COMPUTER SCIENCE PROJECT

2019-2020

GRAPHING CALCULATOR

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DECLARATION

I hereby declare that the project work entitled "Graphing Calculator", submitted to the Department of Computer Science, Doha Modern Indian School, is prepared by me and my team members Reona Malaika Lobo and Surya Suddir. All the coding is the result of our personal efforts.

-Charisma Kausar

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I would like to thank my team members, Reona Malaika Lobo and Surya Suddir, for their efforts to make this project a success. I would also like to thank my parents and friends for their constant support and motivation throughout the course of the project.

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INTRODUCTION

C++ is a multi-paradigm, general-purpose middle-level programming language created by Bjarne Stroustrup in 1979. It is an extension of the C programming language, or "C with Classes".

The language has expanded significantly over time, and modern C++ has object-oriented, generic, and functional features in addition to facilities for low-level memory manipulation.

C++ introduces object-oriented programming (OOP) features to C. It offers classes, which provide abstraction, encapsulation, inheritance, and polymorphism.

It also offers the feature of portability or platform independence which allows the user to run the same program on different operating systems or interfaces at ease.

Many of today's operating systems, system drivers, browsers and games use C++ as their core language. This makes C++ one of the most popular programming languages today.

WORKING DESCRIPTION

A **graphing calculator** is a calculator that is capable of plotting graphs, solving simultaneous equations, and performing other tasks with variables. They are mainly used by high school and college students for solving complex math problems and scientific calculations.

This project is an attempt to make a graphing calculator in C++. It is a menu-driven program, written using various functions, loops, conditional statements and simple graphics.

FEATURES:

- Basic calculations with functions such as addition, subtraction, multiplication, division and exponentiation
- Finding factorials, sine, cosine, tangent, square root, natural logarithm and logarithm to the base 10
- Plotting polynomial functions and trigonometric functions
- Solving simultaneous equations, 1st and 2nd degree polynomials

HEADER FILES USED AND THEIR PURPOSE

- **iostream.h:** for cin and cout statements
- **conio.h:** for getch() and clrscr() functions
- **graphics.h:** for simple graphics
- **math.h:** for mathematical operations
- **string.h:** for string handling
- **ctype.h:** for character handling
- **process.h:** for exit() function
- **stdio.h:** for standard I/O operations
- **stdlib.h:** for atoi() function

FUNCTIONS USED IN THE PROGRAM

- **start():** displays splash screen using simple graphics
- **menu():** displays the main menu and inputs the user choice
- **expr():** inputs the expression to be evaluated and passes it to parser(); calls the menu() or help() function when asked by the user
- **parser():** takes the expression entered as a parameter, evaluates it and returns the result
- **help():** list of functions and values supported
- **graph():** inputs the equation or trigonometric function to be plotted
- **plot():** plots polynomial and trigonometric functions using graphics
- **solve():** asks for the types of equations to be solved
- **sim():** inputs two simultaneous equations in 2 variables, solves them for x and y and displays the result
- **poly():** inputs a polynomial, finds its roots and displays them

SOURCE CODE

```
#include<iostream.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>
#include<string.h>
#include<ctype.h>
#include<process.h>
#include<stdio.h>
#include<stdlib.h>
void menu();
void help();

void start()
{       int gd=DETECT,gm;
        initgraph(&gd,&gm,"");

        int midX=getmaxx()/2;
        int midY=getmaxy()/2;
        settextstyle(0,0,7);
        setcolor(LIGHTRED);
        int w1=textwidth("GRAPHING");
        int h1=textheight("GRAPHING");
        int w2=textwidth("CALCULATOR");
        outtextxy(midX-(w1/2),midY-h1-20,"GRAPHING");
        outtextxy(midX-(w2/2),midY+15,"CALCULATOR");
        getch();
        closegraph();
}

double parser(char exp[],double ans)
{       double num[10],res[10],n=0,a=0,f=1;
        int len=strlen(exp);
        for(int i=0;i<len;i++)
```

```cpp
{    if((isdigit(exp[i]))||(exp[i]=='p')||(exp[i]=='A'))
     {    if(exp[i]=='p')
          {    num[n]=3.14;
               exp[i]=n+48;
          }
          else if(exp[i]=='A')
          {    num[n]=ans;
               exp[i]=n+48;
          }
          else
          {    num[n]=exp[i]-48;
               exp[i]=n+48;
               if(isdigit(exp[i+1]))
               {    num[n]=(num[n]*10)+(exp[i+1]-48);
                    exp[i+1]=n+48;
                    if(isdigit(exp[i+2]))
                    {    num[n]=(num[n]*10)+(exp[i+2]-48);
                         exp[i+2]=n+48;
                         if(isdigit(exp[i+3]))
                         {    num[n]=
                                (num[n]*10)+(exp[i+3]-48);
                              exp[i+3]=n+48;
                              if(isdigit(exp[i+4]))
                              {    cout<<"\n\t\tPlease
                                     limit values from
                                     -9999.9999 to
                                     9999.9999\n";
                                   return 0;
                              }
                              i=i+3;
                         }
                         else
                         {    i=i+2;
                         }
                    }
```

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```
                        else
                        {       i=i+1;
                        }
                }
        }
        n++;
    }
}
for(i=0;i<len;i++)
{       if(exp[i]=='.')
        {       int d=0;
                for(int j=1;j<=4;j++)
                {       if(isdigit(exp[i+j]))
                        {       d++;
                        }
                        else
                        {       break;
                        }
                }
                num[exp[i-1]-48]=
                  num[exp[i-1]-48]+(num[exp[i+1]-48])/(pow(10,d));
                for(j=1;j<=d;j++)
                {       exp[i+j]=exp[i-1];
                }
        }
}
if(strncmp("sin",exp,3)==0)
{       if((exp[3]=='-')||(exp[4]=='-'))
        {       num[0]=0-num[0];
                exp[3]=exp[4]='o';
        }
        res[a]=sin(num[0]);
        num[0]=res[a];
        a++;
}
```

```c
if(strncmp("cos",exp,3)==0)
{       if((exp[3]=='-')||(exp[4]=='-'))
        {       num[0]=0-num[0];
                exp[3]=exp[4]='o';
        }
        res[a]=cos(num[0]);
        num[0]=res[a];
        a++;
}
if(strncmp("tan",exp,3)==0)
{       if((exp[3]=='-')||(exp[4]=='-'))
        {       num[0]=0-num[0];
                exp[3]=exp[4]='o';
        }
        res[a]=tan(num[0]);
        num[0]=res[a];
        a++;
}
if(strncmp("log",exp,3)==0)
{       if((exp[3]=='-')||(exp[4]=='-'))
        {       num[0]=0-num[0];
                exp[3]=exp[4]='o';
        }
        res[a]=log10(num[0]);
        num[0]=res[a];
        a++;
}
if(strncmp("ln",exp,2)==0)
{       if((exp[2]=='-')||(exp[3]=='-'))
        {       num[0]=0-num[0];
                exp[2]=exp[3]='o';
        }
        res[a]=log(num[0]);
        num[0]=res[a];
        a++;
```

```c
        }
        if(strncmp("sqrt",exp,4)==0)
        {       if((exp[4]=='-')||(exp[5]=='-'))
                {       num[0]=0-num[0];
                        exp[4]=exp[5]='o';
                }
                res[a]=sqrt(num[0]);
                num[0]=res[a];
                a++;
        }
        if(exp[0]=='-')
        {       num[0]=0-num[0];
                exp[0]='o';
        }
        for(i=0;i<len;i++)
        {       if(exp[i]=='!')
                {       int fn=num[exp[i-1]-48];
                        while(fn>0)
                        {       f=f*fn;
                                fn=fn-1;
                        }
                        res[a]=f;
                        num[exp[i-1]-48]=res[a];
                        a++;
                }
        }
        for(i=0;i<len;i++)
        {       if(exp[i]=='^')
                {       if(exp[i+1]=='-')
                        {       num[exp[i+2]-48]=0-num[exp[i+2]-48];
                                num[exp[i-1]-48]=
                                  pow(num[exp[i-1]-48],num[exp[i+2]-48]);
                                res[a]=num[exp[i-1]-48];
                                num[exp[i+2]-48]=res[a];
                                a++;
```

```
                        exp[i+1]='o';
                }
                else
                {       num[exp[i-1]-48]=
                          pow(num[exp[i-1]-48],num[exp[i+1]-48]);
                        res[a]=num[exp[i-1]-48];
                        num[exp[i+1]-48]=res[a];
                        a++;
                }
        }
}
for(i=0;i<len;i++)
{       if(exp[i]=='/')
        {       if(exp[i+1]=='-')
                {       num[exp[i+2]-48]=0-num[exp[i+2]-48];
                        num[exp[i-1]-48]/=num[exp[i+2]-48];
                        res[a]=num[exp[i-1]-48];
                        num[exp[i+2]-48]=res[a];
                        a++;
                        exp[i+1]='o';
                }
                else
                {       num[exp[i-1]-48]/=num[exp[i+1]-48];
                        res[a]=num[exp[i-1]-48];
                        num[exp[i+1]-48]=res[a];
                        a++;
                }
        }
}
for(i=0;i<len;i++)
{       if(exp[i]=='*')
        {       if(exp[i+1]=='-')
                {       num[exp[i+2]-48]=0-num[exp[i+2]-48];
                        num[exp[i-1]-48]*=num[exp[i+2]-48];
                        res[a]=num[exp[i-1]-48];
```

```
                        num[exp[i+2]-48]=res[a];
                        a++;
                        exp[i+1]='o';
                }
                else
                {       num[exp[i-1]-48]*=num[exp[i+1]-48];
                        res[a]=num[exp[i-1]-48];
                        num[exp[i+1]-48]=res[a];
                        a++;
                }
            }
        }
    }
    for(i=0;i<len;i++)
    {       if(exp[i]=='+')
            {       num[exp[i-1]-48]+=num[exp[i+1]-48];
                    res[a]=num[exp[i-1]-48];
                    num[exp[i+1]-48]=res[a];
                    a++;
            }
            if(exp[i]=='-')
            {       num[exp[i-1]-48]-=num[exp[i+1]-48];
                    res[a]=num[exp[i-1]-48];
                    num[exp[i+1]-48]=res[a];
                    a++;
            }
    }
    return res[a-1];
}

void expr()
{       char exp[40];
        int m,h;
        double ans=0;
        clrscr();
        cout<<"\n\n\n\t\tEnter the expression to be evaluated: \n\t";
```

```cpp
			cout<<"\t  help: for list of functions supported";
			cout<<"\n\t\t  menu: to return\n\n\t\t";
			a:
			gets(exp);
			m=strcmp("menu",exp);
			if(m==0)
			{	menu();
			}
			h=strcmp("help",exp);
			if(h==0)
			{	help();
			}
			ans=parser(exp,ans);
			cout<<"\t\t\t\t\t\t\t"<<ans<<"\n\n\t\t";
			goto a;
}


void help()
{	clrscr();
			cout<<"\n\t\tFunctions: ";
			cout<<"\n\t\t+\t\tAddition";
			cout<<"\n\t\t-\t\tSubtraction";
			cout<<"\n\t\t*\t\tMultiplication";
			cout<<"\n\t\t/\t\tDivision";
			cout<<"\n\t\t^\t\tExponentiation";
			cout<<"\n\n\t\t!\t\tFactorial";
			cout<<"\n\t\tsin\t\tSine";
			cout<<"\n\t\tcos\t\tCosine";
			cout<<"\n\t\ttan\t\tTangent";
			cout<<"\n\t\tlog\t\tLogarithm to the base 10";
			cout<<"\n\t\tln\t\tNatural Logarithm";
			cout<<"\n\t\tsqrt\t\tSquare Root";
			cout<<"\n\n\t\tValues: ";
			cout<<"\n\t\tA\t\tPrevious Answer";
			cout<<"\n\t\tp\t\tpi";
```

```cpp
        cout<<"\n\n\n\t\tPress any key to return to Basic Calculator";
        getch();
        expr();
}


void plot(float a,float b,float c,char ch)
{       clrscr();
        int gd=DETECT,gm;
        initgraph(&gd,&gm,"");

        int i,j,xt=-30,yt=20;
        float x,y;
        int maxX=getmaxx();
        int maxY=getmaxy();
        int midX=(maxX/2)+1;
        int midY=(maxY/2)+1;
        line(0,midY,maxX,midY);
        line(midX,0,midX,maxY);
        if(ch==0)
        {       if(!a)
                {       if(!b)
                        {       cout<<"\ny = "<<c;
                        }
                        else
                        {       cout<<"\ny = "<<b<<"x + "<<c;
                        }
                }
                else
                {       cout<<"\ny = "<<a<<"x^2 + "<<b<<"x + "<<c;
                }
        }
        for(i=-320;i<320;i+=10)
        {       for(j=-1;j<=2;j++)
                {       putpixel(midX+i,midY+j,LIGHTGRAY);
                }
```

```
        }
        for(j=-240;j<240;j+=10)
        {       for(i=-1;i<=2;i++)
                {       putpixel(midX+i,midY+j,LIGHTGRAY);
                }
        }
        for(i=-300;i<=300;i+=50)
        {       char s[3];
                itoa(xt,s,10);
                outtextxy(midX+i-3,midY+3,s);
                xt+=5;
                for(j=-2;j<=2;j++)
                {    putpixel(midX+i,midY+j,WHITE);
                }
        }
        for(j=-200;j<=200;j+=50)
        {       if(j==0)
                {       yt-=5;
                }
                else
                {       char s[3];
                        itoa(yt,s,10);
                        outtextxy(midX+3,midY+j-2,s);
                        for(i=-2;i<=2;i++)
                        {       putpixel(midX+i,midY+j,WHITE);
                        }
                        yt-=5;
                }
        }
        if(ch==0)
        {       for(x=-32;x<=32;x=x+0.0004)
                {       putpixel(midX+x*10,
                           midY-(a*(pow(x,2))+b*x+c)*10,LIGHTGREEN);
                }
        }
```

```cpp
        else if(ch==1)
        {       for(x=-32;x<=32;x=x+0.0004)
                {       putpixel(midX+x*10,midY-(sin(x))*10,LIGHTGREEN);
                }
        }
        else if(ch==2)
        {       for(x=-32;x<=32;x=x+0.0004)
                {       putpixel(midX+x*10,midY-(cos(x))*10,LIGHTGREEN);
                }
        }
        else if(ch==3)
        {       for(x=-32;x<=32;x=x+0.0004)
                {       putpixel(midX+x*10,midY-(tan(x))*10,LIGHTGREEN);
                }
        }
        getch();
        closegraph();
        menu();
}

void graph()
{       clrscr();
        int ch,a,b,c,g;
        cout<<"\n\n\n\n\n\t\t\t1. Polynomial function";
        cout<<"\n\t\t\t2. Trigonometric function";
        cout<<"\n\n\t\t\tEnter your choice: ";
        choice:
        cin>>ch;
        switch(ch)
        {       case 1: int h;
                        clrscr();
                        cout<<"\n\n\n\n\t\t\t1. Constant Function";
                        cout<<"\n\t\t\t2. Linear Function";
                        cout<<"\n\t\t\t3. Quadratic Function";
                        cout<<"\n\n\t\t\tEnter your choice: ";
```

```cpp
                    deg:
                    cin>>h;
                    float a,b,c;
                    if(h==1)
                    {       a=0,b=0;
                            clrscr();
                            cout<<"\n\n\n\n\t\t\tEnter the equation: ";
                            cout<<"\n\t\t\t  General form: y = a\n";
                            cout<<"\n\t\t\ta: ";
                            cin>>c;
                    }
                    else if(h==2)
                    {       a=0;
                            clrscr();
                            cout<<"\n\n\n\n\t\t\tEnter the equation: ";
                            cout<<"\n\t\t\t  General form: y = ax + b\n";
                            cout<<"\n\t\t\ta: ";
                            cin>>b;
                            cout<<"\t\t\tb: ";
                            cin>>c;
                    }
                    else if(h==3)
                    {       clrscr();
                            cout<<"\n\n\n\n\t\t\tEnter the equation: ";
                            cout<<"\n\t\t\t  General form:
                                    y = ax^2 + bx + c\n";
                            cout<<"\n\t\t\ta: ";
                            cin>>a;
                            cout<<"\t\t\tb: ";
                            cin>>b;
                            cout<<"\t\t\tc: ";
                            cin>>c;
                    }
                    else
                    {       cout<<"\nInvalid choice, Try again: ";
```

```cpp
                        goto deg;
                }
                g=0;
                plot(a,b,c,g);
        case 2: a=0,b=0,c=0;
                clrscr();
                cout<<"\n\n\n\n\t\t\t1. Sine";
                cout<<"\n\t\t\t2. Cosine";
                cout<<"\n\t\t\t3. Tangent";
                cout<<"\n\n\t\t\tEnter your choice: ";
                cin>>g;
                if((g>0)&&(g<4))
                {       plot(a,b,c,g);
                }
                else
                {   cout<<"\n\t\t\tError";
                    getch();
                    menu();
                }
        default:  cout<<"\n\t\t\tInvalid choice, Try again: ";
                goto choice;
    }
}

void sim()
{       float x,y,A,a,B,b,C,c;
        clrscr();
        cout<<"\n\n\n\n\t\tEnter the simultaneous equations:";
        cout<<"\n\t\t  General form:\n\t\t\tAx + By + C = 0";
        cout<<"\n\t\t\tax + by + c = 0";
        cout<<"\n\t\tA: ";
        cin>>A;
        cout<<"\t\tB: ";
        cin>>B;
        cout<<"\t\tC: ";
```

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```cpp
        cin>>C;
        cout<<"\n\t\ta: ";
        cin>>a;
        cout<<"\t\tb: ";
        cin>>b;
        cout<<"\t\tc: ";
        cin>>c;
        if((A/a)!=(B/b))
        {       y=(a*C-A*c)/(A*b-a*B);
                x=(-C-B*y)/A;
                cout<<"\n\t\t\tx = "<<x;
                cout<<"\ty = "<<y;
        }
        else if(((A/a)==(B/b))&&((B/b)==(C/c)))
        {       cout<<"\n\t\tThere are infinitely many solutions ";
        }
        else
        {       cout<<"\n\t\t\tThere are no solutions ";
        }
        cout<<"\n\n\n\t\tPress any key to return to menu";
        getch();
        menu();
}

void poly()
{       int ch;
        clrscr();
        cout<<"\n\n\n\n\n\t\tEnter the degree of the equation (1 or 2): ";
        choice:
        cin>>ch;
        float x,a,b,c,root1,root2,d;
        if(ch==1)
        {       a=0;
                clrscr();
                cout<<"\n\n\n\n\t\t\tEnter the equation: ";
```

```cpp
            cout<<"\n\t\t\t  General form: ax + b = 0\n";
            cout<<"\n\t\t\ta: ";
            cin>>b;
            cout<<"\t\t\tb: ";
            cin>>c;
    }
    else if(ch==2)
    {       clrscr();
            cout<<"\n\n\n\n\t\t\tEnter the equation: ";
            cout<<"\n\t\t\t  General form: ax^2 + bx + c = 0\n";
            cout<<"\n\t\t\ta: ";
            cin>>a;
            cout<<"\t\t\tb: ";
            cin>>b;
            cout<<"\t\t\tc: ";
            cin>>c;
    }
    else
    {       cout<<"\nInvalid choice, Try again: ";
            goto choice;
    }
    if(!a)
    {       if(!b)
            {       cout<<"\n\t\t\tError ";
                    getch();
                    menu();
            }
            x=-c/b;
            cout<<"\n\t\t\t\tx = "<<x;
    }
    else
    {       d=b*b-4*a*c;
            if(d>=0)
            {       root1=(-b+sqrt(d))/(2*a);
                    root2=(-b-sqrt(d))/(2*a);
```

```
                        cout<<"\n\t\t\t\tx = "<<root1<<", "<<root2;
            }
            else
            {       cout<<"\n\t\t\tRoots are complex and imaginary";
            }
      }
      cout<<"\n\n\n\t\t\tPress any key to return to menu";
      getch();
      menu();
}

void solve()
{     clrscr();
      int ch;
      cout<<"\n\n\n\n\n\t\t\t1. Simultaneous Equations";
      cout<<"\n\t\t\t2. Polynomial";
      cout<<"\n\n\t\t\tEnter your choice: ";
      choice:
      cin>>ch;
      switch(ch)
      {     case 1:  sim();
            case 2:  poly();
            default:cout<<"\n\t\t\tInvalid choice, Try again: ";
                    goto choice;
      }
}

void menu()
{     clrscr();
      int ch,i=0;
      cout<<"\n\n\n\n\n\t\t\n\t\t\tMENU\n";
      while(i<20)
      {     cout<<" ";
            i++;
      }
```

```cpp
        while(i<60)
        {       cout<<".";
                i++;
        }
        cout<<"\n\n\t\t\t1. Basic Calculator\n";
        cout<<"\t\t\t2. Graph Plotter\n";
        cout<<"\t\t\t3. Equation Solver\n";
        cout<<"\t\t\t(Enter 0 to exit)\n";
        cout<<"\n\t\t\tEnter your choice: ";
        choice:
        cin>>ch;
        switch(ch)
        {       case 1: expr();
                case 2: graph();
                case 3: solve();
                case 0: exit(0);
                default:cout<<"\n\t\t\tInvalid choice, Try again: ";
                        goto choice;
        }
}

void main()
{       clrscr();
        start();
        menu();
}
```

OUTPUT

Splash screen:
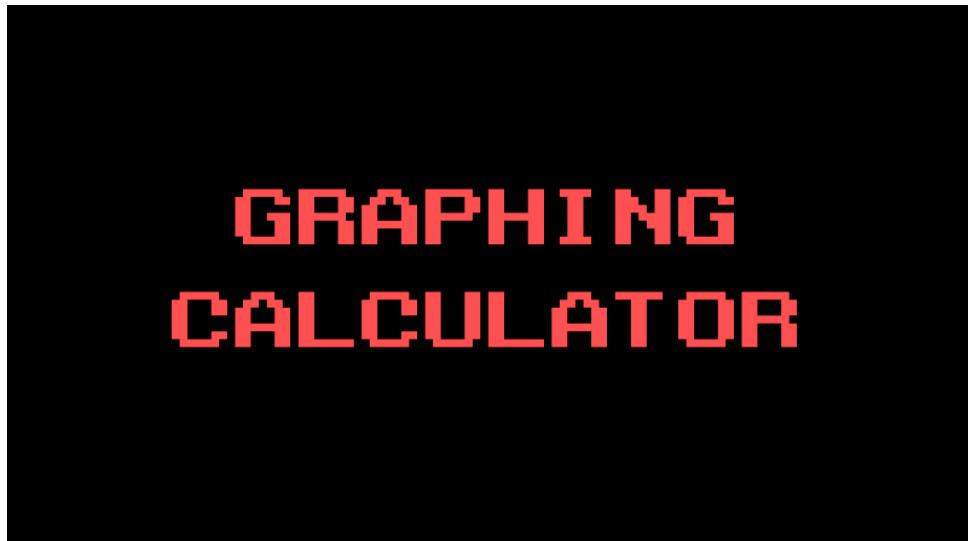
Menu:
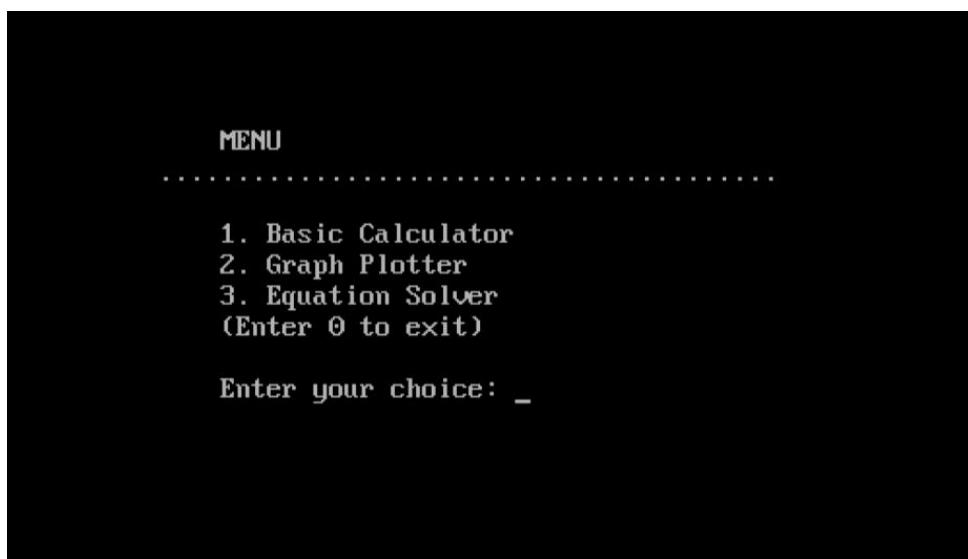
Basic Calculator:

```
Enter the expression to be evaluated:
  help: for list of functions supported
  menu: to return

p*10^2
                                    314

A+2436-366-278+7299-23+346
                                    9728

10!
                                    3628800

sin 1
                                    0.841471

log 0.0001
                                    -4

sqrt 2
                                    1.414214
```

Graph Plotter Menu:

```
1. Polynomial function
2. Trigonometric function

Enter your choice: 1_
```

Graph of polynomial entered:

y = 0.5x^2 + -3x + 2

Equation Solver menu:

```
1. Simultaneous Equations
2. Polynomial

Enter your choice: 1_
```

Simultaneous Equations:

```
Enter the simultaneous equations:
  General form:
        Ax + By + C = 0
        ax + by + c = 0
A: 2
B: 3
C: 6

a: 4
b: -7
c: -3

        x = -1.269231   y = -1.153846


Press any key to return to menu
```

Polynomial:

```
Enter the equation:
  General form: ax^2 + bx + c = 0

a: 11
b: 6
c: -7

        x = 0.570329, -1.115783


Press any key to return to menu
```
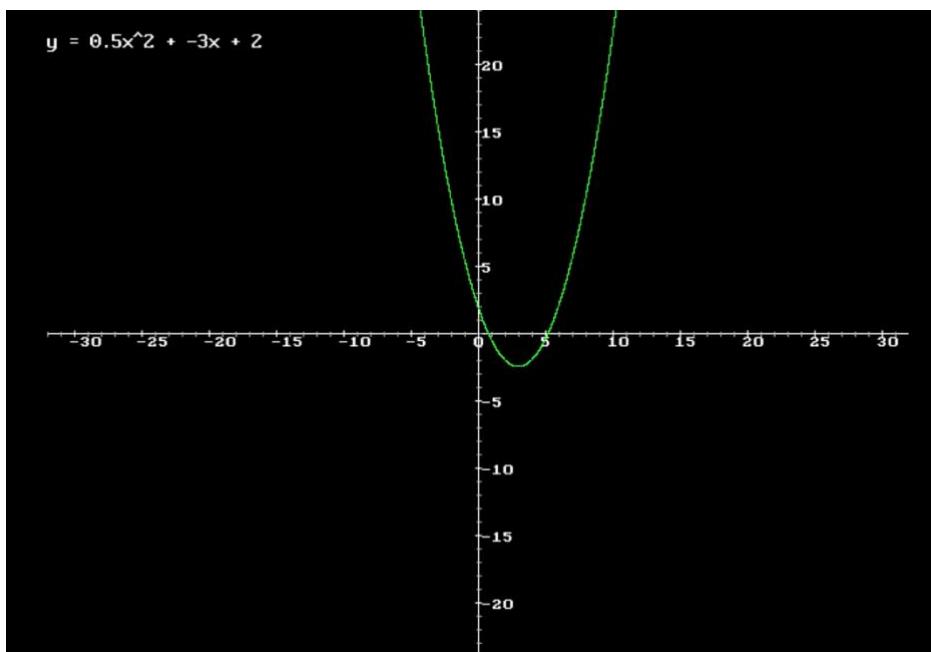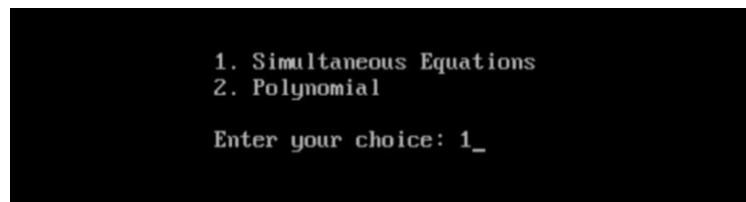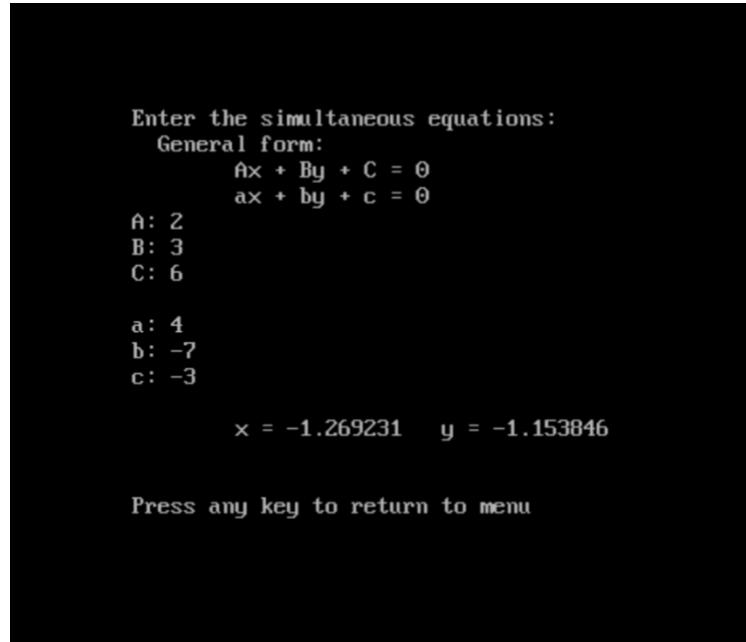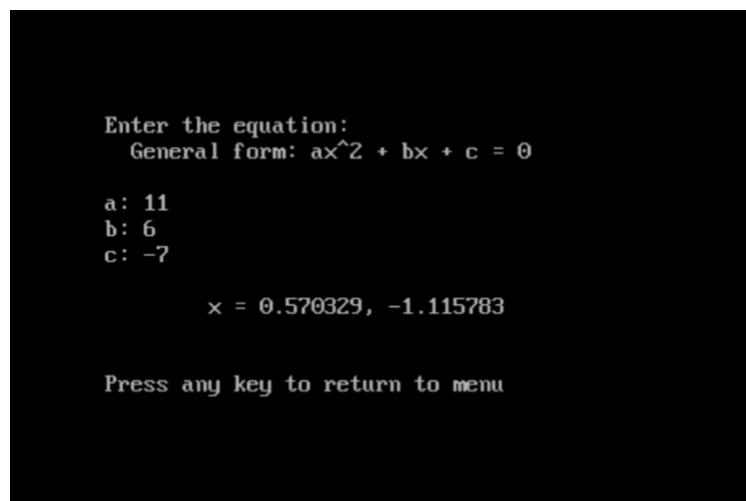
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