# HW5 problem 1

In the compressed file you can find three images (*HW5_ima1*, *HW5_ima2, and HW5_ima3*) with different additive noises. Please answer Problem 1 with both ima1 and ima2 and use ima3 for answering Problem 2 if applicable.

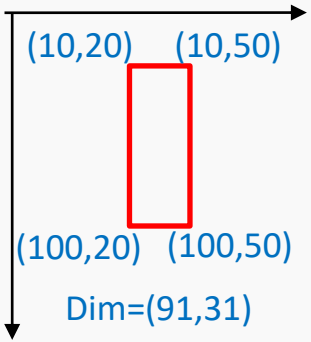
(a) Display the **noise** histograms by properly choosing the region of interest. Indicate what you think the noise PDFs are and its relevant parameters. (Hint: Use *roipoly* to specify your region of interest). 原圖 – 濾雜訊後之圖 = 雜訊

(b) Apply the most suitable approach as described in class to suppress the noise in each image. Comment about which of the filters you find best performing if two or more methods you applied.

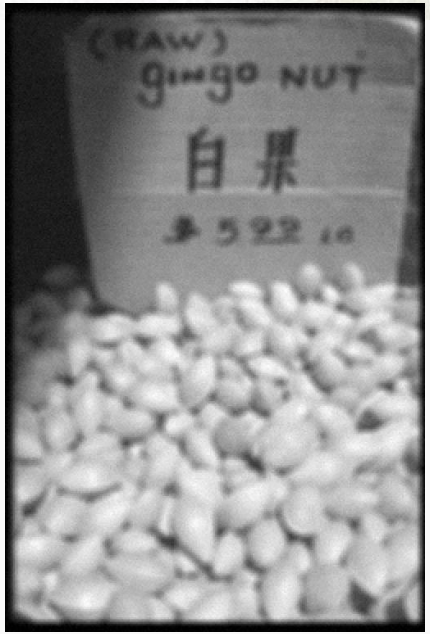
(a) Display the **noise** histograms by properly choosing the region of interest. Indicate what you think the noise PDFs are and its relevant parameters. (Hint: Use *roipoly* to specify your region of interest).

*roipoly(Image,Column,Row)

## Problem 1-(a)




(ima1)

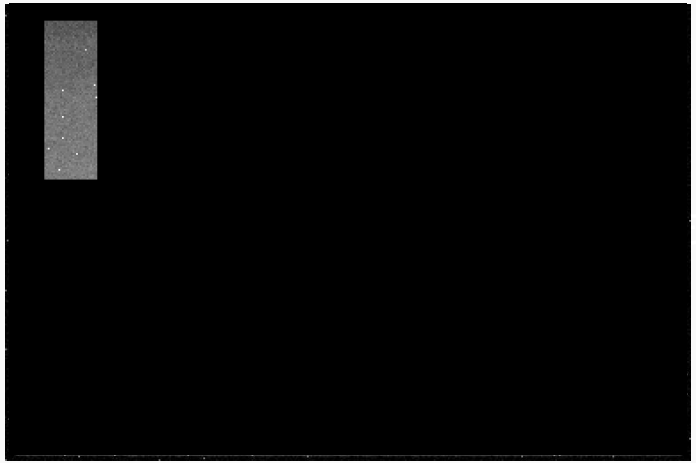



(ima2)

$$m - 2 \times s \leq (x, y) \leq m + 2 \times s$$

m :過濾器範圍內影像強度平均值
S :過濾器範圍內影像強度標準差
(x,y)：過濾器中心點影像強度

## 找尋雜訊



(region of interest -- ima1)

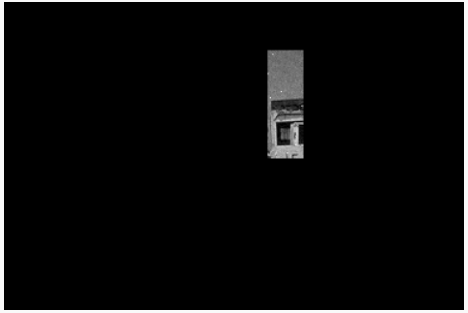
(noise in the region of interest -- ima1)

Reference : https://stackoverflow.com/questions/22434482/error-image-noise-detection-in-matlab/22438813

# Problem 1-(a)

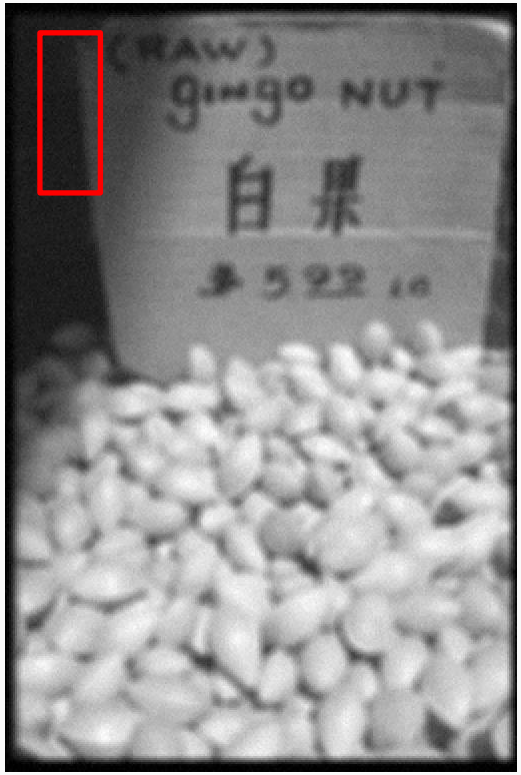
(region of interest -- ima1)

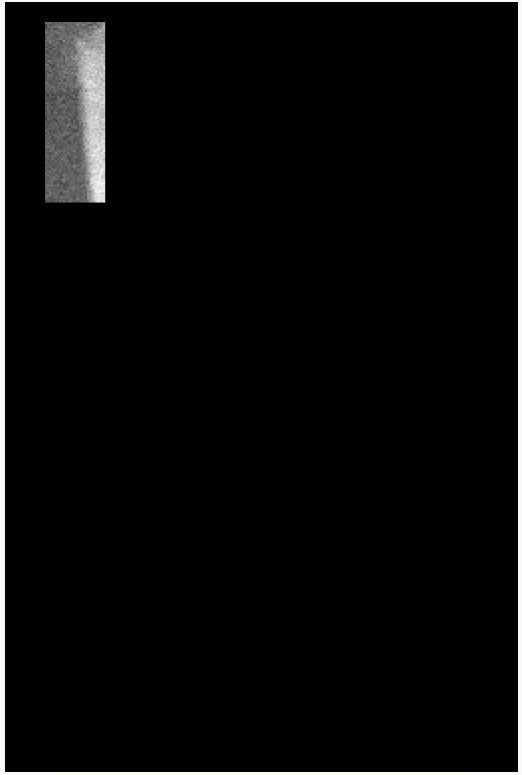
(noise in the region of interest -- ima1)



(region of interest -- ima1)

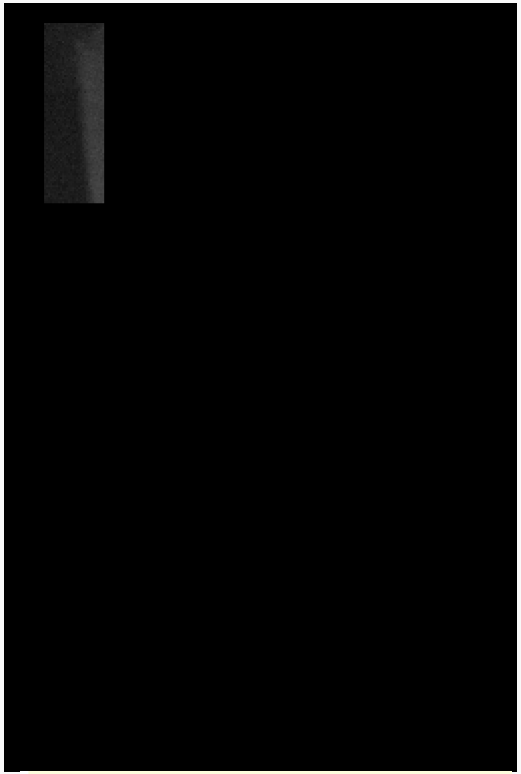
(noise in the region of interest -- ima1)



figure;imshow(ROI_2,[]);

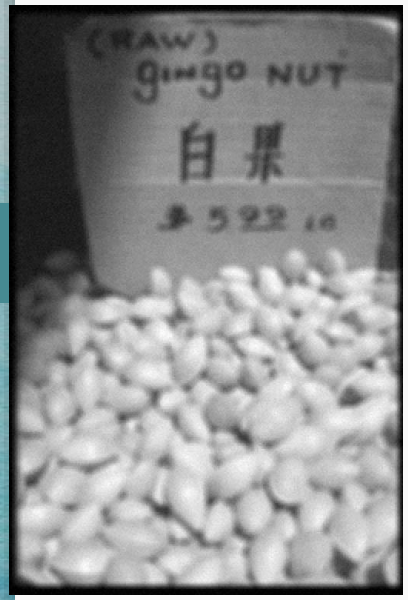
(region of interest -- ima2)

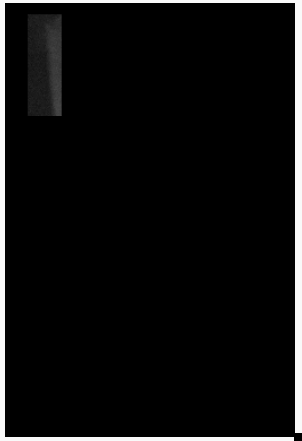


figure;imshow(ROI_2,[0 255]);

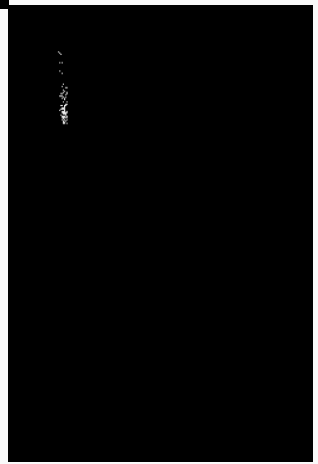
(region of interest -- ima2)

# Problem 1-(a)



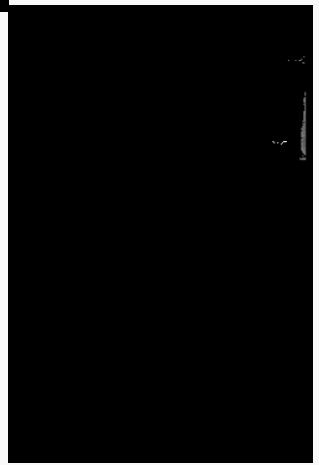



(region of interest -- ima2)



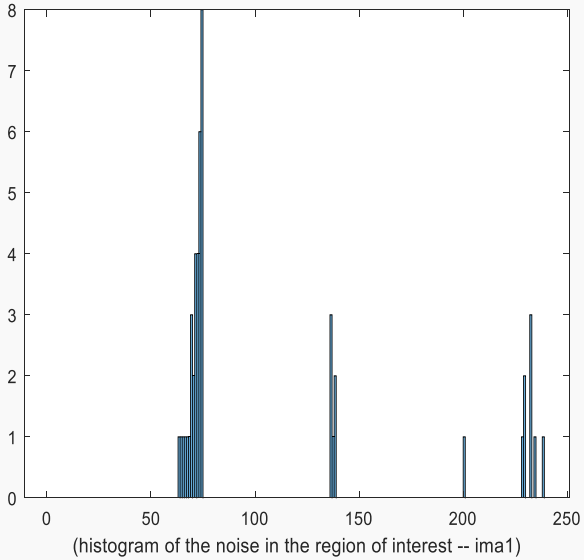
(noise in the region of interest -- ima2)

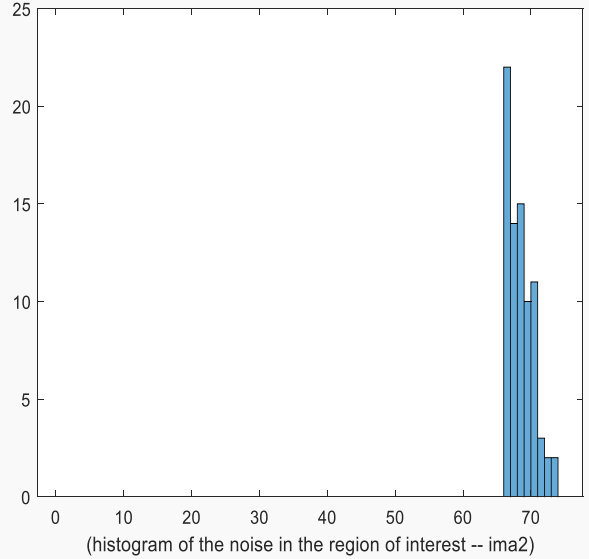
(region of interest -- ima2)



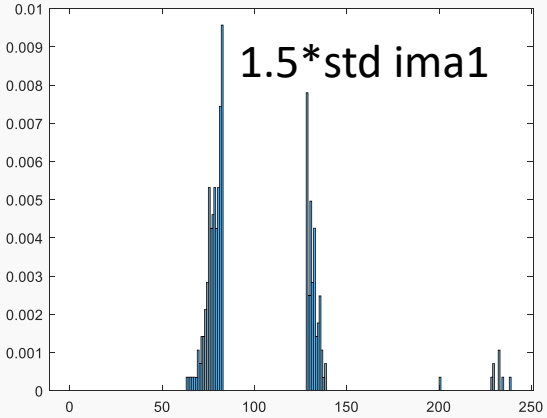
(noise in the region of interest -- ima2)

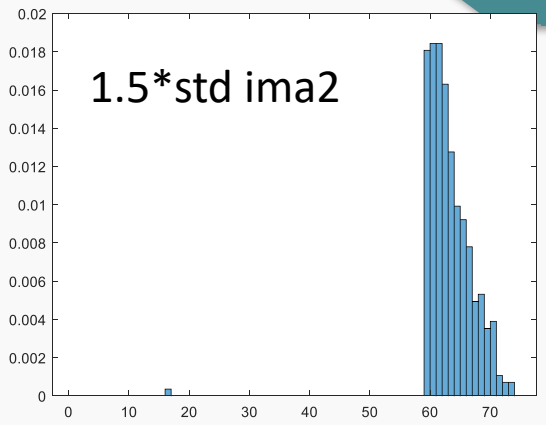
## histogram

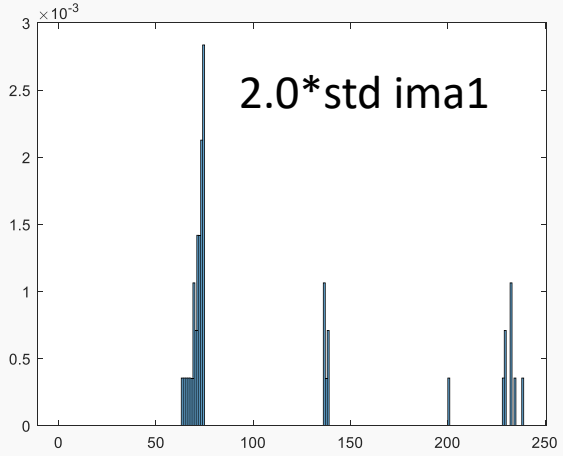

8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
(histogram of the noise in the region of interest -- ima1)

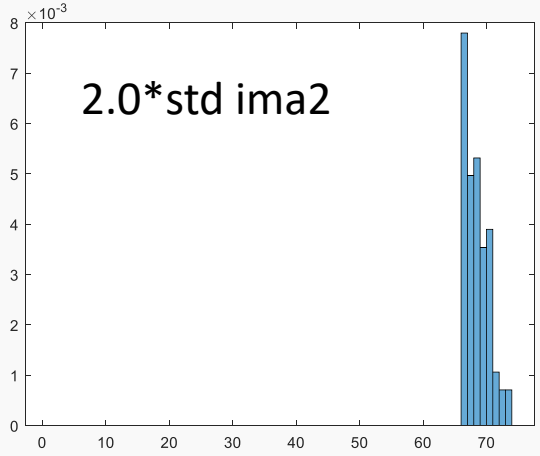

25
20
15
10
5
0
0
10
20
30
40
50
60
70
(histogram of the noise in the region of interest -- ima2)

PDF



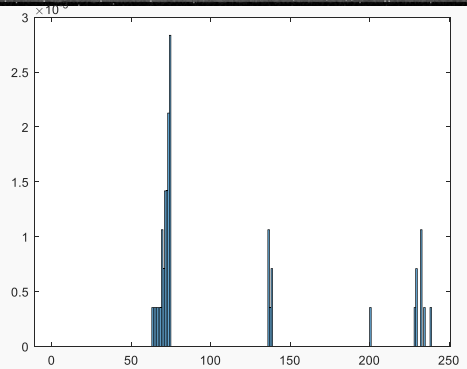



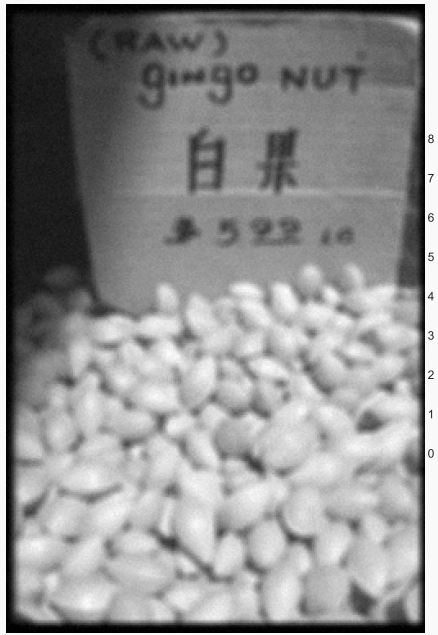



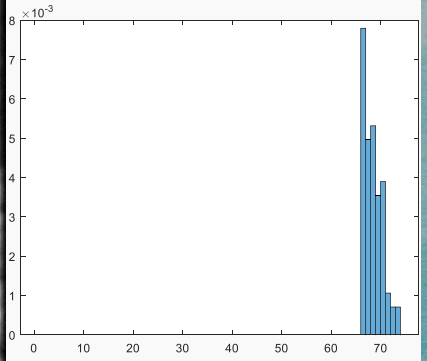
(b) Apply the most suitable approach as described in class to suppress the noise in each image. Comment about which of the filters you find best performing if two or more methods you applied.

Problem 1-(b)




Impulse?




exponential?

# Problem 1-(b)

(After median filter -- ima1)

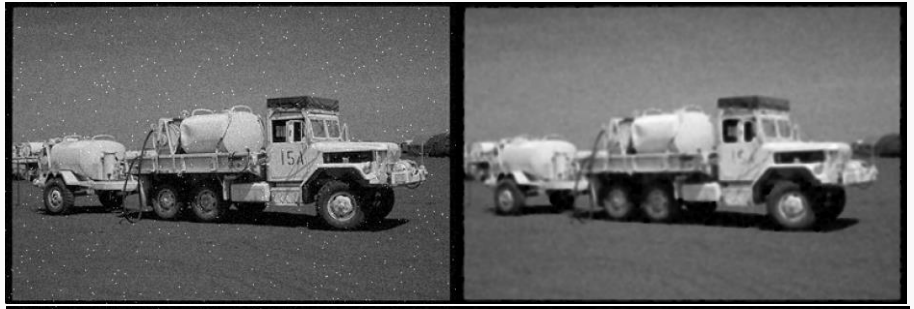
median filter

First time


(After wiener filter -- ima2)

Wiener filter

# Problem 1-(b)



geometric mean filter

arithmetic mean filter

Wiener filter

r -- ima1)

(After median filter and wiener filter -- ima1)

## Second time



(After wiener filter -- ima2)

(After wiener filter and arithmetic mean filter -- ima2)

3. We want to use Hough transform to identify the presence of parabolas in an edge image. Consider a parabola given by this equation $y = ax^2 + bx + c$. The Hough space for identifying parabolas is

   (a) One dimensional

C  (b) Two dimensional

   (c) Three dimensional

   (d) Four dimensional

4. Following question 3, the parabola in space corresponds to what in the Hough space

d  (a) Parabola (b) Line (c) Sphere (d) Plane

5. Following question 3, the general equation of the entity corresponding to the parabola in the Hough space is given by

   (a) $ax + by = c$

b  (b) $ax + by + z = c$

   (c) $y^2 = 4ax$

   (d) $x^2 + y^2 + z^2 = 1$

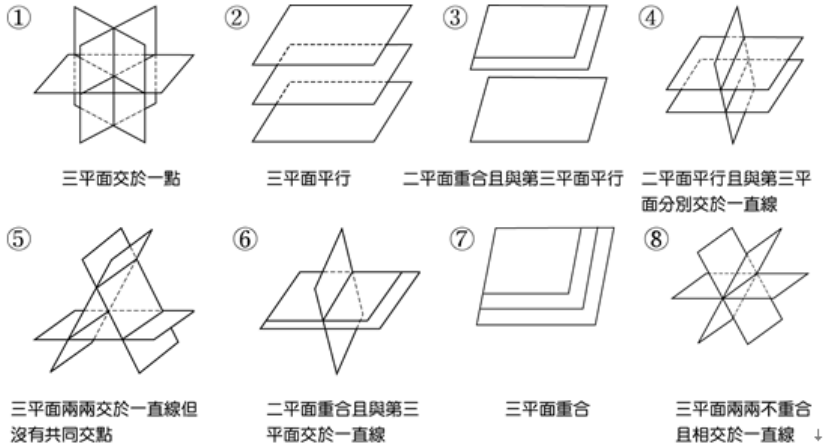
$y = ax^2 + bx + \mathrm{c} \quad x, y \in R$

$a = \frac{y}{x^2} - \frac{b}{x} - \frac{c}{x^2} \Rightarrow a + \alpha_1 b + \beta_1 c = \gamma_1 \qquad \forall \alpha_i 、 \beta_i 、 \gamma_i \in R$

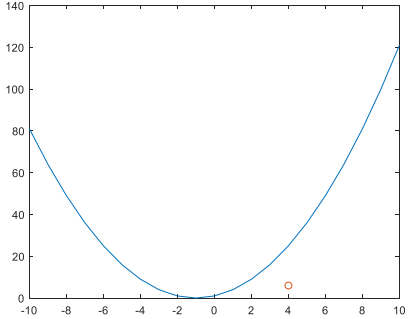
$b = \frac{y}{x} - ax - \frac{c}{x} \Rightarrow \alpha_2 a + b + \beta_2 c = \gamma_2$

$c = y - ax^2 - bx \Rightarrow \alpha_3 a + \beta_3 b + c = \gamma_3$

$find\ a$ 、$b$、 c



*example 1.*



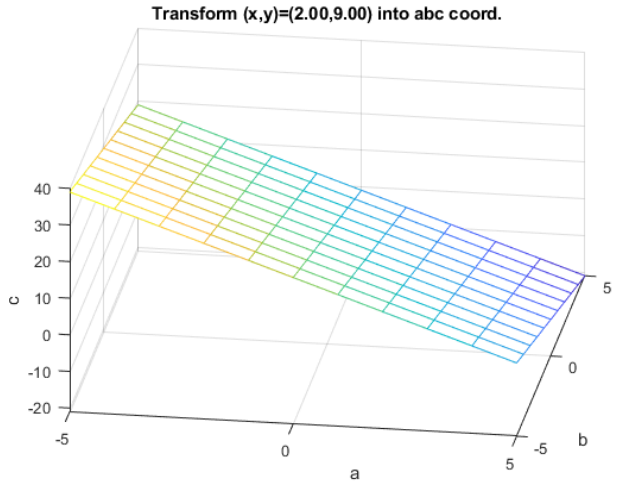
$y = x^2 + 2x + 1 = (x+1)^2$

Determining whether or not a point (4,6) lies on the line.

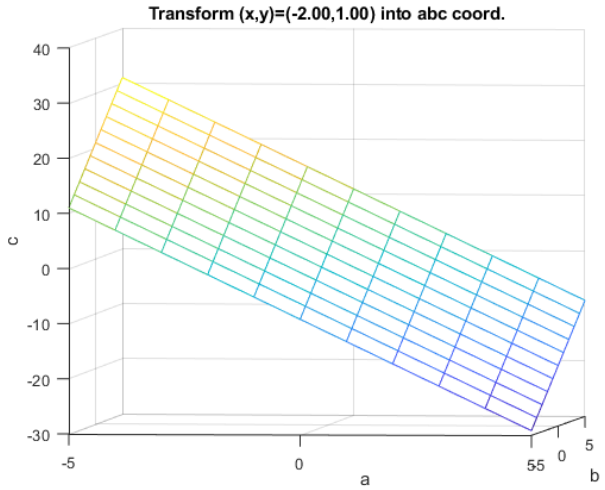
Selected points (2,9) (-2,1)(-1,0)

$c = y - ax^2 - bx$

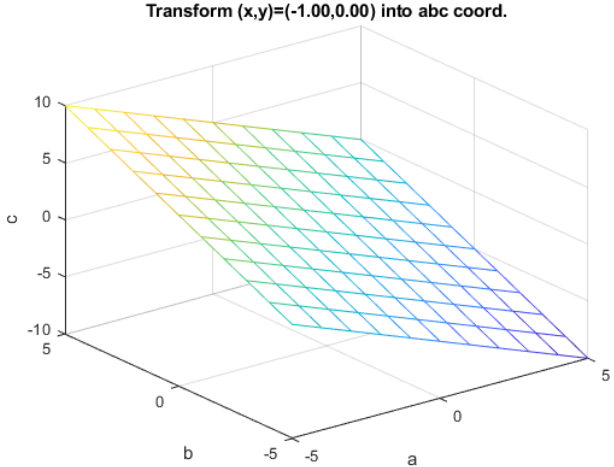
$c = 9 - 4a - 4b$



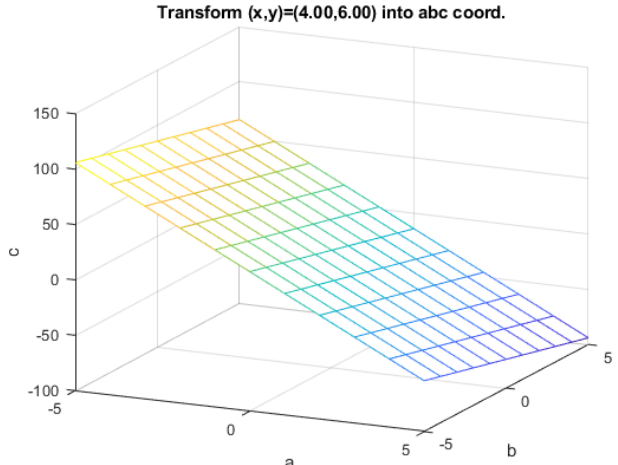

$c = 1 - 4a + 2b$

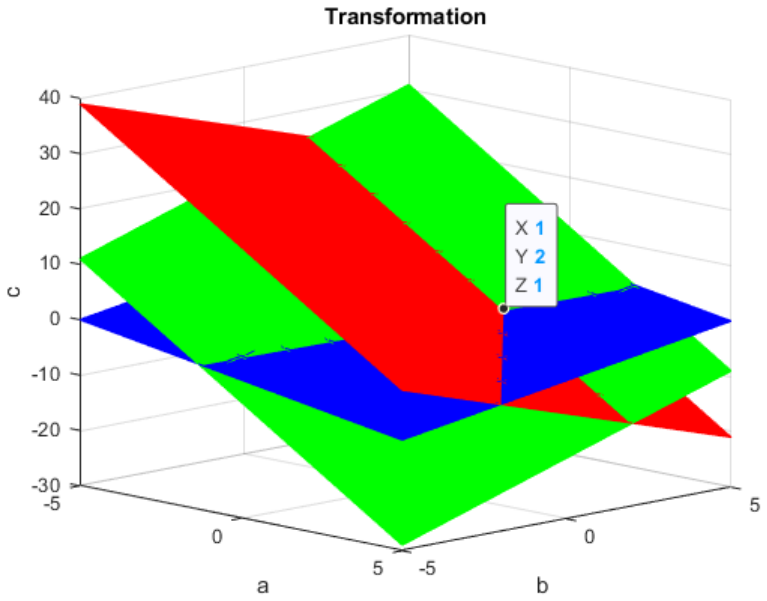


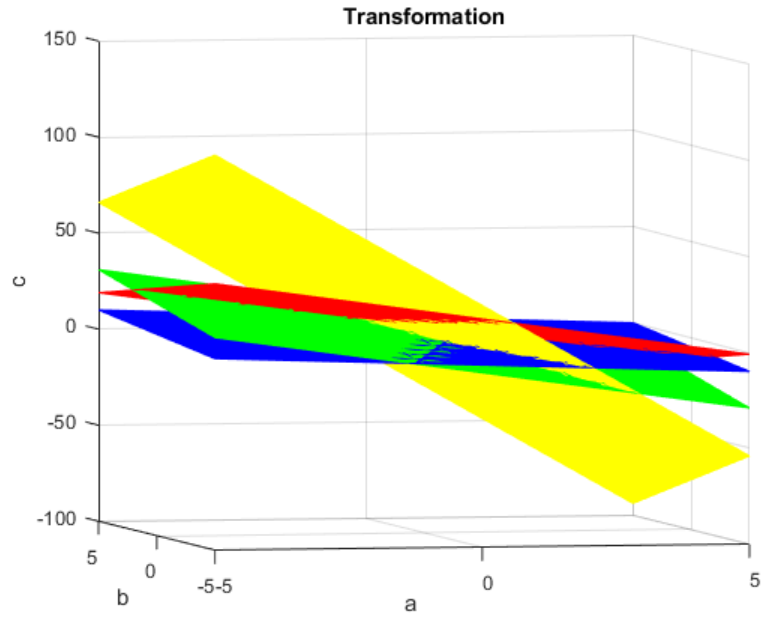

$c = 0 - 1a + 1b$



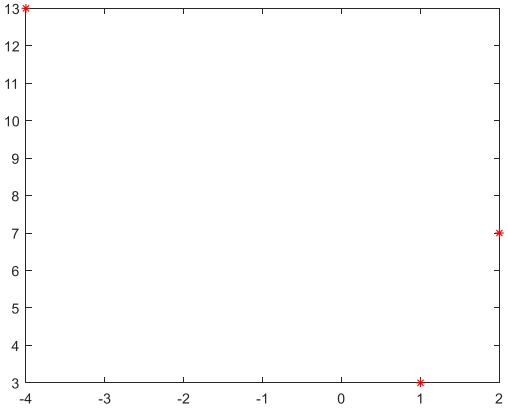

$c = 4 - 36a - 6b$



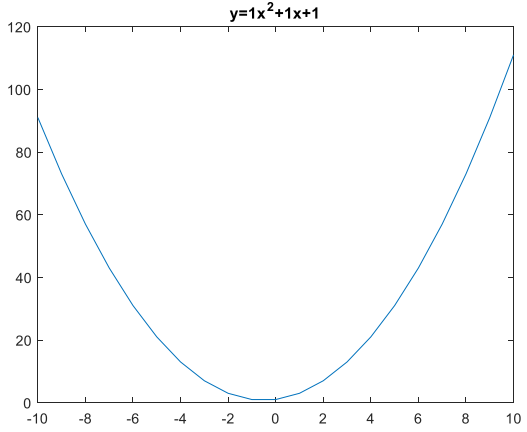

Transformation
40
30
20
10
0
-10
-20
-30
c
-5
0
5
a
-5
0
5
b
X 1
Y 2
Z 1

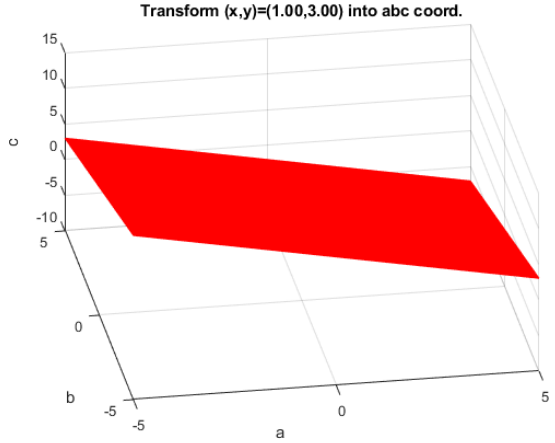

Transformation
150
100
50
0
-50
-100
c
5
0
-5
b
-5
0
5
a

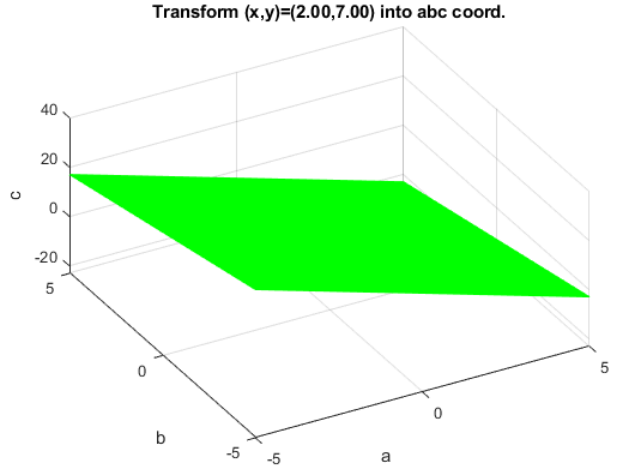
*example 2.* a, b, c are unknown

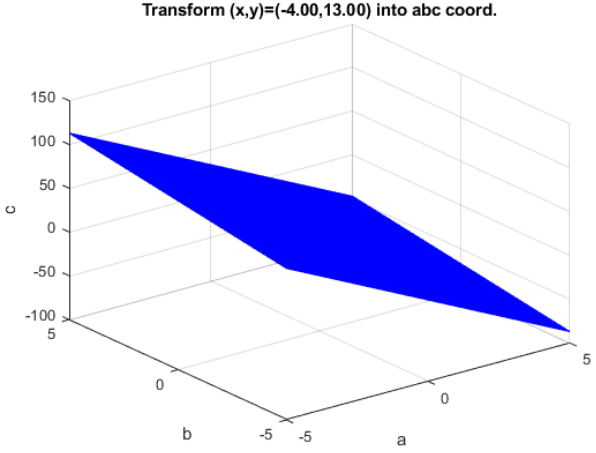


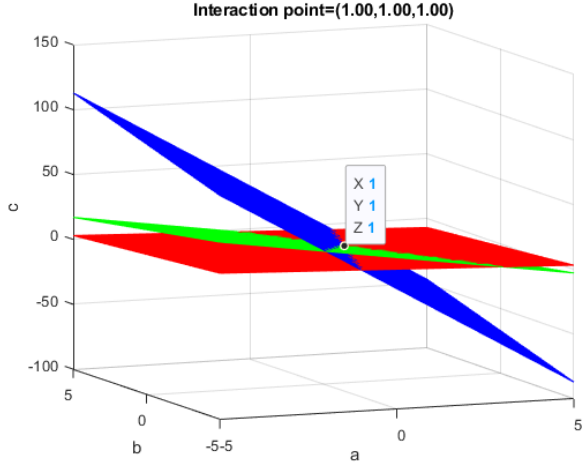
Selected points (1,3) (2,7)(-4,13)



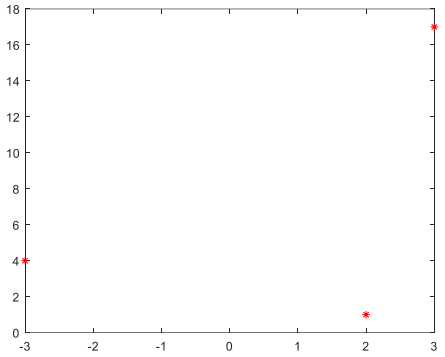



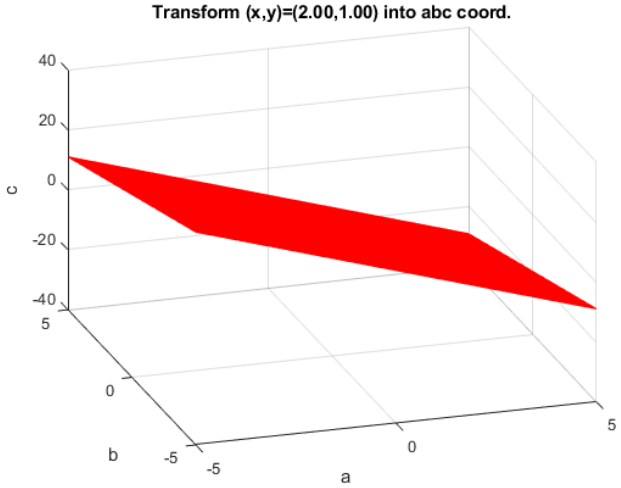



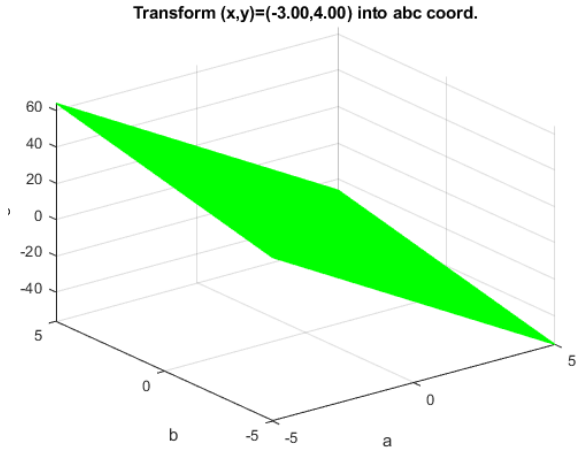



*example 3.* a, b, c are unknown

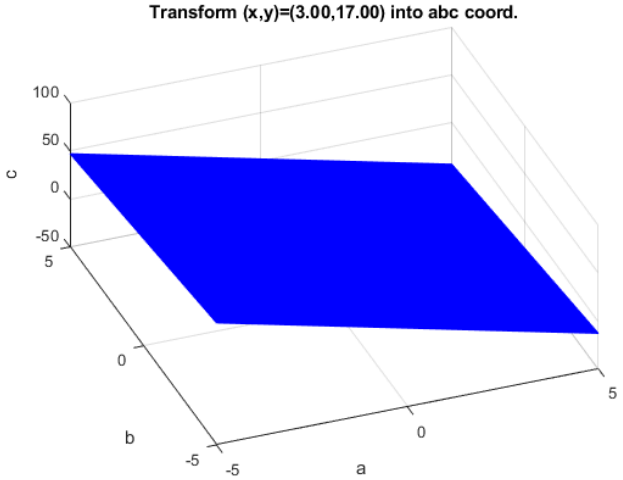


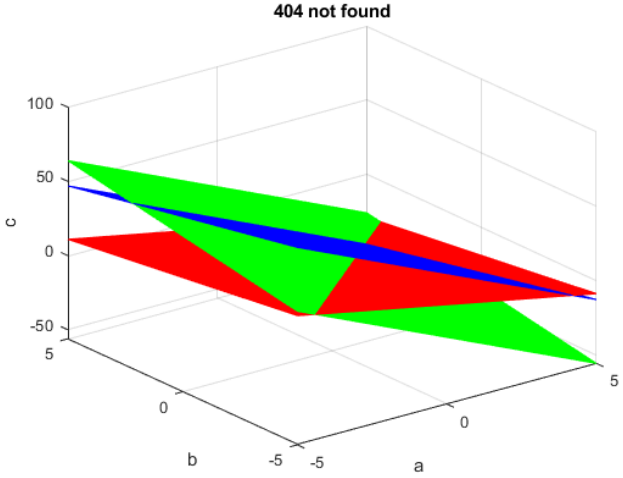



Selected points (2,1) (-3,4)(3,17)

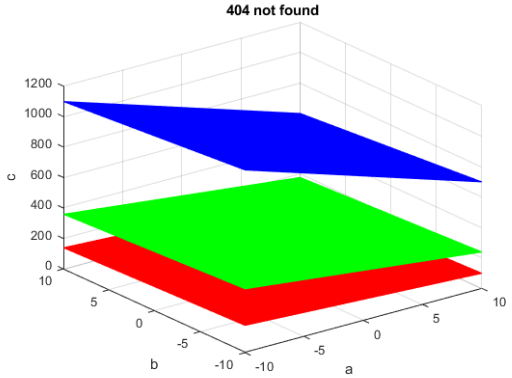
$$4a + 2b + c = 1$$
$$9a - 3b + c = 4$$
$$9a + 3b + c = 17$$
$$a = \frac{83}{30} = 2.7\overline{66}$$
$$b = \frac{13}{6} = 2.1\overline{66}$$
$$c = \frac{-72}{5} = -14.5$$

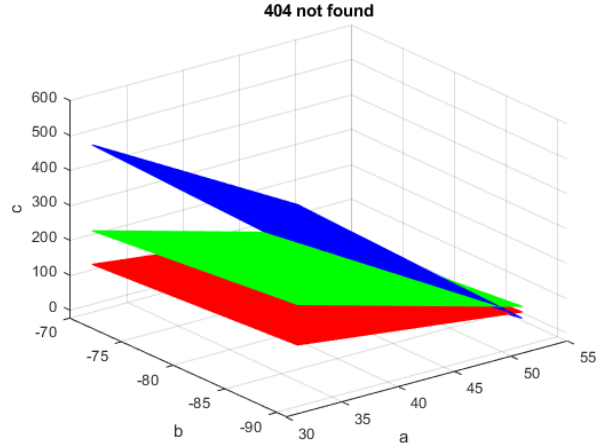


$$y = 40x^2 - 20x - 1$$

Selected points (2,119)(3,299)(5,899)

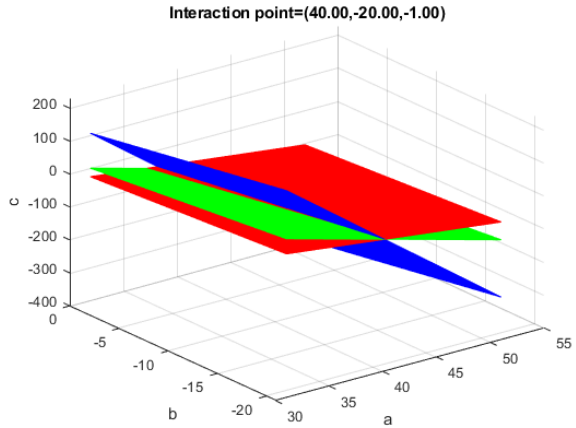


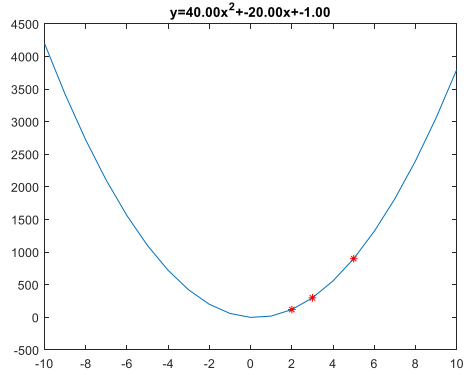




```
X=[2,3,5;119,299,899],UL=[51,-71]
```

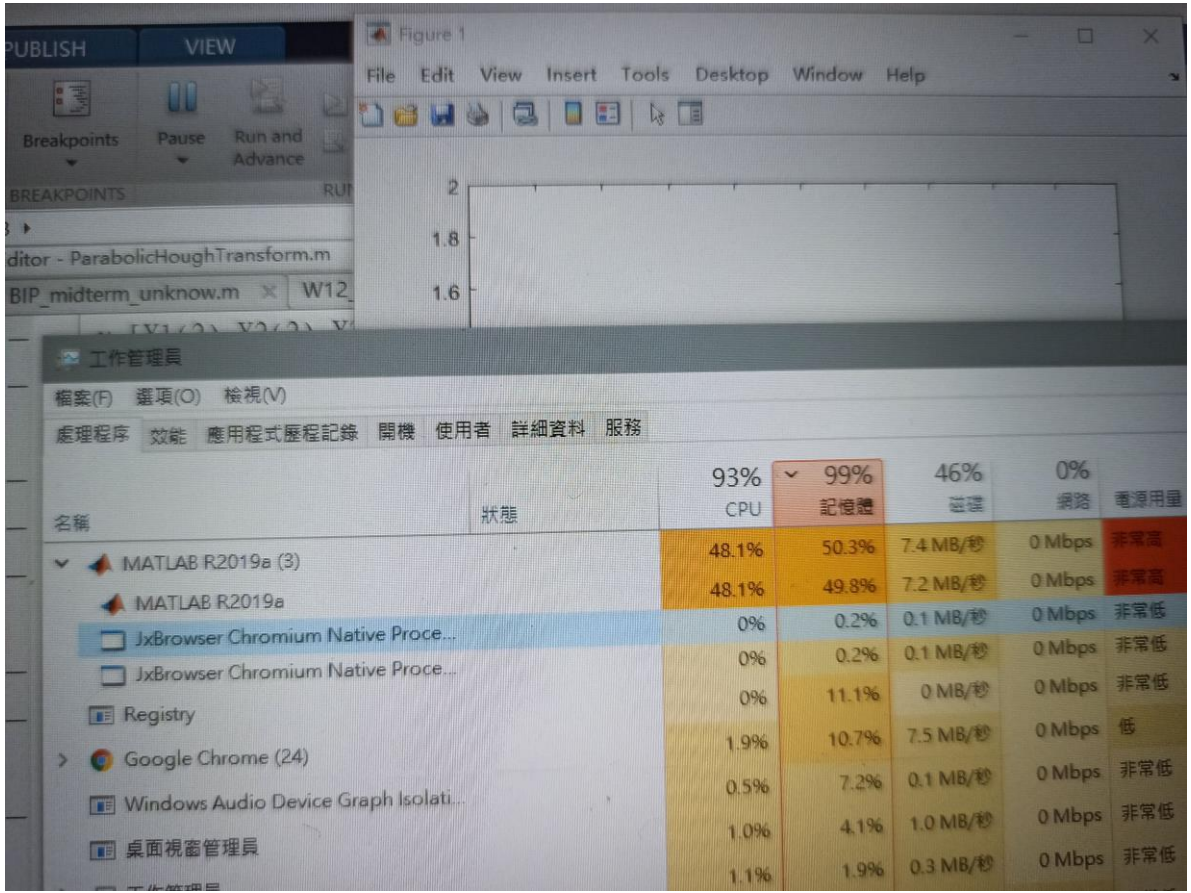
```
Error using ParabolicHoughTransform (line 95)
b is out of range.You have to change the parameter 'UL',-19.00<UL(2)<-1.00.
```

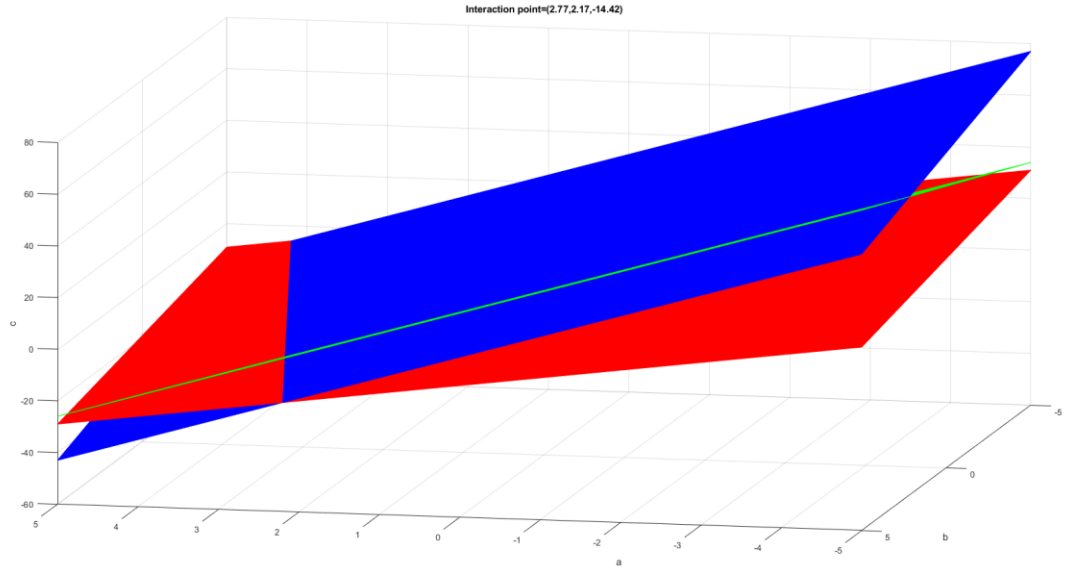
```
a_x=-10:0.01:10;b_y=-10:0.01:10;
```

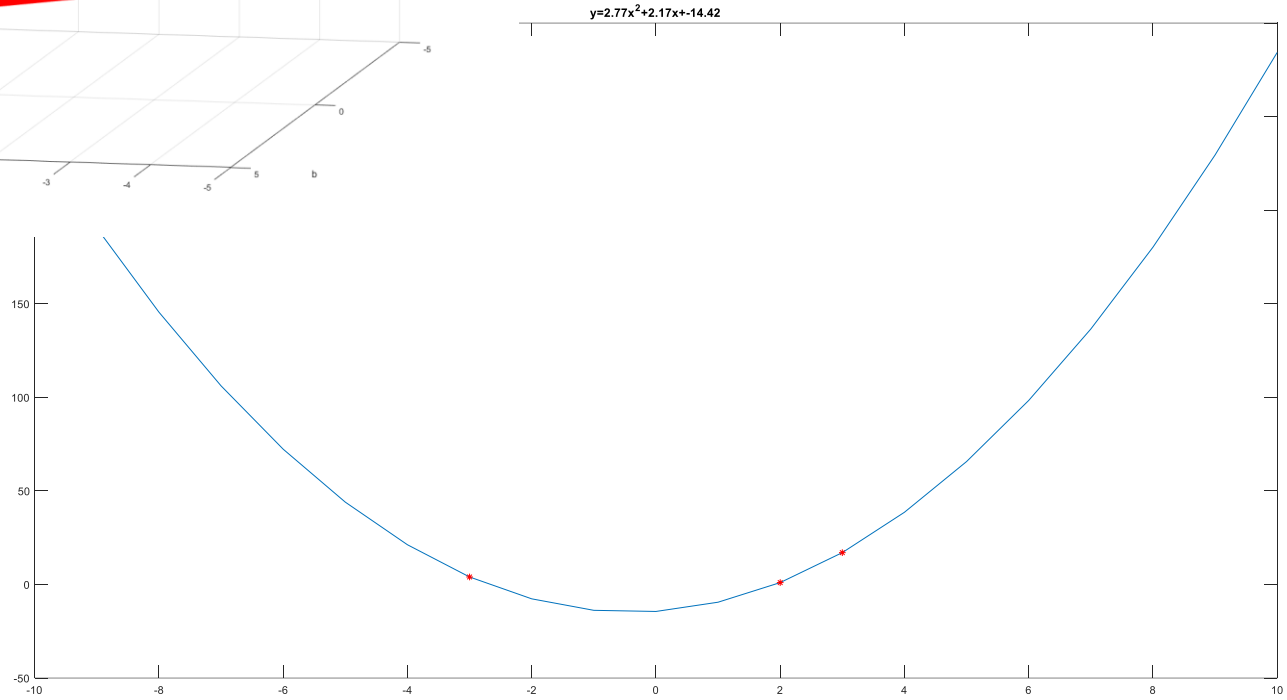


a_x=-100:0.01:100;b_y=-100:0.01:100;

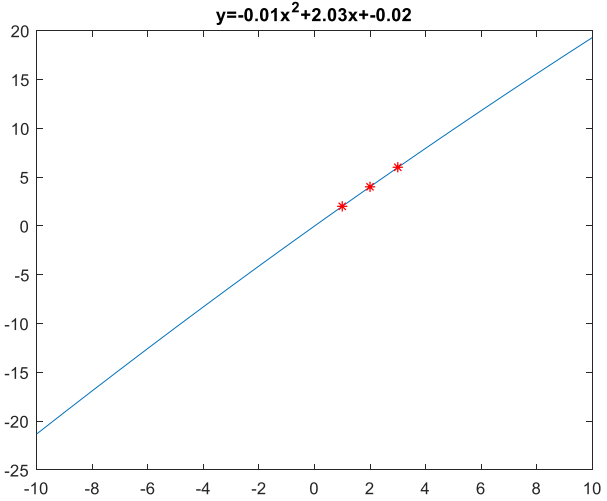



Interaction point=(2.77,2.17,-14.42)
c
a
b

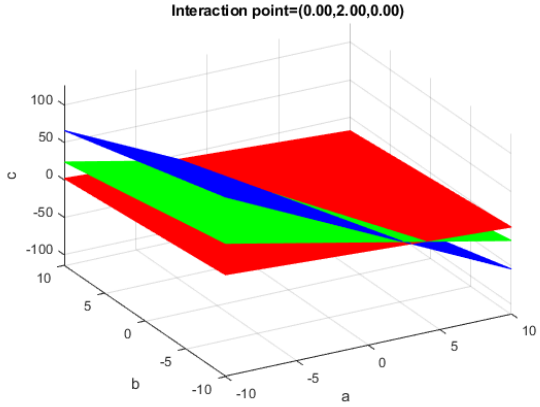

y=2.77x^2+2.17x+-14.42

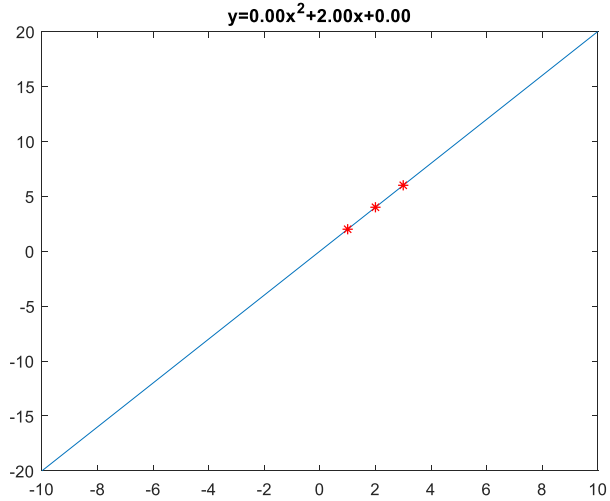
# *example 4.* line and point

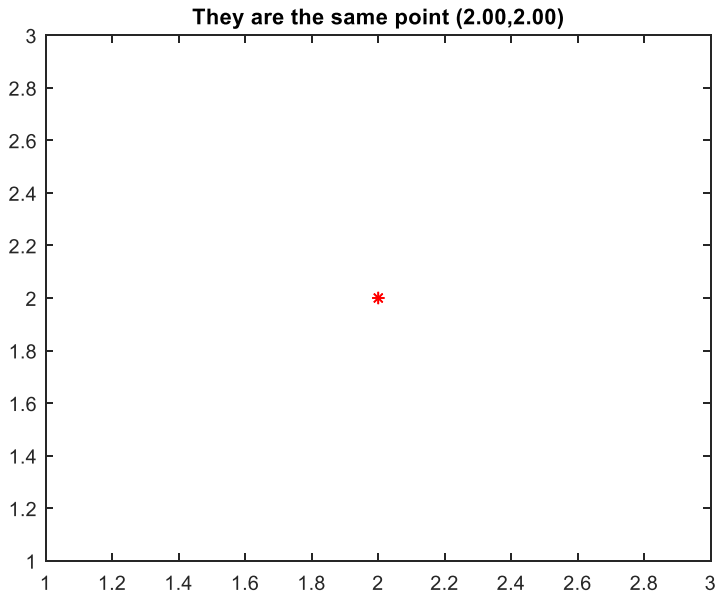
Selected points (1,2) (2,4) (3,6)

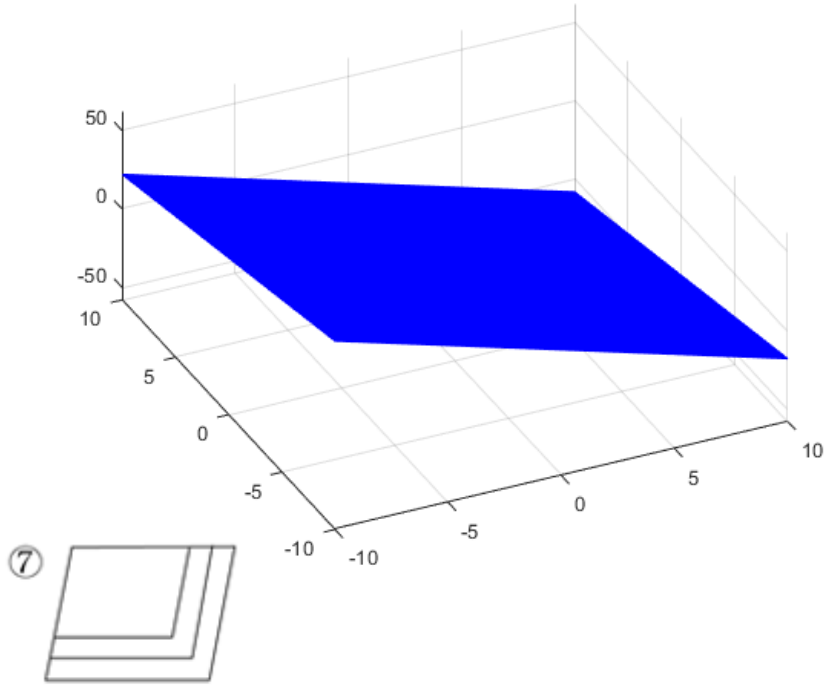



```
E_1=abs(cc2-cc1)<1e-10;
    if isempty(E_1)
        E_1=abs(cc2-cc1)<0.02;
    end
E_2=abs(cc3-cc1)<1e-10;
    if isempty(E_2)
        E_2=abs(cc3-cc1)<0.02;
    end
E_3=abs(cc3-cc2)<1e-10;
    if isempty(E_3)
        E_3=abs(cc3-cc2)<0.02;
    end
```



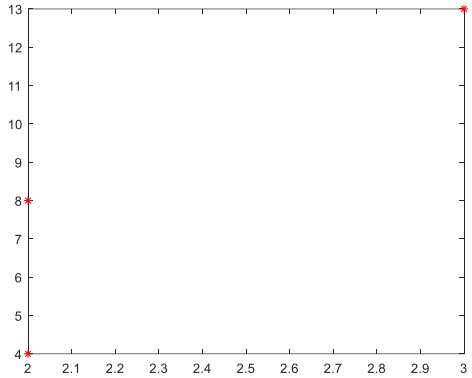

They are the same point (2.00,2.00)
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3


50
0
-50
10
5
0
-5
-10
-10
-5
0
5
10

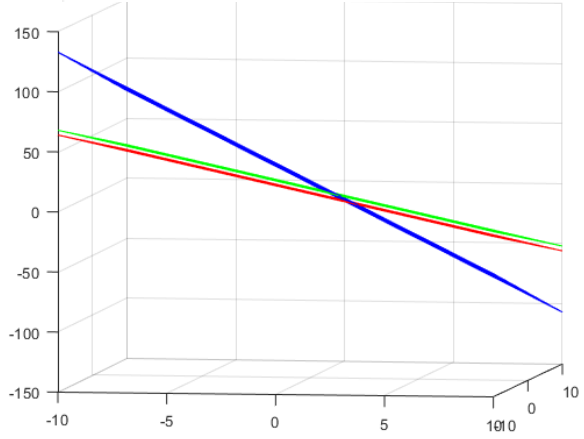
三平面重合

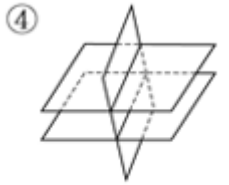
*final example* can't be a parabola

Selected points (2,4) (2,8) (3,13)



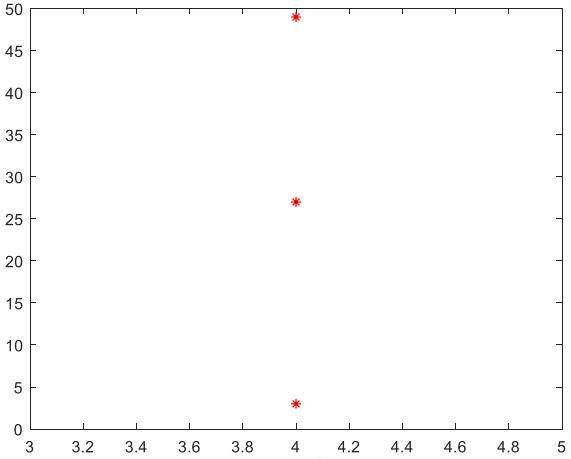

They can't form a parabola

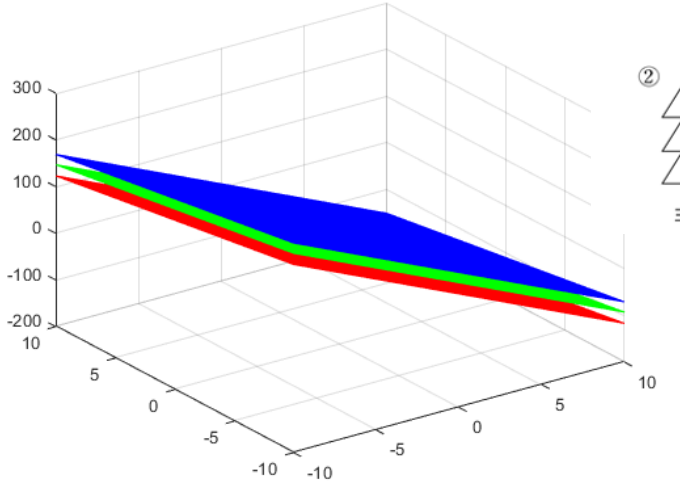


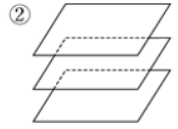




二平面平行且與第三平面分別交於一直線

Selected points (4,3) (4,27) (4,49)

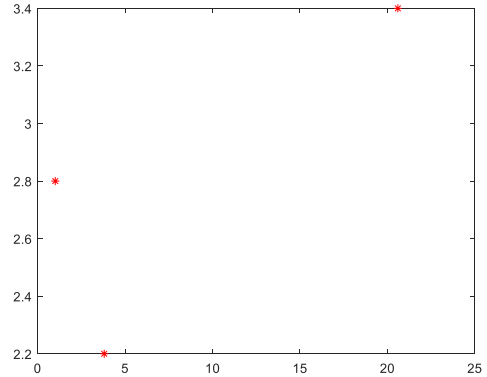


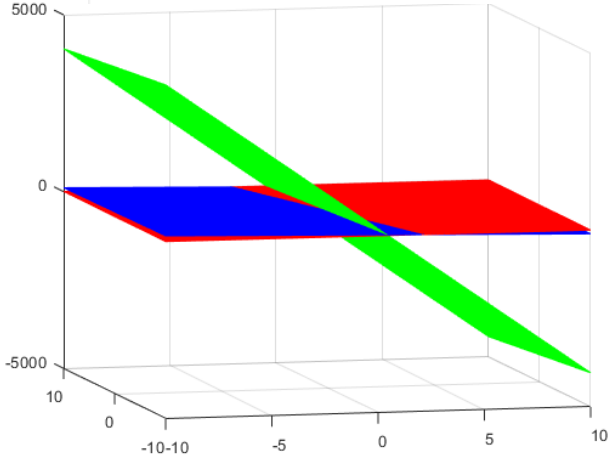



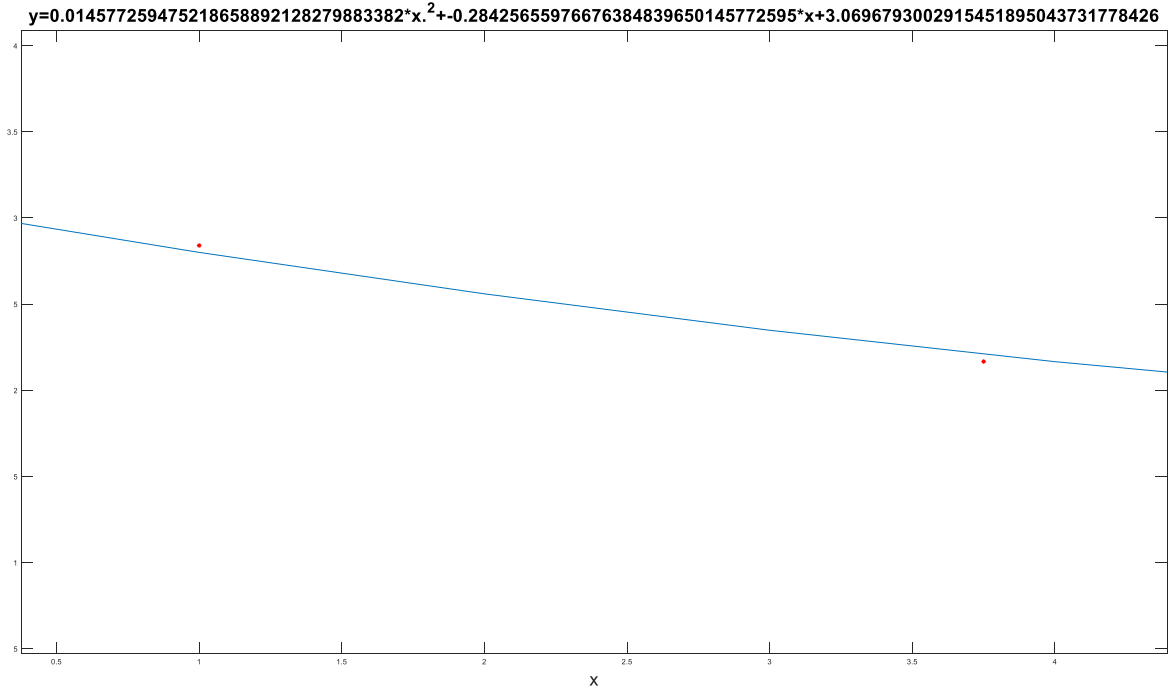

三平面平行

# Selected points (1,2.84) (20.56,3.4) (3.4,13/6)




They can't form a parabola



# In Sum

| Parameter space | | x-y space |
| --- | --- | --- |
| 平面重合 | => | 同一個點 |
| 兩平面交線 | => | 兩點同線 |
| 三平面交點 | => | 同一條拋物線 |