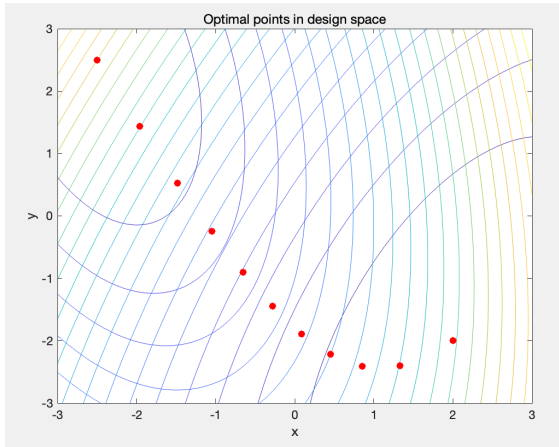**Problem 1.**

- The equation is like:

$$f(x, y; \lambda) = (1 - \lambda) \begin{bmatrix} (x - 2) & (y + 2) \end{bmatrix} A_1 \begin{bmatrix} (x - 2) \\ (y + 2) \end{bmatrix} + 5$$
$$+ \lambda \begin{bmatrix} (x + 2.5) & (y - 2.5) \end{bmatrix} A_2 \begin{bmatrix} (x + 2.5) \\ (y - 2.5) \end{bmatrix} + 9$$

So we have

$$\nabla f = (1 - \lambda)(A_1 + A_1^T) \begin{bmatrix} (x - 2) \\ (y + 2) \end{bmatrix} + \lambda(A_2 + A_2^T) \begin{bmatrix} (x + 2.5) \\ (y - 2.5) \end{bmatrix}$$

- Here I use fsolve for this problem. The main function is opt.m. The test function is **test_P1.m**. The plotting is like figure 1a. The result is like figure 1b.

(a) Problem 1 plotting1

```
>> test_P1
The motimal for lambda = 0.000000 is [2.000000, -2.000000]
The motimal for lambda = 0.100000 is [1.327997, -2.396136]
The motimal for lambda = 0.200000 is [0.850269, -2.409726]
The motimal for lambda = 0.300000 is [0.451279, -2.218645]
The motimal for lambda = 0.400000 is [0.083111, -1.888682]
The motimal for lambda = 0.500000 is [-0.279394, -1.445900]
The motimal for lambda = 0.600000 is [-0.652448, -0.898302]
The motimal for lambda = 0.700000 is [-1.048731, -0.243539]
The motimal for lambda = 0.800000 is [-1.480027, 0.528357]
The motimal for lambda = 0.900000 is [-1.958877, 1.434483]
The motimal for lambda = 1.000000 is [-2.500000, 2.500000]
```

(b) Problem 1 result

Figure 1: Problem 1

Problem 2.

The test function here is **test_P2.m**. It may take some time for the function to react. The weighted sum method main function is in opt.m. The plotting is figure 2.

Problem 3.

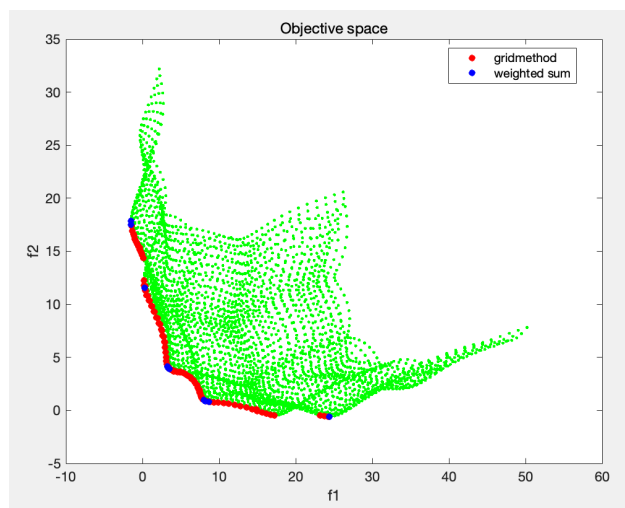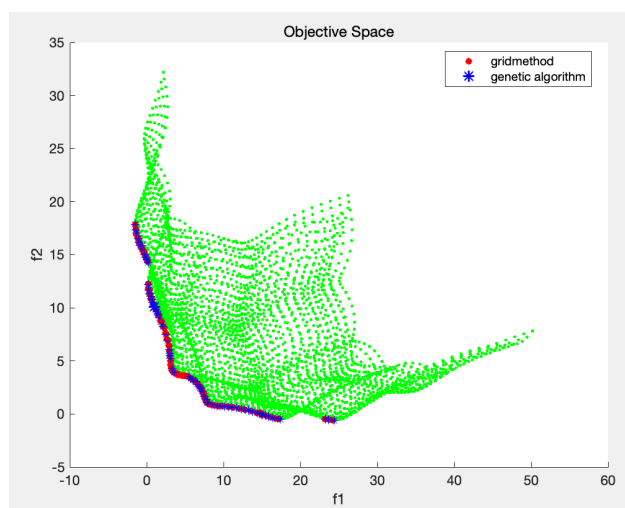Here the test function is **test_P3.m**. The plotting should be like figure 3.

Figure 2: Problem 2 plotting

Figure 3: Problem 3 plotting