Homework 4: Explore TensorFlow Playground
due：2023-06-25, 2 points penalty for each late day (within 3 days)

In this homework, you will experiment playing the Tensorflow Playground (http://playground.tensorflow.org). Please submit your homework report files in PDF format by logging onto your Moodle account.

For each of the following questions, you will need to submit a full screenshot including the network configuration, test loss, and your parameter settings (including the DATA column on the left). Please also give the run time for getting the results. For each part of this question, you will be asked to classify a different dataset (available in the DATA column).

The following figure is a sample screenshot similar to what you are going to submit in your writeup. After you configure your network and parameter settings, you will use the "play" button to train the neural network and check whether the test loss can drop below the 0.1 threshold.

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(A) Circle data set: Can you obtain a test loss of less than 0.1 using only the raw input features? i.e., using only X_1 and X_2 as features? Please share a screenshot of your network as described.
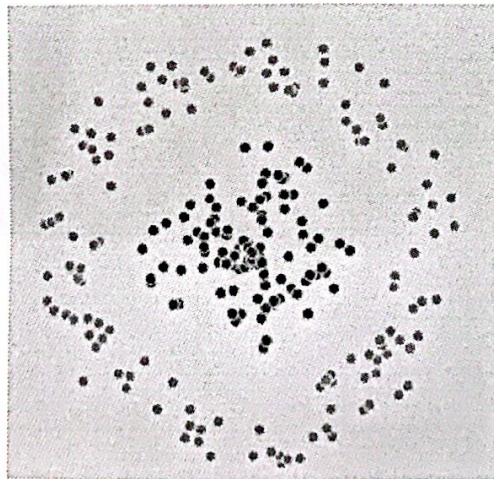

Now suppose you use features X_1^2 and X_2^2, instead of raw features X_1 and X_2. Your objective now is to obtain a test loss of less than 0.1 in as few neurons as possible. How many neurons would you need to classify the dataset? Explain and justify your answer.

You can change the network structure (number of layers, and number of neurons in each layer), and adjust the following hyperparameters: learning rate, activation, regularization type and regularization rate. Please leave other parameters fixed: leave ratio of training to test data to 50%, leave Noise at 0, and Batch size at 10.
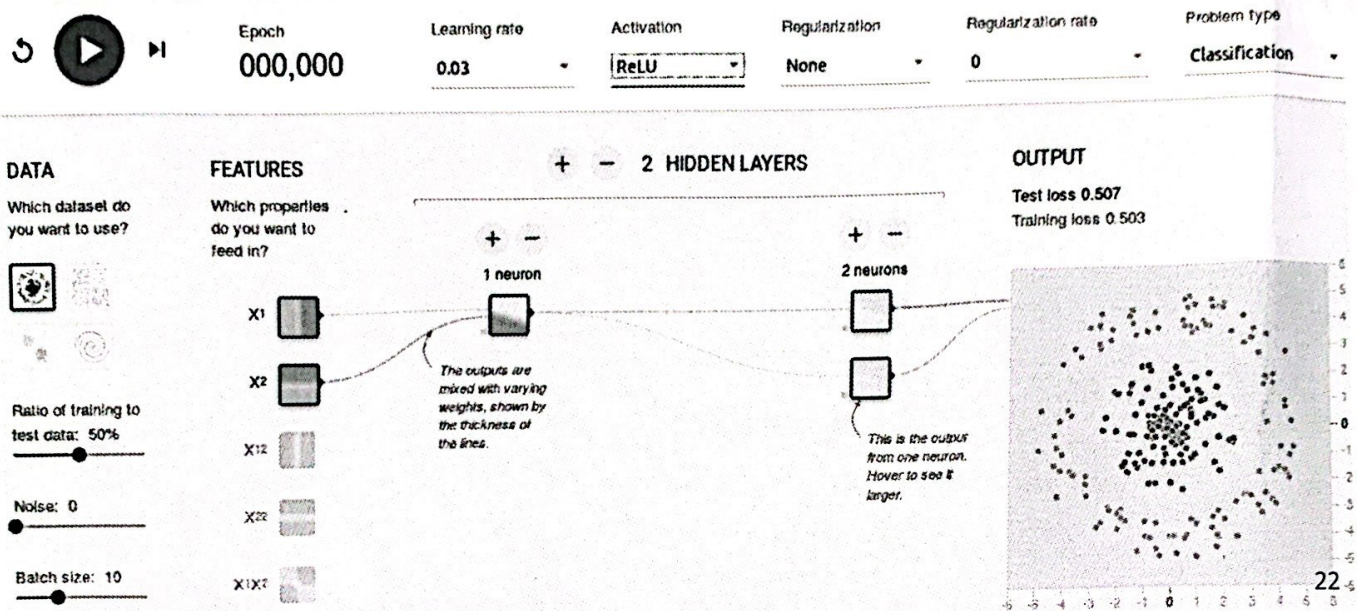
(B) Exclusive-Or data set: Consider the following method to train your neural network model with raw features X_1, X_2. Set the activation function to be tanh, use a learning rate of 0.03 and don't use any regularization. Use a neural network with two hidden layers with the first hidden layer having 3 neurons and the second layer having 2 neurons. Do you obtain a test loss of less than 0.1?

Now change the learning rate to 0:3 and report the final test loss. Repeat the same for learning rate = 3 now. How does the test loss change as you increase the learning rate? Briefly explain why.

Find another network architecture that also gives you a test loss of less than 0.1 on this dataset. Please share a screenshot of this network as described earlier.
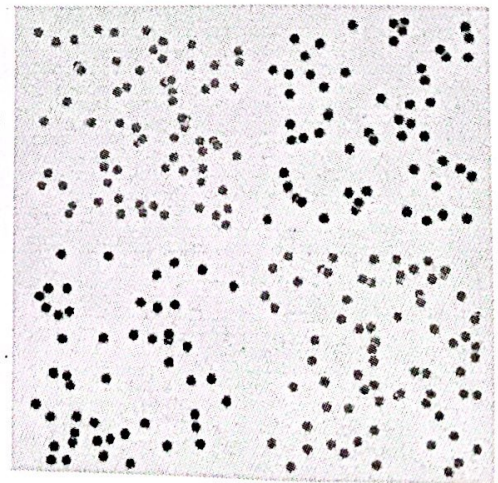
(C) Gaussian data set: Can you obtain test loss of less than 0.1 using only the raw inputs? i.e., using only X_1 and X_2? Try to use as few neurons as possible. Report the number of neurons used in your model and justify your answer.
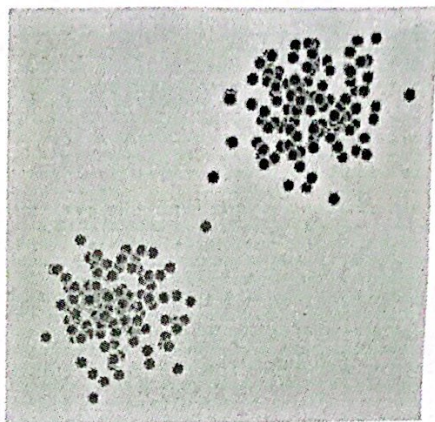
Now suppose you use features X_1^2 and X_2^2 instead of X_1 and X_2. Can you still obtain a test loss of less than 0.1? Justify your answer.
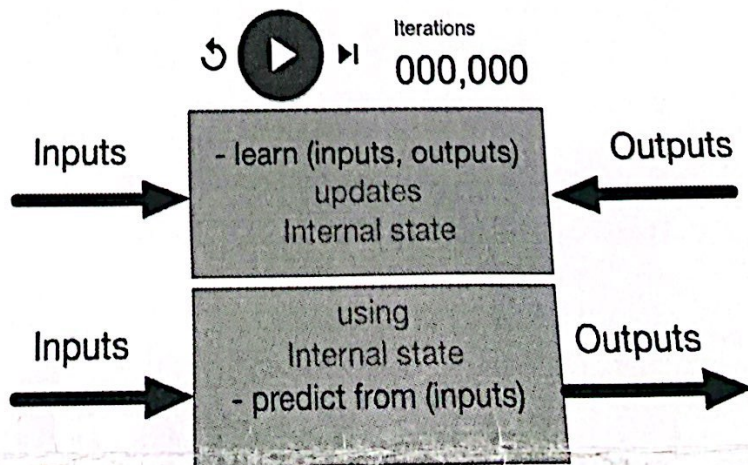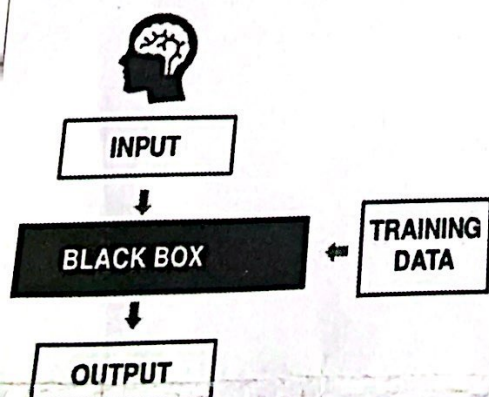
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TensorFlow Playground

http://playground.tensorflow.org/

- An interactive visualization of neural networks, written in typescript using d3.js. 由 Daniel Smilkov、Shan Carter 設計。
  開源碼：https://github.com/tensorflow/playground
- 這是一個用 JavaScript 寫的網頁應用，能讓你在瀏覽器中測試、訓練及執行類神經網路，並且可以讓你點擊按鈕和調整參數，從而了解它是怎麼工作的。

MACHINE LEARNING

Iterations
000,000

INPUT

BLACK BOX ← TRAINING DATA

OUTPUT

Inputs → - learn (inputs, outputs) updates Internal state ← Outputs

Inputs → using Internal state - predict from (inputs) → Outputs

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(D) Spiral data set: Can you obtain test loss of less than 0.1 using only the raw inputs? i.e., using only X_1 and X_2? Please share your screenshot of the network as described.

Now you are allowed to use any/all of the 7 different input features (X_1, X_2, X_1^2, X_2^2, X_1X_2, $sin(X_1)$, and $sin(X_2)$). Can you obtain test loss of less than 0.1 for the Spiral data set with fewer neurons? Please share your screenshot of the network as described.
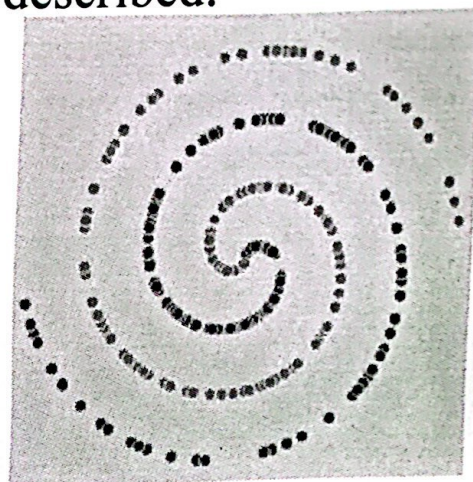
(E) What is L1 regulations? Explain detailly.
(F) What is L2 regulations? Explain detailly.
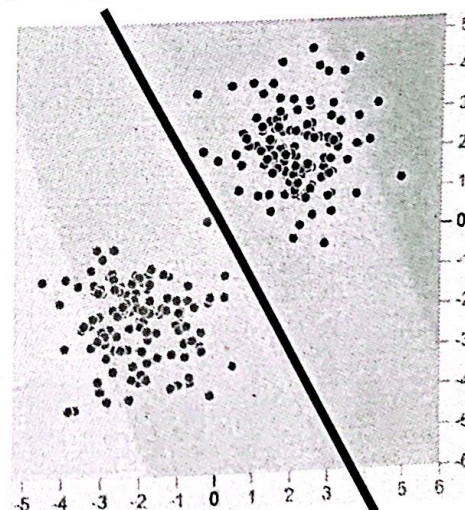(G) What is regulation rate? Explain detailly.
(H) What is Noise? Explain detailly.
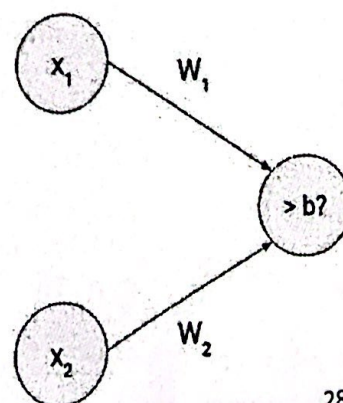(I) What is Batch size? Explain detailly.

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一個簡單的分類問題：傳統解題做法

- 假設有一個資料集合：每個資料有兩個座標值：x1（橫坐標）和x2（縱坐標）。分類為橙色組和藍色組。

- 要區分一個資料是橙色的還是藍色的，你該如何編寫程式？

- 也許你可畫一條對角線來分隔兩群資料，定義一些參數值以確定每個資料屬於哪一群。程式應該看起來是這樣：

if (x1 *w1＋ x2 *w2＞ b) then "屬於藍色組"
                    else "屬於橙色組".

✓ 但問題的關鍵是程式設計師必須為 w1、w2 和 b 找到合適的值——即所謂的參數值。

read01.com/yMg576.html

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