**Exercise 1**

1. Since -1 represents non-fiction books, The prediction -1 means that the book with [3, 2] features is non-fiction book.
2. The total errors = 2 + 1 + 2 + 1 + 1 + 1 + 0 + 0 + 0 + 0 = 8 errors
3. The perceptron learned how to put all the examples in a correct manner so will errors drop to 0 by epoch 7. With this we can say that the data is linear separable. The straight line will separate fiction and non-fiction.

**Exercise 2**

Record Observations

In epoch no 1, the errors start at 2 which means half wrong. The errors then fluctuate between 2 and 1 for the first 4 epoch. The errors remain constant from epoch 4 to epoch 6. The errors decrease to 0 from epoch 6 to epoch 7, The errors become 0 from epoch 7 upward, meaning the perceptron stops making mistakes after epoch no 7.

2.1 The weight updates at the initial epochs may also update examples which were previously correct, making them incorrect. This is part of the process.

2.2 It means that the perceptron has finally got a perfect hyperplane that classifies all the provided examples without errors.

**Exercise 3**

* 1. The new book Is located in the Red (-1) line. This means that it is predicted as non-fiction
  2. The decision line is the line which separate the fiction which are in blue circles and the non-fiction which are in red crosses.
  3. If we move the new book to [4, 4], it will be predicted as fiction as it will now be inside the blue area of the graph.

**Exercise 4**

4.1 smaller eta makes learning slower and bigger eta makes learning faster. Smaller eta makes the learning stable, while bigger eta can sometimes overshoot. To notice this on this graph, you must use a larger random state instead of one.

4.2 Less epochs are required when the learning rate is large. The model still reaches 0 errors due to the higher learning rate which allows fast convergence.

4.3 The predictions do not change because the final decision boundary converges to almost the same position regardless of the learning parameters. This is because the data is linearly separable.

**Exercise 5**

* 1. prediction 1 means Versicolor

5.2 The Iris dataset is linearly separable so the errors list does reach 0 based on petal measurements, meaning the perceptron will be able to find the perfect decision boundary.

5.3 The decision boundary is similar in principle but is positioned differently depending on the measurements. The difference in the species is clear.

**Bonus Questions:**

1. most of the time the prediction remains the same because [3,2] is still closer to non-fiction. However, the prediction may change depending on the new book and its measurements.
2. Even with a new book the dataset remains linear separable, so the errors still reach 0.
3. Yes, it does affect, leading to slightly different decision boundaries and convergent speed but the predictions stay consistent.

**What I learned**

In this lab, I implemented a Perceptron that acts like a robot librarian. It learns to classify books as either fiction (+1) or non-fiction (-1). The robot librarian starts with random rules (weights) and improves through practice (epochs), learning and improving through trial and error (weight updates). The librarian creates and linear boundary which separates the two book types. The learning rate (eta) controls the aggressive rules changes, while epochs (n\_iter) determine the practice time. The librarian adapts when new books are added, while still maintaining reliability.