and C3 are true the triangle can be formed, then depending on conditions C4, C5 and C6 we can decide what type of triangle will be formed. (i.e requirement R2).

ALGORITHM:

Step 1: Input a, b & c i.e three integer values which represent three sides of the triangle.
Step 2: if (a < (b + c)) and (b < (a + c)) and (c < (a + b) then do
 step 3
 else

 print not a triangle. do step 6.

Step 3: if (a=b) and (b=c) then
 Print triangle formed is equilateral. do step 6.
Step 4: if (a ≠ b) and (a ≠ c) and (b ≠ c) then
 Print triangle formed is scalene. do step 6.
Step 5: Print triangle formed is Isosceles.
Step 6: stop

1.3 PROGRAM CODE:

```
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<process.h>
 int main()
 {
	int a, b, c;
	clrscr();
	printf("Enter three sides of the triangle");
	scanf("%d%d%d", &a, &b, &c);
	if((a<b+c)&&(b<a+c)&&(c<a+b))
	{
		if((a==b)&&(b==c))
		{
			printf("Equilateral triangle");
		}
		else if((a!=b)&&(a!=c)&&(b!=c))
		{
			printf("Scalene triangle");
			}
			else
```

```
}
else
{
printf("Isosceles triangle");

printf("triangle cannot be formed");
}
getch();
return 0;
}
```

1.4
TESTING:

Technique Used: Decision Table Approach

Decision Table-Based Testing has been around since the early 1960's; it is used to depict complex logical relationships between input data. A Decision Table is the method used to build a complete set of test cases without using the internal structure of the program in question. In order to create test cases we use a table to contain the input and output values of a program.

The decision table is as given below:

Conditions	**Condition Entries (Rules)**										
	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11
C1: a<b+c?	F	T	T	T	T	T	T	T	T	T	T
C2: b<a+c?	--	F	T	T	T	T	T	T	T	T	T
C3: c<a+b?	--	--	F	T	T	T	T	T	T	T	T
C4: a=b?	--	--	--	F	T	T	T	F	F	F	T
C5: a=c?	--	--	--	T	F	T	F	T	F	F	T
C6: b=c?	--	--	--	T	T	F	F	F	T	F	T
Actions	**Action Entries**										
a1: Not a Triangle	X	X	X								
a2: Scalene										X	
a3: Isosceles							X	X	X		
a4: Equilateral											X
a5: Impossible				X	X	X					

The "--" symbol in the table indicates don't care values. The table shows the six conditions and 5 actions. All the conditions in the decision table are binary; hence, it is called as "Limited Entry decision table".

Each column of the decision table represents a test case. That is, The table is read as follows:

Action: Not a Triangle

1. When condition C1 is false we can say that with the given ‘a’ ‘b’ and ‘c’ values, it’s Not a triangle.

2. Similarly condition C2 and C3, if any one of them are false, we can say that with the given ‘a’ ‘b’ and ‘c’ values it’s Not a triangle.

Action: Impossible

3. When conditions C1, C2, C3 are true and two conditions among C4, C5, C6 is true, there is no chance of one conditions among C4, C5, C6 failing. So we can neglect these rules.

Example: if condition C4: a=b is true and C5: a=c is true

Then it is impossible, that condition C6: b=c will fail, so the action is Impossible.

Action: Isosceles

4. When conditions C1, C2, C3 are true and any one condition among C4, C5 and C6 is true with remaining two conditions false then action is Isosceles triangle.

Example: If condition C4: a=b is true and C5: a=c and C6: b=c are false, it means two sides are equal. So the action will be Isosceles triangle.

Action: Equilateral

5. When conditions C1, C2, C3 are true and also conditions C4, C5 and C6 are true then, the action is Equilateral triangle.

Action: Scalene

6. When conditions C1, C2, C3 are true and conditions C4, C5 and C6 are false i.e sides a, b and c are different, then action is Scalene triangle.

Number of Test Cases = Number of Rules.

Using the decision table we obtain 11 functional test cases: 3 impossible cases, 3 ways of failing the triangle property, 1 way to get an equilateral triangle, 1 way to get a scalene triangle, and 3 ways to get an isosceles triangle.

Deriving test cases using

Decision Table Approach:

Test Cases:

TC ID	**Test Case Description**	**a**	**B**	**c**	**Expected Output**	**Actual Output**	**Status**
1	Testing for Requirement 1	4	1	2	Not a Triangle		
2	Testing for Requirement 1	1	4	2	Not a Triangle		
3	Testing for Requirement 1	1	2	4	Not a Triangle		
4	Testing for Requirement 2	5	5	5	Equilateral		
5	Testing for Requirement 2	2	2	3	Isosceles		
6	Testing for Requirement 2	2	3	2	Isosceles		
7	Testing for Requirement 2	3	2	2	Isosceles		
8	Testing for Requirement 2	3	4	5	Scalene		

1.5 EXECUTION & RESULT DISCUSION

Execute the program against the designed test cases and complete the table for Actual output column and status column.

Test Report:

1. No of TC's Executed: 08
2. No of Defects Raised:
3. No of TC's Pass:

,

4. No of TC’s Failed:

The decision table technique is indicated for applications characterised by any of the following:

Prominent if-then-else logic

Logical relationships among input variables

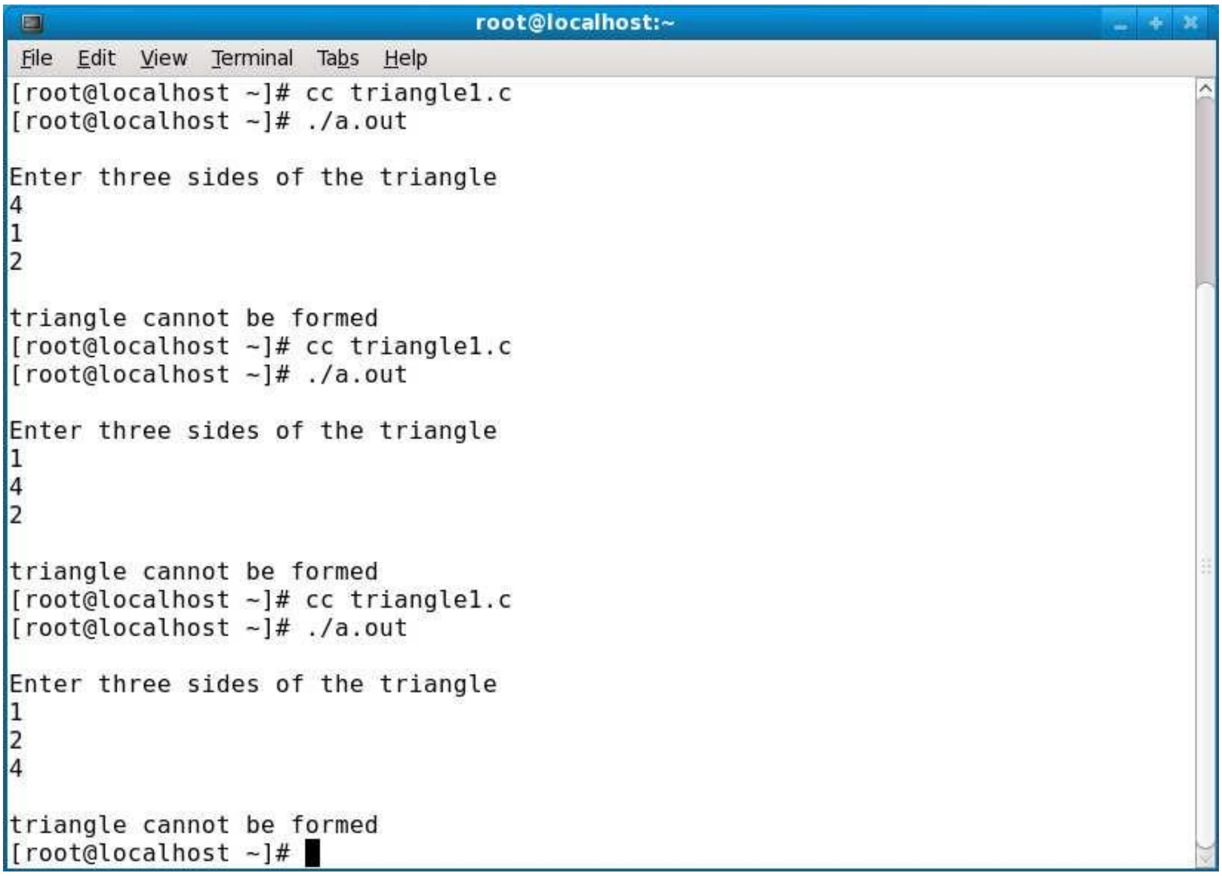
Calculations involving subsets of the input variables

Cause-and-effect relationship between inputs and outputs

The decision table-based testing works well for triangle problem because a lot of decision making i.e if-then-else logic takes place.

1.6 SNAPSHOTS:

1. Output screen of Triangle cannot be formed



,

2. Output screen of Equilateral and Isosceles Triangle.

```
root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# cc triangle1.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
5

Equilateral triangle
[root@localhost ~]# cc triangle1.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
2
2
3

Isosceles triangle
[root@localhost ~]# cc triangle1.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
2
3
2

Isosceles triangle
[root@localhost ~]#
```

3. Output screen for Scalene Triangle

```
root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# cc triangle1.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
3
2
2

Isosceles triangle
[root@localhost ~]# cc triangle1.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
3
4
5

Scalene triangle
[root@localhost ~]#
```

1.7. REFERENCES:

1. Requirement Specification
2. Assumptions

2. Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.

2.1 REQUIREMENTS

R1. The system should accept 3 positive integer numbers (a, b, c) which represents 3 sides of the triangle.

R2. Based on the input should determine if a triangle can be formed or not.

R3. If the requirement R2 is satisfied then the system should determine the type of the triangle, which can be

- Equilateral (i.e. all the three sides are equal)
- Isosceles (i.e Two sides are equal)
- Scalene (i.e All the three sides are unequal)

R4. Upper Limit for the size of any side is 10

2.2 DESIGN

ALGORITHM:

Step 1: Input a, b & c i.e three integer values which represent three sides of the triangle.

Step 2: if (a < (b + c)) and (b < (a + c)) and (c < (a + b) **then do**

step 3

else

print not a triangle. **do** step 6.

Step 3: if (a=b) and (b=c) **then**

Print triangle formed is equilateral. **do** step 6.

Step 4: if (a ≠ b) and (a ≠ c) and (b ≠ c) **then**

Print triangle formed is scalene**. do** step 6.

,

Step 5: Print triangle formed is Isosceles.
Step 6: stop

2.3 PROGRAM CODE:

```
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<process.h>
 int main()
 {
	int a, b, c;
	clrscr();
	printf("Enter three sides of the triangle");
	scanf("%d%d%d", &a, &b, &c);
	if((a > 10) || (b > 10) || (c > 10))
	{
		printf("Out of range");
		getch();
		exit(0);
	}
	if((a<b+c)&&(b<a+c)&&(c<a+b))
	{
		if((a==b)&&(b==c))
		{
			printf("Equilateral triangle");
		}
		else if((a!=b)&&(a!=c)&&(b!=c))
		{
			printf("Scalene triangle");
		}
		else
			printf("Isosceles triangle");
	}
	else
```

,

```
        {
                printf("triangle cannot be formed");
        }
getch();
return 0;
}
```

2.4 TESTING

1. **Technique used: Boundary value analysis**
2. **Test Case design**

For BVA problem the test cases can be generation depends on the output and the constraints on the output. Here we least worried on the constraints on Input domain.

The Triangle problem takes 3 sides as input and checks it for validity, hence n = 3. Since BVA yields (4n + 1) test cases according to single fault assumption theory, hence we can say that the total number of test cases will be (4*3+1) =12+1=13.

The maximum limit of each sides a, b, and c of the triangle is 10 units according to requirement R4. So a, b and c lies between

$0 \le a \le 10$

$0 \le b \le 10$

$0 \le c \le 10$

Equivalence classes for a:

E1: Values less than 1.

E2: Values in the range.

E3: Values greater than 10.

Equivalence classes for b:

E4: Values less than 1.

,

E5: Values in the range.
E6: Values greater than 10.

Equivalence classes for c:
E7: Values less than 1.
E8: Values in the range.
E9: Values greater than 10.

From the above equivalence classes we can derive the following test cases using boundary value analysis approach.

TC Id	**Test Case Description**	**Input Data**			**Expected Output**	**Actual Output**	**Status**
		A	**b**	**C**			
1	For A input is not given	X	3	6	Not a Triangle		
2	For B input is not given	5	X	4	Not a Triangle		
3	For C input is not given	4	7	X	Not a Triangle		
4	Input of C is in negative(-)	5	5	-1	Not a Triangle		
5	Two sides are same one side is given different input	5	5	1	Isosceles		
6	All Sides of inputs are equal	5	5	5	Equilateral		
7	Two sides are same one side is given different input	5	5	9	Isosceles		
8	The input of C is out of range (i.e., range is <10)	5	5	10	Not a Triangle		

9	Two sides are same one side is given different input (i.e., A & C are 5, B=1)	5	1	5	Isosceles		
10	Two sides are same one side is given different input (i.e., A & C are 5, B=2)	5	2	5	Isosceles		
11	Two sides are same one side is given different input (i.e., A & C are 5, B=9)	5	9	5	Isosceles		
12	Two sides are same one side is given different input (i.e., A & C are 5, B=10 so, it is out of given range)	5	10	5	Not a Triangle		
13	Two sides are same one side is given different input (i.e., B & C are 5, A=1)	1	5	5	Isosceles		
14	Two sides are same one side is given different input (i.e., B & C are 5, A=2)	2	5	5	Isosceles		
15	Two sides are same one side is	9	5	5	Isosceles		

	given different input (i.e., B & C are 5, A=9)						
16	Two sides are same one side is given different input (i.e., B & C are 5, A=10, so the given input of A is out of range)	10	5	5	Not a Triangle		

Table-1: Test case for Triangle Problem

2.5 EXECUTION:

Execute the program and test the test cases in Table-1 against program and complete the table with for Actual output column and Status column

Test Report:

1. No of TC's Executed:
2. No of Defects Raised:
3. No of TC's Pass:
4. No of TC's Failed:

,

2.6 SNAPSHOTS:

1. Snapshot of Isosceles and Equilateral triangle and triangle can not be formed.

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
-1

triangle cannot be formed
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
1

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
5

Equilateral triangle
[root@localhost ~]# 
```

2. Snapshot for Isosceles and triangle cannot be formed

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
9

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
10

triangle cannot be formed
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
1
5

Isosceles triangle
[root@localhost ~]# 
```

,

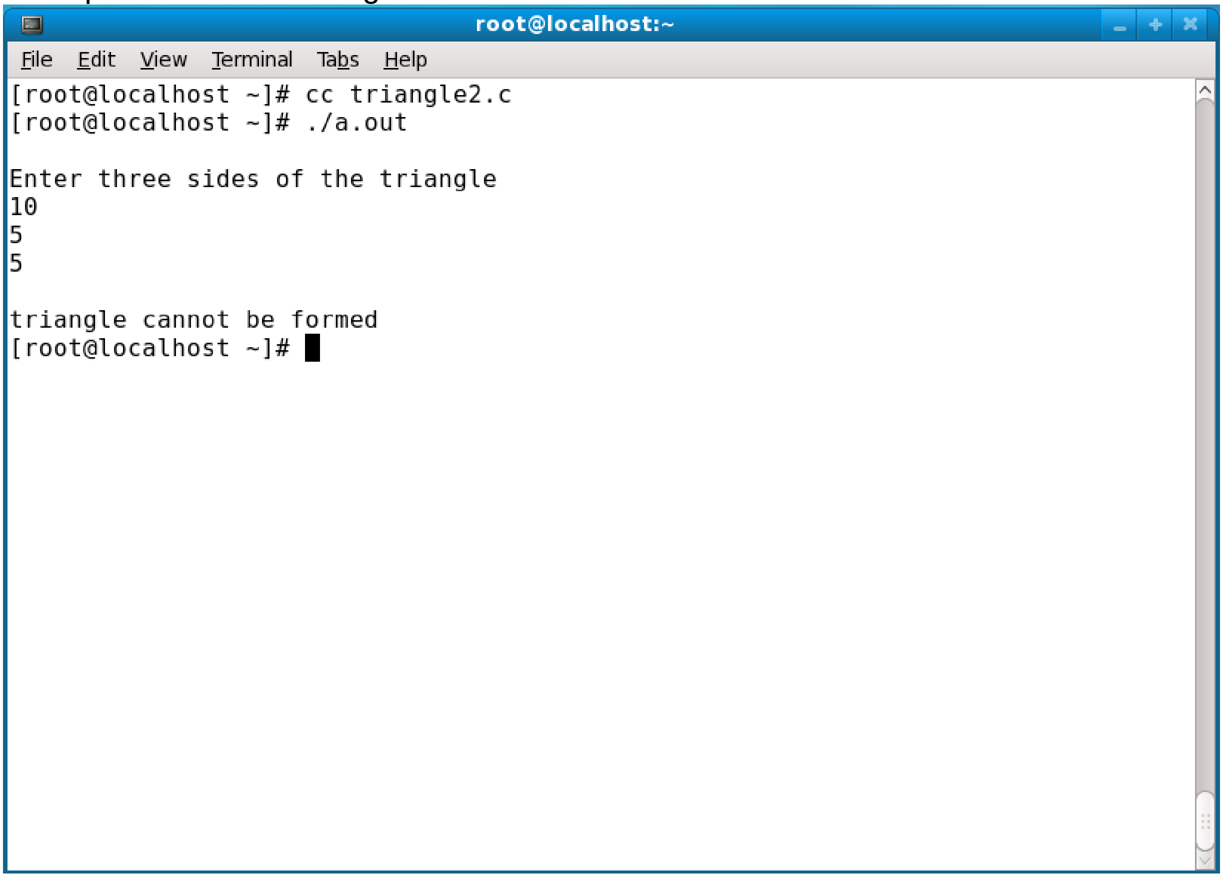
3. Snapshot for Isosceles and triangle cannot be formed

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
2
5

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
9
5

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
10
5

triangle cannot be formed
[root@localhost ~]#
```

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
1
5
5

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
2
5
5

Isosceles triangle
[root@localhost ~]# cc triangle2.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
9
5
5

Isosceles triangle
[root@localhost ~]#
```

,

4. Output screen for Triangle cannot be formed



2.7 REFERENCES:

1. Requirement Specification
2. Assumptions

3. Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on equivalence class partitioning, execute the test cases and discuss the results.

3.1 REQUIREMENTS

R1. The system should accept 3 positive integer numbers (a, b, c) which represents 3 sides of the triangle.

R2. Based on the input should determine if a triangle can be formed or not. **R3.** If the requirement R2 is satisfied then the system should determine the type of the triangle, which can be

- Equilateral (i.e. all the three sides are equal)
- Isosceles (i.e. two sides are equal)
- Scalene (i.e. All the three sides are unequal)

R4. Upper Limit for the size of any side is 10

3.2 DESIGN

Form the given requirements we can draw the following conditions:

C1: a<b+c?

C2: b<a+c?

C3: c<a+b?

C4: a=b?

C5: a=c?

C6: b=c?

According to the property of the triangle, if any one of the three conditions C1, C2 and C3 are not satisfied then triangle cannot be constructed. So only when C1, C2 and C3 are true the triangle can be formed, then depending on conditions C4, C5 and C6 we can decide what type of triangle will be formed. (i.e requirement R3).

,

ALGORITHM:

Step 1: Input a, b & c i.e three integer values which represent three sides of the triangle.
Step 2: if (a < (b + c)) and (b < (a + c)) and (c < (a + b) **then do**
step 3
else
print not a triangle. **do** step 6.
Step 3: if (a=b) and (b=c) **then**
Print triangle formed is equilateral. **do** step 6.
Step 4: if (a ≠ b) and (a ≠ c) and (b ≠ c) **then**
Print triangle formed is scalene**. do** step 6.
Step 5: Print triangle formed is Isosceles. **Step 6: stop**

3.3 PROGRAM CODE

```
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<process.h>
 int main()
 {
        int a, b, c;
        clrscr();
        printf("Enter three sides of the triangle");
        scanf("%d%d%d", &a, &b, &c);
        if((a > 10) || (b > 10) || (c > 10))
        {
                printf("Out of range");
                getch();
                exit(0);
        }
        if((a<b+c)&&(b<a+c)&&(c<a+b))
        {
```

,

```
            if((a==b)&&(b==c))
            {
                printf("Equilateral triangle");
            }
            else if((a!=b)&&(a!=c)&&(b!=c))
            {
                printf("Scalene triangle");
            }
            else
                printf("Isosceles triangle");
        }
        else
        {
            printf("triangle cannot be formed");
        }
getch();
return 0;
}
```

3.4 TESTING

1. **Technique used: Equivalence class partitioning**
2. **Test Case design**

   Equivalence class partitioning technique focus on the Input domain, we can obtain a richer set of test cases. What are some of the possibilities for the three integers, a, b, and c? They can all be equal, exactly one pair can be equal.

   The maximum limit of each side a, b, and c of the triangle is 10 units according to requirement R4. So a, b and c lies between

   $0 \le a \le 10$

   $0 \le b \le 10$

   $0 \le c \le 10$

,

First Attempt

Weak normal equivalence class: In the problem statement, we note that four possible outputs can occur: Not a Triangle, Scalene, Isosceles and Equilateral. We can use these to identify output (range) equivalence classes as follows:

R_1= {<a,b,c>: the triangle with sides a, b, and c is equilateral} R_2=
{<a,b,c>: the triangle with sides a, b, and c is isosceles}
R_3= {<a,b,c>: the triangle with sides a, b, and c is scalene}
R_4= {<a,b,c>: sides a, b, and c do not form a triangle}

Four weak normal equivalence class test cases, chosen arbitrarily from each class, and invalid values for weak robust equivalence class test cases are as follows.

TC Id	**Test Case Description**	**Input Data**			**Expected Output**	**Actual Output**	**Status**
		a	**b**	**c**			
1	WN1	5	5	5	Equilateral		
2	WN2	2	2	3	Isosceles		
3	WN3	3	4	5	Scalene		
4	WN4	4	1	2	Not a Triangle		
5	WR1	-1	5	5	Value of a is not in the range of permitted values		
6	WR2	5	-1	5	Value of b is not in the range of permitted values		
7	WR3	5	5	-1	Value of c is not in the range of permitted values		
8	WR4	11	5	5	Value of a is not in the range of permitted values		

,

9	WR5	5	11	5	Value of b is not in the range of permitted values		
10	WR6	5	5	11	Value of c is not in the range of permitted values		

Table-1: Weak Normal and Weak Robust Test case for Triangle Problem

Second attempt

The strong normal equivalence class test cases can be generated by using following possibilities:

D1 = {<a, b, c>: a=b=c}
D2 = {<a, b, c>: a=b, a≠ c}
D3= {<a, b, c>: a=c, a≠ b}
D4 = {<a, b, c>: b=c, a≠ b}
D5 = {<a, b, c>: a≠ b, a≠ c, b≠ c}
D6 = {<a, b, c>: a≥ b+ c}
D7 = {<a, b, c>: b≥ a+ c}
D8 = {<a, b, c>: c≥ a+ b}

TC Id	**Test Case Description**	**Input Data**			**Expected Output**	**Actual Output**	**Status**
		a	**b**	**c**			
1	SR1	-1	5	5	Value of a is not in the range of permitted values		
2	SR 2	5	-1	5	Value of b is not in the range of permitted values		
3	SR3	5	5	-1	Value of c is not in the range of permitted values		
4	SR4	-1	-1	5	Value of a, b is not in the range of permitted values		

,

5	SR5	5	-1	-1	Value of b, c is not in the range of permitted values		
6	SR6	-1	5	-1	Value of a, c is not in the range of permitted values		
7	SR7	-1	-1	-1	Value of a, b, c is not in the range of permitted values		

Table-2: Strong Robust Test case for Triangle Problem

3.5 EXECUTION:

Execute the program and test the test cases in Table-1 and Table-2 against program and complete the table with for Actual output column and Status column

Test Report:

1. No of TC's Executed:
2. No of Defects Raised:
3. No of TC's Pass:
4. No of TC's Failed:

,

3.6 SNAPSHOTS:

1. Snapshot of Equilateral. Isosceles and scalene triangle.

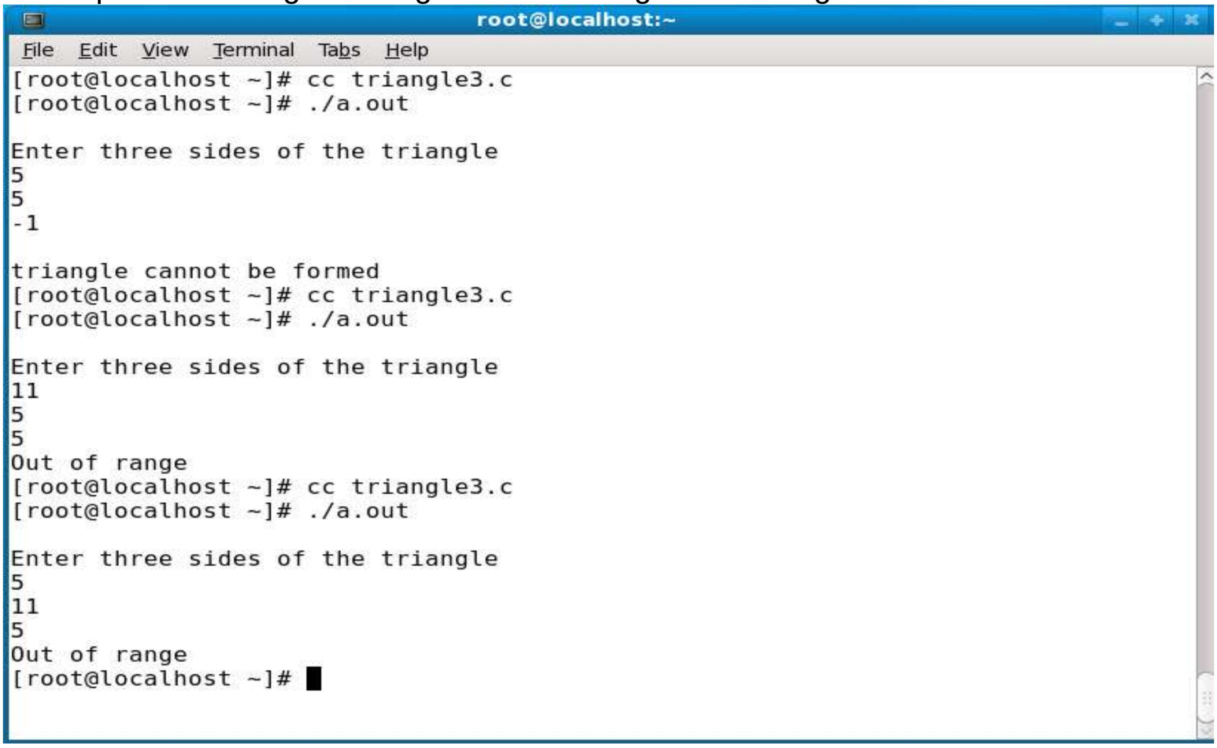
```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
5

Equilateral triangle
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
2
2
3

Isosceles triangle
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
3
4
5

Scalene triangle
[root@localhost ~]#
```

2. Snapshot for Triangle cannot be formed

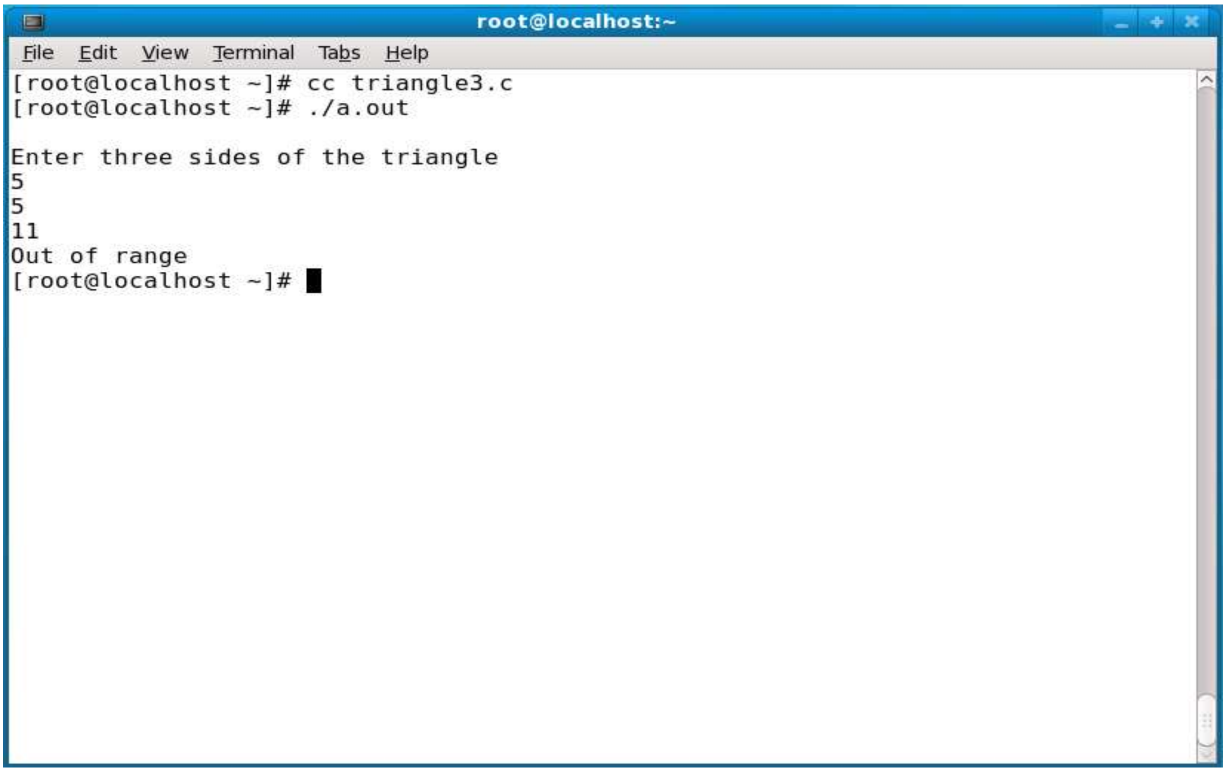
```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
4
1
2

triangle cannot be formed
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
-1
5
5

triangle cannot be formed
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
-1
5

triangle cannot be formed
[root@localhost ~]#
```

,

3. Snapshot for the given range is Out of range and Triangle cannot be formed.



```
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
-1

triangle cannot be formed
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
11
5
5
Out of range
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
11
5
Out of range
[root@localhost ~]#
```



```
[root@localhost ~]# cc triangle3.c
[root@localhost ~]# ./a.out

Enter three sides of the triangle
5
5
11
Out of range
[root@localhost ~]#
```

,

3.7 REFERENCES

1. Requirement Specification
2. Assumptions

4. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive different test cases, execute these test cases and discuss the test results.

4.1 REQUIREMENT SPECIFICATION

Problem Definition: The Commission Problem includes a salesperson in the former Arizona Territory sold rifle locks, stocks and barrels made by a gunsmith in Missouri. Cost includes

Locks- $45

Stocks- $30

Barrels- $25

The salesperson had to sell at least one complete rifle per month and production limits were such that the most the salesperson could sell in a month was 70 locks, 80 stocks and 90 barrels.

After each town visit, the sales person sent a telegram to the Missouri gunsmith with the number of locks, stocks and barrels sold in the town. At the end of the month, the salesperson sent a very short telegram showing -
-1 lock sold. The gunsmith then knew the sales for the month were complete and computed the salesperson's commission as follows:

On sales up to(and including) $1000= 10% On

the sales up to(and includes) $1800= 15% On the

sales in excess of $1800= 20%

The commission program produces a monthly sales report that gave the total number of locks, stocks and barrels sold, the salesperson's total dollar sales and finally the commission

4.2 DESIGN

Algorithm

STEP 1: Define lockPrice=45.0, stockPrice=30.0, barrelPrice=25.0

STEP2: Input locks

,

STEP3: while(locks!=-1) ‘input device uses -1 to indicate end of data goto STEP 12

STEP4:input (stocks, barrels)

STEP5: compute lockSales, stockSales, barrelSales and sales

STEP6: output(“Total sales:” sales)

STEP7: if (sales > 1800.0) goto STEP 8 else goto STEP 9

STEP8: commission=0.10*1000.0; commission=commission+0.15 * 800.0;

commission = commission + 0.20 * (sales-1800.0) STEP9: if

(sales > 1000.0) goto STEP 10 else goto STEP 11

STEP10: commission=0.10* 1000.0; commission=commission + 0.15 * (sales-1000.0)

STEP11: Output(“Commission is $”, commission)

STEP12: exit

4.3 PROGRAM CODE:

```
#include<stdio.h>
#include<conio.h>
int main()
{
	int locks, stocks, barrels, t_sales, flag = 0;
	float commission;
	clrscr();
	printf("Enter the total number of locks");
	scanf("%d",&locks);
	if ((locks <= 0) || (locks > 70))
	{
		flag = 1;
	}
```

,

```
printf("Enter the total number of stocks");
scanf("%d",&stocks);
if ((stocks <= 0) || (stocks > 80))
{
        flag = 1;
}
printf("Enter the total number of barrelss");
scanf("%d",&barrels);
if ((barrels <= 0) || (barrels > 90))
{
        flag = 1;
}
if (flag == 1)
{
        printf("invalid input");
        getch();
        exit(0);
}
t_sales = (locks * 45) + (stocks * 30) + (barrels * 25);
if (t_sales <= 1000)
{
        commission = 0.10 * t_sales;
}
else if (t_sales < 1800)
{
        commission = 0.10 * 1000;
        commission = commission + (0.15 * (t_sales - 1000));
}
else
{
        commission = 0.10 * 1000;
        commission = commission + (0.15 * 800);
        commission = commission + (0.20 * (t_sales - 1800));
}
```

,

```
    printf("The total sales is %d \n The commission is %f",t_sales,
commission);
    getch();
    return;
}
```

4.4 TESTING TECHNIQUE: DATAFLOW TESTING

A structural testing technique

• Aims to execute sub-paths from points where each variable is defined to points where it is referenced. These sub-paths are called definition-use pairs, or du-pairs (du-paths, du-chains) Data flow testing is centred on variables (data) Data flow testing follows the sequences of events related to a given data item with the objective to detect incorrect sequences It explores the effect of using the value produced by every and each computation.

Variable definition

Occurrences of a variable where a variable is given a new value (assignment, input by the user, input from a file, etc.) Variable DECLARATION is NOT its definition !!!

• **Variable uses**

Occurences of a variable where a variable is not given a new value (variable DECLARATION is NOT its use)

p-uses (predicate uses)

Occur in the predicate portion of a decision statement such as if-then-else, while-do etc.

c-uses (computation uses)

All others, including variable occurrences in the right hand side of an assignment statement, or an output statement

,

• **du-path:** A sub-path from a variable definition to its use. Test case definitions based on four groups of coverage

– All definitions.

– All c-uses.

– All p-uses.

– All du-paths.

DATA FLOW TESTING: KEY STEPS

Given a code (program or pseudo-code).

1. Number the lines.
2. List the variables.
3. List occurrences & assign a category to each variable.
4. Identify du-pairs and their use (p- or c-).
5. Define test cases, depending on the required coverage.

line	**catogary**		
	Definition	**c-use**	**p-use**
1			
2			
3			
4			
5			
6			
7			
8			
9	locks, stocks, barrels		
10			locks, stocks, barrels
11			
12	Flag		
13			
14			flag
15			
16			
17			

,

18			
19			
20	t_sales	locks, stocks, barrels	
21			t_sales
22			
23	commission	t_sales	
24			
25			t_sales
26			
27	commission		
28	commission	commission, t_sales	
29			
30			
31			
32	commission		
33	commission	commission	
34	commission	commission, t_sales	
35			
36		commission	
37			
38			
39			

Fig: list occurrences & assign a category to each variable

,

definition - use pair	variables()	
start line → end line	c-use	p-use
9→10		locks
9→10		stocks
9→10		barrels
9→20	locks	
9→20	stocks	
9→20	barrels	
12→14		flag
20→21		t_sales
20→23	t_sales	
20→25		t_sales
20→28	t_sales	
20→34	t_sales	
23→36	commission	
27→28	commission	
28→36	commission	
32→33	commission	
33→34	commission	
34→36	commission	

Fig: define test cases

TEST CASES BASED ON ALL DEFINITION

To achieve 100% All-definitions data flow coverage at least one sub-path from **each variable definition** to **some** use of that definition (either c- or p- use) must be executed.

			Inputs			**Expected output**	
Variable(s)	**du-pair**	**sub-path**	**locks**	**stocks**	**barrels**	**t_sales**	**commission**
locks, stocks, barrels	9→20	9,10,20	10	10	10	1000	
locks, stocks, barrels	9→10	9→10	5	-1	22	Invalid Input	
Flag	12→14	12→14	-1	40	45	Invalid Input	

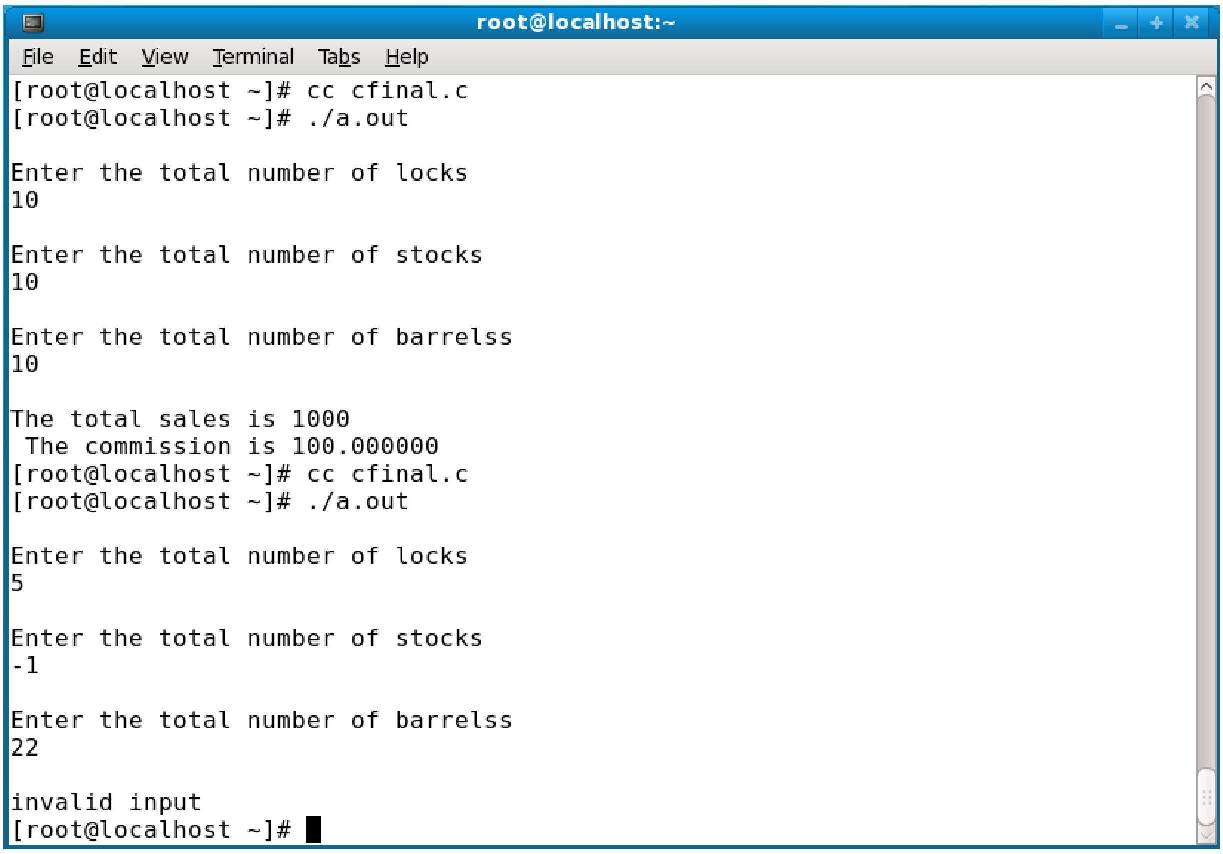
t_sales	20→21	20,21	5	5	5	500	
t_sales	20→25	20,21,25	15	15	15	1500	
commission	23→36	23→36	5	5	5		50
commission	27→36	27,28,36	15	15	15		175
commission	32→36	32,33,34, 36	25	25	25		360

4.5 EXECUTION

Execute the program and test the test cases in above Tables against program and complete the table with for Actual output column and Status column

4.6 SNAPSHOTS:

1. Snapshot for Total sales and commission when total sales are within 1000 and Invalid input



,

2. Invalid Input and Total sales and commission when total sales are within 1000

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc cfinal.c
[root@localhost ~]# ./a.out

Enter the total number of locks
-1

Enter the total number of stocks
40

Enter the total number of barrelss
45

invalid input
[root@localhost ~]# cc cfinal.c
[root@localhost ~]# ./a.out

Enter the total number of locks
5

Enter the total number of stocks
5

Enter the total number of barrelss
5

The total sales is 500
 The commission is 50.000000
[root@localhost ~]# 
```

3. Snapshot for for Total sales and commission when total sales are within 1800 and to find out the total commission 360

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc cfinal.c
[root@localhost ~]# ./a.out

Enter the total number of locks
15

Enter the total number of stocks
15

Enter the total number of barrelss
15

The total sales is 1500
 The commission is 175.000000
[root@localhost ~]# cc cfinal.c
[root@localhost ~]# ./a.out

Enter the total number of locks
25

Enter the total number of stocks
25

Enter the total number of barrelss
25

The total sales is 2500
 The commission is 360.000000
```

,

4. Snapshot for total sales and commission

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# ./a.out

Enter the total number of locks
15

Enter the total number of stocks
15

Enter the total number of barrelss
15

The total sales is 1500
 The commission is 175.000000
[root@localhost ~]# cc cfinal.c
[root@localhost ~]# ./a.out

Enter the total number of locks
5

Enter the total number of stocks
5

Enter the total number of barrelss
5

The total sales is 500
 The commission is 50.000000
[root@localhost ~]#
```

4.7 REFERENCES

1. Requirement Specification
2. Assumptions

5. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases and discuss the test results.

5.1 REQUIREMENTS:

R1: The system should read the number of Locks, Stocks and Barrels sold in a month.

(i.e 1≤ Locks≤ 70) (i.e
1 ≤ Stocks ≤ 80) (i.e 1
≤ Barrels ≤ 90).

R2: If R1 is satisfied the system should compute the salesperson's commission depending on the total number of Locks, Stocks & Barrels sold else it should display suitable error message. Following is the percentage of commission for the sales done:

10% on sales up to (and including) $1000

15% on next $800

20% on any sales in excess of $1800

Also the system should compute the total dollar sales. The system should output salespersons total dollar sales, and his commission.

5.2 DESIGN:

Form the given requirements we can draw the following conditions:

C1: 1≤locks≤70? Locks = -1? (occurs if locks = -1 is used to control input iteration).

C2: 1≤stocks≤80?

C3: 1≤barrels≤90?

C4: **s**ales>1800?

Here C1 can be expanded as:
C1a: 1≤locks
C1b: locks≤70

C5: **s**ales>1000?

C6: sales≤1000?

ALGORITHM

Step 1: Input 3 integer numbers which represents number of Locks, Stocks and Barrels sold.

Step 2: compute the total sales =

(Number of Locks sold *45) + (Number of Stocks sold *30) + (Number of Barrels sold *25)

Step 3: if a totals sale in dollars is less than or equal to $1000

then commission = 0.10* total Sales **do step** 6

Step 4: else if total sale is less than $1800

then commission1 = 0.10* 1000

commission = commission1 + (0.15 * (total sales – 1000))

do step 6

Step 5: else commission1 = 0.10* 1000

commission2 = commission1 + (0.15 * 800))

commission = commission2 + (0.20 * (total sales – 1800)) **do step 6**

Step 6: Print commission.

Step 7: Stop.

5.3 PROGRAM CODE:

```
#include<stdio.h>
#include<conio.h>
int main()
{
	int locks, stocks, barrels, t_sales, flag = 0;
	float commission;
```

```
clrscr();
printf("Enter the total number of locks");
scanf("%d",&locks);
if ((locks <= 0) || (locks > 70))
{
	flag = 1;
}
printf("Enter the total number of stocks");
scanf("%d",&stocks);
if ((stocks <= 0) || (stocks > 80))
{
	flag = 1;
}
printf("Enter the total number of barrelss");
scanf("%d",&barrels);
if ((barrels <= 0) || (barrels > 90))
{
	flag = 1;
}
if (flag == 1)
{
	printf("invalid input");
	getch();
	exit(0);
}
t_sales = (locks * 45) + (stocks * 30) + (barrels * 25);
if (t_sales <= 1000)
{
	commission = 0.10 * t_sales;
}
else if (t_sales < 1800)
{
	commission = 0.10 * 1000;
	commission = commission + (0.15 * (t_sales - 1000));
```

```
        }
        else
        {
                commission = 0.10 * 1000;
                commission = commission + (0.15 * 800);
                commission = commission + (0.20 * (t_sales - 1800));
        }
        printf("The total sales is %d \n The commission is %f",t_sales,
commission);
        getch();
        return;
}
```

5.4 TESTING

Technique Used: Decision Table Approach

The decision table is given below

Conditions	**Condition Entries (Rules)**					
C1: 1≤locks≤70?	F	T	T	T	T	T
C2: 1≤stocks≤80?	--	F	T	T	T	T
C3: 1≤barrels≤90?	--	--	F	T	T	T
C4: sales>1800?	--	--	--	T	F	F
C5: sales>1000?	--	--	--	--	T	F
C6: sales≤1000?	--	--	--	--	--	T
Actions	**Action Entries**					
a1: com1 = 0.10*Sales						X
a2: com2 = com1+0.15*(sales-1000)					X	
a3: com3 = com2+0.20*(sales-1800)				X		
a4: Out of Range.	X	X	X			

Using the decision table we get 6 functional test cases: 3 cases out of range, 1 case each for sales greater than $1800, sales greater than $1000, sales less than or equal to $1000.

DERIVING TEST CASES USING Decision Table Approach:

Test Cases:

TC ID	Test Case Description	Locks	Stocks	Barrels	Expected Output		Actual Output	Status
1	Testing for Requirement 1 Condition 1 (C1)	-2	40	45	Out of Range			
2	Testing for Requirement 1 Condition 1 (C1)	90	40	45	Out of Range			
3	Testing for Requirement 1 Condition 2 (C2)	35	-3	45	Out of Range			
4	Testing for Requirement 1 Condition 2 (C2)	35	100	45	Out of Range			
5	Testing for Requirement 1 Condition 3 (C3)	35	40	-10	Out of Range			
6	Testing for Requirement 1 Condition 3 (C3)	35	40	150	Out of Range			
7	Testing for Requirement 2	5	5	5	500	a1:50		
8	Testing for Requirement 2	15	15	15	1500	a2: 175		
9	Testing for Requirement 2	25	25	25	2500	a3: 360		

5.5 EXECUTION & RESULT DISCUSION:

Execute the program against the designed test cases and complete the table for Actual output column and status column.

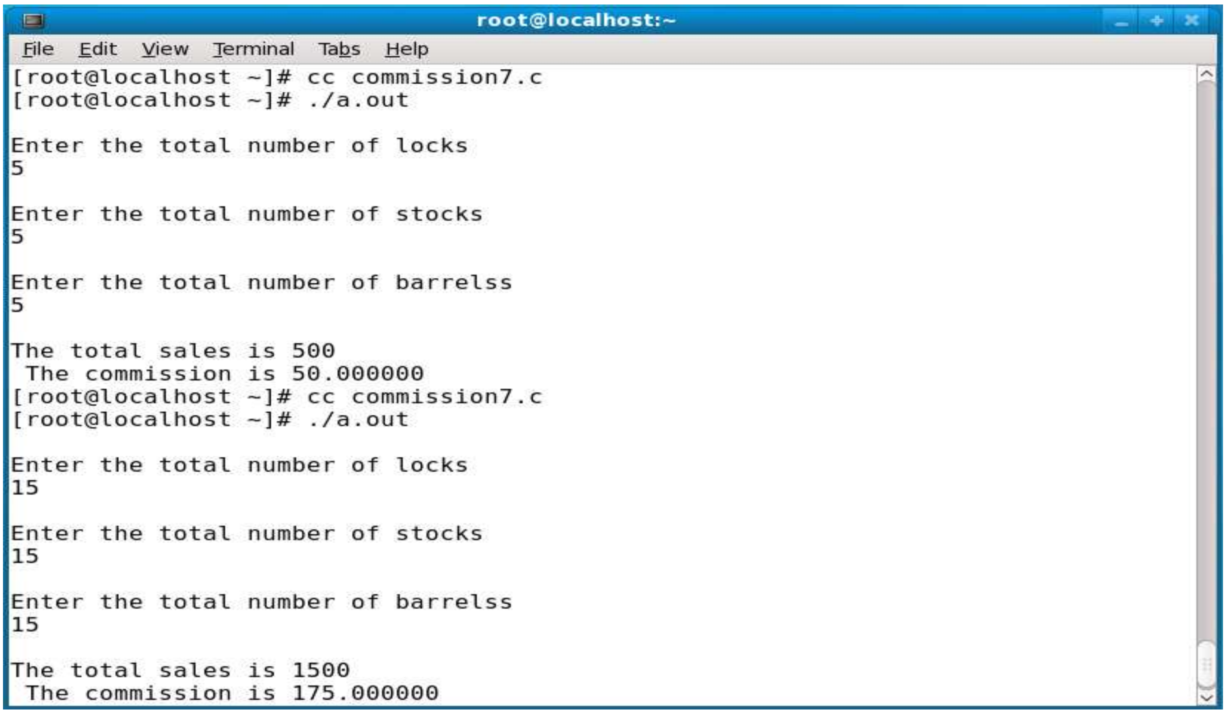
TEST REPORT:

1. No of TC's Executed: **06**
2. No of Defects Raised:
3. No of TC's Pass:
4. No of TC's Failed:

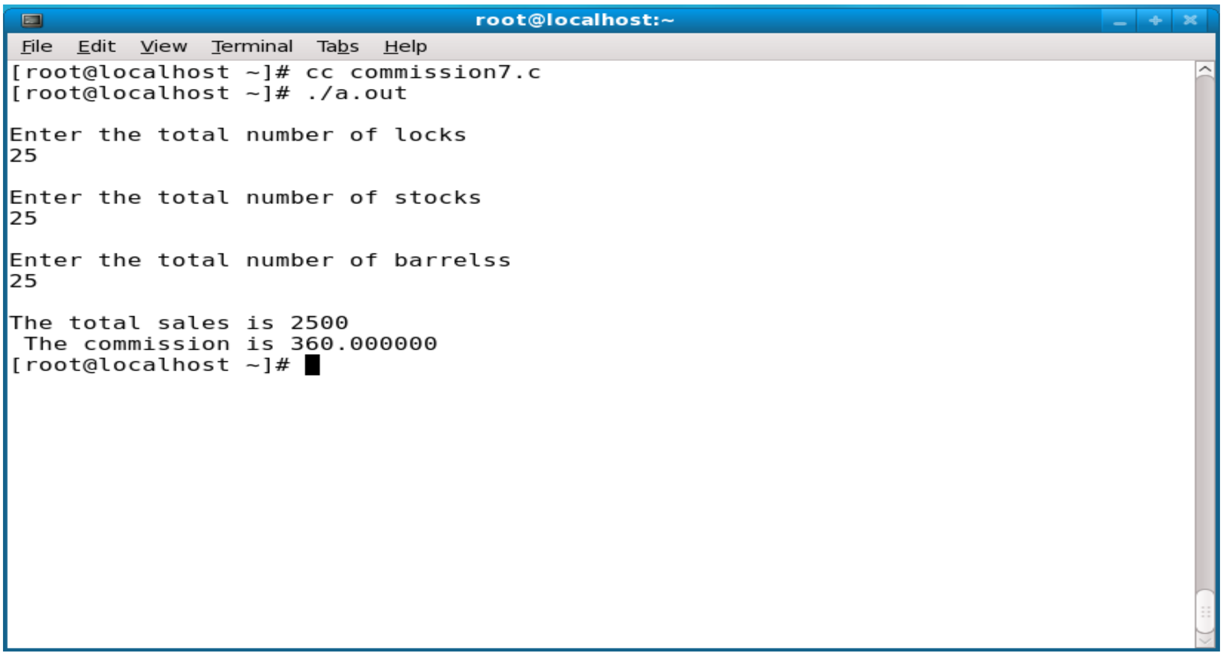
The commission problem is not well served by a decision table analysis because it has very little decisional. Because the variables in the equivalence classes are truly independent, no impossible rules will occur in a decision table in which condition correspond to the equivalence classes.

5.6 SNAPSHOTS:

1. Snapshot for Total sales and commission when total sales are within 1000 and 1800



2. Snapshot when the inputs all are 25.



5.7 REFERENCES:

1. Requirement Specification
2. Assumptions

6. Design, develop, code and run the program in any suitable language to implement the binary search algorithm. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.

6.1 REQUIREMENTS

R1: The system should accept 'n' number of elements and key element that is to be searched among 'n' elements..

R2: Check if the key element is present in the array and display the position if present otherwise print unsuccessful search.

6.2 DESIGN

We use integer array as a data structure to store 'n' number of elements. Iterative programming technique is used.

ALGORITHM

Step 1: Input value of 'n'. Enter 'n' integer numbers in array int mid;
Step 2: Initialize low = 0, high = n -1
Step 3: until (low <= high) **do** mid =
(low + high) / 2 if (
a[mid] == key)
then do Step 5
else if (a[mid] > key)
then do
high = mid - 1
else
low = mid + 1
Step 4: Print unsuccessful search **do** step 6.
Step 5: Print Successful search. Element found at position mid+1.
Step 6: Stop.

6.3 PROGRAM CODE:

```
#include<stdio.h>
#include<conio.h>
int main()
{
	int a[20],n,low,high,mid,key,i,flag=0;
	clrscr();
	printf("Enter the value of n:\n");
	scanf("%d",&n);
	if(n>0)
	{
		printf("Enter %d elements in ASCENDING order\n",n);
		for(i=0;i<n;i++)
		{
			scanf("%d",&a[i]);
		}
		printf("Enter the key element to be searched\n");
		scanf("%d",&key);
		low=0; high=n-1;
		while(low<=high)
		{
			mid=(low+high)/2;
			if(a[mid]==key)
			{
				flag=1;
				break;
			}
			else if(a[mid]<key)
			{
				low=mid+1;
			}
			else
			{
```

```
                        high=mid-1;
                    }
                }
                if(flag==1)
                    printf("Successful   search\n      Element   found   at    Location
%d\n",mid+1);

                else
                    printf("Key Element not found\n");
        }
        else
                printf("Wrong input");
        getch();
        return 0;
}
```

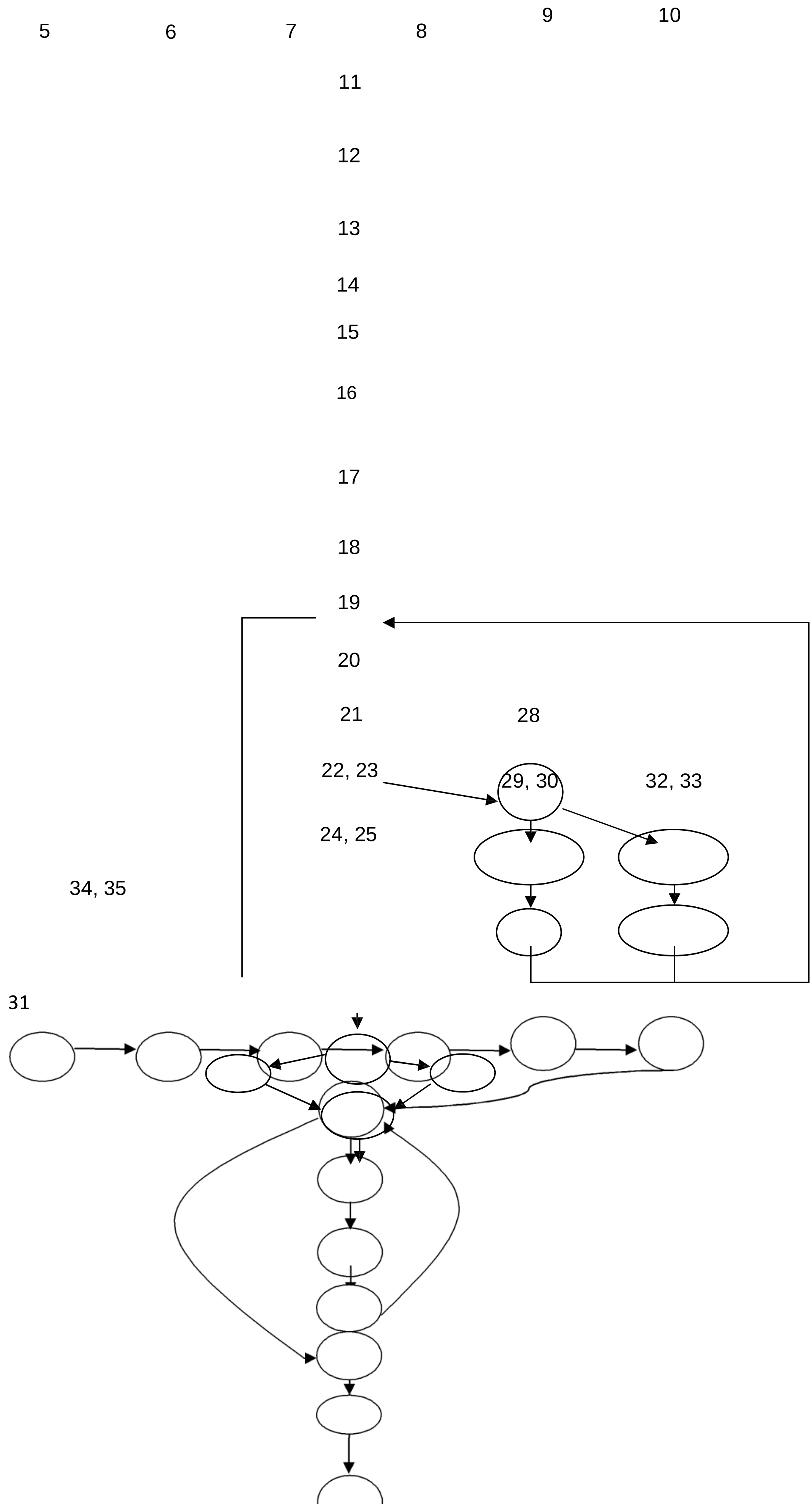
6.4 TESTING

Technique Used: Basis Path Testing

Basis path testing is a form of Structural testing (White Box testing). The method devised by McCabe to carry out basis path testing has four steps. These are:

1. Compute the program graph.
2. Calculate the cyclomatic complexity.
3. Select a basis set of paths.
4. Generate test cases for each of these paths.

Below is the program graph of binary search code.

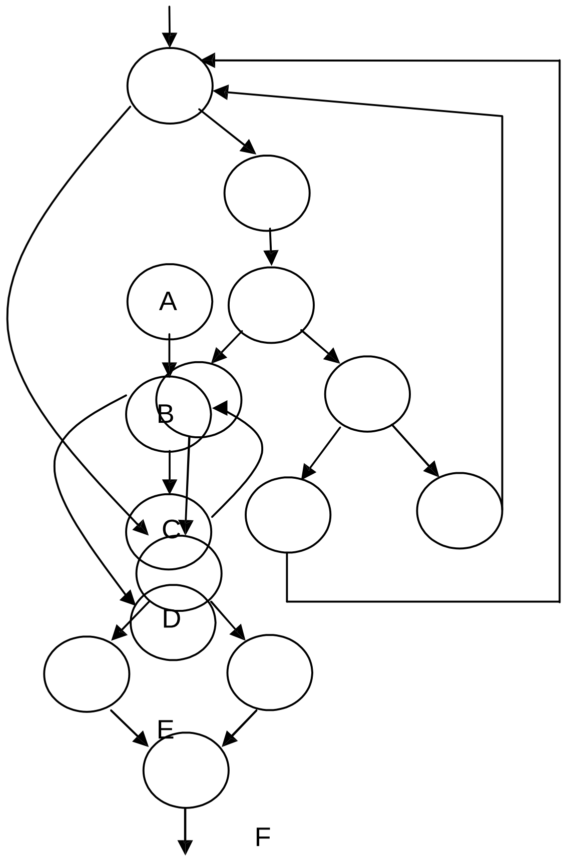


26, 27

37 40 38 41

Program Graph Nodes	DD – Path Name
First	5
A	6,7,8,9,10
B	11
C	12,13,14
D	15,16,17
E	18
F	19,20
G	37
H	21
I	22,23,24,25,26,27
J	28
K	29.30,31
L	32,33,34,35
M	38
N	40
O	41

Using the program graph we derive (Decision-to-Decision) DD path graph for binary search program



F

H

I J

K L

G

N M

O

The cyclomatic complexity of a connected graph is provided by the formula V(G) = e – n + 2p. The number of edges is represented by e, the number of nodes by n and the number of connected regions by p. If we apply this formula to the graph given below, the number of linearly independent circuits is:

Number of edges = 21

Number of nodes = 15

Number of connected regions = 1

21 – 15 + 2(1) = 4.

Here we are dealing code level dependencies, which are absolutely incompatible with the latent assumption, that basis path are independent. McCabe's procedure successfully identifies basis path that are topologically independent, but when these contradict semantic dependencies, topologically possible paths are seen to be logically infeasible. One solution to this problem is to always require that flipping a decision result in a semantically feasible path. For this problem we identify some of the rules:

If node C not traversed, then node M should be traversed.

If node E and node G is traversed, then node M should be traversed. If node I is traversed, then node N should be traversed.

Taking into consideration the above rules, next step is to find the basis paths.

According to cyclomatic complexity 4 feasible basis path exists: P1: A, B, D, E, G, N, O if n value is 0.

P2: A, B, C, B, D, E, F, H, I, G, M, O key element found.

P3: A, B, C B, D, E, F, H, J, K, E, F, H, J, K, E, G, N, O key element not found.

P4: A, B, C, B, D, E, F, H, J, L, E, F, H, J, L, E, G, N, O key element not found.

,

DERIVING TEST CASES USING BASIS PATH TESTING

The last step is to devise test cases for the basis paths.

TEST CASES

TC ID	Test Case Description	Value of ‘n‘	array elements	key	Expected Output	Actual Output	Status
1	Testing for requirement 1 Path P1	0	--	5	key not found		
2	Testing for requirement 2 Path P2	4	2,3,5,6,7	5	Key found at position 3		
3	Testing for requirement 2 Path P3	3	1,2,5	6	key not found		
4	Testing for requirement 2 Path P4	3	1,2,5	1	key not found		
5	Testing for requirement 2 Path P4+P2-P1	5	1,2,4,6,7	2	Key found at position 2		
6	Testing for requirement 2 Path P3+P2-P1	5	4,5,7,8,9	8	key found at position 4		

6.5 EXECUTION & RESULT DISCUSION:

Execute the program against the designed test cases and complete the table for Actual output column and status column.

Test Report:

1. No of TC’s Executed: **06**
2. No of Defects Raised:
3. No of TC’s Pass:
4. No of TC’s Failed:

6.6 SNAPSHOTS:

1. Snapshot to check successful search and not found key element.

```
[root@localhost ~]# cc binary.c
[root@localhost ~]# ./a.out
Enter the value of n:
4
Enter 4 elements in ASCENDING order
2
3
5
6
Enter the key element to be searched
5
Successful search
Element found at Location 3
[root@localhost ~]# cc binary.c
[root@localhost ~]# ./a.out
Enter the value of n:
3
Enter 3 elements in ASCENDING order
1
2
5
Enter the key element to be searched
6
Key Element not found
[root@localhost ~]#
```

3. Snapshot to check successful search and not found key element.

```
[root@localhost ~]# ./a.out
Enter the value of n:
5
Enter 5 elements in ASCENDING order
1
2
4
6
7
Enter the key element to be searched
2
Successful search
Element found at Location 2
[root@localhost ~]# cc binary.c
[root@localhost ~]# ./a.out
Enter the value of n:
5
Enter 5 elements in ASCENDING order
4
5
7
8
9
Enter the key element to be searched
8
Successful search
Element found at Location 4
[root@localhost ~]#
```

6.7 REFERENCES:

1. Requirement Specification
2. Assumptions

,

7. Design, develop, code and run the program in any suitable language to implement the quicksort algorithm. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results. discuss the test results.

7.1 REQUIREMENTS

R1: The system should accept ‘n’ number of elements and key element that is to be searched among ‘n’ elements.

R2: Check if the key element is present in the array and display the position if present otherwise print unsuccessful search.

7.2 DESIGN

We use integer array as a data structure to store ‘n’ number of elements. Iterative programming technique is used.

7.3 PROGRAM CODE:

```
// An iterative implementation of quick sort
#include <stdio.h>

// A utility function to swap two elements void
swap ( int* a, int* b )
{
   int t = *a;
   *a = *b;
   *b = t;
}

/* This function is same in both iterative and recursive*/
int partition (int arr[], int l, int h)
{
   int x = arr[h];
   int i = (l - 1),j;
```

```
    for (j = l; j <= h- 1; j++)
    {
        if (arr[j] <= x)
        {
            i++;
            swap (&arr[i], &arr[j]);
        }
    }
    swap (&arr[i + 1], &arr[h]);
    return (i + 1);
}

/* A[] --> Array to be sorted, l  --> Starting index, h  --> Ending index */

void quickSortIterative (int arr[], int l, int h)
{
    // Create an auxiliary stack int
    stack[10],p;

    // initialize top of stack int
    top = -1;

    // push initial values of l and h to stack
    stack[ ++top ] = l;
    stack[ ++top ] = h;

    // Keep popping from stack while is not empty while
    ( top >= 0 )
    {
            // Pop h and l
            h = stack[ top-- ];
            l = stack[ top-- ];
```

,

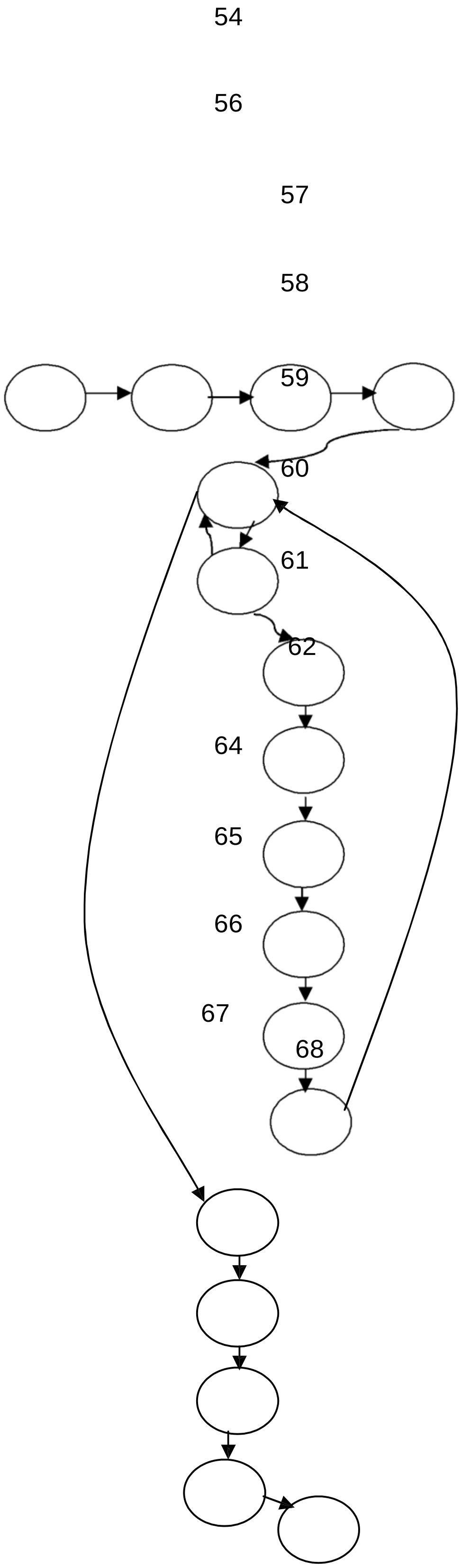
```
        // Set pivot element at its correct position in sorted array p =
        partition( arr, l, h );

      // If there are elements on left side of pivot, then push left
      // side to stack if
      ( p-1 > l )
      {
         stack[ ++top ] = l;
         stack[ ++top ] = p - 1;
      }

      // If there are elements on right side of pivot, then push right
      // side to stack if
      ( p+1 < h )
      {
            stack[ ++top ] = p + 1;
            stack[ ++top ] = h;
         }
   }
}
// Driver program to test above functions int
main()
{
   int arr[20],n,i;
   clrscr();
   printf("Enter the size of the array");
   scanf("%d",&n);
   printf("Enter %d elements",n);
   for(i=0;i<n;i++)
         scanf("%d",&arr[i]);
   quickSortIterative( arr, 0, n - 1 );
   printf("Elements of the array are;");
   for(i=0;i<n;i++)
         printf("%d",arr[i]);
```

```
   getch();
   return 0;
}
```

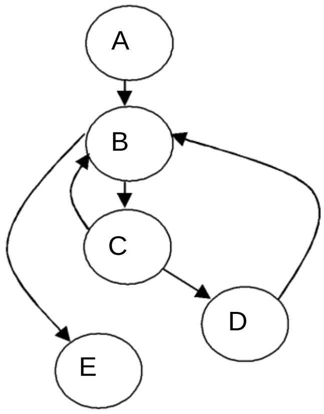
7.4 TESTING

Program Graph for partition:

50 51 52 53


54
56
57
58
59
60
61
62
64
65
66
67
68

DD Path Graph:



Using program graph we derive DD path graph for partition()

DD Path Names	**Program Graph**
A	50,51,52,53
B	54
C	56
D	57,58,59,60,61,62
E	64,65,66,67,68

Cyclomatic complixity
No. of edges =6
No. of nodes=5
e-n+2
6-5+2 =3
No. of predicate nodes +1 (i.e., node B and node C)
2+1=3
No. of region + 1
R1 and R2 are two regions
2+1=3

According to cyclomatic complexity 3 basis path exists. They are;

,

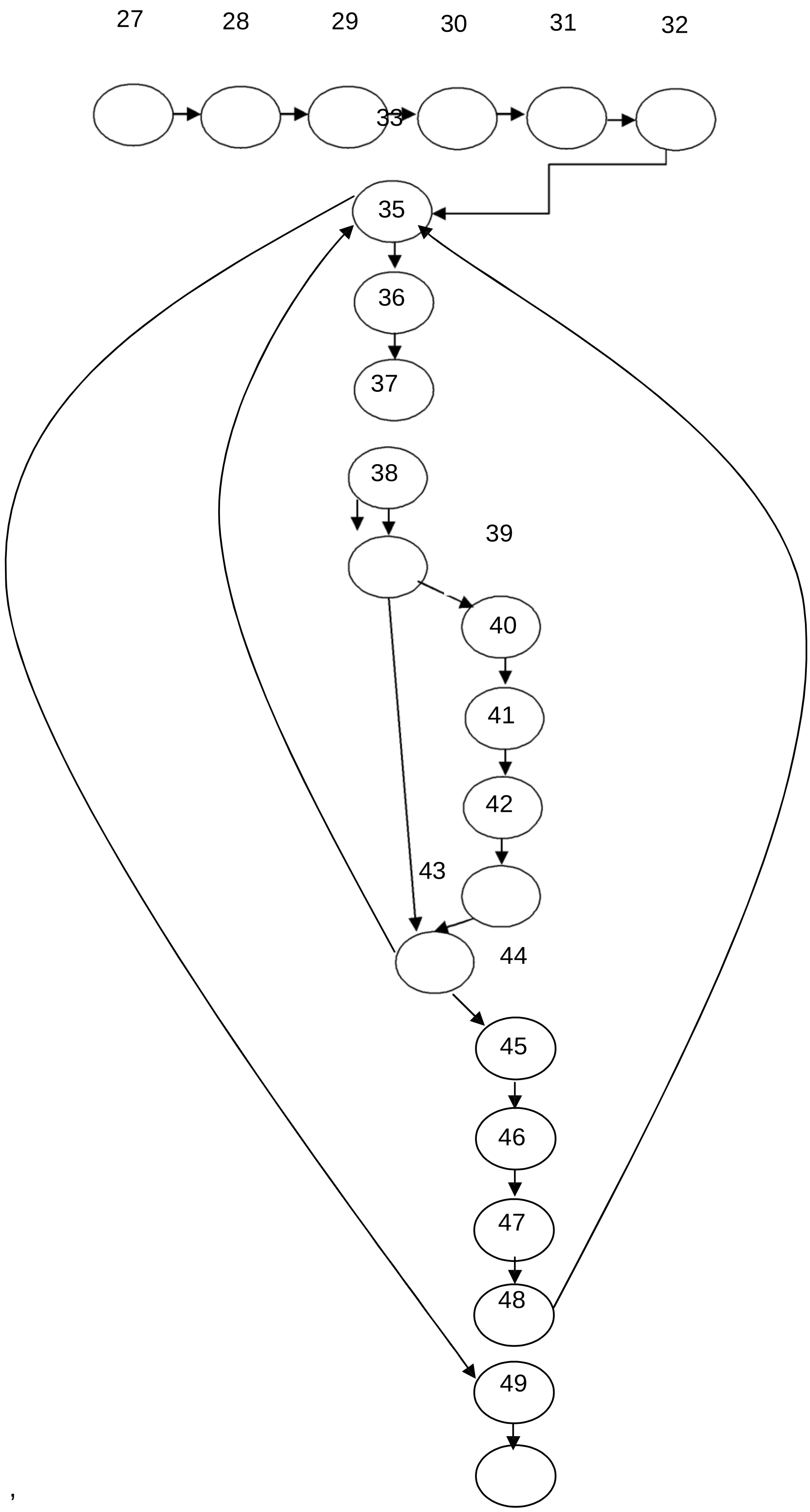
P1: A, B, E
P2: A, B, C, D,
B, E P3: A, B, C,
B, E

4.2 Deriving test cases using basis path testing:

Test Cases

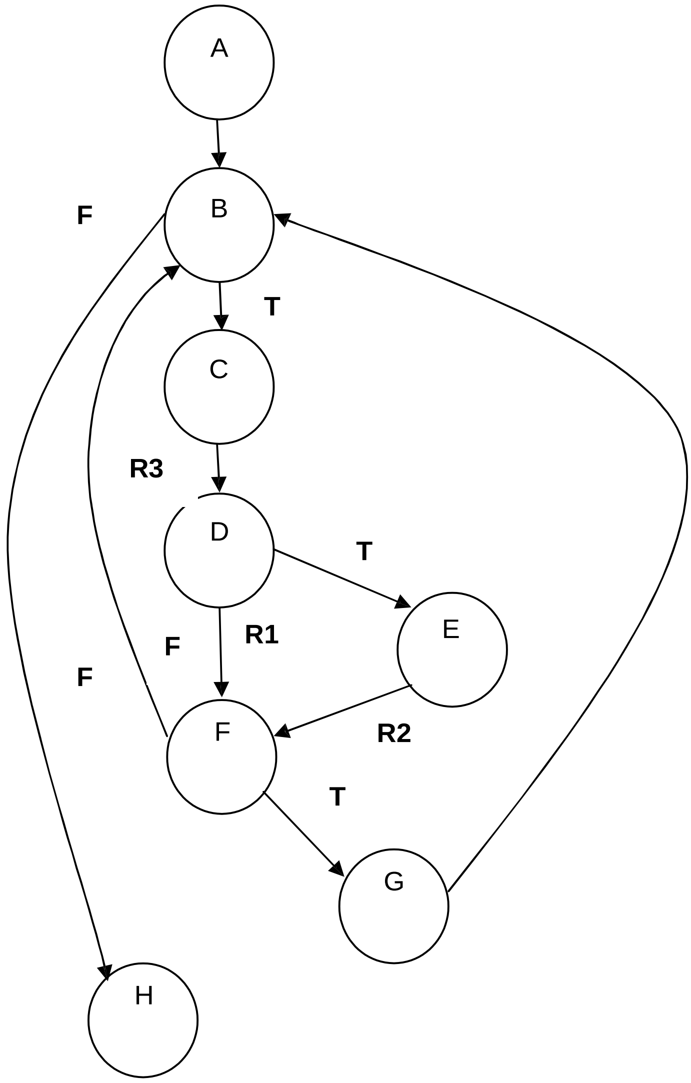
TC ID	Test Case Description	Array elements	Expected output		Actual output	Status
			Array	Value of i		
1	Testing for path P1	5	5	0		
2	Testing for path P2	5, 4, 6, 2, 7	5, 4, 6, 2, 7	4		
3	Testing for path P3	5, 4, 6, 7, 5	5, 4, 6, 7, 5	0		

Program Graph for Quick sort()



,

DD Path Graph



CYCLOMATIC COMPLEXITY

No. of nodes = 8
No. of nodes =10
e-n+2
10-8+2 =4

No. of predicate nodes + 1
3+1=4 (i.e., node B, D & F)
No. of regions+1

3+1=4 (i.e., Region R1, R2 & R3)

According to cyclomatic complexity 4 basis path exists. They are
P1: A, B, C, D, E, F, G, B,
H P2: A, B, C, D, E, F, B,H
P3: A, B, C, D, F, G, B, H
P4: A, B, C, D, F, B, H
Deriving test cases using basis path testing
Test cases:

TC ID	Test Case Description	Array elements	Expected output	Actual output	Status
1	Testing for path 1	5, 7, 4, 2, 1, 3	2, 1, 3, 5, 7, 4		
2	Testing for path 2	5, 4, 8, 2, 7	5, 4, 2, 7, 8		
3	Testing for path 3	5, 4, 6, 7, 3	3, 4, 6, 7, 5		

7.5 EXECUTION

Compile the program and enter inputs Test above table array elements for test cases.

7.6 SNAPSHOTS:

1. Snapshot of quick sort sorted elements are displayed, when the n=6

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc qi.c
[root@localhost ~]# ./a.out
Enter the size of the array
6
Enter 6 elements
5
7
4
2
1
3
Elements of the array are:
1

2

3

4

5

7
[root@localhost ~]#
```

2. Snapshot of quick sort sorted elements are displayed, when the n=5

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc qi.c
[root@localhost ~]# ./a.out
Enter the size of the array
5
Enter 5 elements
5
4
8
2
7
Elements of the array are:
2

4

5

7

8
[root@localhost ~]#
```

3. Snapshot of quick sort sorted elements are displayed, when the n=5

```
root@localhost:~
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]# cc qi.c
[root@localhost ~]# ./a.out
Enter the size of the array
5
Enter 5 elements
5
4
6
7
3
Elements of the array are:
3

4

5

6

7
[root@localhost ~]#
```

7.7 REFERENCES:

1. Requirement Specification
2. Assumptions

8. Design, develop, code and run the program in any suitable language to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.

8.1 REQUIREMENTS:

R1: The system should accept marks of 6 subjects, each marks in the range 1 to 100.

i.e., for example, 1<=marks<=100
1<=kannada<=100
1<=maths<=100 etc.

R2: If R1 is satisfied compyter average of marks scored and percentage of the same and depending on percentage display the grade.

8.2 DESIGN:

We use the total percentage of marks to grade the student marks.

<35 && >0 of percentage make it as FAIL
avmar<=40 && avmar>35 make it as Grade C
avmar<=50 && avmar>40 make it as Grade C+
avmar<=60 && avmar>50 make it as Grade B
avmar<=70 && avmar>60 make it as Grade B+
avmar<=80 && avmar>70 make it as Grade A
avmar<=100 && avmar>80 make it as Grade A+

8.3 PROGRAM CODE:

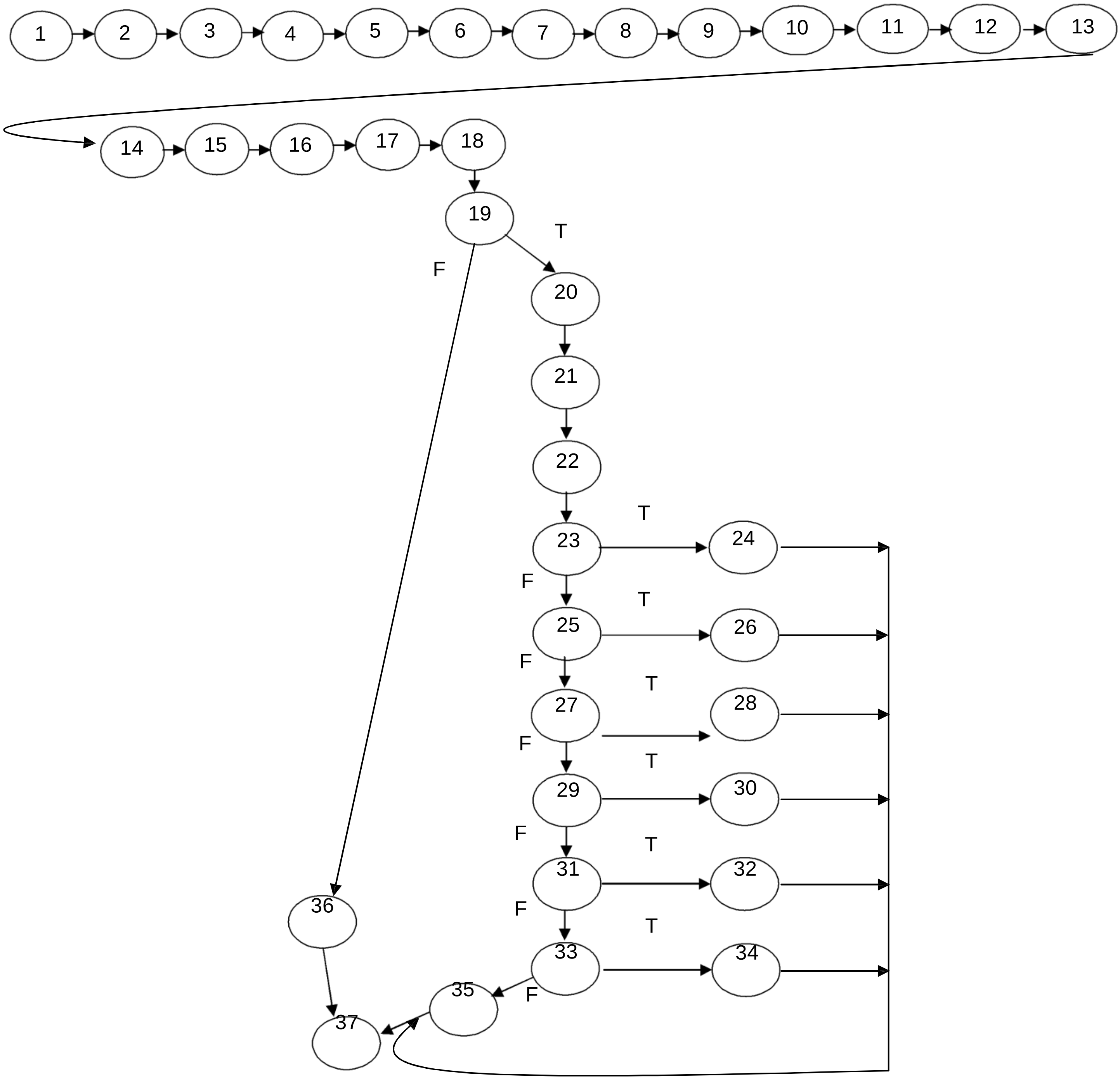
```
#include<stdio.h>
main()
{
float kan,eng,hindi,maths,science, sst,avmar;
printf("Letter Grading\n"); printf("SSLC
Marks Grading\n"); printf("Enter the marks
for Kannada:"); scanf("%f",&kan);
printf("enter the marks for English:");
```

,

```
scanf("%f",&eng);
printf("enter the marks for Hindi:");
scanf("%f",&hindi);
printf("enter the marks for Maths");
scanf("%f",&maths);
printf("enter the marks for Science:");
scanf("%f",&science);
printf("enter the marks for Social Science:");
scanf("%f",&sst);
avmar=(kan+eng+hindi+maths+science+sst)/6.25;
printf("the average marks are=%f\n",avmar);
if((avmar<35)&&(avmar>0))
printf("fail"); else
if((avmar<=40)&&(avmar>35))
printf("Grade C");
else if((avmar<=50)&&(avmar>40))
printf("Grade C+");
else if((avmar<=60)&&(avmar>50))
printf("Grade B");
else if((avmar<=70)&&(avmar>60))
printf("Grade B+");
else if((avmar<=80)&&(avmar>70))
printf("Grade A");
else
if((avmar<=100)&&(avmar>80))
printf("Grade A+");
}
```

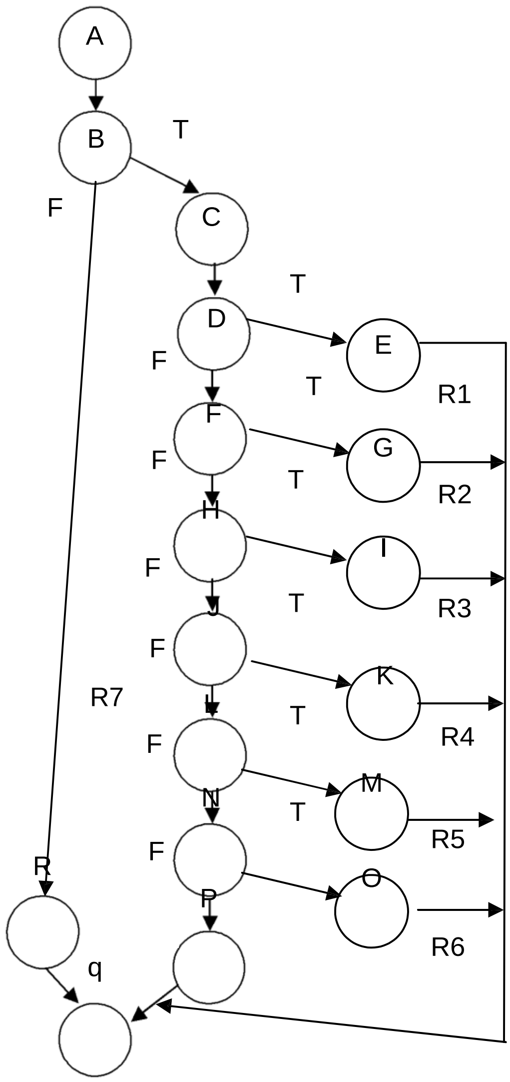
8.4 TESTING

PROGRAM GRAPH:



Using the program graph derive DD path graph

DD path Names	Program Graph Nodes
A	1, 2, 3, 4, 5, 6, 7, 8 . . . 18
B	19
C	20, 21, 22
D	23
E	24
F	25
G	26
H	27
I	28
J	29
K	30
L	31
M	32
N	33
O	34
P	35
Q	37
R	36



CYCLOMATIC COMPLEXITY

No. of nodes = 18

No. of edges = 24

e-n+2

24-18+2=8

No. of predicate nodes + 1

7 + 1 = 8 (i.e., B, D, F, H, J, L, N)

No. of regions + 1

7 + 1 = 8 (i.e., Regions R1, R2, R3, R4, R5, R6, R7)

,

According to cyclomatic complexity we can derive 8 basis path. P1:
A, B, R q
P2: A, B, C, D, E, q **P3:**
A, B, C, D, F, G, q **P4:**
A, B, C, D, F, H, I, q
P5: A, B, C, D, F, H, J, K, q **P6:**
A, B, C, D, F, H, J, L, M, q **P7:**
A, B, C, D, F, H, J, L, N, O, q
P8: A, B, C, D, F, H, J, L, N, P,
q

Test Cases:

TC ID	Test Description	Input	Expected Output	Actual Output	Status
1	Testing for path P1	K=50 E=50 H=50 M=50 S=50 SST=150	Invalid Input		
2	Testing for path P2	K=30 E=30 H=30 M=35 S=35 SST=35 Avg=32.5	Fail		
3	Testing for path P3	K=40 E=38 H=37 M=40 S=40 SST=38 Avg=38.83	Grade C		
4	Testing for path P4	K=45 E=47 H=48 M=46 S=49	Grade C+		

		SST=50 Avg=47.5			
5	Testing for path P5	K=55 E=58 H=60 M=56 S=57 SST=60 Avg=57.66	Grade B		
6	Testing for path P6	K=65 E=65 H=65 M=65 S=65 SST=65 Avg=65.0	Grade B+		
7	Testing for path P7	K=75 E=72 H=78 M=75 S=80 SST=80 Avg=76.6	Grade A		
8	Testing for path P8	K=85 E=90 H=80 M=95 S=85 SST=85 Avg=86.66	Grade A+		

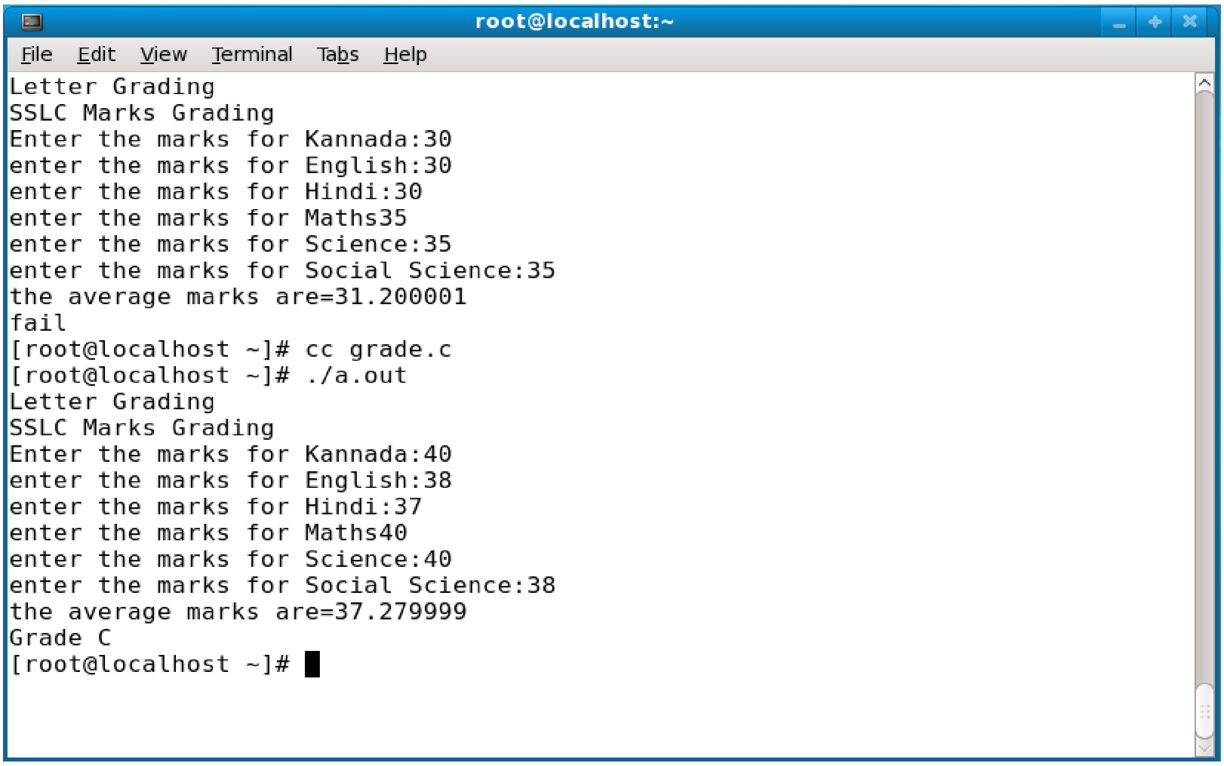
8.5 EXECUTION

Compile the program and enter inputs for subject marks, then it will display the Total percentage, depending on the percentage it will shows the Grade and test the test cases for above table.

,

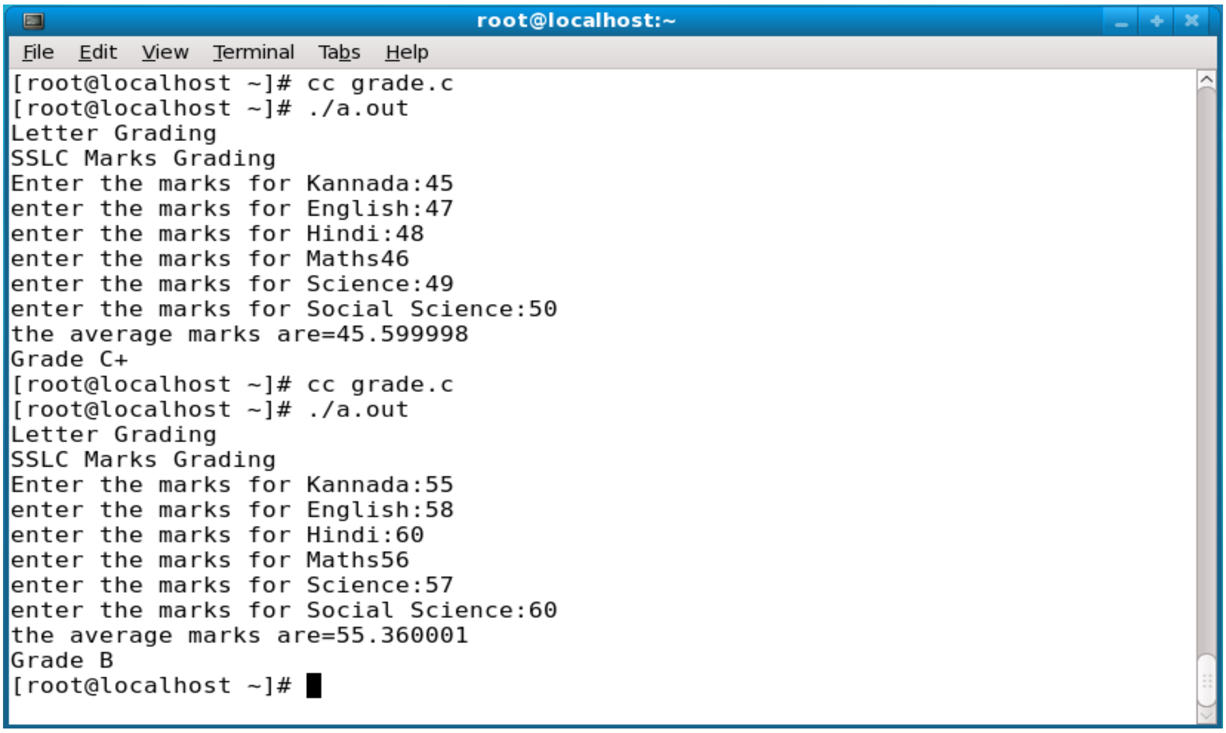
8.6 SNAPSHOTS:

1. Snapshot to Show Fail and Grade C



```
root@localhost:~
File Edit View Terminal Tabs Help
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:30
enter the marks for English:30
enter the marks for Hindi:30
enter the marks for Maths35
enter the marks for Science:35
enter the marks for Social Science:35
the average marks are=31.200001
fail
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:40
enter the marks for English:38
enter the marks for Hindi:37
enter the marks for Maths40
enter the marks for Science:40
enter the marks for Social Science:38
the average marks are=37.279999
Grade C
[root@localhost ~]#
```

2. Snapshot to show Grade B and Grade C+



```
root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:45
enter the marks for English:47
enter the marks for Hindi:48
enter the marks for Maths46
enter the marks for Science:49
enter the marks for Social Science:50
the average marks are=45.599998
Grade C+
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:55
enter the marks for English:58
enter the marks for Hindi:60
enter the marks for Maths56
enter the marks for Science:57
enter the marks for Social Science:60
the average marks are=55.360001
Grade B
[root@localhost ~]#
```

,

4. Snapshot to show the Grade A and Grade B+

```
root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:65
enter the marks for English:65
enter the marks for Hindi:65
enter the marks for Maths65
enter the marks for Science:65
enter the marks for Social Science:65
the average marks are=62.400002
Grade B+
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:75
enter the marks for English:72
enter the marks for Hindi:78
enter the marks for Maths75
enter the marks for Science:80
enter the marks for Social Science:80
the average marks are=73.599998
Grade A
[root@localhost ~]#
```

4. Snapshot to show the Grade A+

```
root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# cc grade.c
[root@localhost ~]# ./a.out
Letter Grading
SSLC Marks Grading
Enter the marks for Kannada:85
enter the marks for English:90
enter the marks for Hindi:80
enter the marks for Maths95
enter the marks for Science:85
enter the marks for Social Science:85
the average marks are=83.199997
Grade A+
[root@localhost ~]#
```

,

8.7 REFERENCES:

1. Requirement Specification
2. Assumptions

,

9. Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of equivalence class value testing, derive different test cases, execute these test cases and discuss the test results.

9.1 REQUIREMENT SPECIFICATION

Problem Definition: "Next Date" is a function consisting of three variables like: month, date and year. It returns the date of next day as output. It reads current date as input date.

The constraints are

C1: 1 ≤ month ≤ 12
C2: 1 ≤ day ≤ 31
C3: 1812 ≤ year ≤ 2012.

If any one condition out of C1, C2 or C3 fails, then this function produces an output "value of month not in the range 1...12".

Since many combinations of dates can exist, hence we can simply displays one message for this function: "Invalid Input Date".

A very common and popular problem occurs if the year is a leap year. We have taken into consideration that there are 31 days in a month. But what happens if a month has 30 days or even 29 or 28 days ?

A year is called as a leap year if it is divisible by 4, unless it is a century year. Century years are leap years only if they are multiples of 400. So, 1992, 1996 and 2000 are leap years while 1900 is not a leap year.

Furthermore, in this Next Date problem we find examples of Zipf's law also, which states that **"80% of the activity occurs in 20% of the space".** Thus in this case also, much of the source-code of Next Date function is devoted to the leap year considerations.

9.2 DESIGN

,

Algorithm

STEP 1: Input date in format DD.MM.YYYY

STEP2: if MM is 01, 03, 05,07,08,10 do STEP3 else STEP6

STEP3:if DD < 31 then do STEP4 else if DD=31 do STEP5 else output(Invalid Date);

STEP4: tomorrowday=DD+1 goto STEP18

STEP5: tomorrowday=1; tomorrowmonth=month + 1 goto STEP18

STEP6: if MM is 04, 06, 09, 11 do STEP7

STEP7: if DD<30 then do STEP4 else if DD=30 do STEP5 else output(Invalid Date);

STEP8: if MM is 12

STEP9: if DD<31 then STEP4 else STEP10

STEP10: tomorrowday=1, tommorowmonth=1, tommorowyear=YYYY+1; goto STEP18

STEP11: if MM is 2

STEP12: if DD<28 do STEP4 else do STEP13

STEP13: if DD=28 & YYYY is a leap do STEP14 else STEP15

STEP14: tommorowday=29 goto STEP18

STEP15: tommorowday=1, tomorrowmonth=3, goto STEP18;

STEP16: if DD=29 then do STEP15 else STEP17

STEP17: output(“Cannot have feb”, DD); STEP19

STEP18: output(tomorrowday, tomorrowmonth, tomorrowyear);

STEP19: exit

,

9.3 PROGRAM CODE:

```
#include<stdio.h>
#include<conio.h>
main( )
{
Int month[12]={31,28,31,30,31,30,31,31,30,31,30,31};
int d,m,y,nd,nm,ny,ndays;
clrscr( );
printf("enter the date,month,year");
scanf("%d%d%d",&d,&m,&y);
ndays=month[m-1];
if(y<=1812 && y>2012)
{
        printf("Invalid Input Year");
        exit(0);
}
if(d<=0 || d>ndays)
{

        printf("Invalid Input Day");
        exit(0);
}
if(m<1 && m>12)
{
        printf("Invalid Input Month");
        exit(0);
}

if(m==2)
{
        if(y%100==0)
        {
```

,

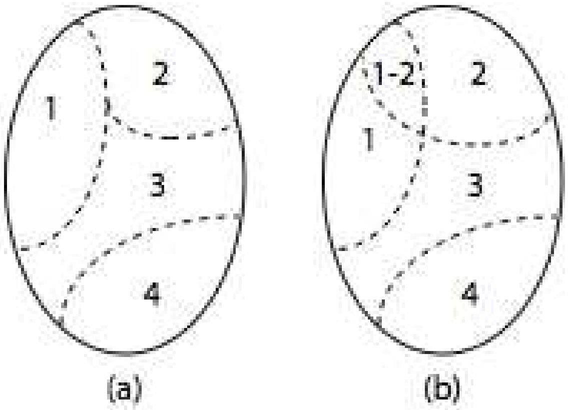
```
            if(y%400==0)
            ndays=29;
      }
      else
      if(y%4==0)
            ndays=29;
}
nd=d+1;
nm=m;
ny=y;

if(nd>ndays)
{
      nd=1;
      nm++;
}
if(nm>12)
{
      nm=1;
      ny++;
}
printf("\n Given date is %d:%d:%d",d,m,y); printf("\n Next
day’s date is %d:%d:%d",nd,nm,ny); getch( );
}
```

9.4 TESTING

Technique used: Equivalence Class testing

Test selection using equivalence partitioning allows a tester to subdivide the input domain into a relatively small number of sub-domains, say N>1, as shown.

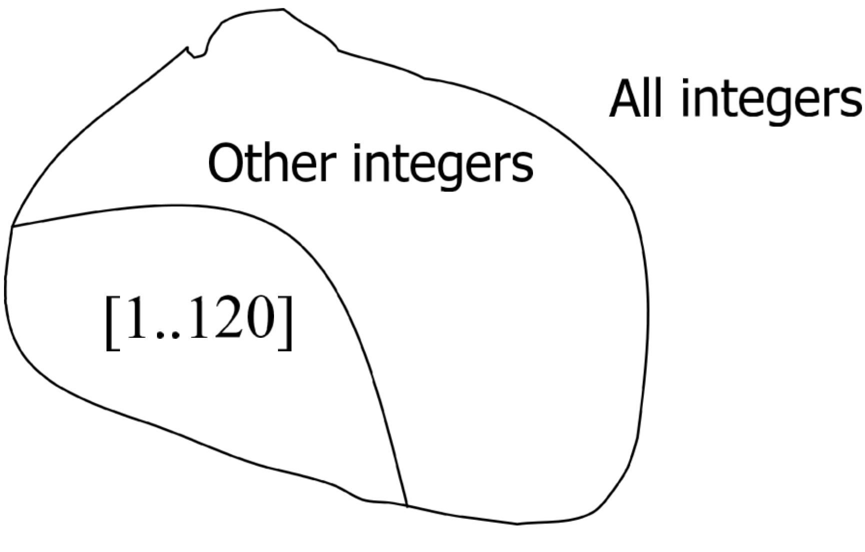
,



In strict mathematical terms, the sub-domains by definition are disjoint. The four subsets shown in (a) constitute a partition of the input domain while the subsets in (b) are not. Each subset is known as an equivalence class.

Example:

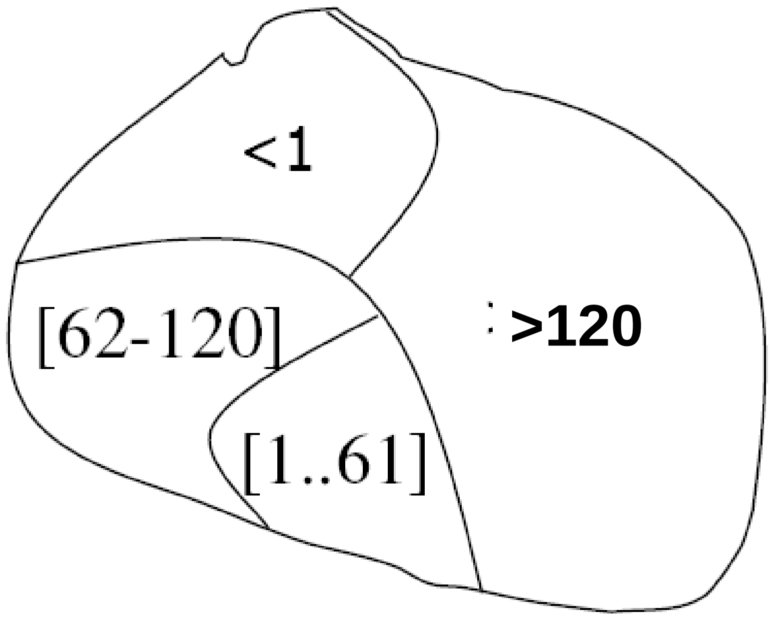
Consider an application A that takes an integer denoted by age as input. Let us suppose that the only legal values of age are in the range [1..120]. The set of input values is now divided into a set E containing all integers in the range [1..120] and a set U containing the remaining integers.



Further, assume that the application is required to process all values in the range [1..61] in accordance with requirement R1 and those in the range [62..120] according to requirement R2. Thus E is further subdivided into two regions depending on the expected behavior.

,

Similarly, it is expected that all invalid inputs less than or equal to 1 are to be treated in one way while all greater than 120 are to be treated differently.
This leads to a subdivision of U into two categories.



Tests selected using the equivalence partitioning technique aim at targeting faults in the application under test with respect to inputs in any of the four regions, i.e. two regions containing expected inputs and two regions containing the unexpected inputs.

It is expected that any single test selected from the range [1...61] will reveal any fault with respect to R1. Similarly, any test selected from the region [62...120] will reveal any fault with respect to R2. A similar expectation applies to the two regions containing the unexpected inputs.

Test Case design

The NextDate function is a function which will take in a date as input and produces as output the next date in the Georgian calendar. It uses three variables (month, day and year) which each have valid and invalid intervals.

First Attempt

,

A first attempt at creating an equivalence relation might produce intervals such as these:

<u>Valid Intervals</u>

M1 = {month: 1 ≤ month ≤ 12} D1
= {day: 1 ≤day ≤31}
Y1 = {year: 1812 ≤ year ≤2012}

<u>Invalid Intervals</u>

M2 = {month: month < 1} M3
= {month: month > 12} D2 =
{day: day < 1}
D3 = {day: day > 31}
Y2 = {year: year < 1812}
Y3 = {year: year > 2012}

At a first glance it seems that everything has been taken into account and our day, month and year intervals have been defined well. Using these intervals we produce test cases using the four different types of Equivalence Class testing.
Weak and Strong Normal

TC Id	**Test Case Description**	**Input Data**			**Expected Output**	**Actual Output**	**Status**
		MM	**DD**	**YYYY**			
1	Testing for Valid input changing the day within the month.	6	15	1900	6/16/1900		

Table 1: Weak and Strong Normal

,

Since the number of variables is equal to the number of valid classes, only one weak normal equivalence class test case occurs, which is the same as the strong normal equivalence class test case (Table 1).

Weak Robust:

TC Id	Test Case Description	Input Data			Expected Output	Actual Output	Status
		MM	DD	YYYY			
1	Testing for Valid input changing the day within the month.	6	15	1900	6/16/1900		
2	Testing for Invalid Day, day with negative number it is not possible	6	-1	1900	Day not in range		
3	Testing for Invalid Day, day with Out of range i.e., DD=32	6	32	1900	Day not in range		
4	Testing for Invalid Month, month with negative number it is not possible	-1	15	1900	Month not in range		
5	Testing for Invalid month, month with out of range i.e., MM=13 it should MM<=12	13	15	1900	Month not in range		
6	Testing for Year, year is out of range YYYY=1899, it should <=1812	6	15	1899	Year not in range		

,

7	Testing for Year, year is out of range YYYY=2013, it should <=2012	6	15	2013	Year not in range		

Table 2:Weak Robust

(Table 2) we can see that weak robust equivalence class testing will just test the ranges of the input domain once on each class. Since we are testing weak and not normal, there will only be at most one fault per test case (single fault assumption) unlike Strong Robust Equivalence class testing.

Strong Robust:

This is a table showing one corner of the cube in 3d-space (the three other corners would include a different combination of variables) since the complete table would be too large to show.

,

TC Id	Test Case Description	Input Data			Expected Output	Actual Output	Status
		MM	DD	YYYY			
1	Testing for Month is not in range MM=-1 i.e., in negative number there is not possible have to be month in negative number	-1	15	1900	Month not in range		
2	Testing for Day is not in range DD=-1 i.e., in negative number there is not possible have to be Day in negative number	6	-1	1900	Day not in range		
3	Testing for Year is not in range YYYY=1899 i.e., Year	6	15	1899	Year not in range		
4	Testing for Day and month is not in range MM=-1, DD=-1 i.e., in negative number there is not possible have to be Day and Month in negative number	-1	-1	1900	i) Day not in range ii) Month not in range		
5	i) Testing for Day is not in range and Year is not in range DD=-1 i.e., in negative number there is not possible have to be Day in negative number, and ii) YYYY=1899, so the range of year is <=1812	6	-1	1899	i) Day not in range ii) Year not in range		

,

6	i) Testing for Month is not in range MM=-1 and i.e., in negative number there is not possible have to be Day in negative number, and ii) Year is not in range YYYY=1899, year should <=1812	-1	15	1899	i) Month not in range ii) Year not in range		
7	i) Testing for Day is not in range DD=-1 i.e., in negative number there is not possible have to be Day in negative number ii) Testing for Month is not in range MM=-1 and i.e., in negative number there is not possible have to be Day in negative number, and iii) Year is not in range YYYY=1899, year should <=1812	-1	-1	1899	i) Day not in range ii) Month not in range iii) Year not in range		

,

Second Attempt

As said before the equivalence relation is vital in producing useful test cases and more time must be spent on designing it. If we focus more on the equivalence relation and consider more greatly what must happen to an input date we might produce the following equivalence classes:

M1 = {month: month has 30 days} M2
= {month: month has 31 days} M3 =
{month: month is February}

Here month has been split up into 30 days (April, June, September and November), 31 days (January, March, April, May, July, August, October and December) and February.

D1 = {day: 1 ≤ day ≤ 28}
D2 = {day: day = 29}
D3 = {day: day = 30}
D4 = {day: day = 31}

Day has been split up into intervals to allow months to have a different number of days; we also have the special case of a leap year (February 29 days).

Y1 = {year: year = 2000}
Y2 = {year: year is a leap year}
Y3 = {year: year is a common year}

Year has been split up into common years, leap years and the special case the year 2000 so we can determine the date in the month of February.

Here are the test cases for the new equivalence relation using the four types of Equivalence Class testing.
<u>Weak Normal</u>

,

TC Id	Test Case Description	Input Data			Expected Output	Actual Output	Status
		MM	DD	YYYY			
1	Testing for all Valid input changing the day within the month.	6	14	2000	6/15/2000		
2	Testing for Valid input changing the day within the month.	7	29	1996	7/30/1996		
3	Testing for Leaf year, i.e., MM=2 (Feb) the input DD=30, there is not possible date 30, in leaf year only 28 and 29 will occur.	2	30	2002	Impossible date		
4	Testing for Impossible Date, i.e., MM=6 (June) the input DD=31, there is only 30 days in the monthof June, So, DD=31 is Impossible	6	31	2000	Impossible input date		

Table 3 Weak normal

,

Strong Normal

TC ID	Test Case Description	Input Data			Expected Output	Actual Output	Status
		MM	DD	YYYY			
1	SN1	6	14	2000	6/15/2000		
2	SN2	6	14	1996	6/15/1996		
3	SN3	6	14	2002	6/15/2002		
4	SN4	6	29	2000	6/30/2000		
5	SN5	6	29	1996	6/30/1996		
6	SN6	6	29	2002	6/30/2002		
7	SN7	6	30	2000	Invalid Input Date		
8	SN8	6	30	1996	Invalid Input Date		
9	SN9	6	30	2002	Invalid Input Date		
10	SN10	6	31	2000	Invalid Input Date		
11	SN11	6	31	1996	Invalid Input Date		
12	SN12	6	31	2002	Invalid Input Date		
13	SN13	7	14	2000	7/15/2000		
14	SN14	7	14	1996	7/15/1996		
15	SN15	7	14	2002	7/15/2002		
16	SN16	7	29	2000	7/30/2000		
17	SN17	7	29	1996	7/30/1996		
18	SN18	7	29	2002	7/30/2002		
19	SN19	7	30	2000	7/31/2000		

,

20	SN20	7	30	1996	7/31/1996		
21	SN21	7	30	2002	7/31/2002		
22	SN22	7	31	2000	8/1/2000		
23	SN23	7	31	1996	8/1/1996		
24	SN25	7	31	2002	8/1/2002		
25	SN24	2	14	2000	2/15/2000		
26	SN26	2	14	1996	2/15/1996		
27	SN27	2	14	2002	2/15/2002		
28	SN28	2	29	2000	Invalid Input Date		
29	SN29	2	29	1996	3/1/1996		
30	SN30	2	29	2002	Invalid Input Date		
31	SN31	2	30	2000	Invalid Input Date		
32	SN32	2	30	1996	Invalid Input Date		
33	SN33	2	30	2002	Invalid Input Date		
34	SN34	2	31	2000	Invalid Input Date		
35	SN35	2	31	1996	Invalid Input Date		
36	SN36	2	31	2002	Invalid Input Date		

Table 4: Strong Normal

,

9.5 EXECUTIONS

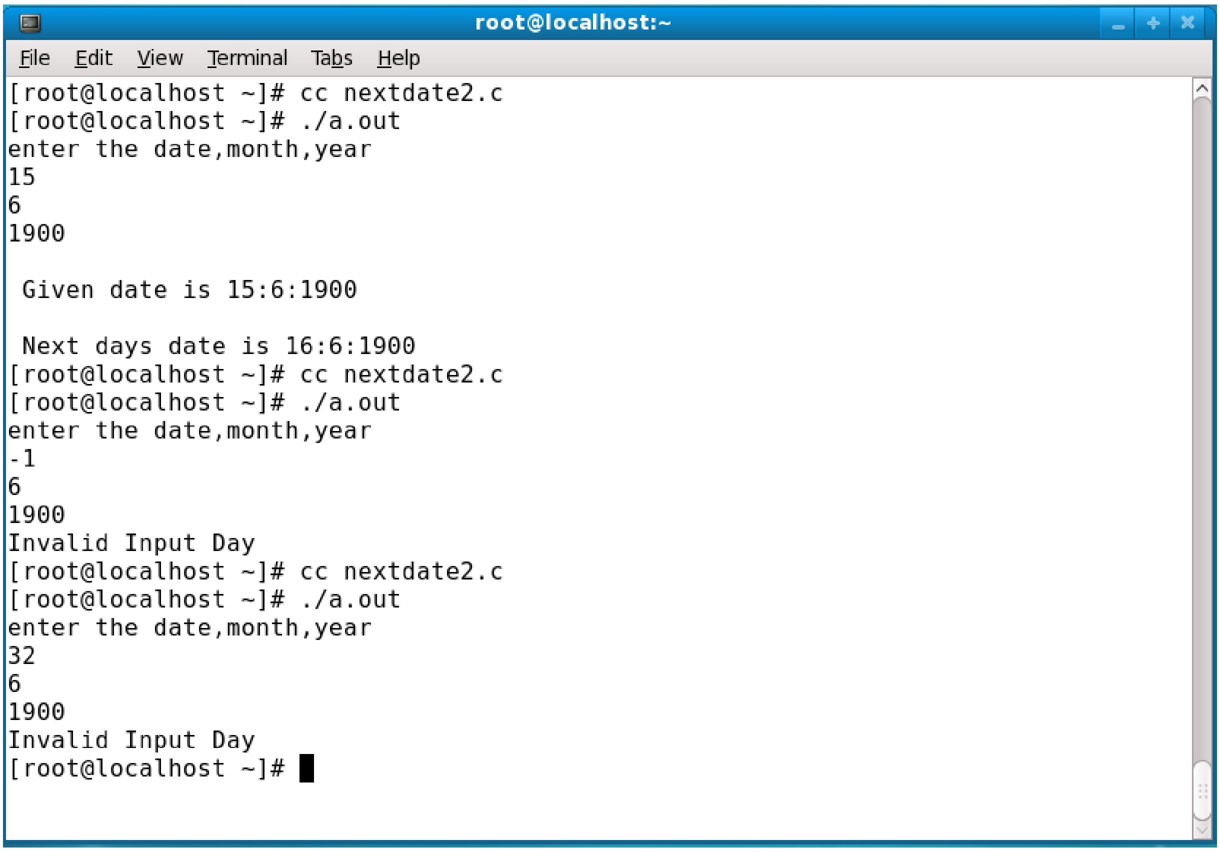
Execute the program and test the test cases in Table-1 against program and complete the table with for Actual output column   and Status column

Test Report:

1. No of TC’s Executed:
2. No of Defects Raised:
3. No of TC’s Pass:
4. No of TC’s Failed:

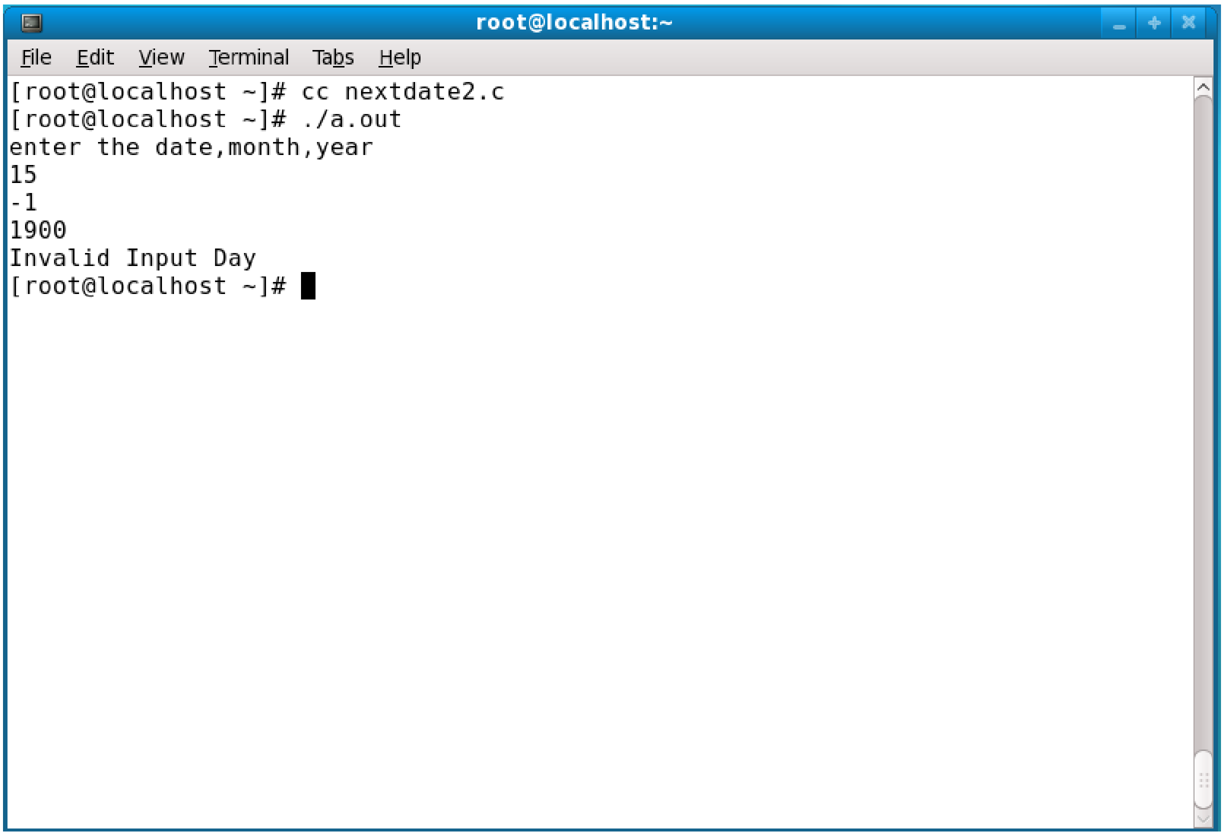
12.6 SNAPSHOTS:

1. Snapshot to show the nextdate for current date and invalid day is entered



,

2. Invalid Input



9.7 REFERENCES:

1. Requirement Specification
2. Assumptions

EXECUTION STEPS IN LINUX

1. Open Terminal
2. Then open **VI –Editor** using the filename, following command will shows that

   [root@localhost ~]# vi   Triangle.c
3. Write the Suitable code for the given program
4. Then compile and execute the program using the command;

   [root@localhost ~]# cc triangle.c
5. Then execute the command;

   [root@localhost ~]# ./a.out
6. Enter the suitable input for the program.
7. Then will get the suitable output.