智慧型控制期末報告

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一、 求 $F(x_1, x_2) = x_1^2 + 2x_2^2 + 2x_1 x_2 + x_1 + 1$ 之最小值。

    a. 使用 steepest descent 法，$x_1(0) = x_2(0) = 0.5$，學習率 $\alpha = 0.01$。
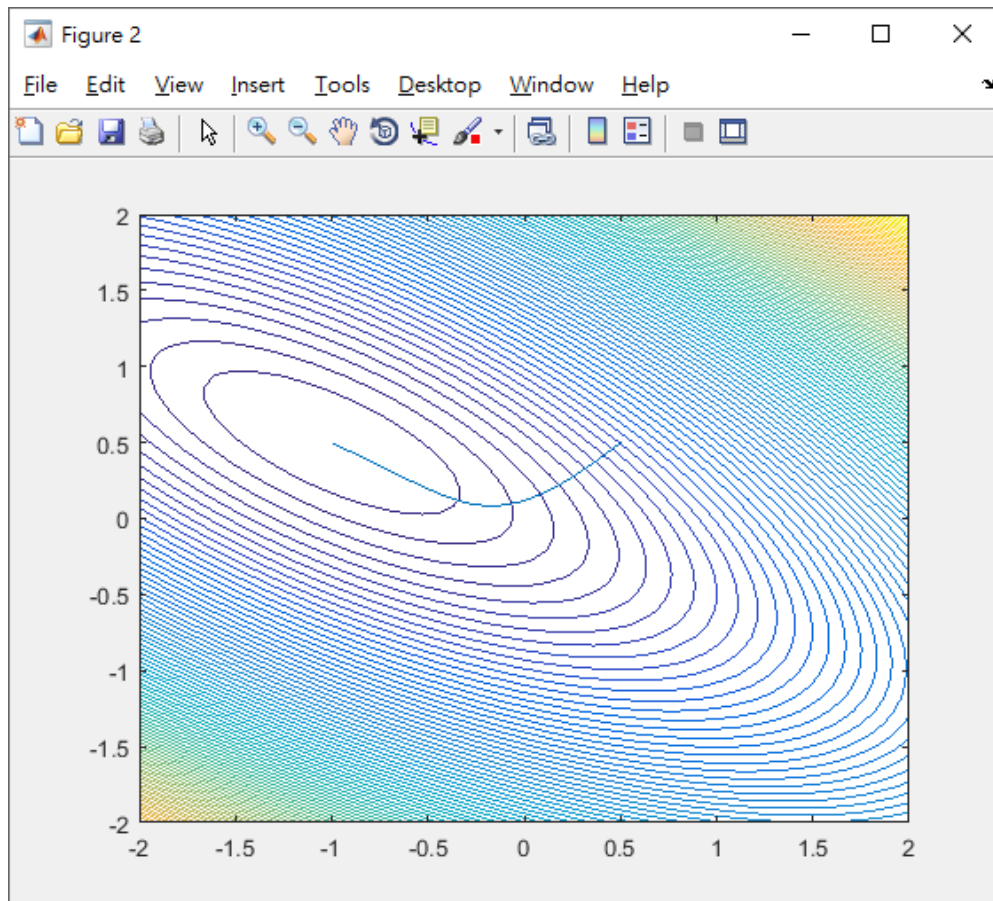
        1. 程式碼

```matlab
clc;
clear;

x1=linspace(-2,2,50);
x2=linspace(-2,2,50);

[x1NEW,x2NEW]=meshgrid(x1,x2);
f=x1NEW.^2+2*x2NEW.^2+2*x1NEW.*x2NEW+x1NEW+1;

figure(1);
mesh(x1NEW,x2NEW,f);%指定figure 1 為3D立體圖
figure(2);
contour(x1NEW,x2NEW,f,100);%指定figure 2 為2D等高圖

x11=0.5;
x22=0.5;
x0=[x11;x22];

while 1

    f1 = 2*x11+2*x22+1;
    f2 = 2*x11+4*x22;

    g = [f1;f2] ;

    x=x0-0.01*g ;

    if abs(x0-x)<=[0.00001;0.00001],
        x11=x(1);
        x22=x(2);
        break
    end
    x0=x;
    line([x11 x(1)],[x22 x(2)]);
    x11=x(1);
    x22=x(2);
end

f=x11.^2+2*x22.^2+2*x11.*x22+x11+1
```

        2. F 之最小值
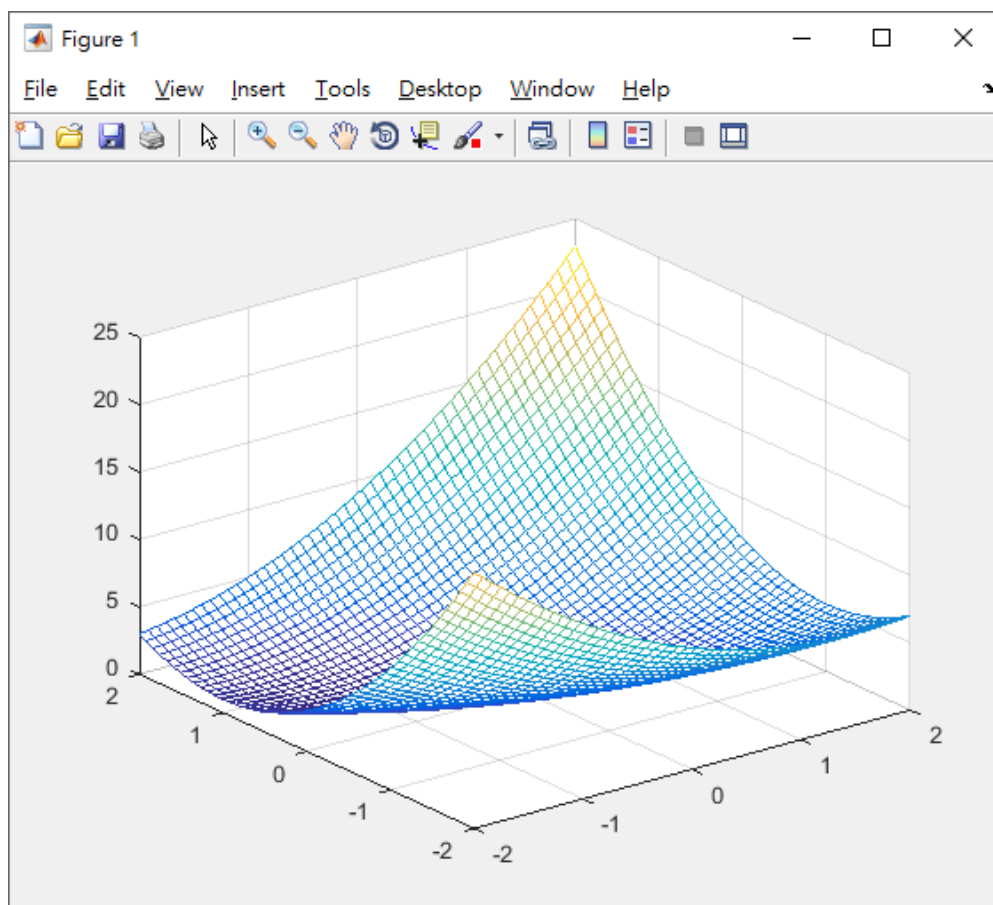
```
Command Window
New to MATLAB? See resources for Getting Started.
  f =

    0.5000
fx >>
```

        F 之最小值為 0.5。

3. 等高圖及路徑

4. 立體圖

b. 使用 minimizing aling a line 之梯度法，$x_1(0) = x_2(0) = 0.5$。
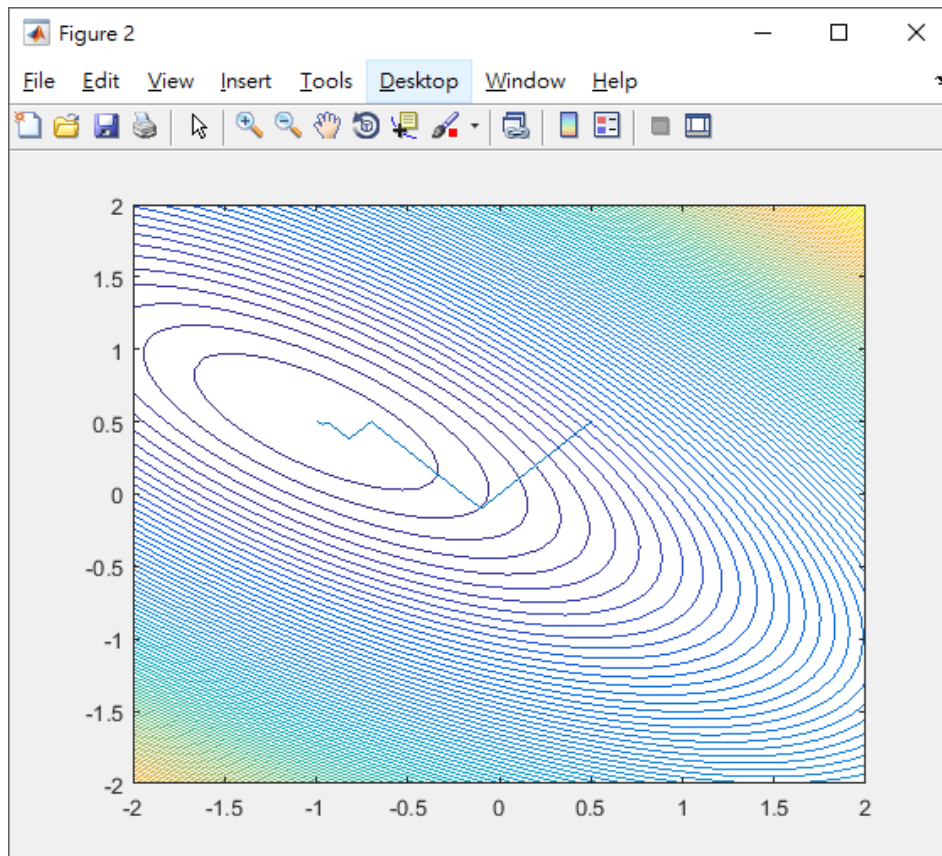
1. 程式碼

```
     clc;
     clear;

     x1=linspace(-2,2,50);
     x2=linspace(-2,2,50);

     [x1NEW,x2NEW]=meshgrid(x1,x2);
     f=x1NEW.^2+2*x2NEW.^2+2*x1NEW.*x2NEW+x1NEW+1;

     figure(1);
     mesh(x1NEW,x2NEW,f);%指定figure 1 為3D立體圖
     figure(2);
     contour(x1NEW,x2NEW,f,100);%指定figure 2 為2D等高圖

     x11=0.5;
     x22=0.5;
     x0=[x11;x22];

     while 1

         f1 = 2*x11+2*x22+1;
         f2 = 2*x11+4*x22;

         f11=2;
         f12=2;
         f21=2;
         f22=4;

         g1 = [f1;f2] ;
         g2 = [f11 f12 ; f21 f22];

         a=-(g1'*(-g1))/((-g1')*g2*(-g1));%疊代學習率

         x=x0-a*g1 ;

         if abs(x0-x)<=[0.00001;0.00001],
             x11=x(1);
             x22=x(2);
             break
         end

         x0=x;
         line([x11 x(1)],[x22 x(2)]);
         x11=x(1);
         x22=x(2);
     end

     f=x11.^2+2*x22.^2+2*x11.*x22+x11+1
```

2. F 之最小值
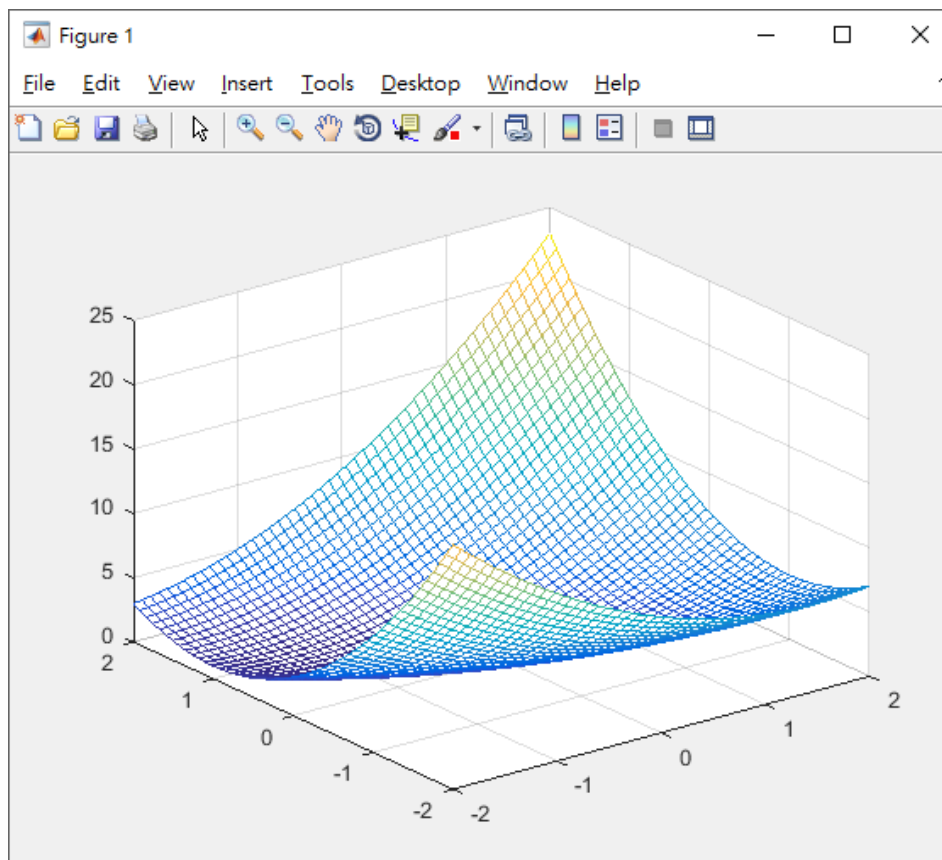
```
Command Window
New to MATLAB? See resources for Getting Started.
f =

   0.5000

fx >>
```
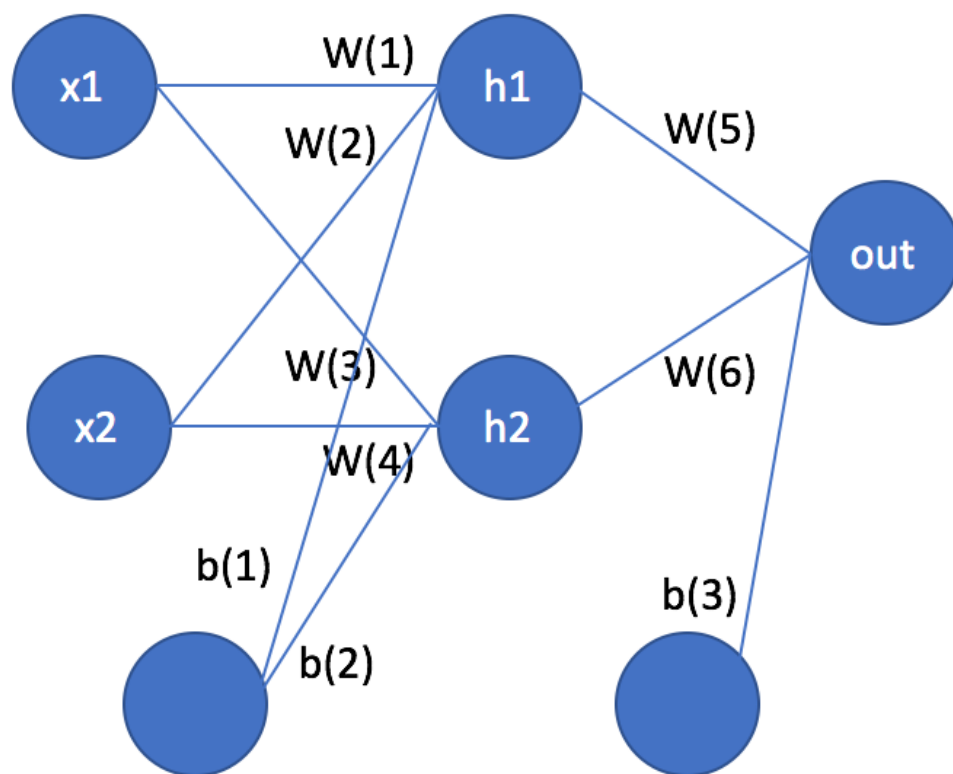
F 之最小值為 0.5。

3. 等高圖及路徑

4. 立體圖

二、 使用 2-2-1 feedforward NN 及倒傳遞演算法執行 2 輸入 1 輸出之 XOR 功能。
    1. NN 結構圖

2. 程式

NND_test1_a.m   NND_test2.m   untitled*   +

```matlab
1 -    clc;
2 -    clear;
3
4 -    w=rand(1,6)
5 -    b=rand(1,3)
6 -    a=1.0;
7 -    tol=0.001;
8 -    x1=[0 0 1 1];
9 -    x2=[0 1 0 1];
10 -   tar=[0.05 0.95 0.95 0.05];
11 -   int=1;
12
13 -  for i=1:4
14 -      while 1
15 -        int=int+1;
16 -        net_h1=w(1)*x1(i)+w(2)*x2(i)+b(1);
17 -        net_h2=w(3)*x1(i)+w(4)*x2(i)+b(2);
18 -        out_h1=1/(1+exp(-net_h1));
19 -        out_h2=1/(1+exp(-net_h2));
20
21 -        net_o=out_h1*w(5)+out_h2*w(6)+b(3);
22 -        out_o=net_o;
23
24 -        Etol=0.5*(tar(i)-out_o)^2;
25
```

NND_test1_a.m   NND_test2.m   untitled*   +

```matlab
25
26 -         if(Etol>0.0001)
27 -             partE_6=-(tar(i)-out_o)*out_o*(1-out_o)*out_h2;
28 -             partE_5=-(tar(i)-out_o)*out_o*(1-out_o)*out_h1;
29
30 -             w(6)=w(6)-a*partE_6;
31 -             w(5)=w(5)-a*partE_5;
32
33 -             partE_4=-(tar(i)-out_o)*(out_o*(1-out_o))*w(6)*(out_h2*(1-out_h2))*x2(i);
34 -             partE_3=-(tar(i)-out_o)*(out_o*(1-out_o))*w(6)*(out_h2*(1-out_h2))*x1(i);
35 -             partE_2=-(tar(i)-out_o)*(out_o*(1-out_o))*w(5)*(out_h1*(1-out_h1))*x2(i);
36 -             partE_1=-(tar(i)-out_o)*(out_o*(1-out_o))*w(5)*(out_h1*(1-out_h1))*x1(i);
37
38 -             w(4)=w(5)-a*partE_4;
39 -             w(3)=w(5)-a*partE_3;
40 -             w(2)=w(5)-a*partE_2;
41 -             w(1)=w(5)-a*partE_1;
42
43 -             partb_3=-(tar(i)-out_o)*out_o*(1-out_o)*1;
44 -             partb_2=-(tar(i)-out_o)*(out_o*(1-out_o))*w(6)*(out_h2*(1-out_h2))*1;
45 -             partb_1=-(tar(i)-out_o)*(out_o*(1-out_o))*w(5)*(out_h1*(1-out_h1))*1;
46
47 -             b(3)=b(3)-a*partb_3;
48 -             b(2)=b(2)-a*partb_2;
49 -             b(1)=b(1)-a*partb_1;
50
51 -         else
52 -             out(i)=out_o;
53
54 -             x=linspace(0,int,int);
55 -             fig=plot(x,tar(i)-out_o);
56 -             break;
57 -         end
58 -      end
59 -      int=int+1;
60
61 -  end
62 -  out
63
```

3. 最終ＮＮ及參數

```
w =

    0.0842    0.1639    0.3242    0.3017    0.0117    0.5399


b =

    0.0954    0.1465    0.6311


out =

    0.0640    0.9367    0.9367    0.0636
```

4. 誤差收斂圖