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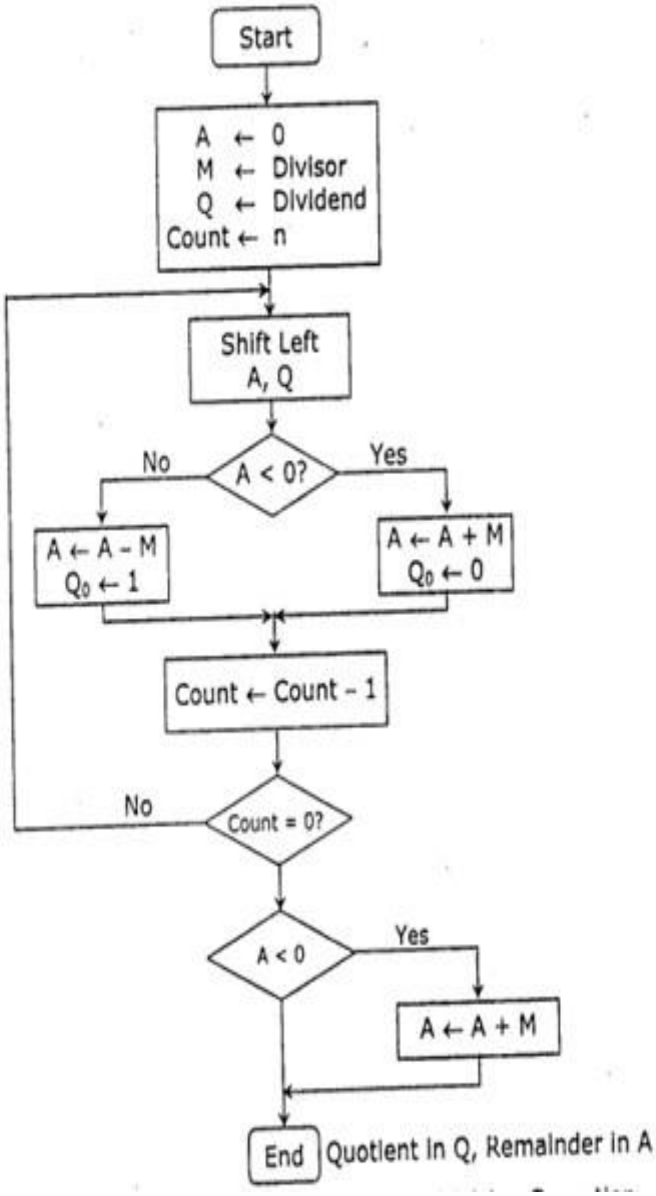
Aim - To implement Non-Restoring division algorithm using c-programming.

Objective -

1. To understand the working of Non-Restoring division algorithm.
2. To understand how to implement Non-Restoring division algorithm 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	First Cycle
Shift	0 0 0 0 1	0 0 0 □	
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 0	0 0 0 0	
Shift	1 1 1 0 0	0 0 0 □	Second Cycle
Add	0 0 0 1 1		
Set Q_0	1 1 1 1 1	0 0 0 0	
Shift	1 1 1 1 0	0 0 0 □	Third Cycle
Add	0 0 0 1 1		
Set Q_0	0 0 0 0 1	0 0 0 1	
Shift	0 0 0 1 0	0 0 1 □	Fourth Cycle
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 1	0 0 1 0	
		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;
   prin ("Enter the number of bits\n");
  scanf("%d",&n);
 prin ("Enter the divisor and dividend\n");
scanf("%d %d", &n1,&n2);

 for (c = n-1; c >= 0; c--)//conver ng 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++)// pu     ng A in the same array as Q
  {
     b[i]=0;

  }

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

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

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

  for(k=0;k<n;k++)//n itera ons
  {
     for(j=0;j<2*n-1;j++)//le shi
       {
        b[j]=b[j+1];

       }

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

      }prin ("_");  prin

      ("\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;
                }
                // prin ("%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)
            prin ("\t");



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

        prin ("\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)
            prin ("\t");



        prin ("%d",b[i]);

      }prin ("_");  prin

      ("\tA+M\n");

}



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



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

```
                prin ("\tQ0=1\n");
            }
            if(b[0]==1)//A==1?
            {
              b[2*n-1]=0;
              for(i=0;i<2*n ;i++)
                {
                  if(i==n)
                     prin ("\t");



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

                prin ("\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)  prin
              ("\t");



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

          prin ("\tA+M\n");
}
 prin ("\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);
}
prin ("The quo ent of the two nos is %d\nThe remainder is %d",quo,rem);

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

Output:

```
                                   Output
11111101        0000000_        LEFT SHIFT
11111111        0000000_        A+M
11111111        00000000        Q0=0
11111110        0000000_        LEFT SHIFT
00000000        0000000_        A+M
00000000        00000001        Q0=1
00000000        0000001_        LEFT SHIFT
11111110        0000001_        A-M
11111110        00000010        Q0=0
11111100        0000010_        LEFT SHIFT
11111110        0000010_        A+M
11111110        00000100        Q0=0
00000000        00000100        A+M

The quotient of the two nos is 4
The remainder is 0
```

Conclusion –

In this work, I am trying to improve the non-restoring algorithm to minimize the hardware cost. If dividend & divisor both are negative then proposed algorithm will not work. Though, in future I can develop this algorithm to divide two signed binary numbers.