Program 1: Triangle Problem **Testing Technique: Boundary Value Analysis**

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.

```
#include<stdio.h>
#include<conio.h>
int main( )
{
  int a,b,c,c1,c2,c3;
  do
  {
    printf("enter the sides of triangle\n");
    scanf("%d%d%d",&a,&b,&c);
    c1=((a>=1) && (a<=10));
    c2=((b>=1) && (b<=10));
    c3=((c>=1) && (c<=10));
    if(!c1)
       printf("value of  a is out of range");
    if(!c2)
       printf("value of  b is out of range");
```

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```
    if(!c3)
       printf("value of  c  is out of range");
  }while(!c1 || !c2 || !c3);
  if((a+b)>c && (b+c)>a && (c+a)>b)
  {
     if(a==b && b==c)
       printf("Triangle is equilateral\n");
     else if(a!=b && b!=c && c!=a)
       printf("Triangle is scalene\n");
     else
       printf("Triangle is isosceles\n");
  }
  else
     printf("Triangle cannot be formed \n");
  getch( );
  return 0;
}
```

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Boundary Value Analysis

Boundary value analysis focuses on the boundary of the input and output space to identify test cases because errors tend to occur near the extreme values of an input variable. The basic idea is to use input variables at their minimum, just above minimum, nominal, just below their maximum and maximum.

Considering Triangle program, we have three variables a, b and c. Each variables value ranges from 1 to 10.

Variables	Min	Min+	Nom	Max-	Max
a	1	2	5	9	10
b	1	2	5	9	10
c	1	2	5	9	10

Boundary Value Analysis = **4n+1** test cases, where n is number of variables

In Triangle program for BVA, we start by taking nominal values for **a** and **b** variables then cross product it with values min, min-, nom, max- and max values of variable **c**. similarly keeping nominal values for variables **a** and **c**, we cross product it with min, min-, nom, max-, max values of variable **b**. Again keeping variable **b** and **c** as nominal combine with 5 values of **a**. By this we get 15 te st cases in which a test case with all nominal values for **a**, **b** and **c** is repeated thrice, so we discard 2 duplicate such cases and finally we get 15-2=**13** test cases which is equal to BVA i.e., 4(3)+1=**13**.

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Test cases using Boundary value analysis for Triangle Program

Test cases	Description	Inputs			Output	Comments
		A	B	C		
BVA1	Enter the values of a(nom),b(nom) and c(min)	5	5	**1**	Isosceles	Valid
BVA 2	Enter the values of a(nom),b(nom) and c(min+)	5	5	**2**	Isosceles	Valid
BVA 3	Enter the values of a(nom),b(nom) and c(nom)	5	5	**5**	Equilateral	Valid
BVA 4	Enter the values of a(nom),b(nom) and c(max-)	5	5	**9**	Isosceles	Valid
BVA 5	Enter the values of a(nom),b(nom) and c(max)	5	5	**10**	Triangle cannot be formed	Valid
BVA 6	Enter the values of a(nom),b(min) and c(nom)	5	**1**	5	Isosceles	Valid
BVA 7	Enter the values of a(nom),b(min+) and c(nom)	5	**2**	5	Isosceles	Valid
BVA 8	Enter the values of a(nom),b(max-) and c(nom)	5	**9**	5	Isosceles	Valid
BVA 9	Enter the values of a(nom),b(max) and c(nom)	5	**10**	5	Triangle cannot be formed	Valid
BVA 10	Enter the values of a(min),b(nom) and c(nom)	**1**	5	5	Isosceles	Valid
BVA 11	Enter the values of a(min+),b(nom) and c(nom)	**2**	5	5	Isosceles	Valid
BVA 12	Enter the values of a(max-),b(nom) and c(nom)	**9**	5	5	Isosceles	Valid
BVA 13	Enter the values of a(max),b(nom) and c(nom)	**10**	5	5	Triangle cannot be formed	Valid

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Program 2: Commission Problem **Testing Technique: Boundary Value Analysis**

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

```
#include<stdio.h>
#include<conio.h>
int main()
{
int c1,c2,c3,temp;
int locks,stocks,barrels,totallocks,totalstocks,totalbarrels;
float lockprice,stockprice,barrelprice,locksales,stocksales,barrelsales,sales,com;
lockprice=45.0;
stockprice=30.0;
barrelprice=25.0;
totallocks=0;
totalstocks=0;
totalbarrels=0;
clrscr();
printf("Enter the number of locks and to exit press -1\n");
scanf("%d",&locks);
while(locks != -1)
{
```

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```
c1=(locks<=0 || locks>70);
printf("\nEnter the number of stocks and barrels\n");
scanf("%d %d",&stocks,&barrels);
c2=(stocks<=0 || stocks>80);
c3=(barrels<=0 || barrels>90);

if(c1)
   printf("\nValue of locks are not in the range of 1....70\n");
else
{
   temp=totallocks+locks;
    if(temp>70)
        printf("New totallocks = %d not in the range of 1....70\n",temp);
    else
        totallocks=temp;
 }
printf("Total locks = %d",totallocks);
if(c2)
printf("\n Value of stocks not in the range of 1....80\n");
else
  {
    temp=totalstocks+stocks;
```

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```
    if(temp>80)
       printf("\nNew total stocks = %d not in the range of 1....80",temp);
    else
       totalstocks=temp;
   }
printf("\nTotal stocks = %d",totalstocks);
if(c3)
   printf("\n Value of barrels not in the range of 1....90\n");
else
  {
       temp=totalbarrels+barrels;
       if(temp>90)
          printf("\nNew total barrels = %d not in the range of 1....90\n",temp);
       else
          totalbarrels=temp;
   }
printf("\nTotal barrels=%d", totalbarrels);
printf("\nEnter the number of locks and to exit press -1\n");
scanf("%d",&locks);
}
printf("\n Total locks = %d",totallocks);
prin tf("\n Total stocks = %d",totalstocks);
printf("\n Total barrels = %d",totalbarrels);
```

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```
locksales=totallocks*lockprice;
stocksales=totalstocks*stockprice;
barrelsales=totalbarrels*barrelprice;
sales=locksales+stocksales+barrelsales;
printf("\n Total sales = %f",sales);
if(sales>1800)
{
     com=0.10*1000;
     com=com+(0.15*800);
     com=com+0.20*(sales-1800);
 }
else if(sales>1000)
{
    com=0.10*1000;
    com=com+0.15*(sales-1000);
}
else
    com=0.10*sales;
printf("\nCommission = %f",com);
getch();
return 0;
}
```

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Considering **Commission program**, we have three input variables **lock**, **stock** and **barrels**.

Range of value for **locks**= 1-70, **stocks**= 1-80 and **barrels**= 1-90

Variables	Min	Min+	Nom	Max-	Max
locks	1	2	35	69	70
stocks	1	2	40	79	80
barrels	1	2	45	89	90

Considering output variable **sales** we have 3 slots for calculating **com**mission. i.e., if sales are below 1000, com is 10%, if sales are 1001 to 1800 then com is 15% and if sales are greater than 1801, com is 20%.

Sales	**Min** locks, stocks, barrrels	**Min+** locks, stocks, barrrels	**Nom** locks, stocks, barrrels	**Max-** locks, stocks, barrrels	**Max** locks, stocks, barrrels
1-1000	1,1,1	2,1,1 1,2,1 1,1,2	5,5,5	9,10,10 10,9,10 10,10,9	10,10,10
1001-1800	11,10,10 10,11,10 10,10,11	12,10,10 10,12,10 10,10,12	14,14,14	17,18,18 18,17,18 18,18,17	18,18,18
1801- above	19,18,18 18,19,18 18,18,19	20,18,18 18,20,18 18,18,20	48,48,48	69,80,90 70,79,90 70,80,89	70,80,90

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Test cases for commission program using INPUT Boundary value analysis

Test cases	Description	Inputs			Output		Comments
		Locks	Stocks	Barrels	Sales	Com	
BVA1	Enter the values for locks(nom), stocks(nom) and barrels(min)	35	40	**1**	2800	420	Valid
BVA2	Enter the values for locks(nom), stocks(nom) and barrels(min+)	35	40	**2**	2825	425	Valid
BVA3	Enter the values for locks(nom), stocks(nom) and barrels(nom)	35	40	**45**	3900	640	Valid
BVA4	Enter the values for locks(nom), stocks(nom) and barrels(max-)	35	40	**89**	5000	860	Valid
BVA5	Enter the values for locks(nom), stocks(nom) and barrels(max)	35	40	**90**	5025	865	Valid
BVA6	Enter the values for locks(nom), stocks(min) and barrels(nom)	35	**1**	45	2730	406	Valid
BVA7	Enter the values for locks(nom), stocks(min+) and barrels(nom)	35	**2**	45	2760	412	Valid
BVA8	Enter the values for locks(nom), stocks(max-) and barrels(nom)	35	**79**	45	5070	874	Valid
BVA9	Enter the values for locks(nom), stocks(max) and barrels(nom)	35	**80**	45	5100	880	Valid
BVA10	Enter the values for locks(min), stocks(nom) and barrels(nom)	**1**	40	45	2370	334	Valid
BVA11	Enter the values for locks(min+), stocks(nom) and barrels(nom)	**2**	40	45	2415	343	Valid
BVA12	Enter the values for locks(max-), stocks(nom) and barrels(nom)	**69**	40	45	5430	946	Valid
BVA13	Enter the values for locks(max), stocks(nom) and barrels(nom)	**70**	40	45	5475	955	Valid

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Test cases for commission program using OUTPUT Boundary value analysis

Test cases	Description	Inputs			Output		Comments
		Locks	Stocks	Barrels	Sales	Com	
BVA1	Enter the values for locks(min), stocks(min) and barrels(min) for the range 100 to 1000	1	1	1	100	10	Valid
BVA2	Enter the values for locks(min+), stocks(min) and barrels(min) for the range 100 to 1000	2	1	1	145	14.5	Valid
BVA3	Enter the values for locks(min), stocks(min+) and barrels(min) for the range 100 to 1000	1	2	1	130	13	Valid
BVA4	Enter the values for locks(min), stocks(min) and barrels(min+) for the range 100 to 1000	1	1	2	125	12.5	Valid
BVA5	Enter the values for locks(nom), stocks(nom) and barrels(nom) for the range 100 to 1000	5	5	5	500	50	Valid
BVA6	Enter the values for locks(max-), stocks(max) and barrels(max) for the range 100 to 1000	9	10	10	955	95.5	Valid
BVA7	Enter the values for locks(max), stocks(max-) and barrels(max) for the range 100 to 1000	10	9	10	970	97.0	Valid
BVA8	Enter the values for locks(max), stocks(max) and barrels(max-) for the range 100 to 1000	10	10	9	975	97.5	Valid
BVA9	Enter the values for locks(max), stocks(max) and barrels(max) for the range 100 to 1000	10	10	10	1000	100	Valid
BVA10	Enter the values for locks(min), stocks(min) and barrels(min) for the range 1000 to 1800	11	10	10	1045	106.75	Valid
BVA11	Enter the values for locks(min), stocks(min+) and barrels(min) for the range 1000 to 1800	10	11	10	1030	104.5	Valid
BVA12	Enter the values for locks(min), stocks(min) and barrels(min+) for the range 1000 to 1800	10	10	11	1025	103.75	Valid
BVA13	Enter the values for locks(min+), stocks(min) and barrels(min) for the range 1000 to 1800	12	10	10	1090	113.5	Valid
BVA14	Enter the values for locks(min), stocks(min+) and barrels(min) for the range 1000 to 1800	10	12	10	1060	109	Valid
BVA15	Enter the values for locks(min), stocks(min) and barrels(min+) for the range 1000 to 1800	10	10	12	1050	107.5	Valid

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BVA16	Enter the values for locks(nom), stocks(nom) and barrels(nom) for the range 1000 to 1800	14	14	14	1400	160	Valid
BVA17	Enter the values for locks(max-), stocks(max) and barrels(max) for the range 1000 to 1800	17	18	18	1755	213.25	Valid
BVA18	Enter the values for locks(max), stocks(max-) and barrels(max) for the range 1000 to 1800	18	17	18	1770	215.5	Valid
BVA19	Enter the values for locks(max), stocks(max) and barrels(max-) for the range 1000 to 1800	18	18	17	1775	216.25	Valid
BVA20	Enter the values for locks(max), stocks(max) and barrels(max) for the range 1000 to 1800	18	18	18	1800	220	Valid
BVA21	Enter the values for locks(min), stocks(min) and barrels(min) for the range > 1800	19	18	18	1845	229	Valid
BVA22	Enter the values for locks(min), stocks(min) and barrels(min) for the range > 1800	18	19	18	1830	226	Valid
BVA23	Enter the values for locks(min), stocks(min) and barrels(min) for the range > 1800	18	18	19	1825	225	Valid
BVA24	Enter the values for locks(min+), stocks(min) and barrels(min) for the range > 1800	20	18	18	1890	238	Valid
BVA25	Enter the values for locks(min), stocks(min+) and barrels(min) for the range > 1800	18	20	18	1860	232	Valid
BVA26	Enter the values for locks(min), stocks(min) and barrels(min+) for the range > 1800	18	18	20	1850	230	Valid
BVA27	Enter the values for locks(nom), stocks(nom) and barrels(nom) for the range > 1800	48	48	48	4800	820	Valid
BVA28	Enter the values for locks(max-), stocks(max) and barrels(max) for the range > 1800	69	80	90	7755	1411	Valid
BVA29	Enter the values for locks(max), stocks(max-) and barrels(max) for the range > 1800	70	79	90	7770	1414	Valid
BVA30	Enter the values for locks(max), stocks(max) and barrels(max-) for the range > 1800	70	80	89	7775	1415	Valid
BVA31	Enter the values for locks(max), stocks(max) and barrels(max) for the range > 1800	70	80	90	7800	1420	Valid

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Program 3: Next date program **Testing Technique: Boundary Value Analysis**

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

```
#include<stdio.h>
int check(int day,int month)
{
        if((month==4||month==6||month==9 ||month==11) && day==31)
                return 1;
        else
                return 0;
}
int isleap(int year)
{
        if((year%4==0 && year%100!=0) || year%400==0)
                return 1;
        else
                return 0;

}
```

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```
int main()
{
        int day,month,year,tomm_day,tomm_month,tomm_year;
        char flag;
        do
        {
                flag='y';
                printf("\nenter the today's date in the form of dd mm yyyy\n");
                scanf("%d%d%d",&day,&month,&year);
                tomm_month=month;
                tomm_year= year;
                if(day<1 || day>31)
                {
                        printf("value of day, not in the range 1...31\n");
                         flag='n';
                }
                if(month<1 || month>12)
                 {
                        printf("value of month, not in the range 1....12\n");
                        flag='n';
                }

                else if(check(day,month))
```

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```
{
        printf("value of day, not in the range day<=30");
         flag='n';
}

if(year<=1812 || year>2015)
{
          printf("value of year, not in the range 1812.....2015\n");
          flag='n';
        }
if(month==2)
{
        if(isleap(year) && day>29)
         {
                printf("invalid date input for leap year");
                flag='n';
                }
        else if(!(isleap(year))&& day>28)
        {
printf("invalid date input for not a leap year");
                flag='n';
         }
}
```

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```
}while(flag=='n');

switch (month)
{
        case 1:
        case 3:
        case 5:
        case 7:
        case 8:
        case 10:if(day<31)
                        tomm_day=day+1;
                else
                  {
                        tomm_day=1;
                        tomm_month=month+1;
                  }
                 break;
        case 4:
        case 6:
        case 9:
        case 11: if(day<30)
                        tomm_day=day+1;
                 else
```

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```
            {
                tomm_day=1;
                tomm_month=month+1;
            }
        break;

case 12: if(day<31)
                tomm_day=day+1;
        else
          {
                tomm_day=1;
                tomm_month=1;
                if(year==2015)
                 {
                   printf("the next day is out of boundary value of year\n");
                   tomm_year=year+1;
                 }
                else
                  tomm_year=year+1;
          }
         break;
case 2:
```

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```
                    if(day<28)
                            tomm_day=day+1;
                    else if(isleap(year)&& day==28)
                                tomm_day=day+1;
                     else if(day==28 || day==29)
                            {
                              tomm_day=1;
                              tomm_month=3;
                            }
                    break;
        }
        printf("next day is : %d  %d  %d",tomm_day,tomm_month,tomm_year);
        return 0;
}
```

Considering Date program, we have three variables day, month and year.

Variables	Min	Min+	Nom	Max-	Max
day	1	2	15	30	31
month	1	2	6	11	12
year	1812	1813	1914	2014	2015

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Test cases for Date program using Boundary Value Analysis

Test cases	Description	Inputs			Output	Comments
		DD	MM	YY		
BVA1	Enter the values for day(nom),month(nom) and year(min)	15	6	**1812**	16/6/1812	Valid
BVA2	Enter the values for day(nom),month(nom) and year(min+)	15	6	**1813**	16/6/1813	Valid
BVA 3	Enter the values for day(nom),month(min) and year(nom)	15	6	**1914**	16/6/1914	Valid
BVA4	Enter the values for day(nom),month(nom) and year(max-)	15	6	**2014**	16/6/2014	Valid
BVA5	Enter the values for day(nom),month(nom) and year(max)	15	6	**2015**	16/6/2015	Valid
BVA6	Enter the values for day(nom),month(min) and year(nom)	15	**1**	1914	16/1/1914	Valid
BVA7	Enter the values for day(nom),month(min+) and year(nom)	15	**2**	1914	16/2/1914	Valid
BVA8	Enter the values for day(nom),month(max-) and year(nom)	15	**11**	1914	16/11/1914	Valid
BVA9	Enter the values for day(nom),month(max) and year(nom)	15	**12**	1914	16/12/1914	Valid
BVA10	Enter the values for day(min),month(nom) and year(nom)	**1**	6	1914	2/6/1914	Valid
BVA11	Enter the values for day(min+),month(nom) and year(nom)	**2**	6	1914	3/6/1914	Valid
BVA12	Enter the values for day(max-),month(nom) and year(nom)	**30**	6	1914	1/7/1914	Valid
BVA13	Enter the values for day(max),month(nom) and year(nom)	**31**	6	1914	Day out of range for the month	Valid

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Program 4: Triangle Problem **Testing Technique: Equivalence Class Testing**

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 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.

```
#include<stdio.h>
#include<conio.h>
int main()
{
   int a,b,c,c1,c2,c3;
   do
   {
      printf("enter the sides of triangle\n");
      scanf("%d%d%d",&a,&b,&c);
      c1=((a>=1) && (a<=10));
      c2=((b>=1) && (b<=10));
      c3=((c>=1) && (c<=10));
      if(!c1)
         printf("value of  a  is out of range");
      if(!c2)
        printf("value of  b is out of range");
```

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```
      if(!c3)
          printf("value of  c is out of range");
    }while(!c1 || !c2 || !c3);
 if((a+b)>c && (b+c)>a && (c+a)>b)
 {
    if(a==b && b==c)
       printf("triangle is equilateral\n");
    else if(a!=b && b!=c && c!=a)
      printf("triangle is scalene\n");
    else
      printf("triangle is isosceles\n");
 }
 else
   printf("triangle cannot be formed \n");
getch( );
return 0;
}
```

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Equivalence Class Test For The Triangle Program

Output Equivalence Classes are as follows:

R1={<a,b,c>:the triangle with sides a,b and c is Equilateral}

R2={<a,b,c>:the triangle with sides a,b and c is Isosceles}

R3={<a,b,c>:the triangle with sides a,b and c is Scalene}

R4={<a,b,c>:sides a,b and c do not form a Triangle}

Weak Normal /Strong Normal

Test cases	Description	Inputs			Expected output	Comments
		A	B	C		
WN/SN1	Enter the valid values for a, b and c from output equivalence classes.	5	5	5	Equilateral	Valid
WN/SN2	Enter the valid values for a, b and c from output equivalence classes.	5	5	3	Isosceles	Valid
WN/SN3	Enter the valid values for a, b and c from output equivalence classes.	5	3	4	Scalene	Valid
WN/SN4	Enter the valid values for a, b and c from output equivalence classes.	10	1	1	Triangle cannot be formed	Valid

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Weak Robust

Test cases	Description	Inputs			Expected output	Comments
		A	B	C		
WR 1	Enter the valid values for b and c from output equivalence classes and invalid value for a.	-1	5	5	Value of a is not in a range	Triangle cannot be formed
WR 2	Enter the valid values for a and c from output equivalence classes and invalid value for b.	3	-1	4	Value of b is not in a range	Triangle cannot be formed
WR 3	Enter the valid values for a and b from output equivalence classes and invalid value for c.	10	10	-1	Value of c is not in a range	Triangle cannot be formed
WR 4	Enter the valid values for b and c from output equivalence classes and invalid value for a.	11	3	3	Value of a is not in a range	Triangle cannot be formed
WR 5	Enter the valid values for a and c from output equivalence classes and invalid value for b.	5	11	6	Value of b is not in a range	Triangle cannot be formed
WR 6	Enter the valid values for a and b from output equivalence classes and invalid value for c.	9	10	11	Value of c is not in a range	Triangle cannot be formed

Strong Robust

Test cases	Description	Inputs			Expected output	Comments
		A	B	C		
SR 1	Enter the valid value for b from output equivalence classes and invalid values for a and c.	-1	3	-1	Values of a and c are not in range	Triangle cannot be formed
SR 2	Enter the valid value for a from output equivalence classes and invalid values for b and c.	5	-1	-1	Values of b and c are not in range	Triangle cannot be formed
SR 3	Enter the valid value for c from output equivalence classes and invalid values for a and b.	-1	-1	10	Values of a and b are not in range	Triangle cannot be formed
SR 4	Enter the valid value for a from output equivalence classes and invalid values for b and c.	7	11	11	Values of b and c are not in range	Triangle cannot be formed
SR 5	Enter the valid value for c from output equivalence classes and invalid values for a and b.	11	11	10	Values of a and b are not in range	Triangle cannot be formed
SR 6	Enter the valid value for b from output equivalence classes and invalid values for a and c.	11	5	11	Values of a and c are not in range	Triangle cannot be formed

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SR 7	Enter the valid values for b and c from output equivalence classes and invalid value for a.	-1	5	5	Values of a is not in range	Triangle cannot be formed
SR 8	Enter the valid values for a and c from output equivalence classes and invalid value for b.	10	-1	10	Values of b is not in range	Triangle cannot be formed
SR 9	Enter the valid values for a and b from output equivalence classes and invalid value for c.	7	6	-1	Values of c is not in range	Triangle cannot be formed
SR 10	Enter the valid values for b and c from output equivalence classes and invalid value for a.	11	5	4	Values of a is not in range	Triangle cannot be formed
SR 11	Enter the valid values for a and c from output equivalence classes and invalid value for b.	2	11	3	Values of b is not in range	Triangle cannot be formed
SR 12	Enter the valid values for a and b from output equivalence classes and invalid value for c.	3	4	11	Values of c is not in range	Triangle cannot be formed
SR 13	Enter the invalid value for a, b and c.	11	11	11	Values of a, b and c are not in a range	Triangle cannot be formed
SR 14	Enter the invalid value for a, b and c.	-1	-1	-1	Values of a, b and c are not in a range	Triangle cannot be formed

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Program 5: Commission Problem **Testing Technique: Equivalence Class Testing**

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

Equivalence Class Test For The Commission Program

Equivalence Classes are as follows:

L1={ locks: 1<=locks<=70}

L2={ locks=-1}

S1={ stocks: 1<=stocks<=80}

B1={ barrels: 1<=barrels<=90}

Weak Normal /Strong Normal

Test cases	Description	Inputs			Expected output		Comments
		Locks	Stocks	Barrels	Sales	Com	
WN/SN1	Enter the valid value within range for locks, stocks and barrels	35	45	65	4550	770	valid
WN/SN2	Enter the value of locks=-1 and valid inputs for stocks and barrels	-1	40	65	2825 For Program termination	425	valid

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Weak Robust

Test cases	Description	Inputs			Expected output		Comments
		Locks	Stocks	Barrels	Sales	Com	
WR 1	Enter the value of lock less than -1 or equal to zero and valid values for stocks and barrels	-2	40	65	2825 Value of locks not in the range of 1..70	425	valid
WR 2	Enter the value of locks greater than 70 and valid values for Stocks and barrels	72	40	65	2825 Value of locks not in the range of 1..70	425	valid
WR 3	Enter the value of stocks less than or equal to zero and valid values for locks and barrels	35	-1	45	2700 Value of stocks not in the range of 1..80	400	valid
WR 4	Enter the value of stocks greater than 80 and valid values for locks and barrels	35	81	45	2700 Value of stocks not in the range of 1..80	400	valid
WR 5	Enter the value of barrels less than or equal to zero and valid values for locks and stocks	35	40	-1	2775 Value of barrels not in the range of 1..90	415	valid
WR 6	Enter the value of barrels greater than 90 and valid values for locks and stocks	35	40	91	2775 Value of barrels not in the range of 1..90	415	valid

Strong Robust

Test cases	Description	Inputs			Expected output		Comments
		Locks	Stocks	Barrels	Sales	Com	
SR 1	Enter the value of lock less than -1 or equal to zero and valid values s for stocks and barrels.	-2	45	60	2850 Value of locks not in the range of 1..70	430	Valid
SR 2	Enter the value of stocks less than or equal to zero and valid values for locks and barrels.	35	-1	45	2700 Value of stocks not in the range of 1..80	400	Valid
SR 3	Enter the value of barrels less than or equal to zero and valid values for locks and stocks.	35	40	-1	2775 Value of barrels not in the range	415	Valid

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					of 1..90	
SR 4	Enter the value of locks & stocks less than or equal to zero and valid values for barrels.	-2	-1	45	1125 118.75 Value of locks and stocks not in the range 1..70 & 1..80 resp	Valid
SR 5	Enter the value of locks and barrels less than or equal to zero and valid values for stocks.	-2	40	-1	1200 130 Value of locks and barrels not in range of 1..70 & 1..80 resp	Valid
SR 6	Enter the value of stocks & barrels less than or equal to zero and valid values for locks.	35	-1	-1	1575 186.25 Value of stocks and barrels not in range of 1..80 & 1..90 resp	Valid
SR 7	Enter the value of locks, stocks and barrels less than or equal to zero.	-2	-1	-1	Value of locks,stocks & barrels not in range of 1..70,1..80 & 1..90 resp	Valid
SR 8	Enter the value of locks greater than 70 and valid values for stocks and barrels.	71	40	45	2325 325 Value of locks not in the range of 1..70	Valid
SR 9	Enter the value of stocks greater than 80 & valid values for locks and barrels.	35	82	45	2700 400 Value of stocks not in the range of 1..80	Valid
SR 10	Enter the value of barrels greater than 90 and valid values for locks and stocks.	35	40	93	2775 415 Value of barrels not in the range of 1..90	Valid
SR 11	Enter the value of locks, stocks greater than 70,80 and valid values for barrels.	71	81	45	1125 118.75 Value of locks & stocks not in the range of 1..70 & 1..80 resp	Valid
SR 12	Enter the value of stocks and barrels greater than 80,90 and valid values for locks.	35	81	91	1575 186.25 Value of stocks & barrels not in the range of 1..80 & 1..90 resp	Valid
SR 13	Enter the value of locks and barrels greater than 70, 90 and valid values for stocks.	71	40	91	1200 130 Value of locks & barrels not in range of 1..70 & 1..90 resp	Valid
SR 14	Enter the value of locks, stocks & barrels greater than 70, 80, 90.	71	81	91	Value of locks,stocks and barrels not in the range of 1..70,1..80 and 1..90 resp	Valid

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Program 6: Next date program **Testing Technique: Equivalence Class Testing**

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.

Equivalence class testing for next date program

Equivalence Classes are as follows:

D1= { Day/DD : 1<=DD<=31 }

M1= { Month/MM : 1<=MM<=12 }

Y1= { Year /YY: 1812<=YY<=2015 }

Weak Normal /Strong Normal

Test cases	Description	Inputs			Output	Comments
		DD	MM	YY		
WN/SN1	Enter valid values for day, month and year from equivalence classes.	12	2	1990	13/2/1990	Valid

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Weak Robust

Test cases	Description	Inputs			Output	Comments
		DD	MM	YY		
WR1	Enter valid values for month and year from equivalence classes and invalid value for day.	-1	6	1992	Day out of range	Valid
WR2	Enter valid values for day and year from equivalence classes and invalid value for month.	15	-1	1992	Month out of range	Valid
WR3	Enter valid values for day and month from equivalence classes and invalid value for year.	15	6	1811	Year out of range	Valid
WR4	Enter valid values for month and year from equivalence classes and invalid value for day.	32	6	1992	Day out of range	Valid
WR5	Enter valid values for day and year from equivalence classes and invalid value for month.	15	13	1992	Month out of range	Valid
WR6	Enter valid values for day and month from equivalence classes and invalid value for year.	15	6	2016	Year out of range	Valid

Strong Robust

Test cases	Description	Inputs			Output	Comments
		DD	MM	YY		
SR1	Enter valid values for month and year from equivalence classes and invalid value for day.	-1	6	1992	Day out of range	Valid
SR2	Enter valid values for day and year from equivalence classes and invalid value for month.	15	-1	1992	Month out of range	Valid
SR3	Enter valid values for day and month from equivalence classes and invalid value for year.	15	6	1811	Year out of range	Valid

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SR4	Enter valid value for year from equivalence classes and invalid values for day and month.	-1	-1	1992	Day, Month out of range	Valid
SR5	Enter valid value month for from equivalence classes and invalid values for day and year.	-1	6	1811	Day, Year out of range	Valid
SR6	Enter valid value for day from equivalence classes and invalid values for month and year.	15	-1	1811	Month, Year out of range	Valid
SR7	Enter valid values for month and year from equivalence classes and invalid value for day.	32	6	1992	Day out of range	Valid
SR8	Enter valid values for day and year from equivalence classes and invalid value for month.	15	13	1992	Month out of range	Valid
SR9	Enter valid values for day and month from equivalence classes and invalid value for year.	15	6	2016	Year out of range	Valid
SR10	Enter valid value for year from equivalence classes and invalid values for day and month.	32	13	1992	Day, Month out of range	Valid
SR11	Enter valid value month for from equivalence classes and invalid values for day and year.	32	6	2016	Day, Year out of range	Valid
SR12	Enter valid value for day from equivalence classes and invalid values for month and year.	15	13	2016	Month, Year out of range	Valid
SR13	Enter invalid values for day, month and year.	-1	-1	1811	Day, Month, Year out of range	Valid
SR14	Enter invalid values for day, month and year.	32	13	2016	Day, Month, Year out of range	Valid

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Program 7: Triangle Problem **Testing Technique: Decision Table Approach**

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.

```
#include<stdio.h>
#include<conio.h>
int main()
{
    int a,b,c;
    printf("enter the sides of triangle\n");
    scanf("%d%d%d",&a,&b,&c);
    if((a+b)>c && (b+c)>a && (c+a)>b)
    {
      if(a==b && b==c)
          printf("triangle is equilateral\n");
      else if (a!=b && b!=c && c!=a)
          printf("triangle is scalene\n");
      else
        printf("triangle is isosceles\n");
    }
```

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```
    else
        printf("triangle cannot be formed\n");
return 0;
}
```

Decision Table for Triangle Problem

		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
Conditions	**C1: a<b+c**	F	T	T	T	T	T	T	T	T	T	T
	C2: b<c+a	--	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	--	--	--	T	T	F	F	F	T	T	F
	C5: b=c	--	--	--	T	F	T	F	F	T	F	T
	C6: c=a	--	--	--	T	F	F	T	F	F	T	T
Actions	**A1: Not a triangle**	x	x	x								
	A2: Equilateral				x							
	A3: Isosceles					x	x	x				
	A4: Scalene								x			
	A5: Impossible									x	x	x

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Test Cases using Decision Table for Triangle Program

Test cases	Description	Inputs			Output	Comments
		A	B	C		
Case 1	Enter the values of a, b and c such that value of a is greater than sum of b and c.	7	2	3	Not a triangle	Valid
Case 2	Enter the values of a, b and c such that value of b is greater than sum of a and c.	2	8	3	Not a triangle	Valid
Case 3	Enter the values of a, b and c such that value of c is greater than sum of a and b.	2	4	7	Not a triangle	Valid
Case 4	Enter the values of a, b and c such that values of a,b and c are equal.	5	5	5	Equilateral	Valid
Case 5	Enter the values of a, b and c Such that value of a is equal to value of b.	4	4	3	Isosceles	Valid
Case 6	Enter the values of a, b and c such that value of b is equal to value of c.	2	5	5	Isosceles	Valid
Case 7	Enter the values of a, b and c such that value of a is equal to value of c.	6	2	6	Isosceles	Valid
Case 8	Enter the values of a, b and c such that values of a,b and c are different.	2	3	4	Scalene	Valid
Case 9	Enter the values of a, b and c such that value of a is equal to value of b and c but value of b is not equal to c.	?	?	?	Impossible	Valid
Case 10	Enter the values of a, b and c such that value of b is equal to value of c and value of c is equal to a but value of a not equal to b.	?	?	?	Impossible	Valid
Case 11	Enter the values of a, b and c such that value of a is equal to b and value of b is equal to value of c but value of a not equal to c.	?	?	?	Impossible	Valid

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Program 8: Commission Problem **Testing Technique: Decision Table-based Testing**

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

INPUT DECISION TABLE

	RULES	R1	R2	R3	R4	R5	R6	R7	R8	R9
Conditions	C1: 1<= locks <=70	---	T	T	T	T	F	F	F	F
	C2: 1<= stocks <=80	---	F	T	F	T	F	T	F	T
	C3: 1<= barrels <= 90	---	F	F	T	T	F	F	T	T
	C4: locks = -1	T	T	T	T	T	T	T	T	T
Actions	a1: Invalid lock input						X	X	X	X
	a2: Invalid stock input		X		X		X		X	
	a3: Invalid barrels input		X	X			X	X		
	a4: Calculate totallocks, totalstocks and totalbarrels	X	X	X	X	X	X	X	X	X
	a5: Calculate sales	X	X	X	X	X	X	X	X	X

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Test cases for Commission program for Input Decision table.

Test cases	Description	Inputs			Expected output		Comments
		Locks	Stocks	Barrels	Sales	Com	
IDT1	Enter no. of locks=-1	-1	-	-	0 Program Terminates	0	valid
IDT2	Enter the valid no. of locks and invalid values for stocks and barrels	20	81	91	900 Invalid no.of stocks and barrels	90	valid
IDT3	Enter the valid values for locks, stocks and invalid value for barrels	20	20	96	1500 Invalid no.of barrels	175	valid
IDT4	Enter the valid values for locks and barrels and invalid value for stocks	20	-1	20	1400 Invalid no.of stocks	160	valid
IDT5	Enter the valid values for locks, stocks and barrels	20	20	20	2000 Calculates sales and commission	260	valid
IDT6	Enter the invalid values for locks, stocks and barrels	-2	81	-1	0 Invalid no.of locks, Stocks and barrels.	0	valid
IDT7	Enter the valid value for stocks and invalid values for locks and barrels	-2	20	91	600 Invalid no.of locks and barrels	60	valid
IDT8	Enter invalid input for locks and stocks and valid input for barrels	71	-1	20	500 Invalid no.of locks and stocks	50	valid
IDT9	Enter the invalid value for locks and valid values for stocks and barrels	-3	20	20	1100 Invalid no.of locks	115	valid

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COMMISSION CALCULATION DECISION TABLE

	RULES	R1	R2	R3
Conditions	**C1: Sales> 1801**	T	F	F
	C2: Sales >1001 and sales <= 1800	---	T	F
	C3: Sales <=1000	---	---	T
Actions	**a1: comm. = 10% *1000 + 15%*800 + (sales-1800) * 20%**	X		
	a2: comm. = 10% *1000 + (sales-1000)* 15%		X	
	a3: comm. = 10% *sales			X

Test cases for Commission program for Output Decision table

Test cases	Description	Inputs			Expected output		Comments
		Locks	Stocks	Barrels	Sales	Com	
IDT1	Enter the value of locks,stocks and Barrels such that sales>1800.	19	18	18	1845	229	Valid
IDT2	Enter the value of locks,stocks and Barrels such that sales>1000 and sales <=1800.	14	14	14	1400	160	Valid
IDT3	Enter the value of locks,stocks and Barrels such that sales<=1000.	5	5	5	500	50	Valid

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Program 9: Commission Problem **Testing Technique: Dataflow Testing**

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

```
1  #include<stdio.h>
2  #include<conio.h>
3  int main()
4  {
5  int c1,c2,c3,temp;
6  int locks,stocks,barrels,totallocks,totalstocks,totalbarrels;
7  float lockprice,stockprice,barrelprice,locksales,stocksales,barrelsales,sales,com;
8  lockprice=45.0;
9  stockprice=30.0;
10 barrelprice=25.0;
11 totallocks=0;
12 totalstocks=0;
13 totalbarrels=0;
14 clrscr();
15 printf("Enter the number of locks and to exit press -1\n");
16 scanf("%d",&locks);
17 while(locks != -1)
18 {
19 c1=(locks<=0 || locks>70);
20 printf("\nEnter the number of stocks and barrels\n");
21 scanf("%d %d",&stocks,&barrels);
22 c2=(stocks<=0 || stocks>80);
23 c3=(barrels<=0 || barrels>90);
24 if(c1)
25 printf("\nValue of locks are not in the range of 1....70\n");
```

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```
26 else
27 {
28 temp=totallocks+locks;
29 if(temp>70)
30 printf("New totallocks = %d not in the range of 1....70\n",temp);
31 else
32 totallocks=temp;
33 }
34 printf("Total locks = %d",totallocks);
35 if(c2)
36 printf("\n Value of stocks not in the range of 1....80\n");
37 else
38 {
39 temp=totalstocks+stocks;
40 if(temp>80)
41 printf("\nNew total stocks = %d not in the range of 1....80",temp);
42 else
43 totalstocks=temp;
44 }
45 printf("\nTotal stocks = %d",totalstocks);
46 if(c3)
47 printf("\n Value of barrels not in the range of 1....90\n");
48 else
49 {
50 temp=totalbarrels+barrels;
51 if(temp>90)
52 printf("\nNew total barrels = %d not in the range of 1....90\n",temp);
53 else
54 totalbarrels=temp;
55 }
56 printf("\nTotal barrels=%d", totalbarrels);
57 printf("\nEnter the number of locks and to exit press -1\n");
```

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```
scanf("%d",&locks);
}
printf("\n Total locks = %d",totallocks);
printf("\n Total stocks = %d",totalstocks);
printf("\n Total barrels = %d",totalbarrels);
locksales=totallocks*lockprice;
stocksales=totalstocks*stockprice;
barrelsales=totalbarrels*barrelprice;
sales=locksales+stocksales+barrelsales;
printf("\n Total sales = %f",sales);
if(sales>1800)
{
com=0.10*1000;
com=com+(0.15*800);
com=com+0.20*(sales-1800);
}
else if(sales>1000)
{
com=0.10*1000;
com=com+0.15*(sales-1000);
}
else
com=0.10*sales;
printf("\nCommission = %f",com);
getch();
return 0;
}
```

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Define/ Use Nodes for variables in the commission problem

Variable	Defined at node	Used at node
lockprice	8	63
stockprice	9	64
barrelprice	10	65
totallocks	11,32	28,34,60,63
totalstocks	12,43	39,45,61,64
totalbarrels	13,54	50,56,62,65
Locks	16,58	17,19,28
stocks	21	22,39
barrels	21	23,50
locksales	63	66
stocksales	64	66
barrelsales	65	66
Sales	66	67,68,72,74,77,80
Com	70,71,72,76,77,80	71,72,77,81

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Define /Use paths with definition clear status

Test id	Description	Variables (beginning ,end nodes)	DU paths	DC path ?
1	Check for lockprice variable DEF(ocklprice,8) And USE(lockprice,63)	<8,63>	8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29, 31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49 ,50,51,53,54,55,56,57,58,59,60,61,62,63	**YES**
2	Check for stockprice variable DEF(stockprice,9) And USE(stockprice,64)	<9,64>	9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,26, 27,28,29,31,32,33,34,35,37,38,39,40,42,43,44,45, 46,48,49,50,51,53,54,55,56,57,58,59,60,61,62,63,64	**YES**
3	Check for barrelprice variable DEF(barrelprice,10) And USE(barrelprice,65)	<10,65>	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28, 29,31,32,33,34,35,37,38,39,40,42,43,44,45,46, 48,49,50,51,53,54,55,56,57,58,59,60,61,62,63,64,65	**YES**
4	Check for totallocks variable DEF(totallocks,11,32) And USE(totallocks, 28,34,60,63)	<11,28>	11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28	**YES**
		<11,34>	11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29,31,32,33,34	**NO**
		<11,60>	11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29,31,32,33,34,35,37 ,38,39 ,40,42,43 ,44,45,46,48,49,50,51,53,54,55,56,57,58,59,60	**NO**
		<11,63>	11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29,31,32,33,34,35,37 ,38,39 ,40,42,43 ,44,45,46,48,49,50,51,53,54,55,56,57,58,59,60,61,62,63	**NO**
		<32,28>	32,33,34,35,37,38,39,40,42,43,44,45,46,48,49,50,51,53,54,55,56,57,58,17 ,18,19,20,21,22,23,24,26,27,28	**YES**

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		<32,34>	32,33,34	**YES**
		<32,60>	32,33,34,35,37,38,39,40,42,43,44,45,46,48,49,50,51,53,54, 55,56,57,58,59, 60	**YES**
		<32,63>	32,33,34,35,37,38,39,40,42,43,44,45,46,48,49,50,51, 53,54,55,56,57,58,59 ,60,61,62,63	**YES**
5	Check for totalstocks variable DEF(totalstocks,12,43) And USE(totalstocks, 39,45,61,64)	<12,39>	12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29,31 ,32,33,34,35,37,38,39	**YES**
		<12,45>	12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 ,31,32,33,34,35,37,38,39,40,42,43,44,45	**NO**
		<12,61>	12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 ,31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49 ,50,51,53,54,55,56,57,58,59,60,61	**NO**
		<12,64>	12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 ,31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49 ,50,51,53,54,55,56,57,58,59,60,61,62,63,64	**NO**
		<43,45>	43,44,45	**YES**

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		<43,61>	43,44,45,46,48,49,50,51,53,54,55,56,57,58,59,60,61	**YES**
		<43,64>	43,44,45,46,48,49,50,51,53,54,55,56,57,58,59,60,61,62,63,64	**YES**
6	Check for totalbarrels variable DEF(totalbarrels,13,54) And USE(totalbarrels, 50,56,62,65)	<13,50>	13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 ,31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49,50	**YES**
		<13,56>	13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 ,31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49 ,50,51,53,54,55,56	**NO**
		<13,62>	13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29, 31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49, 50,51,53,54,55,56,57,58,59,60,61,62	**NO**
		<13,65>	13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29, 31,32,33,34,35,37,38,39,40,42,43,44,45,46,48,49, 50,51,53,54,55,56,57,58,59,60,61,62,63,64,65	**NO**
		<54,56>	54,55,56	**YES**
		<54,62>	54,55,56,57,58,59,60,61,62	**YES**
		<54,65>	54,55,56,57,58,59,60,61,62,63,74,65	**YES**

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7	Check for locks variable DEF(locks,16,58) And USE(locks,17,19,28)	<16,17>	16,17	**YES**
		<16,19>	16,17,18,19	**YES**
		<16,28>	16,17,18,19,20,21,22,23,24,26,27,28	**YES**
		<58,17>	58,17	**YES**
		<58,19>	58,17,18,19	**YES**
		<58,28>	58,17,18,19,20,21,22,23,24,26,27,28	**YES**
8	Check for stocks variable DEF(stocks,21) And USE(stocks,22,39)	<21,22>	21,22	**YES**
		<21,39>	21,22,23,24,26,27,28,29,31,32,33,34,35,37,38,39	**YES**
9	Check for barrels variable DEF(barrels,21) And USE(barrels,23,50)	<21,23>	21,22,23	**YES**
		<21,50>	21,22,23,24,25,26,27,28,29,31,32,33,34,35,37,38,39,40,42,43,44,45, 46,47,48,49,50	
10	Check for lockpsales variable DEF(locksales,63) And USE(locksales,66)	<63,66>	63,64,65,66	**YES**
11	Check for stocksales variable DEF(stocksales,64) And USE(stocksales,66)	<64,66>	64,65,66	**YES**
12	Check for barrelsales variable DEF(barrelsales,65) And USE(barrelsales,66)	<65,66>	65,66	**YES**
13	Check for sales variable DEF(sales,66) And USE(sales,67,68,72,74,77,80)	<66,67>	66,67	**YES**
		<66,68>	66,67,68	**YES**
		<66,72>	66,67,68,69,70,71,72	**YES**
		<66,74>	66,67,68,74	**YES**
		<66,77>	66,67,68,74,75,76,77	**YES**

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		<66,80>	66,67,68,74,79,80	**YES**
14	Check for commission variable DEF(com,70,71,72,76,77,80) And USE(com,71,72,77,81)	<70,71>	70,71	**NO**
		<70,72>	70,71,72	**NO**
		<70,81>	70,71,72,73,81	**NO**
		<71,72>	71,72	**NO**
		<71,81>	71,72,73,81	**NO**
		<72,81>	72,73,81	**YES**
		<76,77>	76,77	**NO**
		<76,81>	76,77,78,81	**NO**
		<77,81>	77,78,81	**YES**
		<80,81>	80,81	**YES**

Note

In above Du-Paths, some paths like

<70,77>,<71,71>,<71,77>,<72,71>,<72,72>,<72,77>,<76,71>,<76,72>,<77,71>,<77,71>,<77,77>,
<80,70>,<80,72>,<80,77>,<80,77> are not possible to be formed. So they are not considered in above table.

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Program 10: Binary Search **Testing Technique: Basis paths**

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.

```
   #include<stdio.h>
A. 1  int binsrc(int x [ ],int low,int high,int key)
   2  {
   3  int mid;
B. 4  while(low<=high)
C. 5  {
   6  mid=(low+high)/2;
D. 7  if(x[mid]==key)
I. 8    return mid;
E. 9  elseif(x[mid]<key)
G. 10   low=mid+1;
F. 11 else
   12   high=mid-1;
H. 13 }
J. 14 return -1;
K. 15 }
```

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```
int main()
{
int a[20],key,i,n,succ;
printf("Enter the n value up to max of 20");
scanf("%d",&n);
if(n>0)
{
  printf("enter the elements in ascending order\n");
  for(i=0;i<n;i++)
     scanf("%d",&a[i]);
  printf("enter the key element to be searched\n");
  scanf("%d",&key);
  succ=binsrc(a,0,n-1,key);
  if(succ>=0)
     printf("Element found in position = %d\n",succ+1);
  else
     printf("Element not found \n");
}
else
   printf("Number of element should be greater than zero\n");
return 0;
}
```

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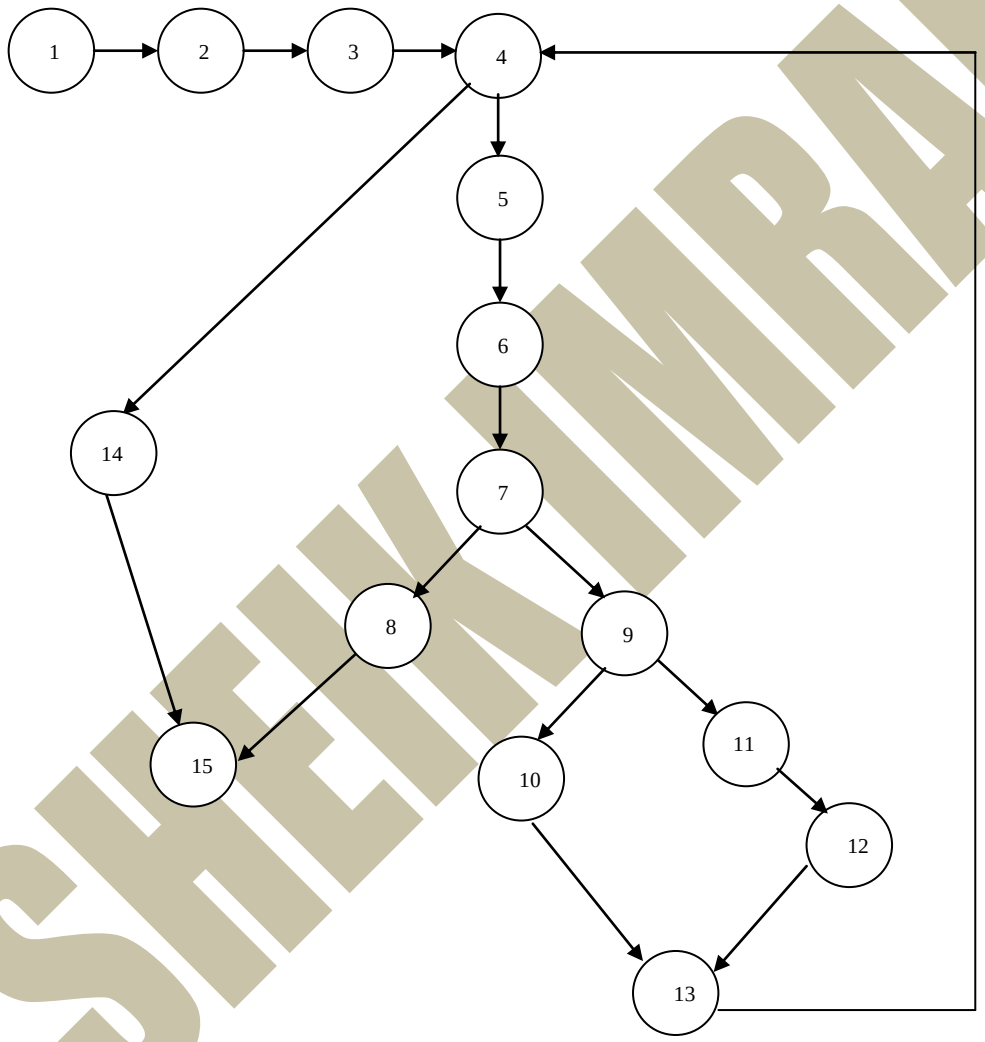
Program Graph



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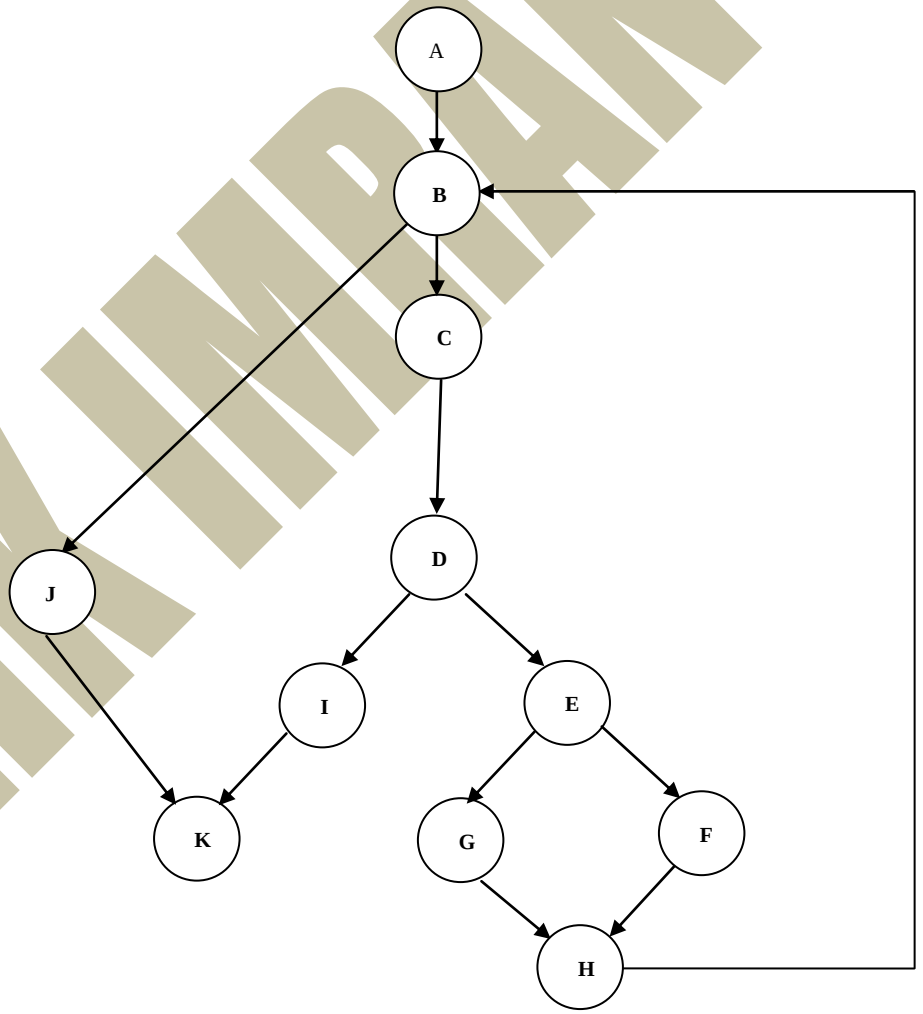
DD Path graph

NODES	DD-paths
1-3	A
4	B
5,6	C
7	D
8	I
9	E
10	G
11,12	F
13	H
14	J
15	K



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McCabe's Basis path method

Considering DD-Path graph of the program, first we need to find Baseline path. A baseline path consists of maximum number of decision nodes. Using Baseline path we start flipping each decision node for finding new paths.

Considering Binary search program

Considering DD-Path graph of Binary search function, function starts at node A and Ends at node K. First, Base Line path is formed by considering all decision nodes as shown below.

Baseline Path: A **B** C **D** **E** F H **B** J K**.**

Nodes which are bold and large are decision nodes. Now start flipping each decision node.

Flipping at B : A B J K.

Flipping at D : A B C D I K.

Flipping at E : A B C D E G H B J.

Cyclomatic Complexity

$$V(G) = e - n + 2p$$

Where,

e is number of edges in DD-Path graph.

n is number of nodes in DD-Path graph.

p is number of regions connected.(always 1)

Number of linearly independent paths for a given graph G **= 13-11+2(1)= 4** Test cases

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Test Cases for Binary Search Program

Test Cases	Description	Input			Expected Output	Comment
		N	Array elements	Key		
TC1	Enter the basis path consisting of all decision nodes **ABCDEFHBJK.**	2 1	{5,10} {10}	4 5	Infeasible because low>high means from B to J then K which means no elements left which is not true in any case.	Valid
TC2	Enter the basis path consisting of all decision nodes **ABJK.**	0	---------	----	Infeasible because low>high means from B to J then K which means no elements left which is not true in any case.	Invalid
TC3	Enter the basis path consisting of all decision nodes **ABCDIK.**	2 3 5	{5,10} {5,10,15} {5,10,15,20,25}	10 10 15	Element found in position 2 Element found in position 2 Element found in position 3	Valid
TC4	Enter the basis path consisting of all decision nodes **ABCDEGHBJK.**	2 1	{5,10} {10}	15 12	Infeasible because low>high means from B to J then K which means no elements left which is not true in any case.	Invalid

Note

Path **B J K** indicates fail of while (low<=high) condition. Because when there is one element in the array, then low will b equal to high (i.e., low=high). Similarly when there are more than one elements in the array low will be greater than high (i.e., low>high). So low>high means there no elements in the array. So in above table paths containing **B J K** are considered as infeasible.

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Program 11: Quick Sort **Testing Technique: Path Testing**

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.

```
#include<stdio.h>
A.  1  void quicksort(int x[10],int first,int last)
B.  2  {
    3    int temp,pivot,i,j;
C.  4    if(first<last)
D.  5    {
    6     pivot=first;
    7     i=first;
    8     j=last;
E.  9     while(i<j)
F.  10    {
G.  11      while(x[i]<=x[pivot] && i<last)
H.  12        i++;
I.  13      while(x[j]>x[pivot])
J.  14        j--;
K.  15      if(i<j)
```

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```
L.  16     {
    17    temp=x[i];
    18     x[i]=x[j];
    19   x[j]=temp;
    20     }
M.  21  }
N.  22     temp=x[pivot];
    23     x[pivot]=x[j];
    24     x[j]=temp;
    25    quicksort(x,first,j-1);
P.  26     quicksort(x,j+1,last);
Q.  27  }
O.  28 }

int main()
{
        int a[20],i,key,n;
        printf("enter the size of the array max of 20 elements");
        scanf("%d",&n);
        if(n>0)
        {
              printf("enter the elements of the array");
              for(i=0;i<n;i++)
```

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```
            scanf("%d",&a[i]);
            quicksort(a,0,n-1);
            printf("the elements in the sorted array is:\n");
            for(i=0;i<n;i++)
              print f("%d\t",a[i]);
        }
        else
            printf("size of array is invalid\n");
}
```

Cyclomatic Complexity

V(G) =e-n+2p

or

V(G) =e-n+p (for closed closed graph)

Where,

e is number of edges in DD-Path graph.
n is number of nodes in DD-Path graph.
p is number of regions connected.(always 1)

Number of linearly independent paths (Test cases) for a given graph G **= 23-17+(1)**

= 6+1

= 7 Test cases

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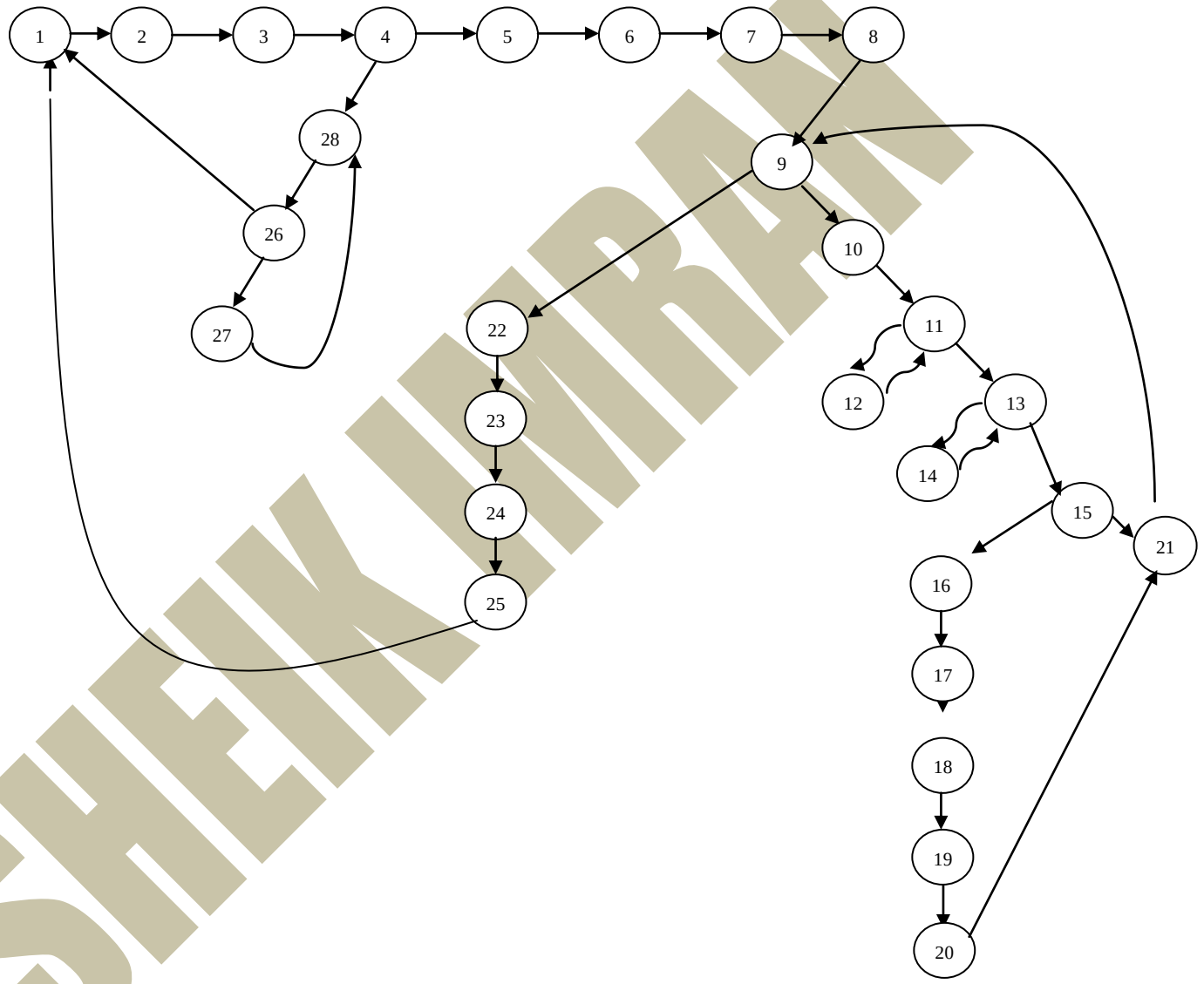
Program graph



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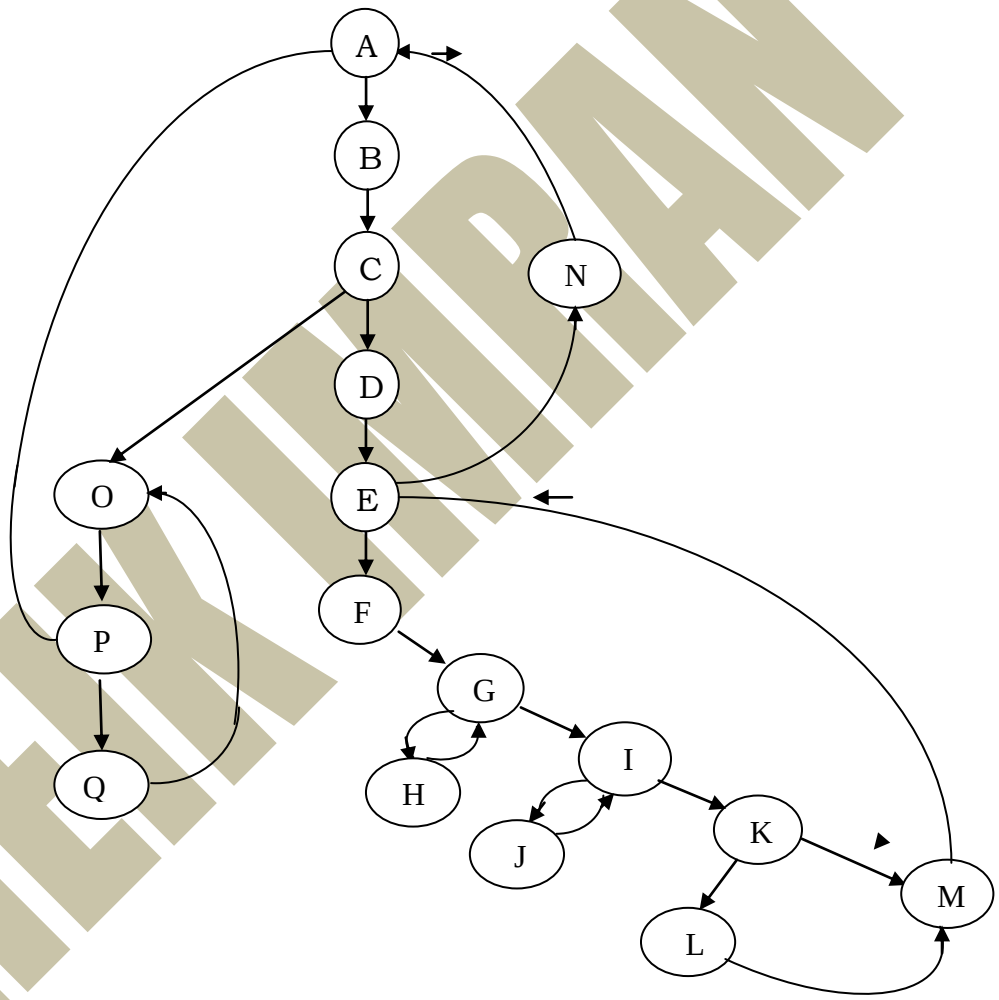
DD path graph

NODES	DDPATHS
1	A
2-3	B
4	C
5-8	D
9	E
10	F
11	G
12	H
13	I
14	J
15	K
16-20	L
21	M
22-25	N
26	P
27	Q
28	O



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McCabe's Basis path method

Considering DD-Path graph of the program, first we need to find Baseline path. A baseline path consists of maximum number of decision nodes. Using Baseline path we start flipping each decision node for finding new paths.

Considering Quick Sort program

Considering DD-Path graph of Quick sort function, function starts at node A and Ends at node O. First, Base Line path is formed by considering all decision nodes as shown below.

Baseline Path: A B **C** D **E** F **G I K** M E N A B C O **P** A B C O.

Nodes which are bold and large are decision nodes. Now start flipping each decision node.

Flipping at C : A B C O.

Flipping at E : A B C D E N A B C O.

Flipping at G : A B C D E F G H G I K M E N A B C O.

Flipping at I : A B C D E F G I J I K M E N A B C O.

Flipping at K : A B C D E F G I K L M E N A B C O.

Flipping at P : A B C D E F G I K L M E N A B C O P A B C O.

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Test Cases for Quick Sort Program

Test Cases	Description	Number of elements (n)	Array Elements	Comment
TC1	Enter the basis path consisting of all decision nodes **ABCDEFGIKMENABCOPABCO.**	----	Infeasible because path from G to I means no elements in array.	Invalid
TC2	Enter the basis path consisting of all decision nodes **ABCO.**	1	{9}	Valid
TC3	Enter the basis path consisting of all decision nodes **ABCDENABCO.**	----	Path C to D indicates if(first<last) is condition is true. So at first iteration while(x[i]<=x[pivot]&&i<last) condition also should be true and path E to F should be present. But we have EN so Infeasible	Invalid
TC4	Enter the basis path consisting of all decision nodes **ABCDEFGHGIKMENABCO.**	2	{5,4 }	Valid
TC5	Enter the basis path consisting of all decision nodes **ABCDEFGIJIKMENABCO.**	----	Infeasible because path from G to I means no elements in array.	Invalid
TC6	Enter the basis path consisting of all decision nodes **ABCDEFGIKLMENABCO.**	----	Infeasible because path from G to I means no elements in array.	Invalid
TC7	Enter the basis path consisting of all decision nodes **ABCDEFGIKLMENABCOPABCO.**	----	Infeasible because path from G to I means no elements in array.	Invalid

Note

If given array contains a single element, then first=last, if(first<last) condition is true indicates there are more than one elements in the given array. Even when there will be single element While(x[i]<=x[pivot]&&i<last) condition will get executed at least once, because x[i]=x[pivot] is also considered. So path there should be one path G to H present for any feasible solution. So in above table paths containing G to I are all infeasible.

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Program 12: Absolute Letter Grading **Testing Technique: Path Testing**

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 cases , execute these test cases and discuss the test results.

```
#include<stdio.h>
#include<conio.h>
A. 1 int main()
   2 {
   3   float per;
   4    char grade;
   5   printf("enter the percentage\n");
   6   scanf("%f",&per);
B. 7   if(per>=90)
C. 8     grade='a';
D. 9   else if((per>=80) && (per<90))
E. 10    grade='b';
F. 11 else if((per>=70) && (per<80))
G. 12    grade='c';
H. 13 else if((per>=60) && (per<70))
I.  14    grade='d';
J.  15 else grade='e';
K. 16    switch(grade)
L. 17    {
M. 18       case 'a':printf("excellent\n");
   19                 break;
```

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```
N. 20      case 'b':printf("very good\n");
   21              break;
O. 22      case 'c':printf("good\n");
   23              break;
P. 24      case 'd':printf("above average\n");
   25              break;
Q. 26      case 'e':printf("satisfactory\n");
   27          break;
R. 28     }
S. 29     printf("the percentage is %f and the grade is %c\n",per,grade);
   30   return 0;
   31 }
```

Cyclomatic Complexity

$$V(G) = e - n + 2p$$

Where,

e is number of edges in DD-Path graph.

n is number of nodes in DD-Path graph.

p is number of regions connected.(always 1)

Number of linearly independent paths (Test cases) for a given graph G = **26-19+2(1)**

= **7+2**

= **9** Test cases

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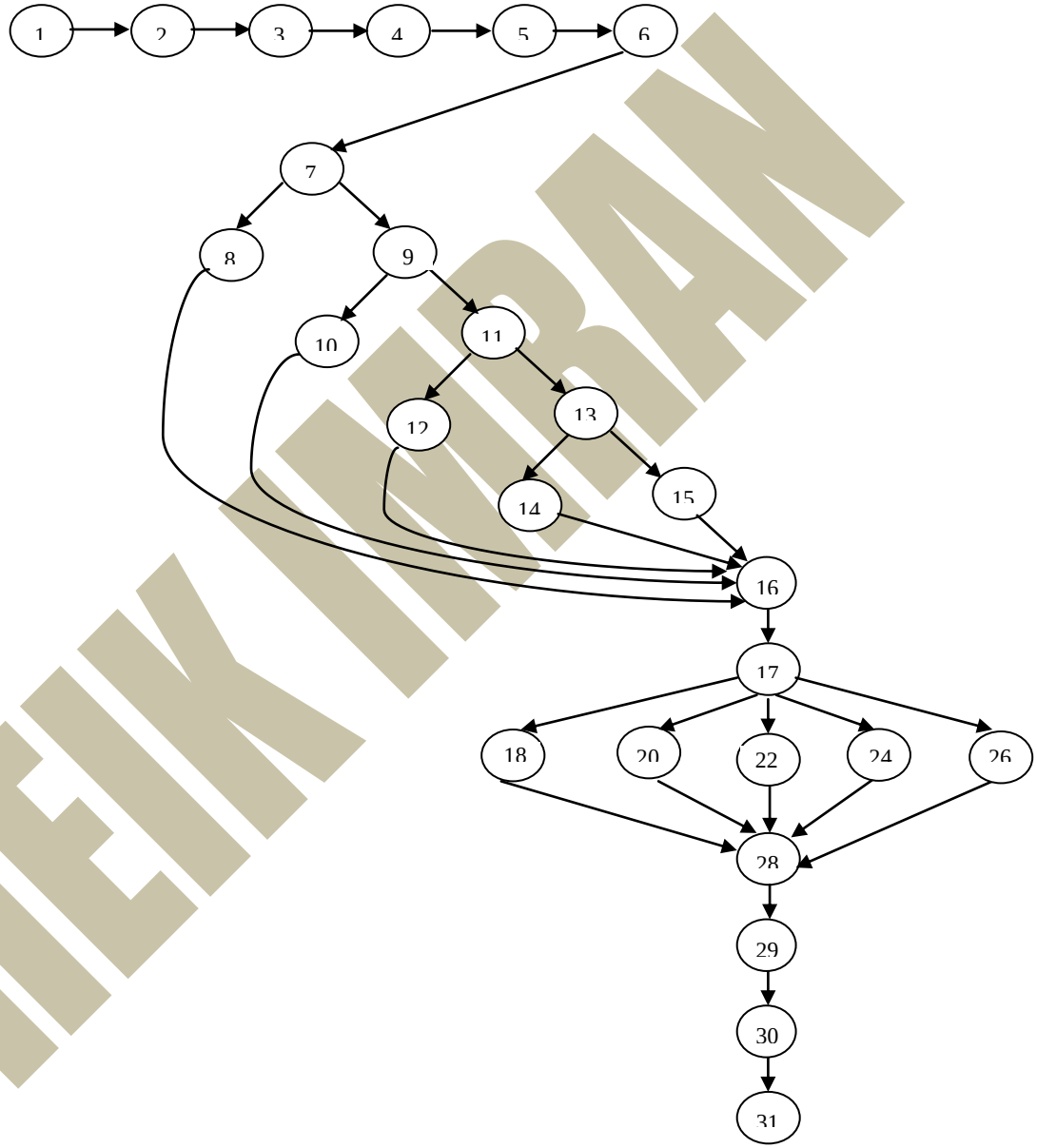
Program graph



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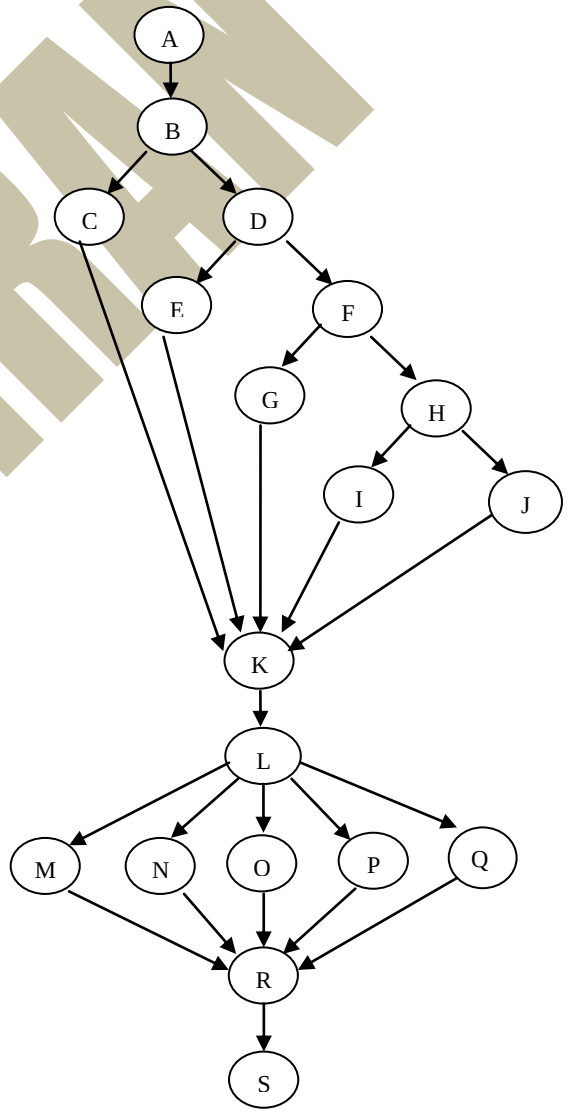
DD path graph

Nodes	DD-Paths
1-6	A
7	B
8	C
9	D
10	E
11	F
12	G
13	H
14	I
15	J
16	K
17	L
18-19	M
20-21	N
22-23	O
24-25	P
26-27	Q
28	R
29-31	S



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Finding Basis paths for Letter Grading program using McCabe's method

Considering DD-Path graph of Absolute Letter grading program, Baseline path is formed by considering all decision nodes as shown below.

Baseline Path: A **B D F H J** K **L** M R S.

Nodes which are bold and large are decision nodes. Now start flipping each decision node.

Flipping at B : A B C K L M R S.

Flipping at D : A B D E K L M R S.

Flipping at F : A B D F G K L M R S.

Flipping at H : A B D F H I K L M R S.

Flipping at L : A B D F H J K L N R S.

A B D F H J K L O R S.

A B D F H J K L P R S.

A B D F H J K L Q R S.

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Test Cases for Letter Grading Program

Test ID	Description	Input	Expected Output	Actual Output	Comment
TC1	Enter the basis path containing the decision nodes **ABDFHJKLMRS**	55	Satisfactory	Node J indicates grade 'e' so case 'e' should be executed i.e., node Q. but there is no Q in this path so Infeasible	Invalid
TC2	Enter the basis path containing the decision nodes **ABCKLMRS**	95	Excellent	**Excellent**	Valid
TC3	Enter the basis path containing the decision nodes **ABDEKLMRS**	85	Very good	Node E indicates grade 'b' so case 'b' should be executed i.e., node N. but there is no N in this path so Infeasible	Invalid
TC4	Enter the basis path containing the decision nodes **ABDFGKLMRS**	75	Good	Node F indicates grade 'c' so case 'c' should be executed i.e., node O. but there is no O in this path so Infeasible	Invalid
TC5	Enter the basis path containing the decision nodes **ABDFHIKLMRS**	65	Above average	Node H indicates grade 'd' so case 'd' should be executed i.e., node P. but there is no P in this path so Infeasible	Invalid
TC6	Enter the basis path containing the decision nodes **ABDFHJKLNRS**	55	Satisfactory	Node J indicates grade 'e' so case 'e' should be executed i.e., node Q. but there is no Q in this path so Infeasible	Invalid
TC7	Enter the basis path containing the decision nodes **ABDFHJKLORS**	55	Satisfactory	Node J indicates grade 'e' so case 'e' should be executed i.e., node Q. but there is no Q in this path so Infeasible	Invalid
TC8	Enter the basis path containing the decision nodes **ABDFHJKLPRS**	55	Satisfactory	Node J indicates grade 'e' so case 'e' should be executed i.e., node Q. but there is no Q in this path so Infeasible	Invalid
TC9	Enter the basis path containing the decision nodes **ABDFHJKLQRS**	55	Satisfactory	**Satisfactory**	Valid

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In above table we got test cases containing only **Excellent** and **satisfactory** type outputs. As we have five types of outputs in our program, three types of outputs (i.e., **good, very good** and **above average**) are left untested. So for completeness we add three more tests for left out cases as shown below.

TC10	Enter the basis path containing the decision nodes **ABDEKLNRS**	85	Very good	**Very good**	Valid
TC11	Enter the basis path containing the decision nodes **ABDFGKLORS**	75	Good	**Good**	Valid
TC12	Enter the basis path containing the decision nodes **ABDFHIKLPRS**	65	Above average	**Above average**	Valid

ALL THE VERY BEST...

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