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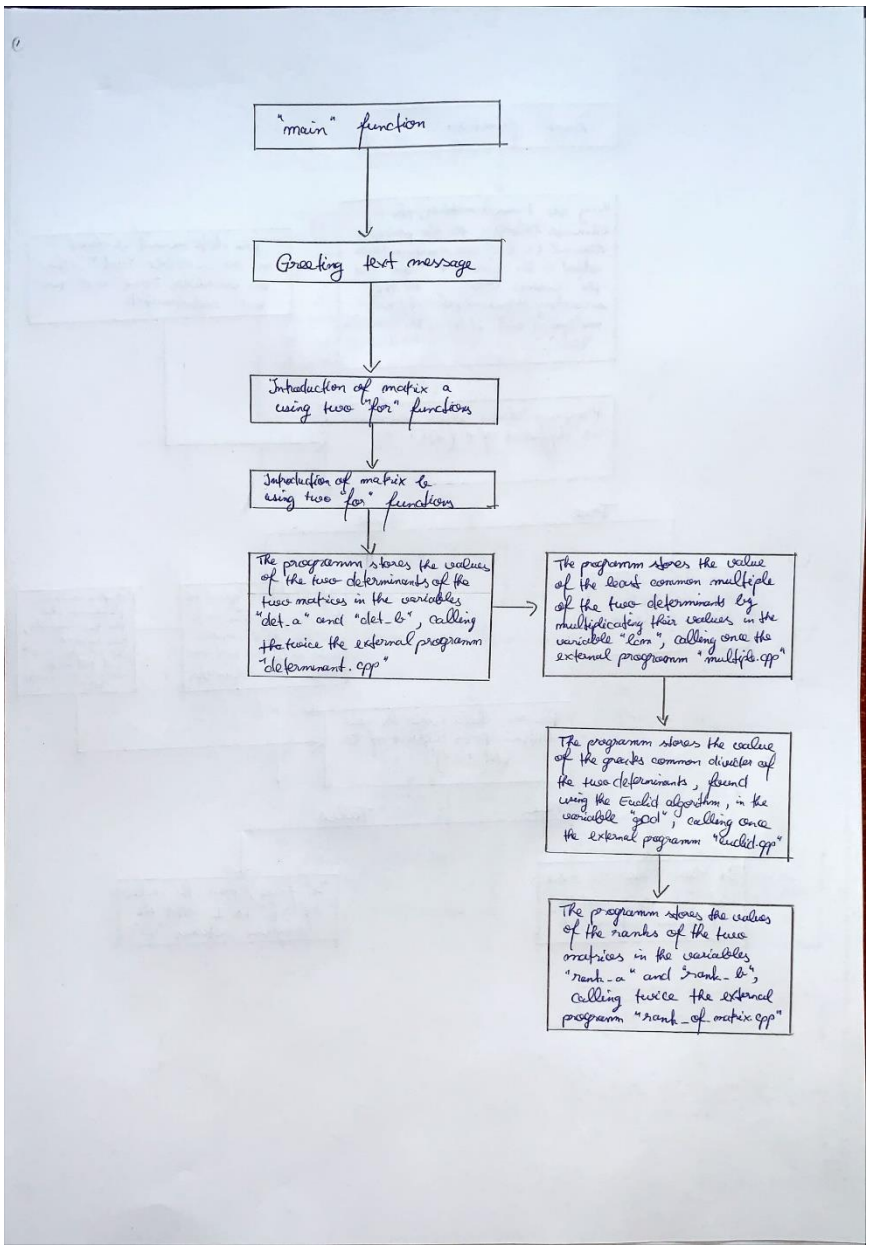
Computer Programming Semestrial Project

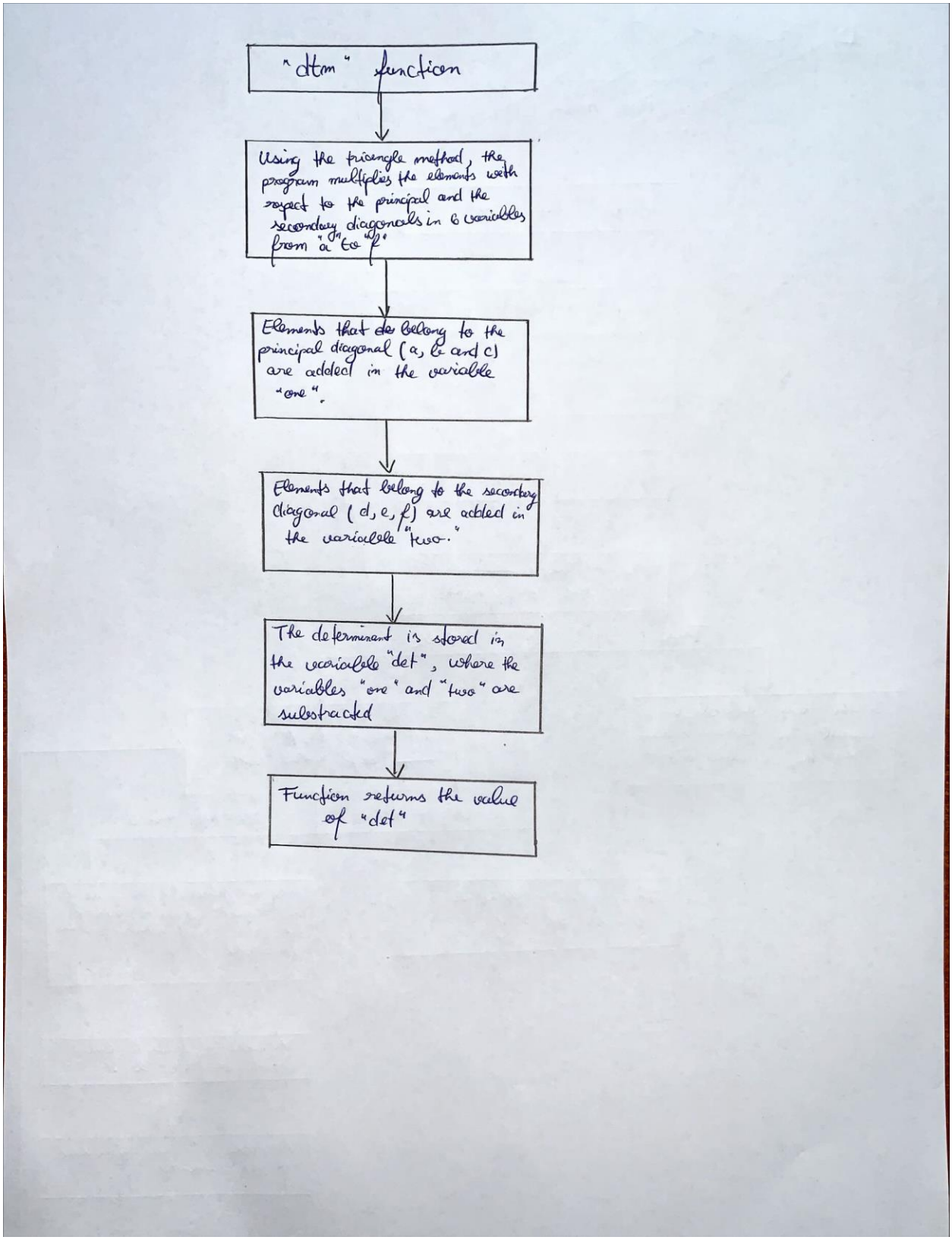
1) The program in natural language

   The program will find the rank of two matrices of size 3x3 and calculate the least common multiple and largest common divider of the two determinants. The results will be displayed on the screen.

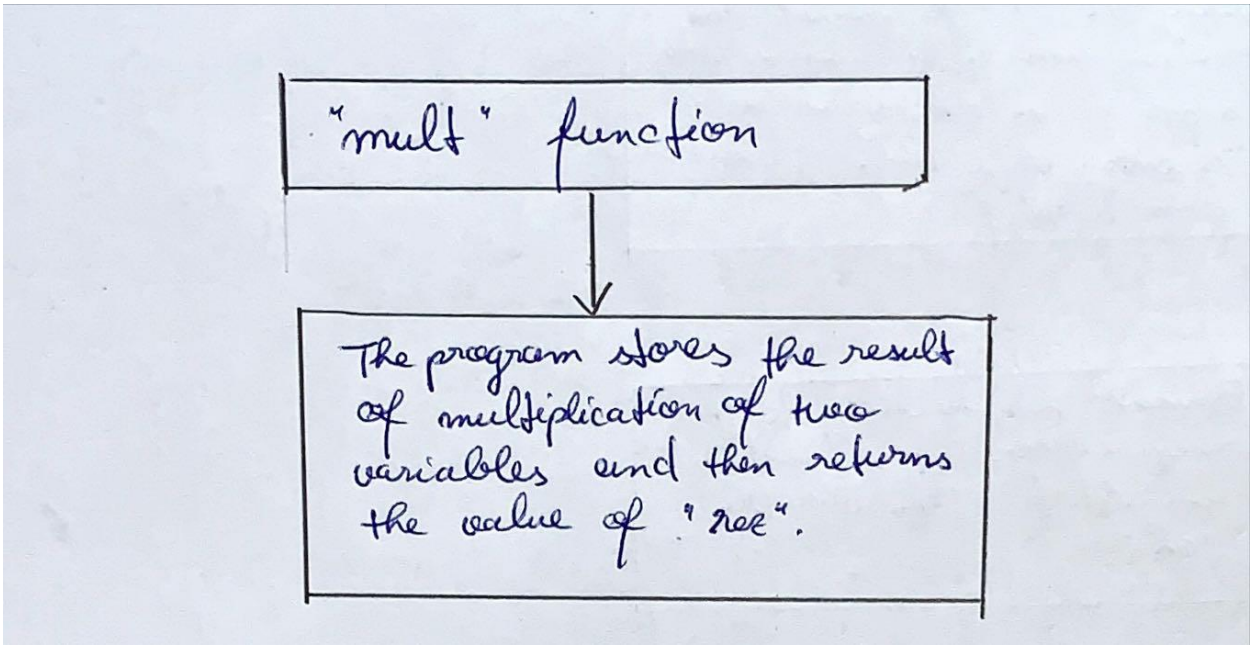
2) Workflow
   a) The “main” function



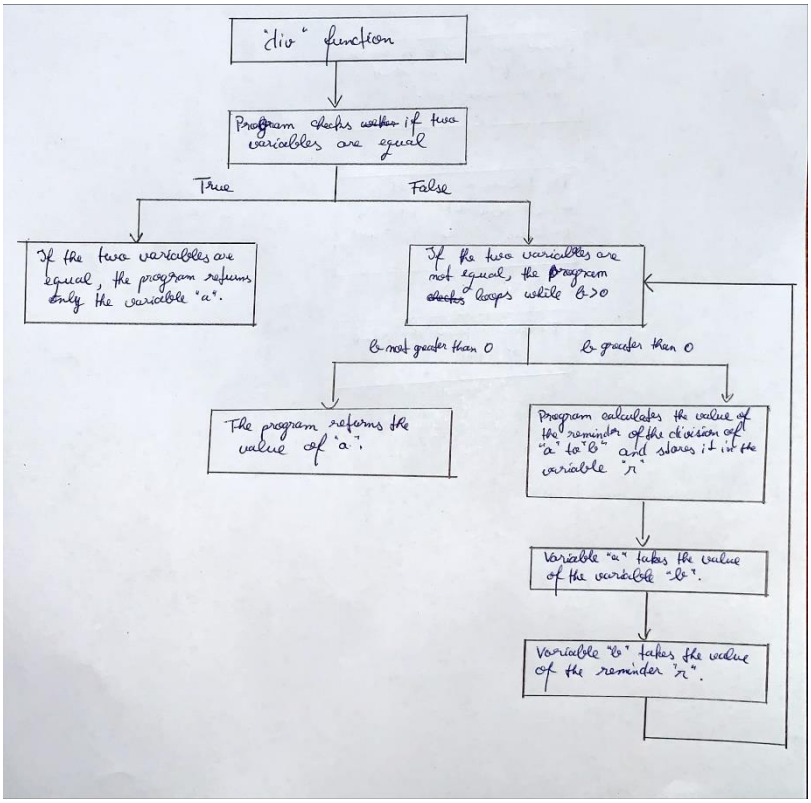
b) The “dtm” function



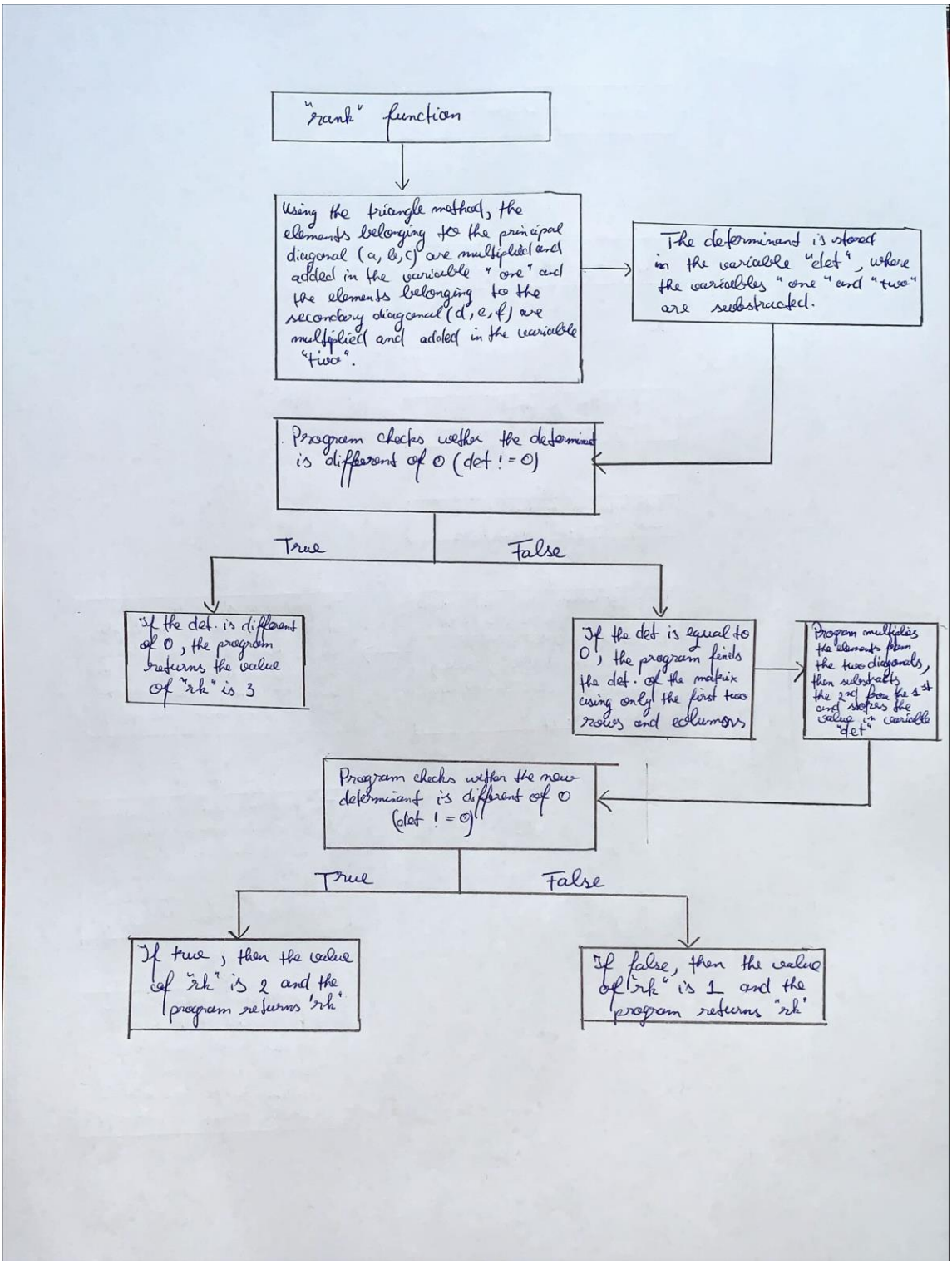
c) The “mult” function



d) The “div” function



e) The “rank” function



3) The listing for entire program

```c
#include <stdio.h>
#include <conio.h>
#include "determinant.cpp"
#include "multiple.cpp"
#include "euclid.cpp"
#include "rank_of_matrix.cpp"
int a[3][3],b[3][3],i,j,det_a,det_b,lcm,gcd,rank_a,rank_b; //declaration of variables
int main()
{
    printf("Hi and welcome! I am here to help you with some very specific mathematical demands. Those being finding the least common multiple and greates

    for(i=0;i<3;i++)
     for(j=0;j<3;j++)
      scanf("%d",&a[i][j]); //introduction of the first matrix

    printf("Great! Now enter the matrix <<b>>. \nb= ");

    for(i=0;i<3;i++)
     for(j=0;j<3;j++)
      scanf("%d",&b[i][j]); //introduction of the second matrix

    printf("Alright! Now that we have both matrices we can calculate their determinants. \n");

    det_a=dtm(a);
    det_b=dtm(b); //call to external function that determines the determinants of the two matrices

    printf("D_a= %d\n",det_a);
    printf("D_b= %d\n",det_b); //display of the two determinants

    printf("Great! Now I will find the Least Common Multiple and Greatest Common Divider of these two determinants.\n");

    lcm=mult(det_a,det_b); //call to external function that determines the least common multiple of the two determinants

    printf("The Least Common Multiple of the two determinants is: %d",lcm);
```

```c
    printf("The Least Common Multiple of the two determinants is: %d",lcm);

    gcd=div(det_a,det_b); //call to external function that determines the greatest common divider of the two determinants

    printf("\nThe Greatest Common Divider of the two determinants is: %d\n",gcd);

    printf("\nAlright! Now I will display the ranks of the two matrices.");

    rank_a=rank(a);
    rank_b=rank(b); //call to external function that determines the ranks of the two matrices

    printf("\nrk_a= %d \nrk_b= %d",rank_a,rank_b); //display of the ranks of the two matrices
}
```

```c
#include <stdio.h>
int dtm(int x[3][3])
{
    int a,b,c,d,e,f,det,one,two;

    a=x[0][0]*x[1][1]*x[2][2];
    b=x[1][0]*x[2][1]*x[0][2];
    c=x[0][1]*x[1][2]*x[2][0];
    d=x[2][0]*x[1][1]*x[0][2];
    e=x[2][1]*x[1][2]*x[0][0];
    f=x[1][0]*x[0][1]*x[2][2]; //finding the det using the triangle method

    one=a+b+c;
    two=d+e+f;
    det=one-two;

    return det;
}
```

```c
#include <stdio.h>
int mult(int a, int b)
{   //finding the lcm
    int rez;
    rez=a*b;
    return rez;
}
```

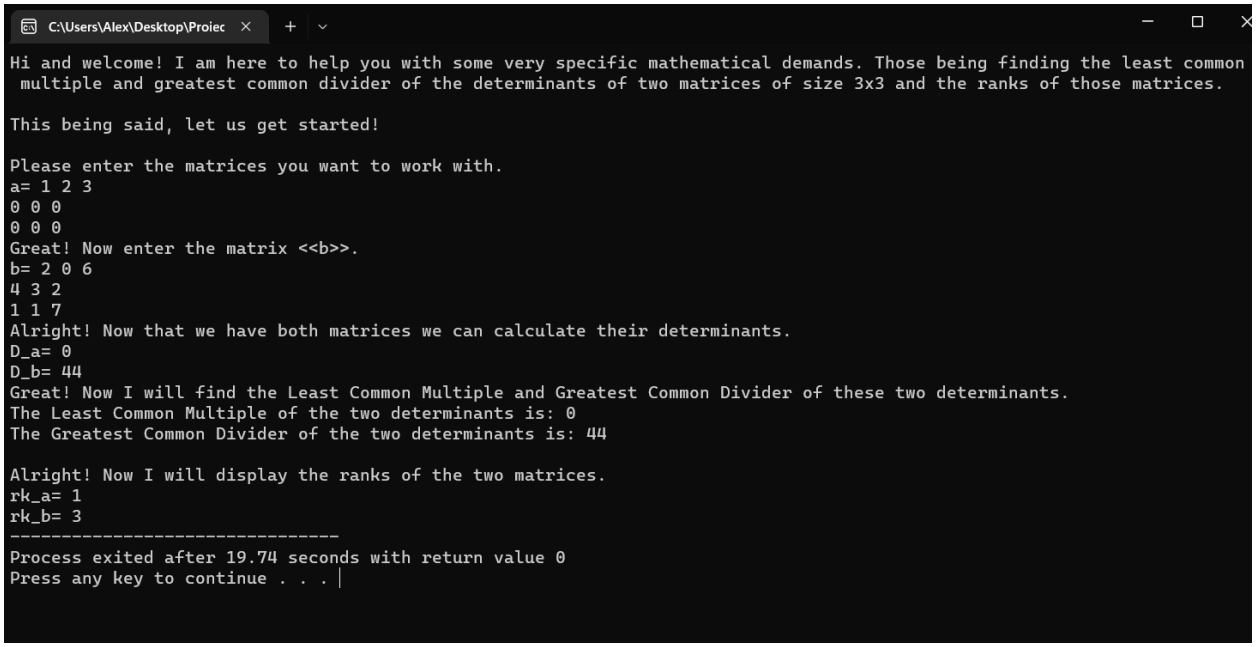
```c
#include <stdio.h>
int div(int a, int b)
{   //finding the gcd using the Euclid algorithm
    int r;
    if(a==b)
     return(a);
    else
    {
        while(b>0)
        {
            r=a%b;
            a=b;
            b=r;
        }
    return a;
    }
}
```

```c
#include <stdio.h>
int rank(int x[3][3])
{   //finding the rank of the matrix using the determinant
    int a,b,c,d,e,f,det,one,two,rk;
    a=x[0][0]*x[1][1]*x[2][2];
    b=x[1][0]*x[2][1]*x[0][2];
    c=x[0][1]*x[1][2]*x[2][0];
    d=x[2][0]*x[1][1]*x[0][2];
    e=x[2][1]*x[1][2]*x[0][0];
    f=x[1][0]*x[0][1]*x[2][2];

    one=a+b+c;
    two=d+e+f;
    det=one-two;

    if(det!=0)
      rk=3;
    else
      {
        one=x[0][0]*x[1][1];
        two=x[1][0]*x[0][1];
        det=one-two;

        if(det!=0)
         rk=2;
        else
         rk=1;
      }
    return rk;
}
```

4) Instances of running the program

```
Hi and welcome! I am here to help you with some very specific mathematical demands. Those being finding the least common
 multiple and greatest common divider of the determinants of two matrices of size 3x3 and the ranks of those matrices.

This being said, let us get started!

Please enter the matrices you want to work with.
a= 13 4 25
4 2 2
0 1 1
Great! Now enter the matrix <<b>>.
b= 2 0 6
4 3 2
1 1 7
Alright! Now that we have both matrices we can calculate their determinants.
D_a= 84
D_b= 44
Great! Now I will find the Least Common Multiple and Greatest Common Divider of these two determinants.
The Least Common Multiple of the two determinants is: 3696
The Greatest Common Divider of the two determinants is: 4

Alright! Now I will display the ranks of the two matrices.
rk_a= 3
rk_b= 3
--------------------------------
Process exited after 656.8 seconds with return value 0
Press any key to continue . . .
```

```
C:\Users\Alex\Desktop\Proiec
Hi and welcome! I am here to help you with some very specific mathematical demands. Those being finding the least common
 multiple and greatest common divider of the determinants of two matrices of size 3x3 and the ranks of those matrices.

This being said, let us get started!

Please enter the matrices you want to work with.
a= 13 4 25
4 2 2
0 1 1
Great! Now enter the matrix <<b>>.
b= 1 2 3
4 5 6
7 8 9
Alright! Now that we have both matrices we can calculate their determinants.
D_a= 84
D_b= 0
Great! Now I will find the Least Common Multiple and Greatest Common Divider of these two determinants.
The Least Common Multiple of the two determinants is: 0
The Greatest Common Divider of the two determinants is: 84

Alright! Now I will display the ranks of the two matrices.
rk_a= 3
rk_b= 2
--------------------------------
Process exited after 29.28 seconds with return value 0
Press any key to continue . . .
```



5) Bibliography

The function that calculates the determinant was made by myself and to calculate the rank of the matrices I adapted the idea from this site (http://see-programming.blogspot.com/2013/07/c-program-to-find-rank-of-matrix.html) of a matrix of size 2x2 to my matrices of 3x3.
For the Euclid alorithm I took my inspiration from thi site: https://ecomputernotes.com/what-is-c/control-structures/gcd-using-euclid-s-algorithm.