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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){

            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

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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;
}
}

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}
}
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

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    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]);
}
}

int 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 Equivalentents are: ");
    printf("\nA = ");
    for (i = 4; i >= 0; i--){
        printf("%d", anum[i]);
    }
}

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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();
q = anum[i];
}
}

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