Experiment No. 9
Implement Non-Restoring algorithm using c-programming
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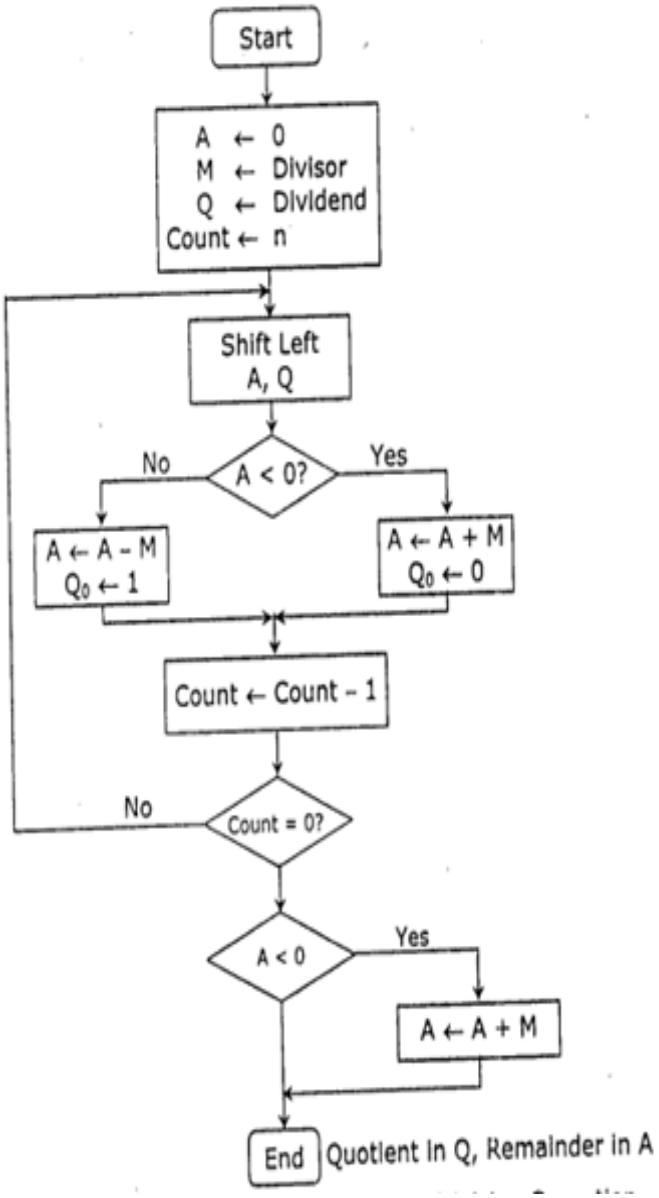
Aim - To implement Non-Restoring division algorithm using c-programming.

Objective -

1. To understand the working of Non-Restoring division algorithms.
2. To understand how to implement Non-Restoring division algorithms using c-programming.

Theory:

In each cycle content of the register, A is first shifted and then the divisor is added or subtracted with the content of register A depending upon the sign of A. In this, there is no need of restoring, but if the remainder is negative then there is a need of restoring the remainder. This is the faster algorithm of division.



Perform 8 ÷ 3 by non-restoring division technique.

	A Register	Q Register	
Initially	0 0 0 0 0	1 0 0 0	
Shift	0 0 0 0 1	0 0 0 □	
Subtract	1 1 1 0 1		First Cycle
Set Q_0	(1) 1 1 1 0	0 0 0 [0]	
Shift	1 1 1 0 0	0 0 [0] □	
Add	0 0 0 1 1		
Set Q_0	(1) 1 1 1 1	0 0 [0] [0]	Second Cycle
Shift	1 1 1 1 0	0 [0] [0] □	
Add	0 0 0 1 1		
Set Q_0	(0) 0 0 0 1	0 0 [0] [1]	Third Cycle
Shift	0 0 0 1 0	0 [0] [1] □	
Subtract	1 1 1 0 1		
Set Q_0	(1) 1 1 1 1	0 0 [1] [0]	Fourth Cycle
			Quotient
Add	1 1 1 1 1		
	0 0 0 1 1		
	0 0 0 1 0		
	Remainder		

Program -

```
#include <math.h>
#include <stdio.h>
//NON RESTORING DIVISION
int main()
{
int a[50],a1[50],b[50],d=0,i,j;
 int n1,n2, c, k1,k2,n,k,quo=0,rem=0;
   printf("Enter the number of bits\n");
   scanf("%d",&n);
 printf("Enter the divisor and dividend\n");
 scanf("%d %d", &n1,&n2);

 for (c = n-1; c >= 0; c--)//converting the 2 nos to binary
 {
   k1 = n1 >> c;

   if (k1 & 1)
     a[n-1-c]=1;// M
   else
    a[n-1-c]=0;

    k2 = n2 >> c;

   if (k2 & 1)
```

```
    b[2*n-1-c]=1;// Q
  else
    b[2*n-1-c]=0;

}

for(i=0;i<n;i++)//making complement
{
   if(a[i]==0)
     a1[i]=1;
   else
     a1[i]=0;
}

a1[n-1]+=1;//twos complement ie -M

if(a1[n-1]==2)
{
      for(i=n-1;i>0;i--)
   {
        if(a1[i]==2)
      {
         a1[i-1]+=1;
         a1[i]=0;
      }
```

```
    }
 }
 if(a1[0]==2)
  a1[0]=0;

 for( i=0;i<n;i++)// putting A in the same array as Q
 {
    b[i]=0;

 }

printf("A\tQ\tPROCESS\n");

 for(i=0;i<2*n;i++)
{
   if(i==n)
      printf("\t");

   printf("%d",b[i]);
}
printf("\n");

 for(k=0;k<n;k++)//n iterations
 {
    for(j=0;j<2*n-1;j++)//left shift
```

```
{
  b[j]=b[j+1];


}


for(i=0;i<2*n -1;i++)
{
   if(i==n)
      printf("\t");
   printf("%d",b[i]);
}printf("_");


printf("\tLEFT SHIFT\n");


   if(b[0]==0)
   {
            for(i=n-1;i>=0;i--)//A=A-M
            {
               b[i]+=a1[i];


                  if(i!=0)
              {
                  if(b[i]==2)
                        {
                           b[i-1]+=1;
```

```
            b[i]=0;
          }
      if(b[i]==3)
          {
            b[i-1]+=1;
            b[i]=1;
          }
         // printf("%d",b[i]);
   }
}
      if(b[0]==2)
        b[0]=0;

      if(b[0]==3)
        b[0]=1;

for(i=0;i<2*n -1;i++)
{
   if(i==n)
      printf("\t");



   printf("%d",b[i]);
}printf("_");
```

```
        printf("\tA-M\n");
}

else
{
        for(j=n-1;j>=0;j--)//A=A+M
          {
            b[j]+=a[j];

            if(j!=0)
         {
            if(b[j]==2)
                  {
                    b[j-1]+=1;
                    b[j]=0;
                  }
            if(b[j]==3)
                  {
                    b[j-1]+=1;
                    b[j]=1;
                  }
          }

            if(b[0]==2)
```

```
                b[0]=0;


              if(b[0]==3)
                b[0]=1;
            }


            for(i=0;i<2*n -1;i++)
          {
            if(i==n)
              printf("\t");




            printf("%d",b[i]);
          }printf("_");


          printf("\tA+M\n");


}




    if(b[0]==0)//A==0?
    {
      b[2*n-1]=1;
```

```
    for(i=0;i<2*n ;i++)
      {
        if(i==n)
            printf("\t");




        printf("%d",b[i]);
      }

      printf("\tQ0=1\n");
}




if(b[0]==1)//A==1?
{
   b[2*n-1]=0;
   for(i=0;i<2*n ;i++)
      {
        if(i==n)
            printf("\t");
```

```
                printf("%d",b[i]);
            }

            printf("\tQ0=0\n");

        }

 }

if(b[0]==1)
{
            for(j=n-1;j>=0;j--)//A=A+M
                {
                    b[j]+=a[j];

                    if(j!=0)
                {
                    if(b[j]==2)
                        {
                            b[j-1]+=1;
                            b[j]=0;
                        }
                    if(b[j]==3)
                        {
                            b[j-1]+=1;
```

```
                    b[j]=1;
                }
            }

            if(b[0]==2)
                b[0]=0;

            if(b[0]==3)
                b[0]=1;
            }

            for(i=0;i<2*n;i++)
        {
            if(i==n)
                printf("\t");



            printf("%d",b[i]);
        }

        printf("\tA+M\n");
}
printf("\n");
for(i=n;i<2*n;i++)
```

```
{
   quo+= b[i]*pow(2,2*n-1-i);
}
for(i=0;i<n;i++)
{
   rem+= b[i]*pow(2,n-1-i);
}
printf("The quotient of the two nos is %d\nThe remainder is %d",quo,rem);


printf("\n");
 return 0;
}
```

Output:

Terminal

```
Enter the number of bits
4
Enter the divisor and dividend
1010
0010
A   Q   PROCESS
0000    1010
0001    010_    LEFT SHIFT
1111    010_    A-M
1111    0100    Q0=0
1110    100_    LEFT SHIFT
0000    100_    A+M
0000    1001    Q0=1
0001    001_    LEFT SHIFT
1111    001_    A-M
1111    0010    Q0=0
1110    010_    LEFT SHIFT
0000    010_    A+M
0000    0101    Q0=1

The quotient of the two nos is 5
The remainder is 0
```

Conclusion -

In conclusion, this experiment successfully implemented the Non-Restoring Division algorithm using C programming. The Non-Restoring Division algorithm is a method for dividing two numbers without the need for restoring the remainder, making it a faster division technique. The C program effectively emulated the algorithm's steps, including left-shifting the dividend and quotient registers and performing addition or subtraction based on the sign of the

accumulator. The program accurately produced the quotient and remainder of the division, demonstrating the efficiency of the Non-Restoring Division algorithm in digital computation and computer arithmetic. This experiment deepened our understanding of this division technique and its practical implementation.