Experiment No. 8
Implement Restoring algorithm using c-programming
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Aim: To implement Restoring division algorithm using c-programming.

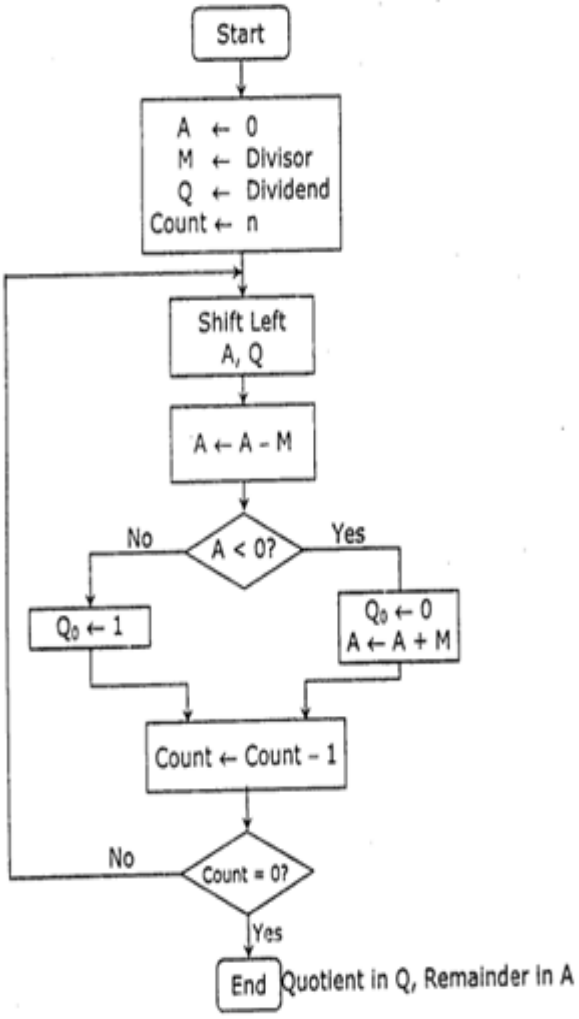
Objective -

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

Theory:

1) The divisor is placed in M register, the dividend placed in Q register.
2) At every step, the A and Q registers together are shifted to the left by 1-bit
3) M is subtracted from A to determine whether A divides the partial remainder. If it does, then Q0 set to 1-bit. Otherwise, Q0 gets a 0 bit and M must be added back to A to restore the previous value.
4) The count is then decremented and the process continues for n steps. At the end, the quotient is in the Q register and the remainder is in the A register.

Flowchart



Perform 8 ÷ 3 by 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 M	1 1 1 0 1		First Cycle
Set Q_0	(1) 1 1 1 0		
Restore(A+M)	0 0 0 1 1		
	0 0 0 0 1	0 0 0 [0]	
Shift	0 0 0 1 0	0 0 [0] □	
Subtract M	1 1 1 0 1		Second Cycle
Set Q_0	(1) 1 1 1 1		
Restore(A+M)	0 0 0 1 1		
	0 0 0 1 0	0 0 [0] [0]	
Shift	0 0 1 0 0	0 [0] [0] □	
Subtract M	1 1 1 0 1		Third Cycle
Set Q_0	(0) 0 0 0 1		
Shift	0 0 0 1 0	0 0 [0] [1]	
Subtract M	1 1 1 0 1	[0] [0] [1] □	
Set Q_0	(1) 1 1 1 1		Fourth Cycle
Restore(A+M)	0 0 0 1 1		
	0 0 0 1 0	[0] [0] [1] [0]	
	Remainder	Quotient	

Program-

```
#include <stdio.h>

#include <stdlib.h>


int dec_bin(int, int []);

int twos(int [], int []);

int left(int [], int []);

int add(int [], int []);
```

```
int main()
{
    int a, b, m[4]={0,0,0,0}, q[4]={0,0,0,0}, acc[4]={0,0,0,0}, m2[4], i, n=4;
    printf("Enter the Dividend: ");
    scanf("%d", &a);
    printf("Enter the Divisor: ");
    scanf("%d", &b);
    dec_bin(a, q);
    dec_bin(b, m);
    twos(m, m2);
    printf("\nA\tQ\tComments\n");
    for(i=3; i>=0; i--)
    {
    printf("%d", acc[i]);
    }
    printf("\t");
    for(i=3; i>=0; i--)
    {
    printf("%d", q[i]);
    }
    printf("\tStart\n");
    while(n>0)
    {
```

```
left(acc, q);
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
printf("%d", q[i]);
}
printf("_\tLeft Shift A,Q\n");
add(acc, m2);
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
printf("%d", q[i]);
}
printf("_\tA=A-M\n");
if(acc[3]==0)
```

```
{
q[0]=1;
for(i=3; i>=0; i--)
{
        printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=0; i--)
{
        printf("%d", q[i]);
}
printf("\tQo=1\n");
}
else
{
q[0]=0;
add(acc, m);
for(i=3; i>=0; i--)
{
        printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=0; i--)
```

```
        {
                printf("%d", q[i]);
        }
           printf("\tQo=0; A=A+M\n");
        }
        n--;
        }
        printf("\nQuotient = ");
        for(i=3; i>=0; i--)
        {
        printf("%d", q[i]);
        }
        printf("\tRemainder = ");
        for(i=3; i>=0; i--)
        {
        printf("%d", acc[i]);
        }
        printf("\n");
        return 0;
}

int dec_bin(int d, int m[])
{
```

```
        int b=0, i=0;
        for(i=0; i<4; i++)
        {
        m[i]=d%2;
        d=d/2;
        }
        return 0;
}

int twos(int m[], int m2[])
{
        int i, m1[4];
        for(i=0; i<4; i++)
        {
        if(m[i]==0)
        {
        m1[i]=1;
        }
        else
        {
        m1[i]=0;
        }
        }
```

```
for(i=0; i<4; i++)
{
m2[i]=m1[i];
}
if(m2[0]==0)
{
m2[0]=1;
}
else
{
m2[0]=0;
if(m2[1]==0)
{
m2[1]=1;
}
else
{
m2[1]=0;
if(m2[2]==0)
{
        m2[2]=1;
}
else
```

```
        {
                m2[2]=0;
                if(m2[3]==0)
                {
                m2[3]=1;
                }
                else
                {
                m2[3]=0;
                }
        }
        }
        }
        return 0;
}

+int left(int acc[], int q[])
{
        int i;
        for(i=3; i>0; i--)
        {
        acc[i]=acc[i-1];
        }
```

```
        acc[0]=q[3];
        for(i=3; i>0; i--)
        {
        q[i]=q[i-1];
        }
}

int add(int acc[], int m[])
{
  int i, carry=0;
  for(i=0; i<4; i++)
  {
        if(acc[i]+m[i]+carry==0)
        {
        acc[i]=0;
        carry=0;
        }
        else if(acc[i]+m[i]+carry==1)
        {
        acc[i]=1;
        carry=0;
        }
        else if(acc[i]+m[i]+carry==2)
```

```
        {
        acc[i]=0;
        carry=1;
        }
        else if(acc[i]+m[i]+carry==3)
        {
        acc[i]=1;
        carry=1;
        }
  }
  return 0;
}
```

Output -

Terminal

```
Enter the Dividend: 15
Enter the Divisor: 5
A   Q   Comments
0000    1111    Start
0001    111_    Left Shift A,Q
1100    111_    A=A-M
0001    1110    Qo=0; A=A+M
0011    110_    Left Shift A,Q
1110    110_    A=A-M
0011    1100    Qo=0; A=A+M
0111    100_    Left Shift A,Q
0010    100_    A=A-M
0010    1001    Qo=1
0101    001_    Left Shift A,Q
0000    001_    A=A-M
0000    0011    Qo=1

Quotient = 0011 Remainder = 0000
```

Conclusion -

Our experiment on the Restoring Division Algorithm has yielded a deep and thorough comprehension of this essential binary division technique. The algorithm's meticulous step-by-step restoration approach enables precise quotient calculation, rendering it an invaluable asset in computer arithmetic. Through this experiment, we've not only underscored the significance of grasping and utilizing division algorithms but also effectively showcased their real-world applications in diverse computer systems and data processing tasks.