Exercise 1.3

Part a

Answer: We know y(t) is equal or -1, and we know when x(t) is misclassified by w(t) y(t) != sign(w^T(t)x(t). So if we multiply y(t) by (w^T(t)x(t), it will always give a negative number.

Part b

Answer: As we know w(t+1)=w(t) + y(t) + x(t),
We can substitute in the left hand side of the equation,
which gives us y(t)w^T(t+1)x(t) = y(t)w^T(t)x(t)+y(t)^2+x(t)^2;
Since y(t) is equal to 1 or -1, y(t)^2 is equal to 1, and x(t)^2 is equal or greater to zero, so adding 1 and a non-negative number will always makes number greater than itself,
so y(t)w^T(t+1)x(t) > y(t)w^T(t)x(t)

Part c:

Answer: from part a we know that when x(t) is misclassified by w(t) y(t)w^T(t)x(t) is less than zero. And if x(t) is right classified by w(t), y(t)w^T(t)x(t) is greater or equal to zero, so the goal is to update w(t) to make y(t)w^T(t)x(t) be greater or equal to zero, and from part b we know updating w(t) to w(t+1) where w(t+1)=w(t) + y(t) + x(t) will add a positive number to y(t)w^T(t)x(t). Therefore updating w(t) to w(t+1) is moving in the right direction because it makes the formula, y(t)w^T(t)x(t), be close to the goal, which is greater or equal to 0.

Exercise 1.5

Part A: Learning Approach.
Part B: Design Approach.
Part C: Learning Approach.
Part D: Design Approach.
Part E: Learning Approach.

Exercise 1.6

Part a:

Type of learning: Supervised Learning or Unsupervised Learning
Training Data:
Supervised Learning:
Providing data of what books users have read and also did users like each book. So it will be able to recommend based on books user liked
Unsupervised Learning:
Only providing data of books users read. It will only be able to provide data based on books users read.

Part B:

Type of learning: Reinforcement Learning
Training Data:
Giving the rule and asking it to play against other people and give some feedback or reward if it wins.

Part C:

Type of learning: Unsupervised Learning

Training Data: Giving movie information like what actors in the movie, which country made the movie, what genre is the movie.

Part D:

Type of learning: Reinforcement Learning

Training Data: ask it to make music and give feedback for every music it makes.

Part E:

Type of Learning: Supervised Learning

Training Data: Giving past year data of customers informations and max allowed debt each customer can have in bank

Exercise 1.7

Part a:

Since there is more black than white, we will take the hypothesis that the next three are all black.

From this hypothesis f8 will agree with all 3; f4, f6, f7 agree with 2; f2, f3, f5 agree with 1; f1 agree with 0;

So 1 agreed with all 3, 3 agree with 2, 3 agree with 1, 1 disagree with all 3;

Part b:

Since there is more black than white, we will take the hypothesis that the next three are all white.

From this hypothesis f1 will agree with all 3; f2, f3, f5 agree with 2; f4, f6, f7 agree with 1; f8 agree with 0;

So 1 agreed with all 3, 3 agree with 2, 3 agree with 1, 1 disagree with all 3;

Part c:

From the hypothesis, it will be white, white, black for next 3;

f2 will agree with all 3; f1, f4, f6 will agree with 2; f3, f5, f8 will agree with 1; f7 will agree with 0;

So 1 agreed with all 3, 3 agree with 2, 3 agree with 1, 1 disagree with all 3;

Part d:

From the hypothesis, it will be black, black, white for next 3;

f7 will agree with all 3; f3, f5, f8 will agree with 2; f1, f4, f6 will agree with 1; f2 will agree with 0

1 agreed with all 3, 3 agree with 2, 3 agree with 1, 1 disagree with all 3;

Problem 1.1

Let A be chosen bag 1(two black), B be chosen bag 2(one black, one white), b be drawn black ball from bag 1.

From formula P[A|b] * P[b] = P[b|A] * P[A]

P[b] = ¾ = 0.75 (because 3 ball is black out of 4 balls)

P[b|A] = 1

P[A] = 0.5

P[A|b] = P[b|A] * P[A] / P[b]

=1 * 0.5 / 0.75

=⅔ = 0.67

Problem 1.2

Part a:

It will be separate at w^T*x = 0;

w^T*x = $w_0 + w_1x_1 + w_2x_2 = 0$

Since $x_2 = ax_1 + b$;

$w_0 + w_1x_1 + w_2x_2 = 0$

$w_2x_2 = -w_0 - w_1x_1$

$x_2 = (-w_0 - w_1x_1)/w_2$

a = $-w_1/w_2$

b = $-w_0/w_2$

Part b:

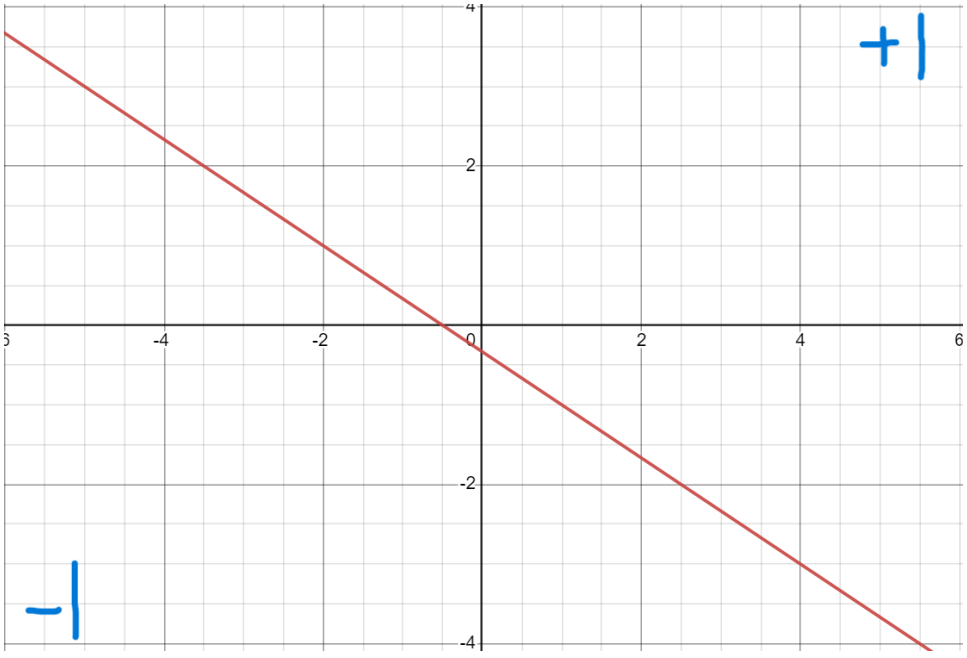
Case 1:

W = [1,2,3]

So we have a = -⅔, b = -⅓

x_2 = -⅔x_1 + -⅓

Here is graph:



Case 2:

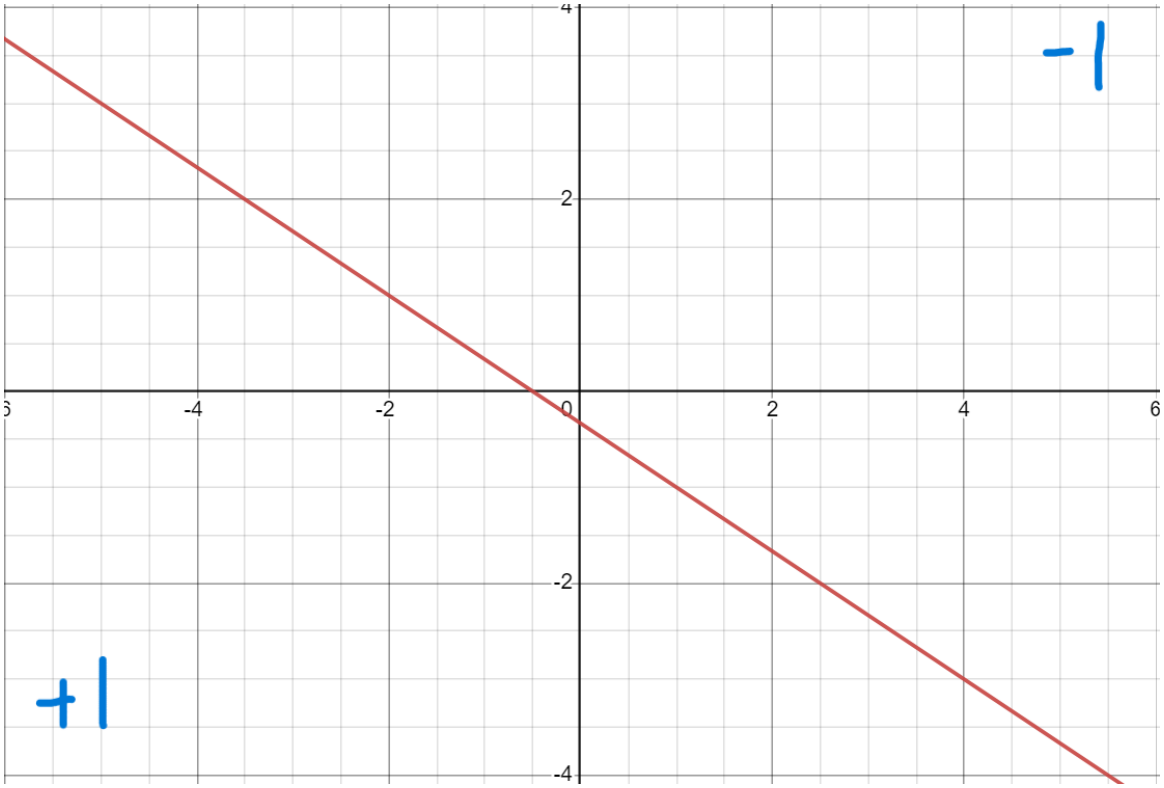
W = -[1,2,3]

So we have a = ⅔, b = ⅓

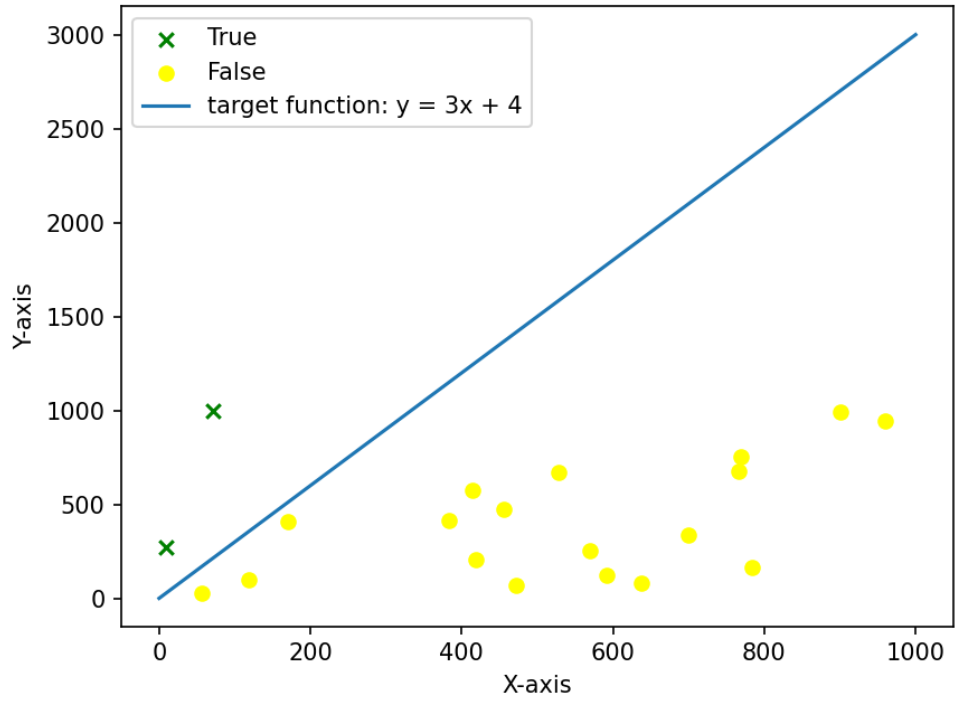
x_2 = ⅔x_1 + ⅓

The plane is the same but since y = sign(w^t*x), and w is -w now, so the +1 area in last case is -1 in this case and -1 in last case is +1 in this case;

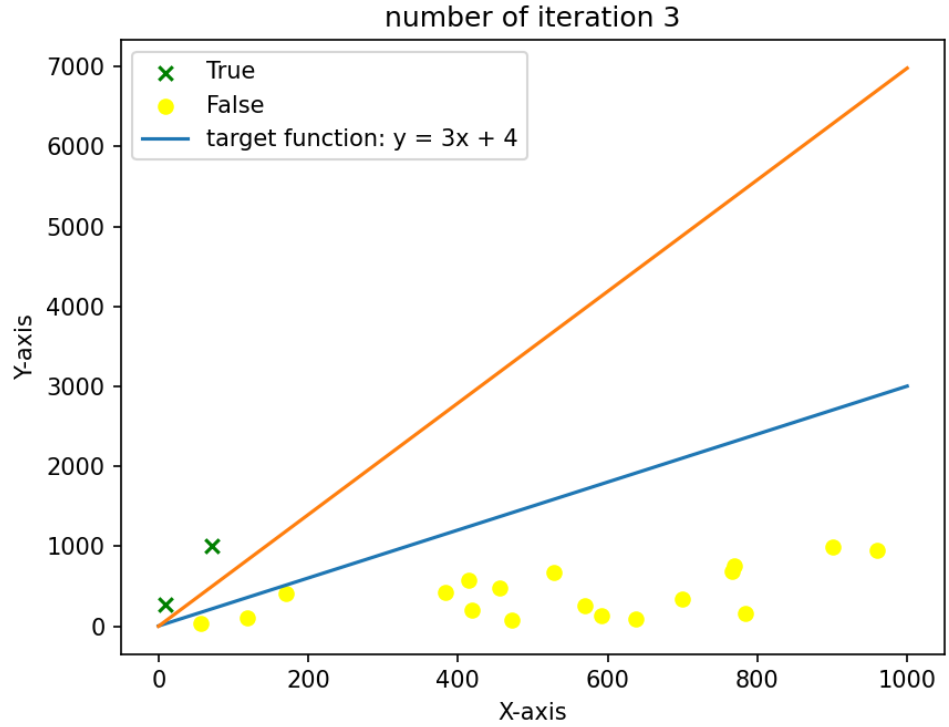
Here is graph:



Problem 1.4:
My target line on the plane is y = 3x + 4, with W where w0 = -8, w1 = -6, w2 = 2
And I will start with W where w0 = 0, w1 = 0, w2 = 0;
So on the plane we have y = 0 at the start
On each graph in this question the blue line is the target function f, the red line is function f.
The green “x” represent y = 1; the yellow “o” represent y = -1
Part a:



Part b:

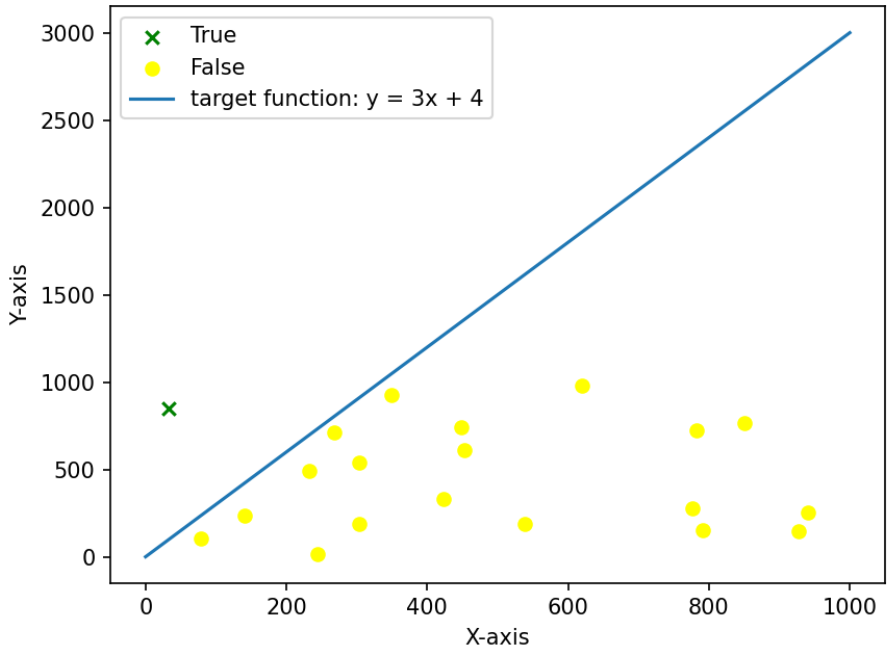


It made 3 updates

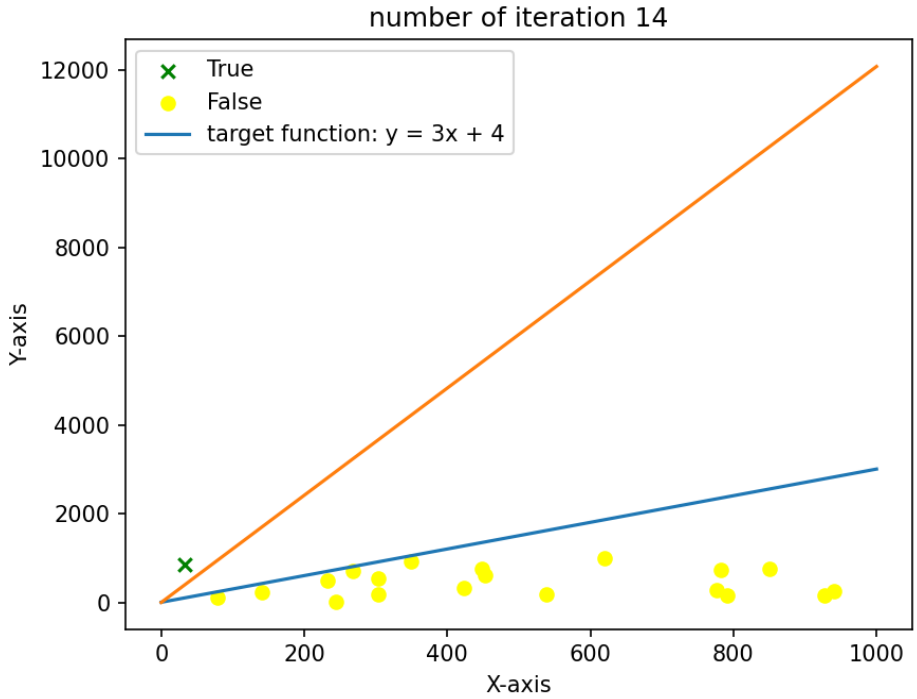
As we can see here is a big difference between f and g.

Part c:

Datas:



Result:

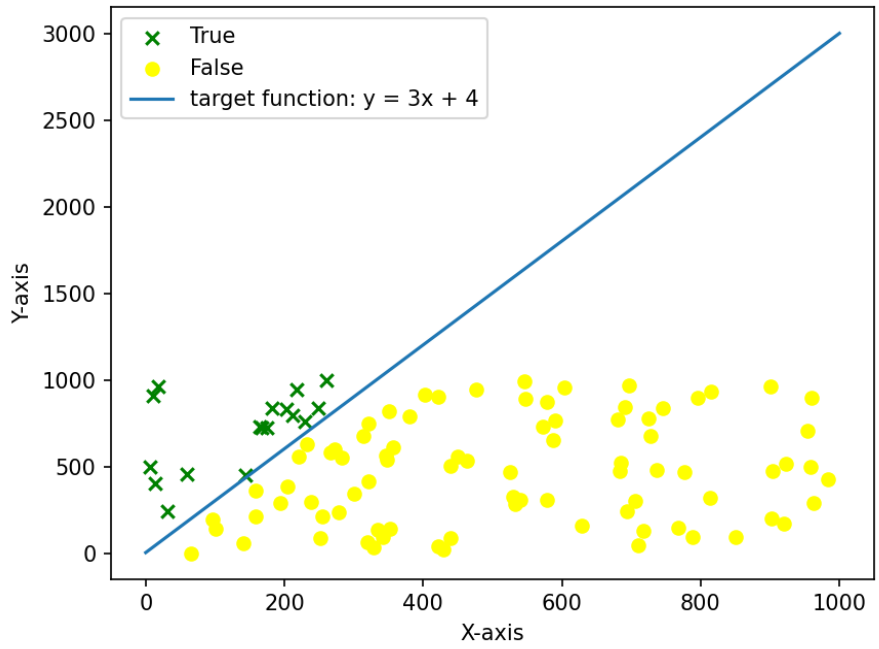


It made 14 updates

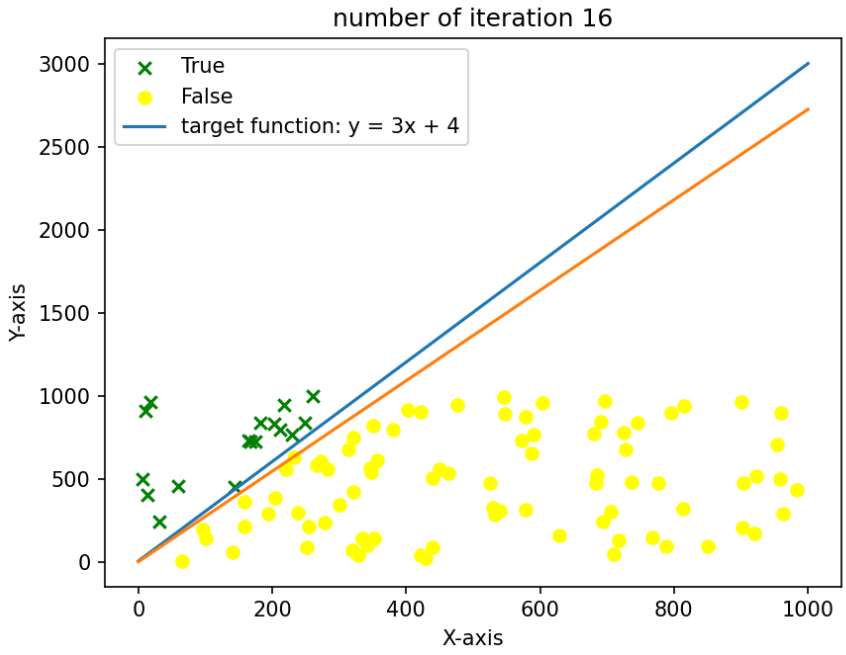
Compared with part b, the gap between g and f is still very big. But in this data set it made more updates.

Part d:

Datas:



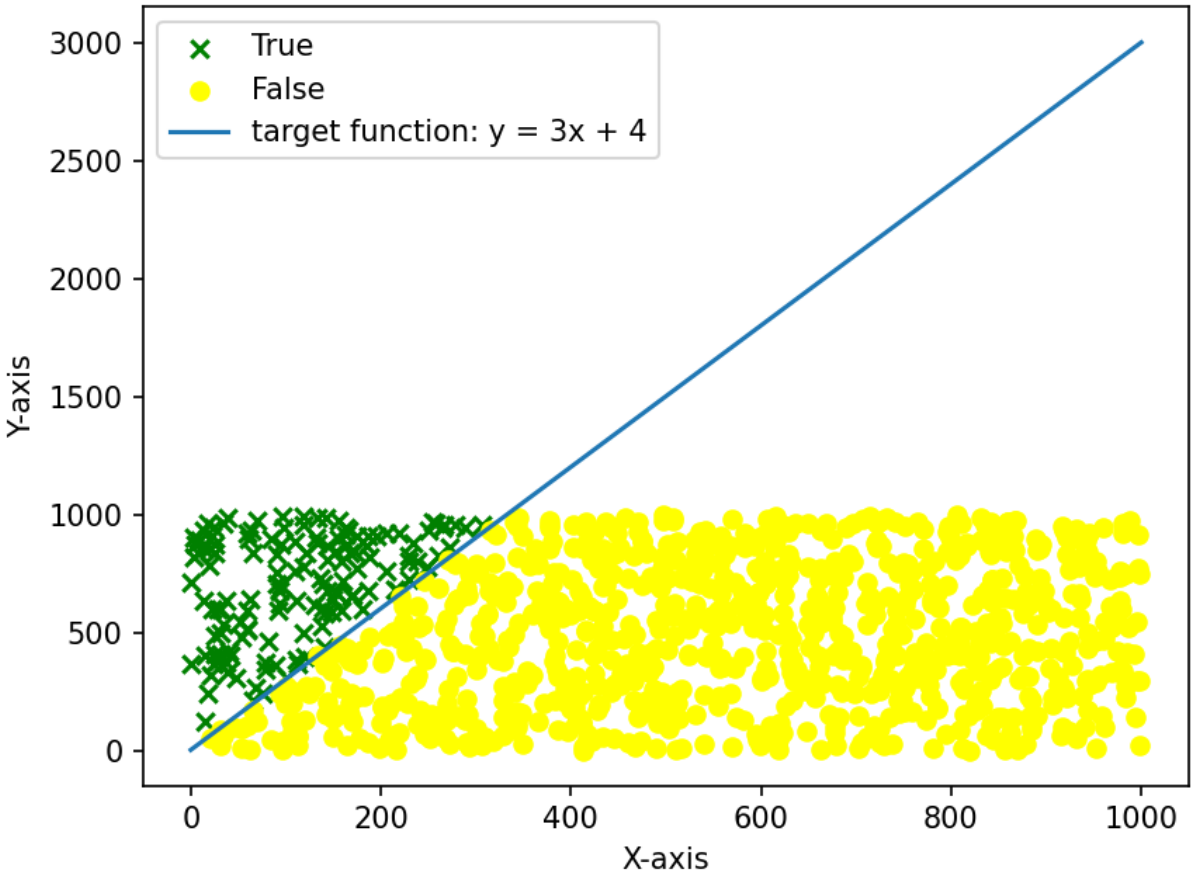
Result:



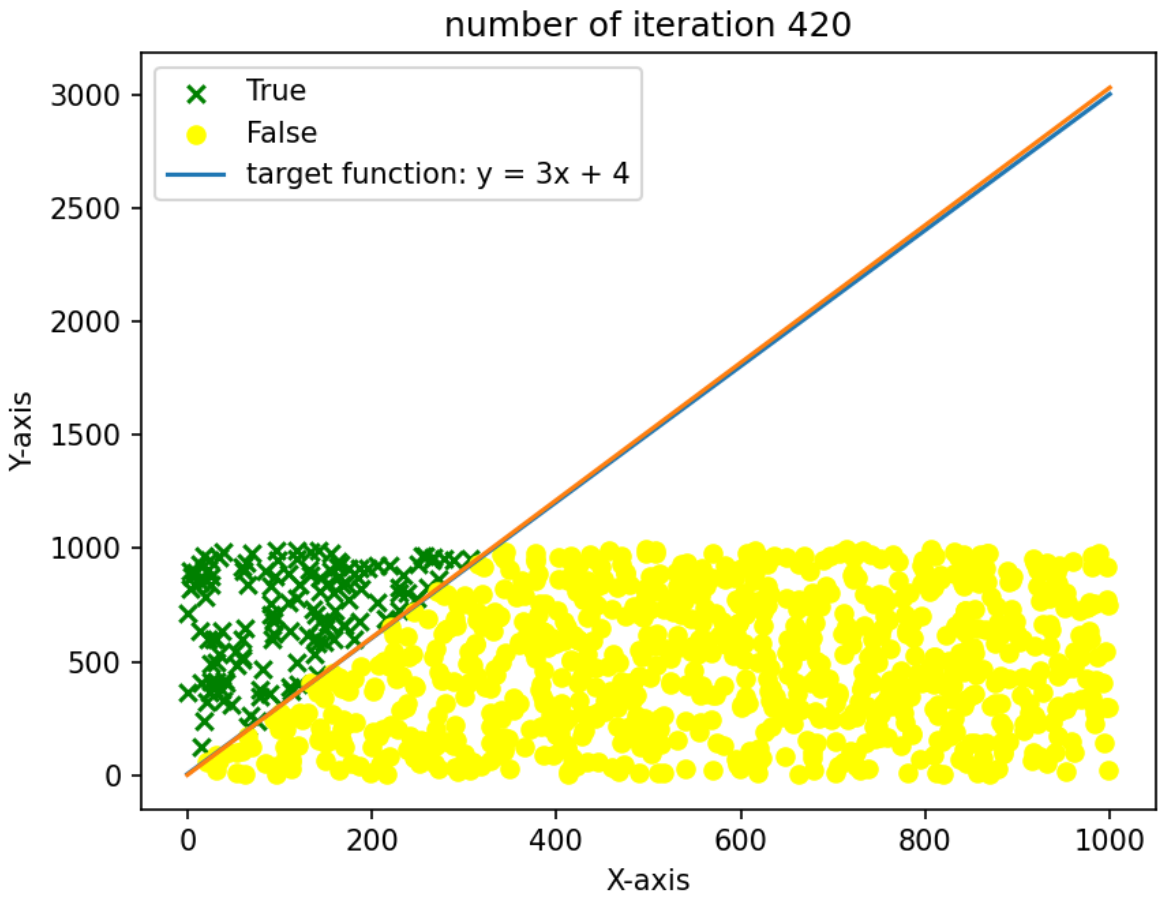
It made 16 updates.
Compared with part b, we can see the gap is much smaller, and it took more updates.

Part e:

Datas:


True
False
target function: y = 3x + 4
3000
2500
2000
1500
1000
500
0
Y-axis
0
200
400
600
800
1000
X-axis

Result:



It made 24 updates.
Compare with part b,now g is almost the same as f, and takes much much much more updates to reach this