Homework #2

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Problem 1

Script

1.main program

```
clear
clc
close all
format compact
%%
f1 = @E1F1;
X1 = [0 5];
x1 = fzero(f1,X1);
disp(x1)
%%
f2 = @E1F2;
X2 = [0 1];
x2 = fzero(f2,X2);
disp(x2)
%%
f3 = @E1F3;
X3 = [-1 1];
x3 = fzero(f3,X3);
disp(x3)
```

2. E1F1

```
function F1 = E1F1(x)
    F1 = 4*x^3-3*x^2-30;
end
```

3. E1F2

```
function F2 = E1F2(x)
    F2 = 3*exp(2*x)-10;
end
```

3. E1F3

```
function F3 = E1F3(x)
    F3 = 5*(10^x)-10*x^2;
end
```

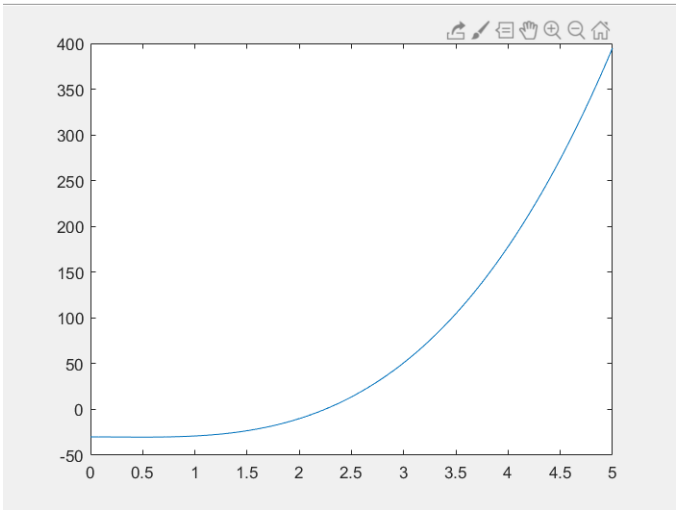
Result

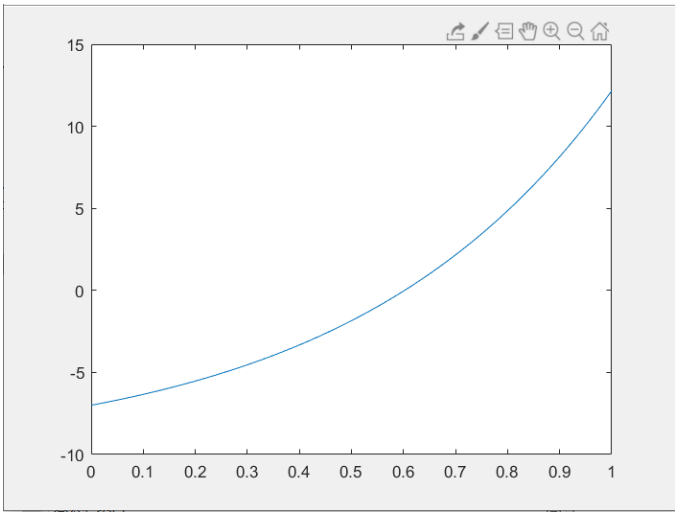
The root of the first function is: 2.2420

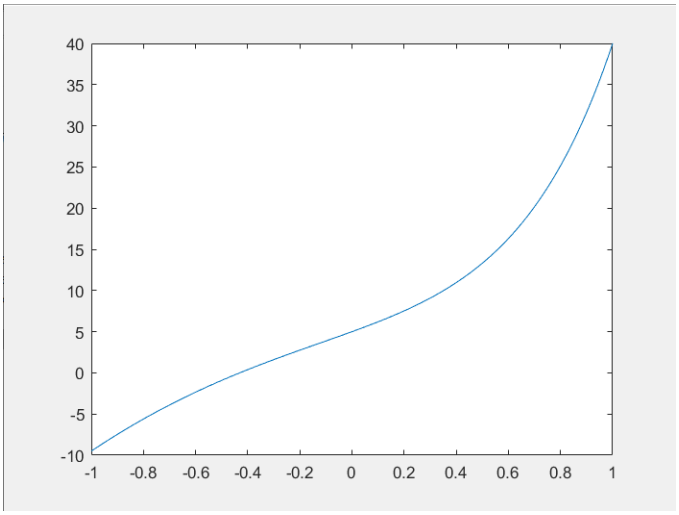
The root of the second function is: 0.6020

The root of the third function is: -0.4307

Graph







Problem 2

Script

1.main program

```
clear
clc
close all
format compact

f = @E2F1;
x = [0,2];
h = fzero(f,x);
disp(h)
```

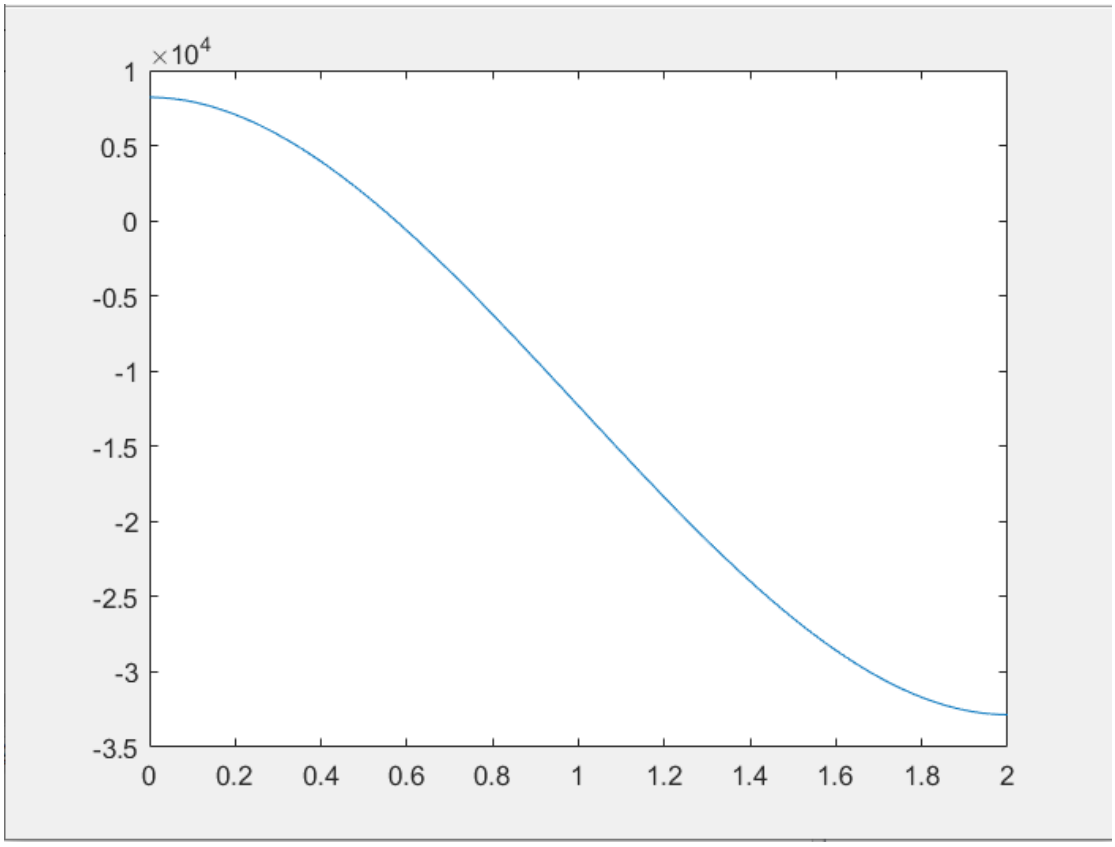
2. E2F1

```
function F = E2F1(h)
    F = (1000*9.8*(4/3*pi*1^3-pi*h^2/3*(3*1-h)))-
(4/3*pi*1^3*800*9.8);
end
```

Result

The height above the water is: 0.5743

Graph



Problem 3

Script

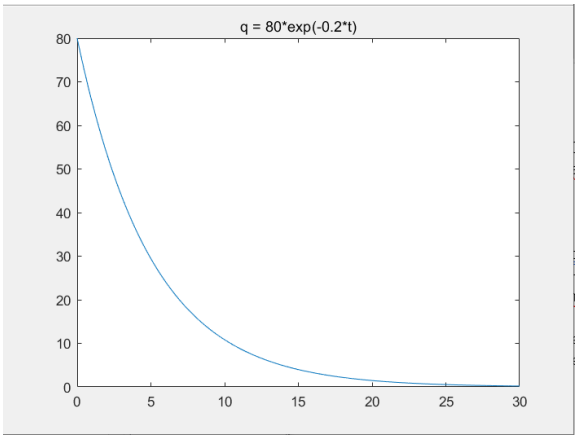
```
clear
clc
close all
format compact
%%
syms t;
syms end_time;
q = 80*exp(-0.2*t);
q_integral = int(q,t,0,end_time);
time = solve(q_integral == 200);
fprintf('%f\n',time)
%%
end_time = 15;
water_emission = int(q,t,0,end_time);
water_Remaining = 400-water_emission;
fprintf('%f',water_Remaining)
```

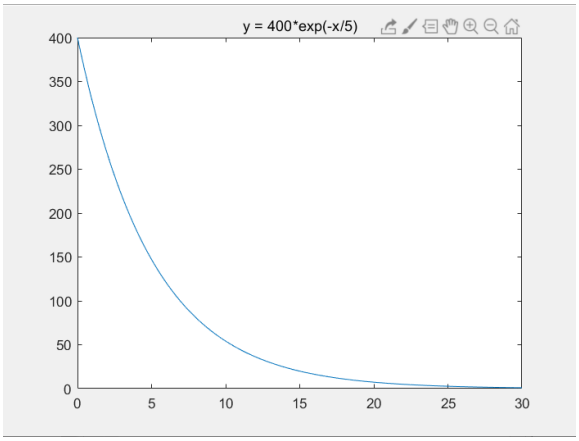
Result

Time required to empty half of the water in the water tank: 3.465736 [5*log(2)]

The amount of water remaining in the water tank after 15 minutes: 19.914827 [400*exp(-3)]

Graph





Problem 4

Script

```
clear
clc
close all
format long

Year = [1750 1800 1850 1900 1950 1990 2000 2009];
Population = [791 980 1260 1650 2520 5270 6060 6800];
cftool(Year,Population)
%%
%{
General model Exp1:
     f(x) = a*exp(b*x)
Coefficients (with 95% confidence bounds):
       a =   9.911e-08  (-6.01e-07, 7.992e-07)
       b =    0.01241  (0.008865, 0.01595)

Goodness of fit:
  SSE: 1.12e+06
  R-square: 0.9738
  Adjusted R-square: 0.9695
  RMSE: 432
%}
a = 9.911e-08;
b = 0.01241;
x1 = 1980;
f1 = a*exp(b*x1);
disp(f1)
%%
%{
Linear model Poly3:
     f(x) = p1*x^3 + p2*x^2 + p3*x + p4
Coefficients (with 95% confidence bounds):
       p1 =    0.001021  (0.0004915, 0.00155)
       p2 =      -5.604  (-8.589, -2.62)
       p3 =   1.026e+04  (4651, 1.586e+04)
       p4 =  -6.254e+06  (-9.758e+06, -2.75e+06)

Goodness of fit:
  SSE: 1.876e+05
  R-square: 0.9956
  Adjusted R-square: 0.9923
  RMSE: 216.6
```

```
%}
p1= 0.001020697301838;
p2= -5.604096642832609;
p3= 1.025536170980091e+04;
p4= -6.253911927981189e+06;
%{
Because the accuracy of the data in the directly used
function is not enough, the result obtained has a
large error, so we derive the value of p1-p4 to
obtain higher-precision data
%}
x2=1980;
f2 = p1*x2^3 + p2*x2^2 + p3*x2 + p4;
disp(f2)
%%
f3 = interp1(Year,Population,1975,'linear');
disp(f3)
%%
f3 = interp1(Year,Population,1975,'spline');
disp(f3)
```

Result

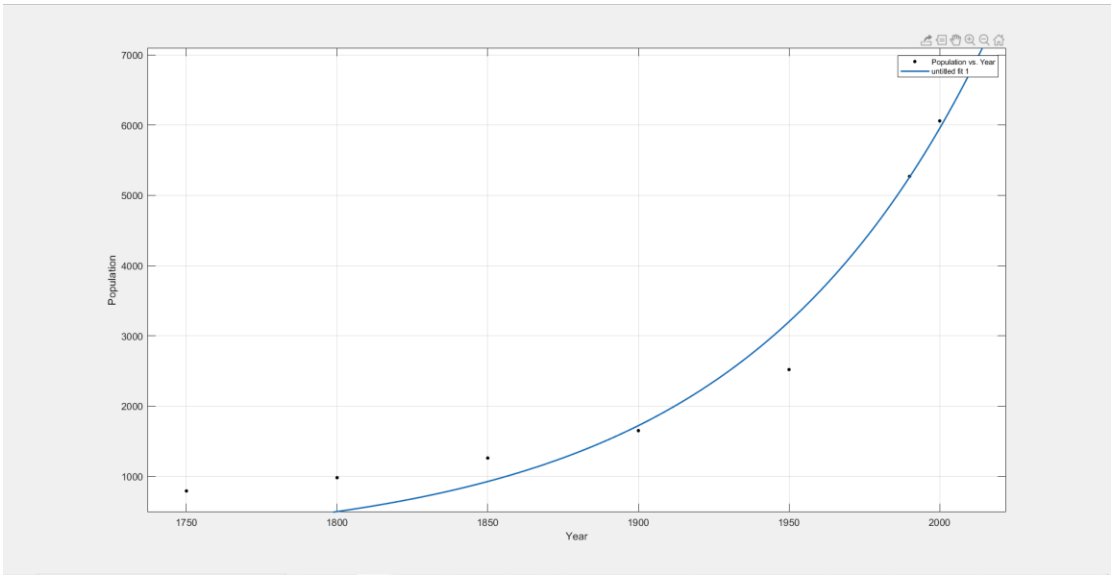
The exponential function fitting estimates the population in 1980 as: 4.6506603882316e+03

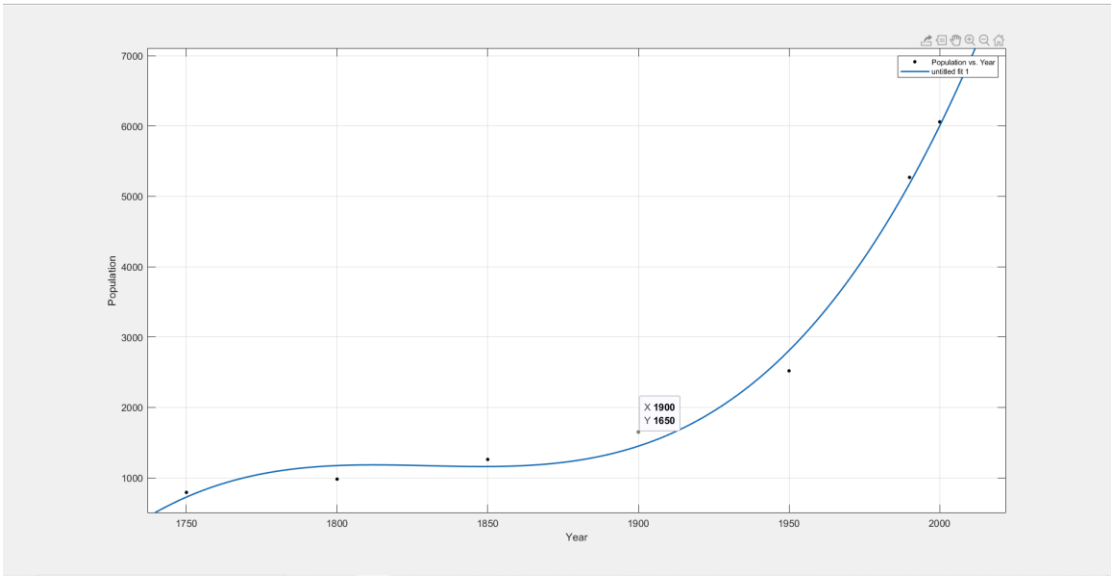
The third-order polynomial fitting estimates the population in 1980 as: 4.45634907253e+03

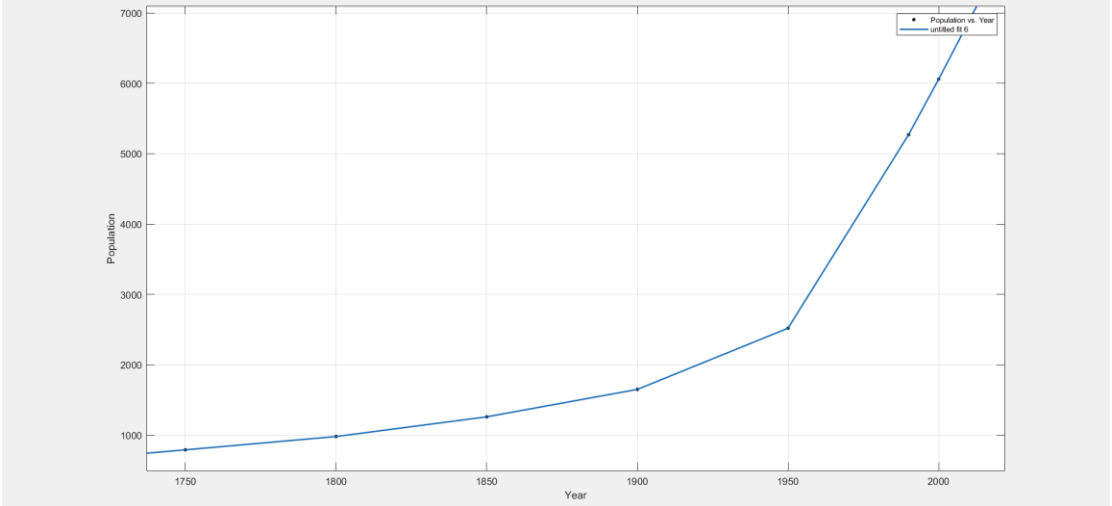
The linear interpolation fitting estimates the population in 1975 as: 4.238750000000000e+03

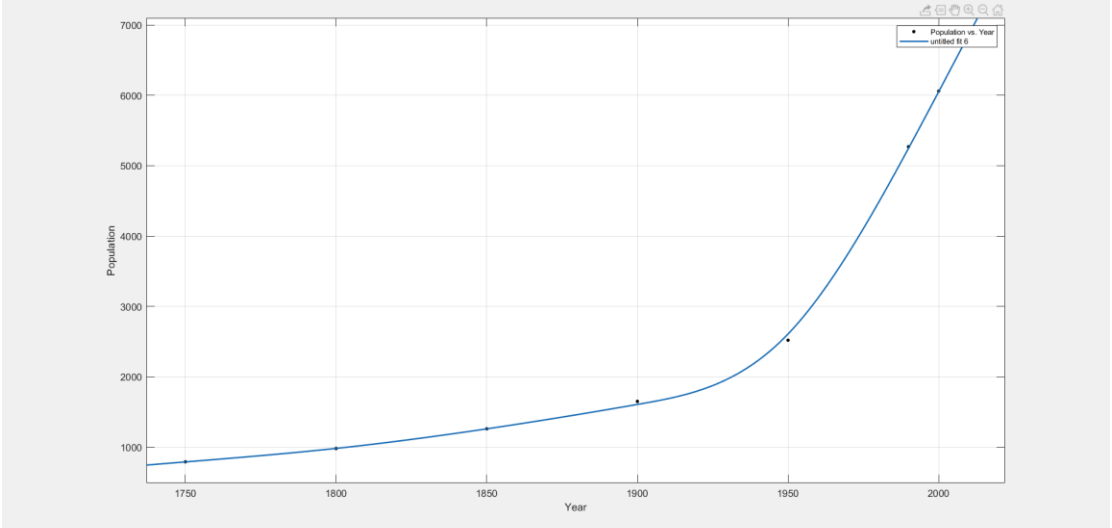
The spline interpolation fitting estimates the population in 1975 as: 4.098602853371127e+03

Graph




Population vs. Year
untitled fit 1
X 1900
Y 1650
Population
Year
7000
6000
5000
4000
3000
2000
1000
1750
1800
1850
1900
1950
2000


Population vs. Year
untitled fit 6
Population
Year
7000
6000
5000
4000
3000
2000
1000
1750
1800
1850
1900
1950
2000


Population vs. Year
untitled fit 6
Population
Year
7000
6000
5000
4000
3000
2000
1000
1750
1800
1850
1900
1950
2000

Problem 5

Script

1.main program

```
clear
clc
close all
format compact

f = @E5F1;
x = [0,0];
min = fminsearch(f,x);

x = -0.851379147149151;
z = 0.500027344117450;
F = 3*x^4-2*x^2+4*x+1+z^2-z;
disp(F)
%%
X = -2:0.002:2;
Z = -1:0.002:3;
[x,z] = meshgrid(X,Z);
Y = 3*x.^4-2*x.^2+4*x+1+z.^2-z;
mesh(X,Z,Y)
```

2. E5F1

```
function F = E5F1(x)
    F = 3*x(1)^4-2*x(1)^2+4*x(1)+1+x(2)^2-x(2);
end
```

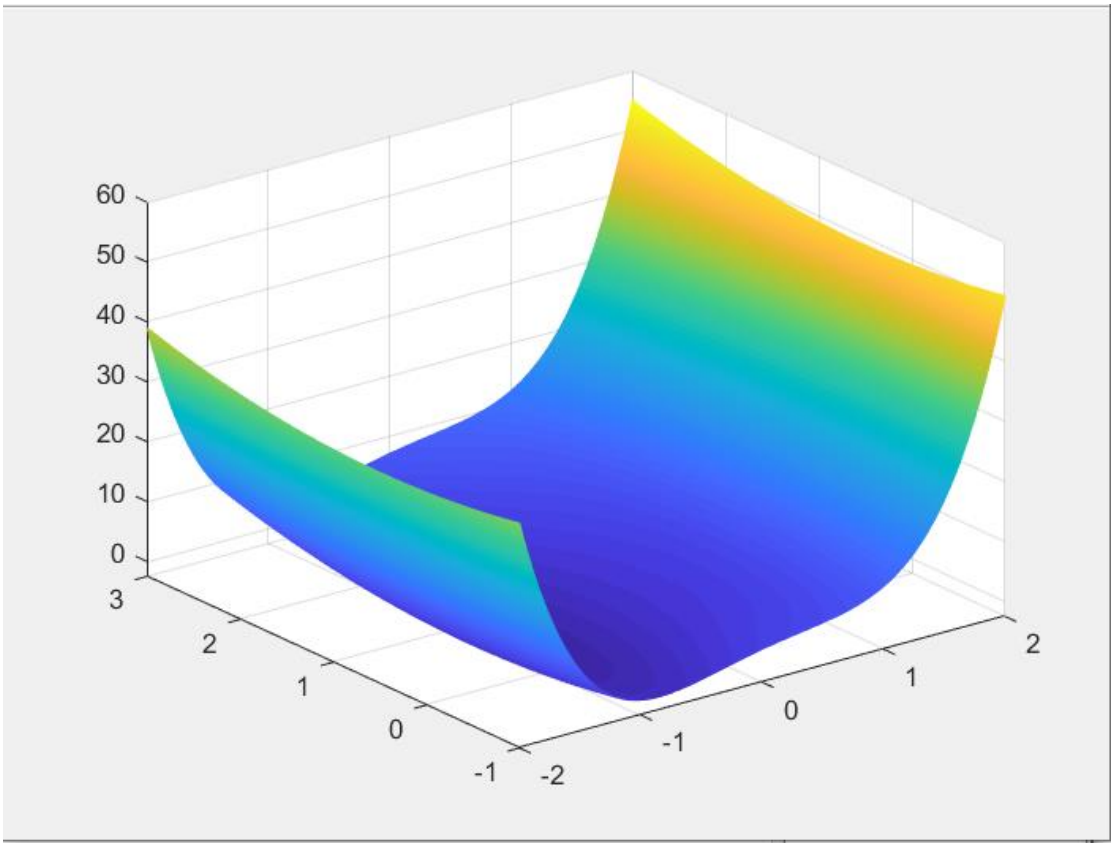
Result

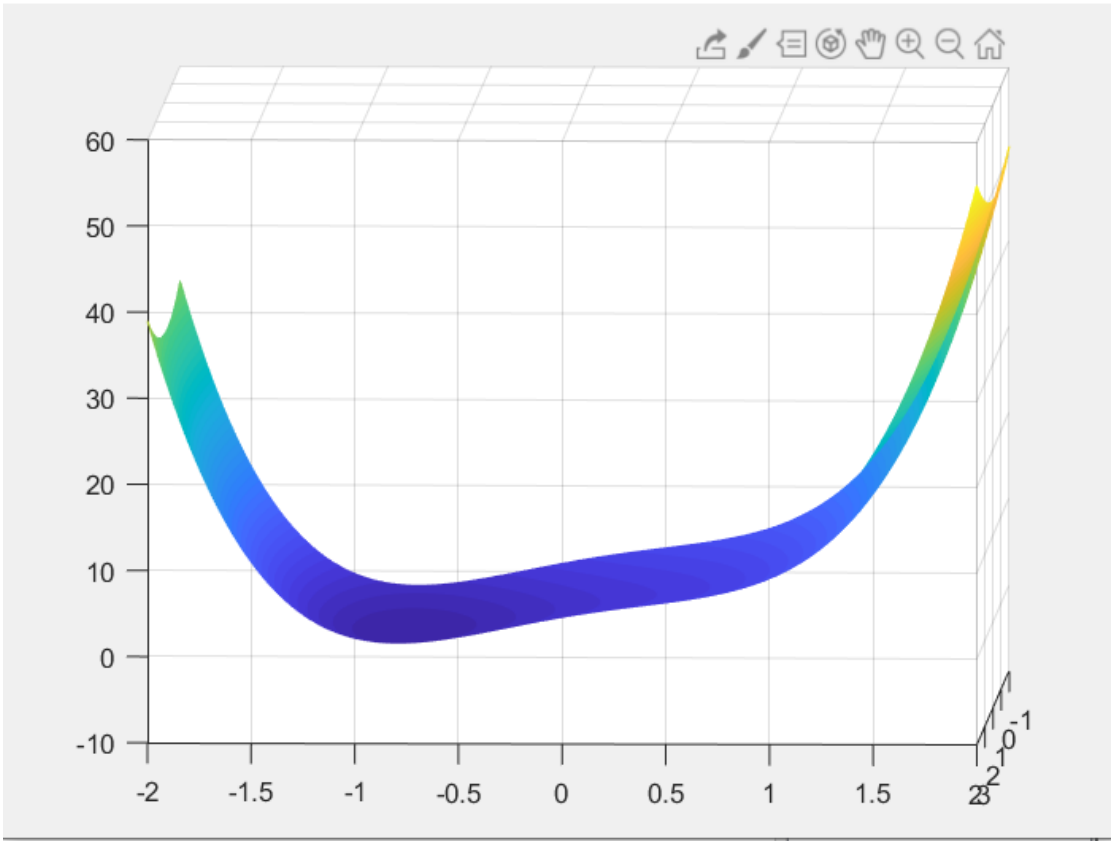
The value of minimizing the multivariate function x is: -0.851379147149151

The value of minimizing the multivariate function y is: -2.529002354447146

The value of minimizing the multivariate function z is: 0.500027344117450

Graph


60
50
40
30
20
10
0
3
2
1
0
-1
-2
-1
0
1
2


60
50
40
30
20
10
0
-10
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
-1
0
1
2

Bonus Problem

Script

1.main program

```
clear
clc
close all
format compact

f = @E6F1;
min_x = fminbnd(f,0,1);
disp(min_x)
min_y = min_x^2*cos(2*pi*min_x);
disp(min_y)
X = 0:0.001:1;
F= X.*2.*cos(2*pi*X);
plot(X,F)
```

2. E6F1

```
function F = E6F1(x)
    F = x^2*cos(2*pi*x);
end
```

Result

The x value of the minimization function is: 0.579900318475678

The y value of the minimization function is: -0.294789657567411

Graph