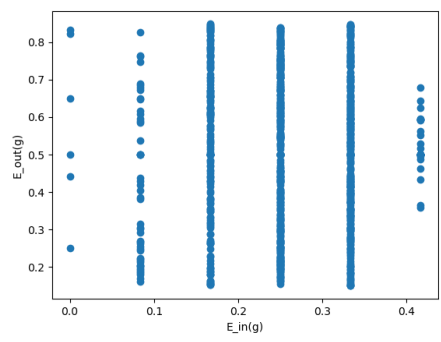


## Problem 5

The answer from ChatGPT does not answer the question we asked. The answer told us to generate an  $N-2$  degree polynomial, then predict the answer of the  $N$ -th number. But we want to know the next integer from the first  $N-1$  terms of an integer sequence generated from the polynomial of degree  $N$ .

# Problem 11



The median of  $E_{out} - E_{in}$  is 0.25

Figure 2: median

Figure 1: scatter plot

```
File: HW10.py
1 import numpy as np
2 import matplotlib.pyplot as plt
3
4 E_in_final = []
5 E_out_final = []
6 E_diff = []
7 p = 0.15
8
9 for i in range(1000):
10
11     # Generate data
12     x = np.random.uniform(-1,1,12)
13     y = np.sign(x)
14     for j in range(12):
15         c = np.random.uniform(0,1,1)
16         if c <= p:
17             y[j] = -1
18
19     # (1) Sort data
20     newx = np.sort(x)
21     E_in = 2000
22     final_s = 0
23     final_theta = 0
24
25     # (2) Generate theta and Calculate E_in
26     for j in range(12):
27         E_in_theta = 0
28         E_in_theta0 = 0
29         s = 0
30         if j == 0:
31             theta = -1
32         else:
33             theta = (newx[j-1] + newx[j]) / 2
34
35         # Calculate E_in
36         for k in range(12):
37             h1 = np.sign(newx[k] - theta) * 1
38             h2 = h1 * (-1)
39             if h1 != y[k]:
40                 E_in_theta += 1
41             if h2 != y[k]:
42                 E_in_theta += 1
43         if E_in_theta < E_in_theta0:
44             E_in_theta = E_in_theta0
45             s = -1
46         else:
47             E_in_theta = E_in_theta0
48             s = 1
49         if E_in > E_in_theta:
50             E_in = E_in_theta
51             final_theta = theta
52             final_s = s
53     E_in = E_in_final
54     E_out = E_out_final
55     E_diff = E_out - E_in
```

Figure 3: snapshot

## Problem 12

For the P11, we choose  $\theta, s$  to minimize  $E_{in}$ . And now, we choose  $\theta, s$  uniformly. From the median, we can easily observe that the  $E_{out} - E_{in}$  is almost 0. The conclusion is that if we choose  $\theta, s$  to minimize  $E_{in}$ , we will have more  $E_{out} - E_{in}$ , while if we choose  $\theta, s$  uniformly, we can minimize  $E_{out} - E_{in}$  but we will have more  $E_{in}$ .

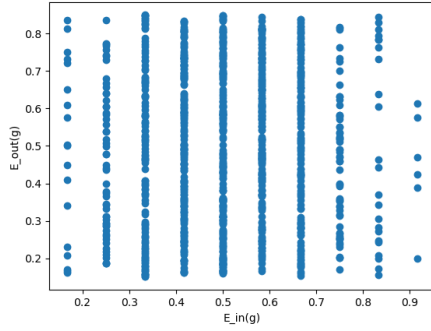


Figure 4: scatter plot

The median of  $E_{out} - E_{in}$  is  $-0.014203931743953596$

Figure 5: median