Experiment No. 7
1mplement Booth's algorithm using c-programming
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Aim: To implement Booth's algorithm using c-programming.

Objective - 1. To understand the working of Booths algorithm.
2. To understand how to implement Booth's algorithm using c-programming.

Theory:

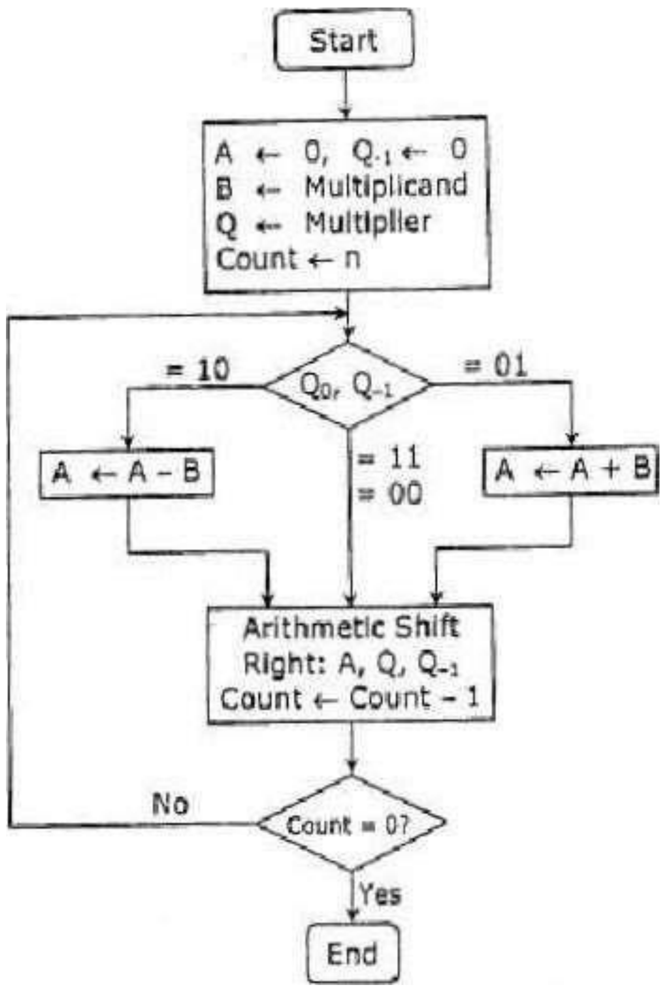
Booth's algorithm is a multiplication algorithm that multiplies two signed binary numbers in 2's complement notation. Booth used desk calculators that were faster at shifting than adding and created the algorithm to increase their speed. The algorithm works as per the following conditions :

l. IfQn and are same i.e. 00 or I I perform arithmetic shift by I bit.

2. IfQn Q = 10 do A= A - B and perform arithmetic shift by I bit.
3. IfQn 01 do A + B and perform arithmetic shift by I bit.

Multiplicand (B)		o 1	Multiplier (Q)	1 0 0 (4)
Steps				Operati o n
	o o o o	o 1 o o		Initial
Step 1	o o o o	o o 1		Shift right
Step 2	o o o	o o o 1	o	Shift right
step 3	1 1	O o 1		
	1 o 1 1	1 o o c		Shift right

Step 4 :	o o 1 o	o o o	1	
	o o o	o 1 o o		Shift right
Result	o o o	= +20		



Program:

```
#include <stdio.h>
#include <math.h>
```

```
int a = 0,b = 0, c = 0, a1 = 0, b1 = 0, com[5] = { 1, 0, 0, 0, 0}; int
anum[5] = {0}, anumcp[5] = {0}, bnum[5] = {0}; int
acomp[5] = {0}, bcomp[5] = {0}, pro[5] = {0}, res[5] = {0};

void
binary(){     a1 =
fabs(a);     b1 =
fabs(b);     int r,
r2, i, temp;     for
(i = 0; i < 5;
i++){          r =
a1 % 2;          a1
= a1 / 2;          r2
= b1 % 2;
b1 = b1 / 2;
anum[i] = r;
anumcp[i] = r;
bnum[i] = r2;
if(r2 ==
0){              bco
mp[i] = 1;
        }
        if(r ==
0){              acomp[i] =1;
        }
   }
  c = 0;   for ( i = 0; i < 5;
i++){          res[i] = com[i]+
bcomp[i] + c;          if(res[i] >=
2){              c = 1;          }          else
c = 0;          res[i] = res[i] % 2;
   }
```

```
  for (i = 4; i >= 0; i-
-){     bcomp[i] = res[i];
  }
  if (a < 0){
    c = 0;     for (i = 4; i
>= 0; i--){          res[i] =
0;
   }
   for ( i = 0; i < 5; i++){          res[i]
= com[i] + acomp[i] + c;          if
(res[i] >= 2){               c = 1;          }
else               c = 0;
        res[i] = res[i]%2;
   }
   for (i = 4; i >= 0; i-
-){          anum[i] = res[i];
anumcp[i] = res[i];
   }

}
  if(b < 0){     for (i = 0; i <
5; i++){          temp =
bnum[i];          bnum[i] =
bcomp[i];          bcomp[i]
= temp;
   }
  }
}
void add(int
   num[]){ int i; c =
   0;
   for ( i = 0; i < 5; i++){
```

```
        res[i] = pro[i] + num[i] + c;
if (res[i] >= 2){            c =
1;         }         else{            c =
0;
        }
        res[i] = res[i]%2;
    }
    for (i = 4; i >= 0; i-
-){        pro[i] = res[i];
printf("%d",pro[i]);
    }
  printf(":");    for (i = 4; i >= 0;
i--){          printf("%d",
anumcp[i]);
    }
}
void arshift(){//for arithmetic shift right     int
temp = pro[4], temp2 = pro[0], i;     for (i = 1; i <
5  ; i++){//shift the MSB of product       pro[i-1] =
pro[i];
   }
   pro[4] = temp;     for (i = 1; i < 5  ; i++){//shift
the LSB of product        anumcp[i-1] = anumcp[i];
   }
   anumcp[4] = temp2; printf("\nAR-SHIFT:
   ");//display together for (i = 4; i >= 0; i-
   -){
      printf("%d",pro[i]);
   }
   printf(":");     for(i = 4; i >=
0; i--){        printf("%d",
anumcp[i]);
```

```
  }
}

void main(){
  int i, q = 0;
  printf("\t\tBOOTH'S MULTIPLICATION ALGORITHM");
printf("\nEnter two numbers to multiply: ");
printf("\nBoth must be less than 16");    //simulating
for two numbers each below 16
  do{        printf("\nEnter A:
");        scanf("%d",&a);
printf("Enter B: ");
scanf("%d",
&b);     }while(a >=16 || b
>=16);

   printf("\nExpected product = %d", a * b);
binary();     printf("\n\nBinary Equivalents
are: ");     printf("\nA = ");     for (i = 4; i >=
0; i--){        printf("%d", anum[i]);
   }
   printf("\nB = ");
   for (i = 4; i >= 0; i--){
      printf("%d", bnum[i]);
   }
   printf("\nB'+ 1 = ");     for
(i = 4; i >= 0; i-
-){        printf("%d",
bcomp[i]);
   }
   printf("\n\n");     for
(i = 0;i < 5;
i++){          if (anum[i]
```

```
==
q){             printf("\n--
>");             arshift();
q = anum[i];
        }
        else if(anum[i] == 1 && q ==
0){            printf("\n-->");
printf("\nSUB B: ");
add(bcomp);             arshift();
q = anum[i];
        }
        else{//add ans shift for 01
printf("\n-->");
printf("\nADD B: ");
add(bnum);             arshift();
q = anum[i];
        }
    }

    printf("\nProduct is = ");
for (i = 4; i >= 0; i-
-){          printf("%d", pro[i]);
    }
    for (i = 4; i >= 0; i-
-){          printf("%d",
anumcp[i]);
    }
}
```

Output:

```
Both must be less than 16
Enter A: 2
Enter B: 4
Expected product = 8

Binary Equivalents are:
A = 00010
B = 00100
B'+ 1 = 11100


-->
AR-SHIFT: 00000:00001
-->
SUB B: 11100:00001
AR-SHIFT: 11110:00000
-->
ADD B: 00010:00000
AR-SHIFT: 00001:00000
-->
```

Conclusion - The aim was to implement Booth's algorithm in C programming, an efficient method for binary multiplication, reducing partial products and enhancing computational speed through a sequential approach.