

An Introduction to Artificial Neural Networks – Exercises

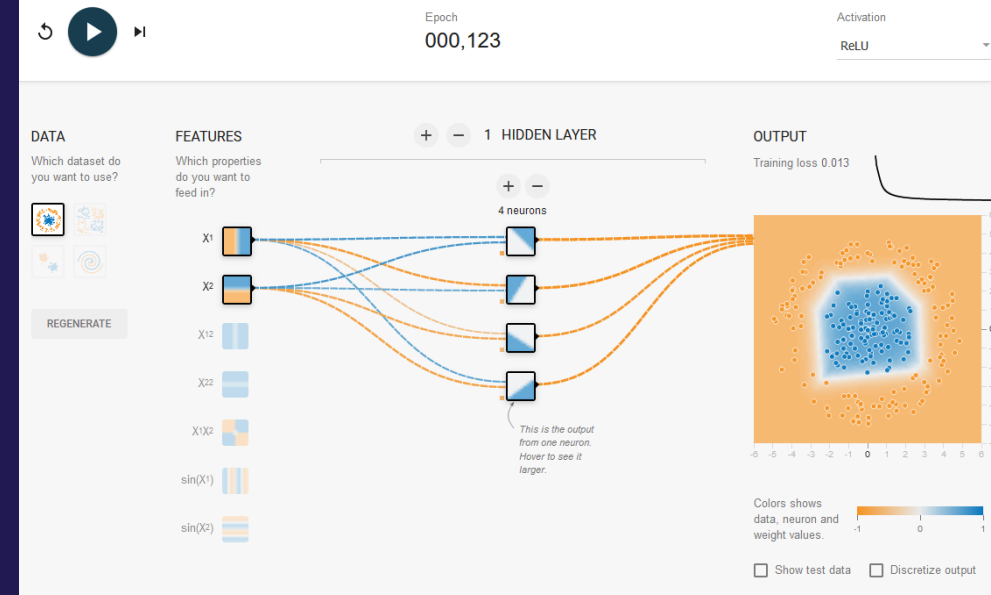
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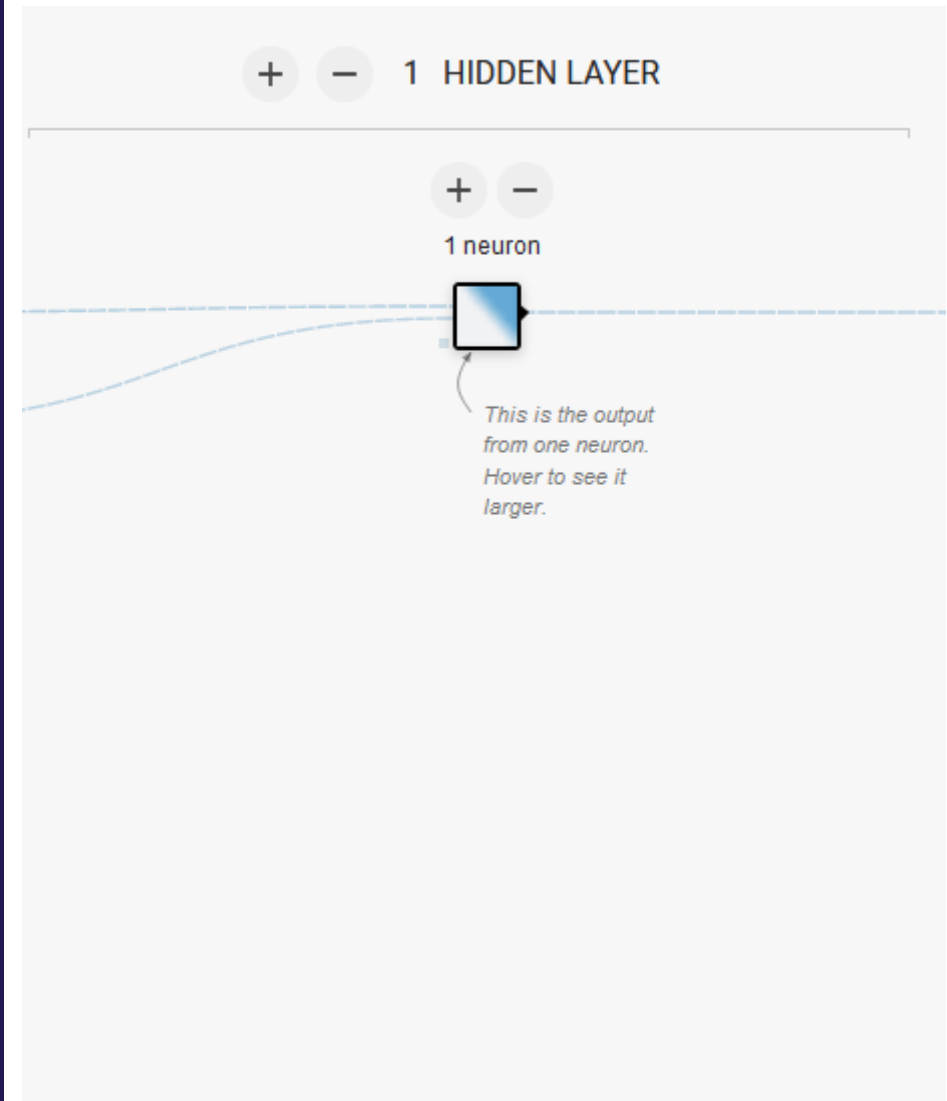
Exercise 1a – get started

- ▶ Go to [TensorFlow playground](#) (follow the link embedded)
- ▶ Press the Play button and watch how the network trains
- ▶ Get familiar with the interface:
 - Hover the mouse over neurons to see which decision surface they represent
 - Hover the mouse over connections (lines) to see their weight
- ▶ Try adjusting the number of neurons and add a second hidden layer



Exercise 1b – more neurons and datasets

- ▶ Follow [this link](#)
- ▶ How does the network perform with:
 - Only one neuron?
 - Two?
 - Three or four?
- ▶ Try other datasets and watch how the network adjusts to new data



Exercise 1c – learning rate

- ▶ Follow [this link](#)
- ▶ Try adjusting the learning rate to different levels
- ▶ Then reset the network and re-run the training
- ▶ How does the training elapse with a low learning rate (e.g. 0.0001)
- ▶ Follow [this link](#) and watch how the network trains with different random initializations (reset the network, press run)
- ▶ Closely watch the learning curve



A Neural Network Playground

Tinker With a **Neural Network** in Your Browser.
Don't Worry, You Can't Break It. We Promise.

Epoch: 000,000 Learning rate: 0.3 Activation: ReLU

DATA
Which dataset do you want to use?

FEATURES
Which properties do you want to feed in?

3 HIDDEN LAYERS
4 neurons 3 neurons 2 neurons

OUTPUT
Training loss 0.492

REGENERATE

The outputs are mixed with varying weights, shown by the thickness of the lines.
This is the output from one neuron. Hover to see it larger.

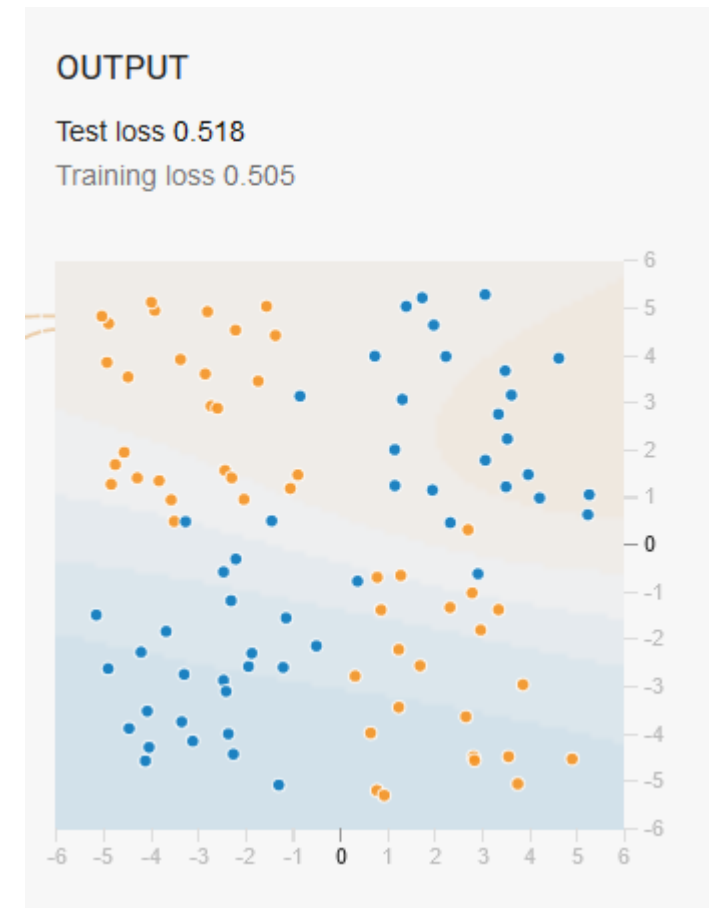
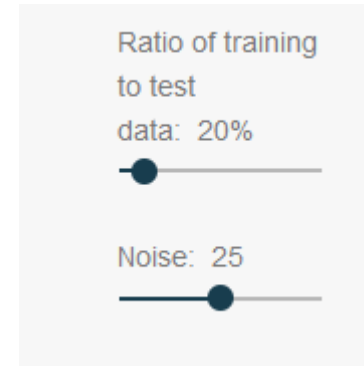
Colors shows data, neuron and weight values.

☐ Show test data ☐ Discretize output

Um, What Is a Neural Network?

Exercise 1d – noise and training data

- ▶ Follow [this link](#)
- ▶ Now we will experiment with
 - Less training data (ratio of training to test data slider)
 - Noise in test and training data (noise slider)
- ▶ Try varying both parameters and watch how they affect training
- ▶ Now you should be able to see overfitting from the learning curve
 - The training loss gradually degrades but the test loss increases



Exercise 1e – spiral dataset

- ▶ Follow [this link](#) to experiment with the spiral dataset
- ▶ Configure the network such that it can handle the spiral dataset. You will need to consider:
 - Adjusting the number of hidden layers
 - Adjusting the number of neurons per layer
 - Including more features into the network
- You might want to start with a higher learning rate and decrease the learning rate as you train the network



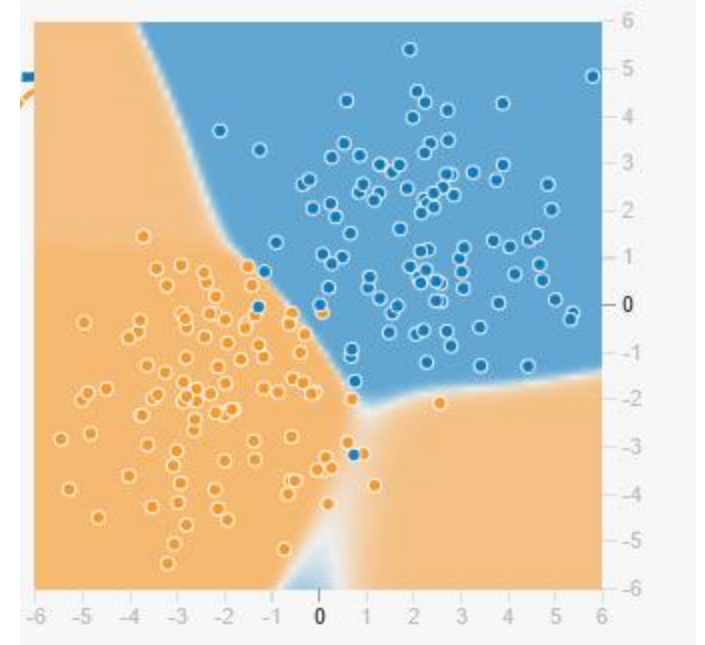
FEATURES

Which properties do you want to feed in?

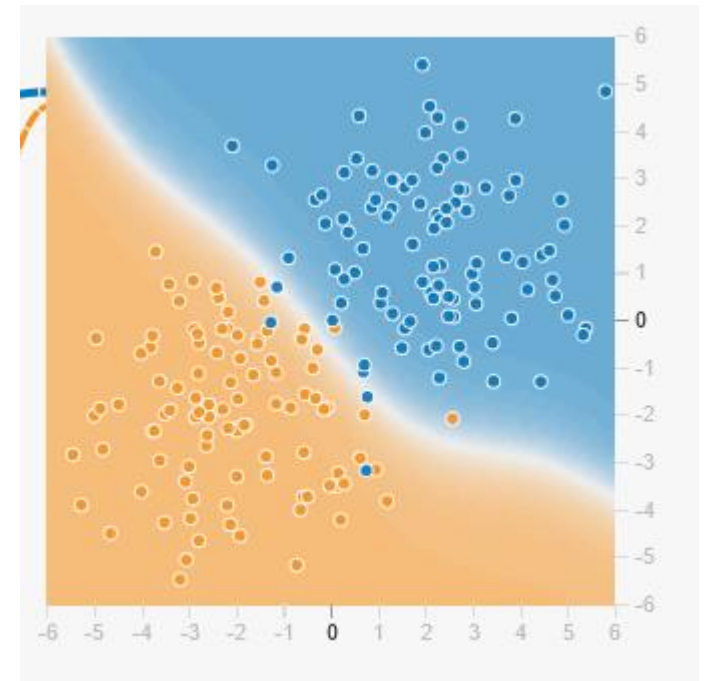


Exercise 1f – regularization

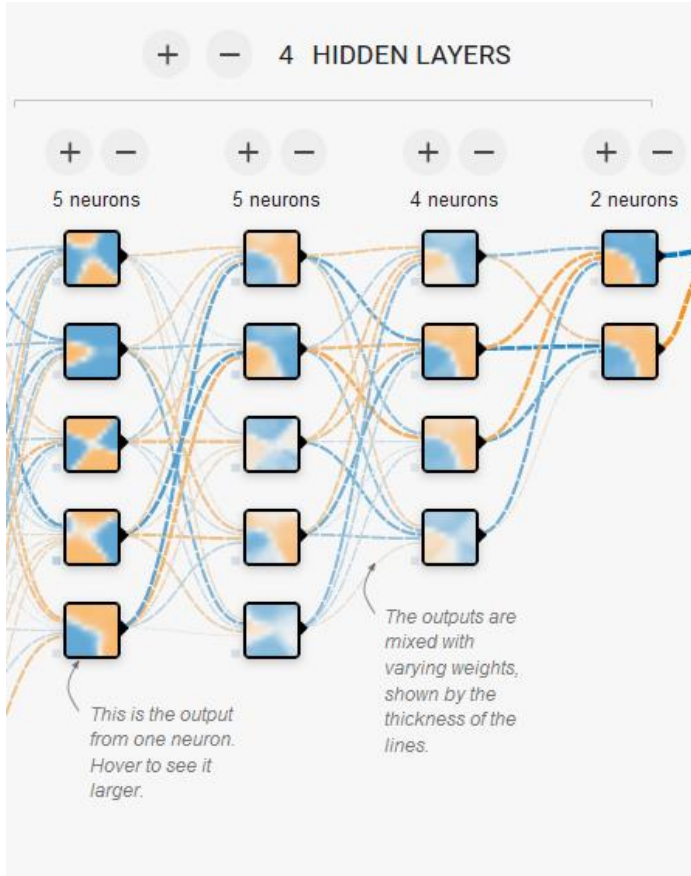
- ▶ Follow [this link](#) to experiment with regularization in a larger network on an easier problem
- ▶ Start training the network with no regularization and observe how it behaves
- ▶ Try add regularization with a small regularization rate (L1, e.g. 0.01) and re-train the network
- ▶ What happens to the decision surface of the classifier? And the weights of the neurons?
- ▶ Try increasing the regularization rate. What happens?



Regularization

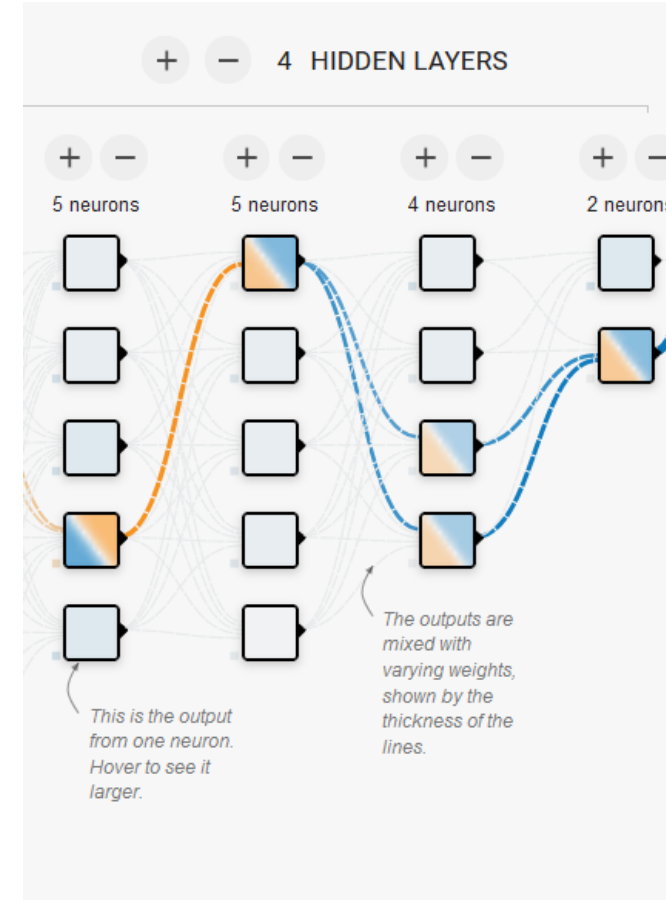


Exercise 1f – regularization



All neurons are utilized.
Complex decision surface

Regularization



Only a small subset of neurons are utilized.
Simple decision surface

