Booth's Algorithm

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Roll No:64

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#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){
            bcomp[i] = 1;
        }
        if(r == 0){
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            acomp[i] =1;
        }
  }
//part for two's complementing
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];
}
//in case of negative inputs
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;
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        }
        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;
        }
```

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        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]);
```

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    }
    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){//just shift for 00 or 11
         printf("\n-->");
         arshift();
         q = anum[i];
      }
      else if(anum[i] == 1 && q == 0){//subtract and shift for 10
        printf("\n-->");
        printf("\nSUB B: ");
        add(bcomp);//add two's complement to implement subtraction
        arshift();
        q = anum[i];
      }
      else{//add ans shift for 01
        printf("\n-->");
        printf("\nADD B: ");
        add(bnum);
        arshift();
```

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            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]);
    }
}
```
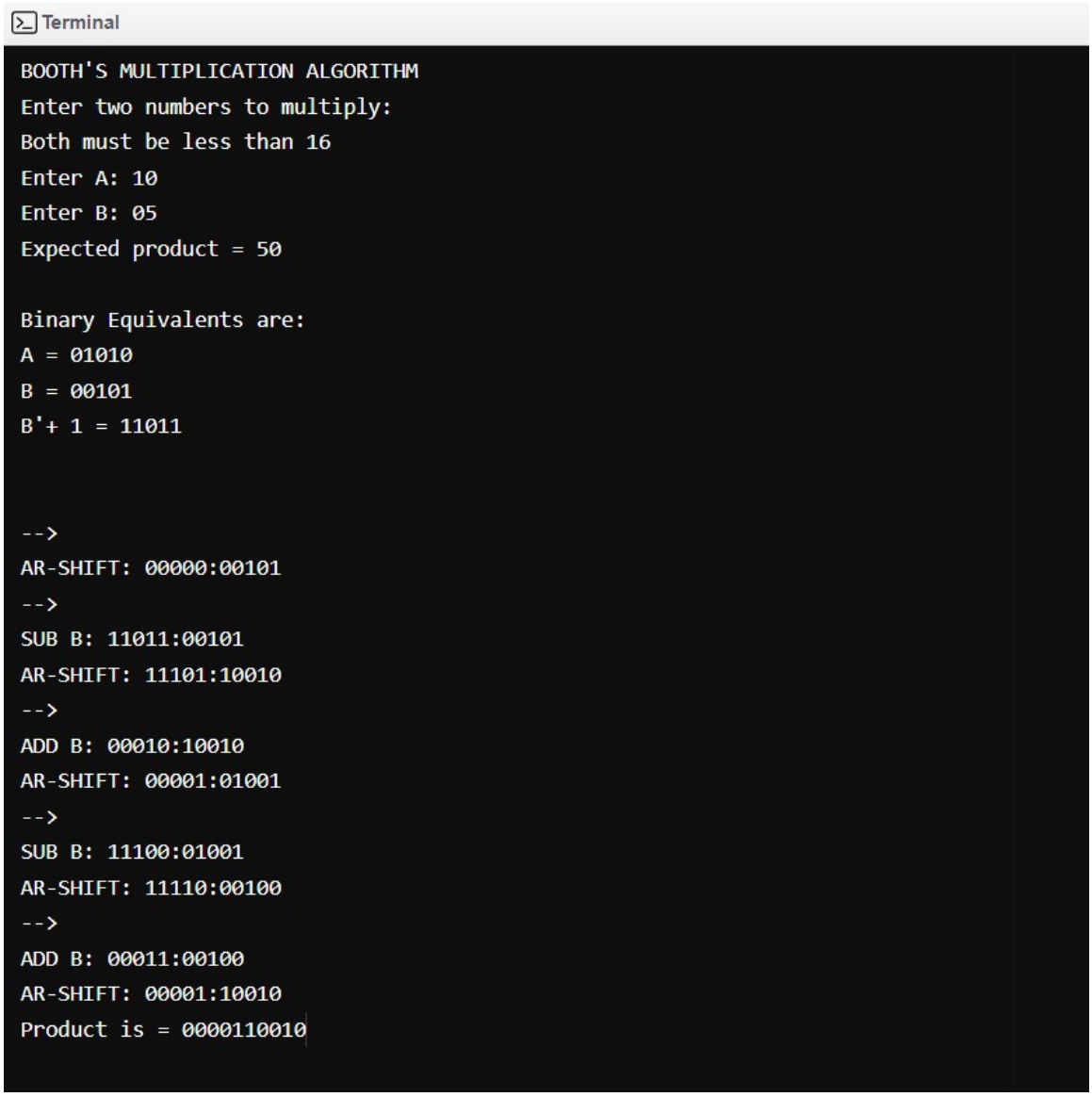

Output:


Terminal
BOOTH'S MULTIPLICATION ALGORITHM
Enter two numbers to multiply:
Both must be less than 16
Enter A: 10
Enter B: 05
Expected product = 50
Binary Equivalents are:
A = 01010
B = 00101
B'+ 1 = 11011
-->
AR-SHIFT: 00000:00101
-->
SUB B: 11011:00101
AR-SHIFT: 11101:10010
-->
ADD B: 00010:10010
AR-SHIFT: 00001:01001
-->
SUB B: 11100:01001
AR-SHIFT: 11110:00100
-->
ADD B: 00011:00100
AR-SHIFT: 00001:10010
Product is = 0000110010