11-785: Deep Learning

HW #1: Backpropagation & Shape Learning

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Single-Layer Neural Network

Implement a single-hidden-layer multi-layer Perceptron with different hidden nodes (less than 8) to classify the example shapes including a circle,a diamond and a random shape (RShape).

Report the best accuracy you can get with the constrained networks.

Answer: Below are two graphs showing the sum of squared errors and overall accuracy on the testing set with different numbers of neurons in a single hidden layer.

Fig 1: Sum of Squared Errors With Single Hidden Layer

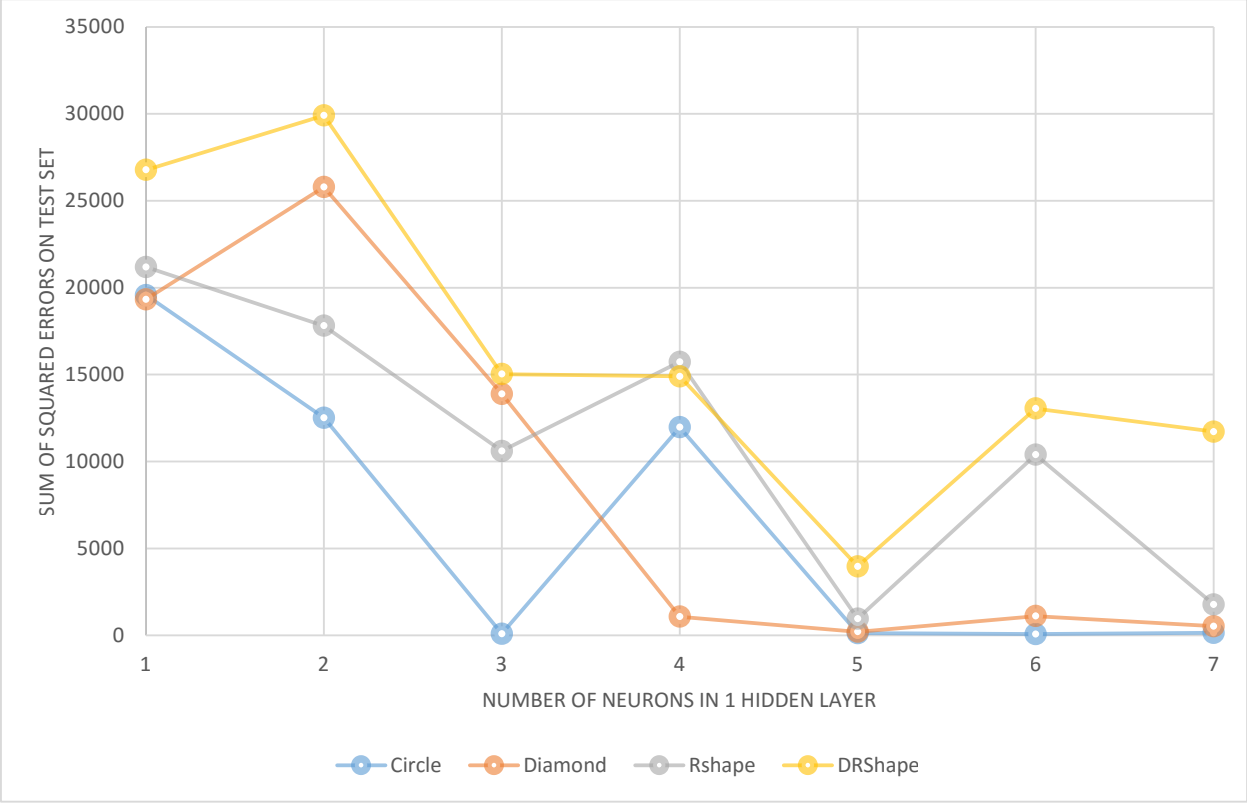
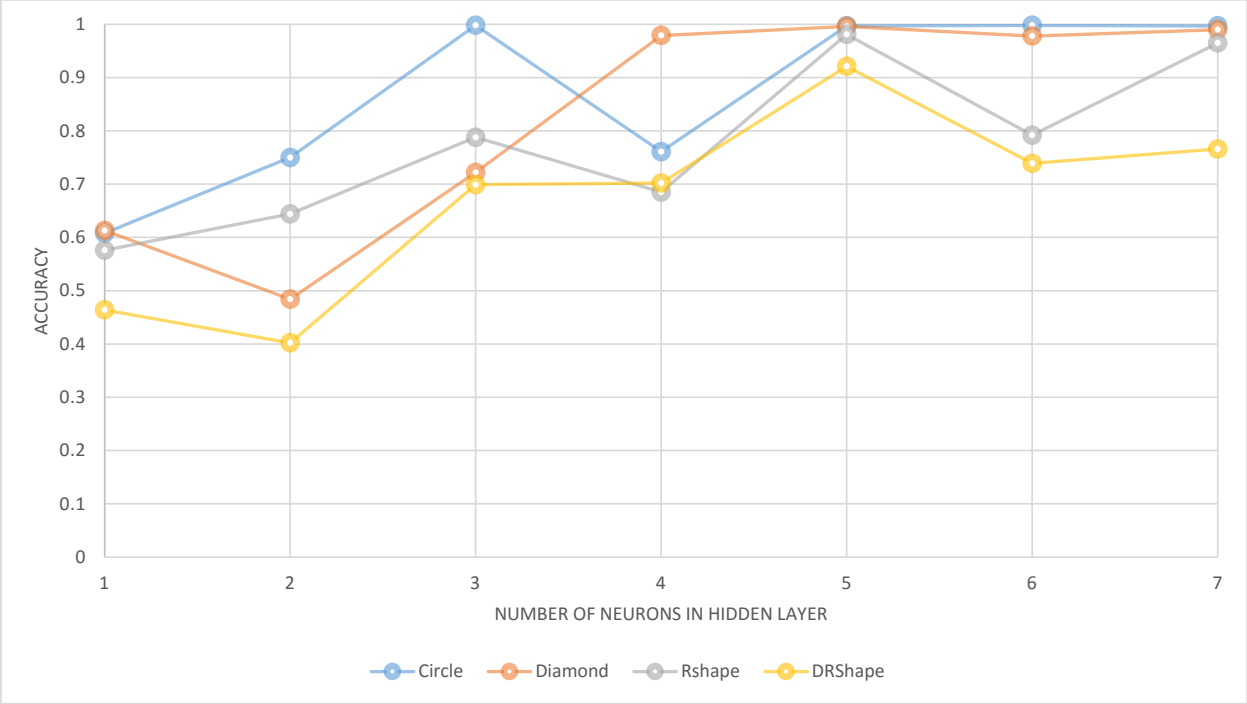
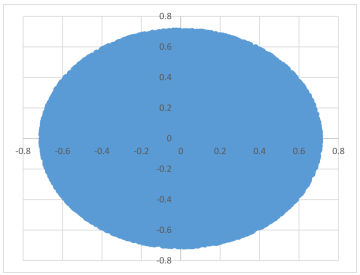


Fig 2: Accuracy With Single Hidden Layer

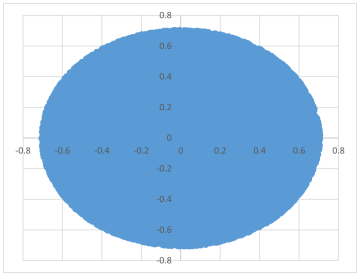


Circle Shape

Visualization of Truth Values for Testing Set

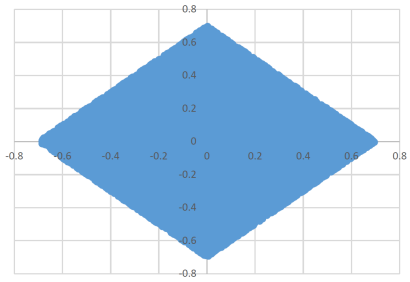


Visualization of Network Output with 6 Neurons

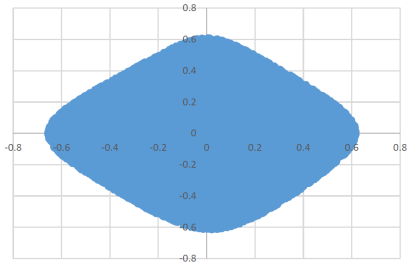


Diamond Shape

Visualization of Truth Values for Testing Set

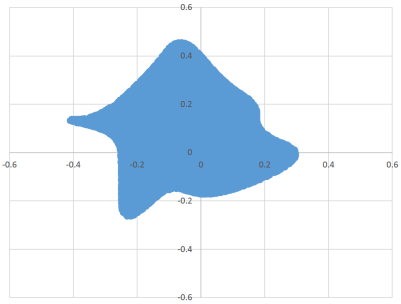


Visualization of Network Output with 5 Neurons

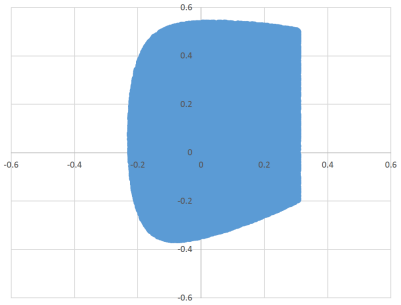


Random Shape

Visualization of Truth Values for Testing Set

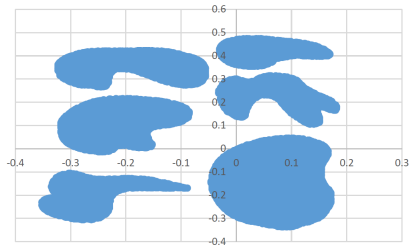


Visualization of Network Output with 5 Neurons

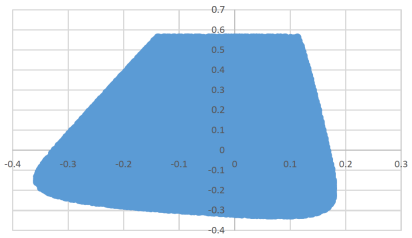


Disconnected Random Shape

Visualization of Truth Values for Testing Set



Visualization of Network Output with 5 Neurons



Multi-Layer Perceptron

Implement a multi-layer Perceptron to classify the random shape (RShape) and disconnected random shape (DRShape). Explore the network structure (depth and width) to achieve best testing accuracy you can get. Report the testing accuracy.

Answer: Below are two graphs showing the sum of squared errors and overall accuracy on the testing set with different numbers of neurons in two hidden layers.

Fig 1: Sum of Squared Errors With Two Hidden Layers

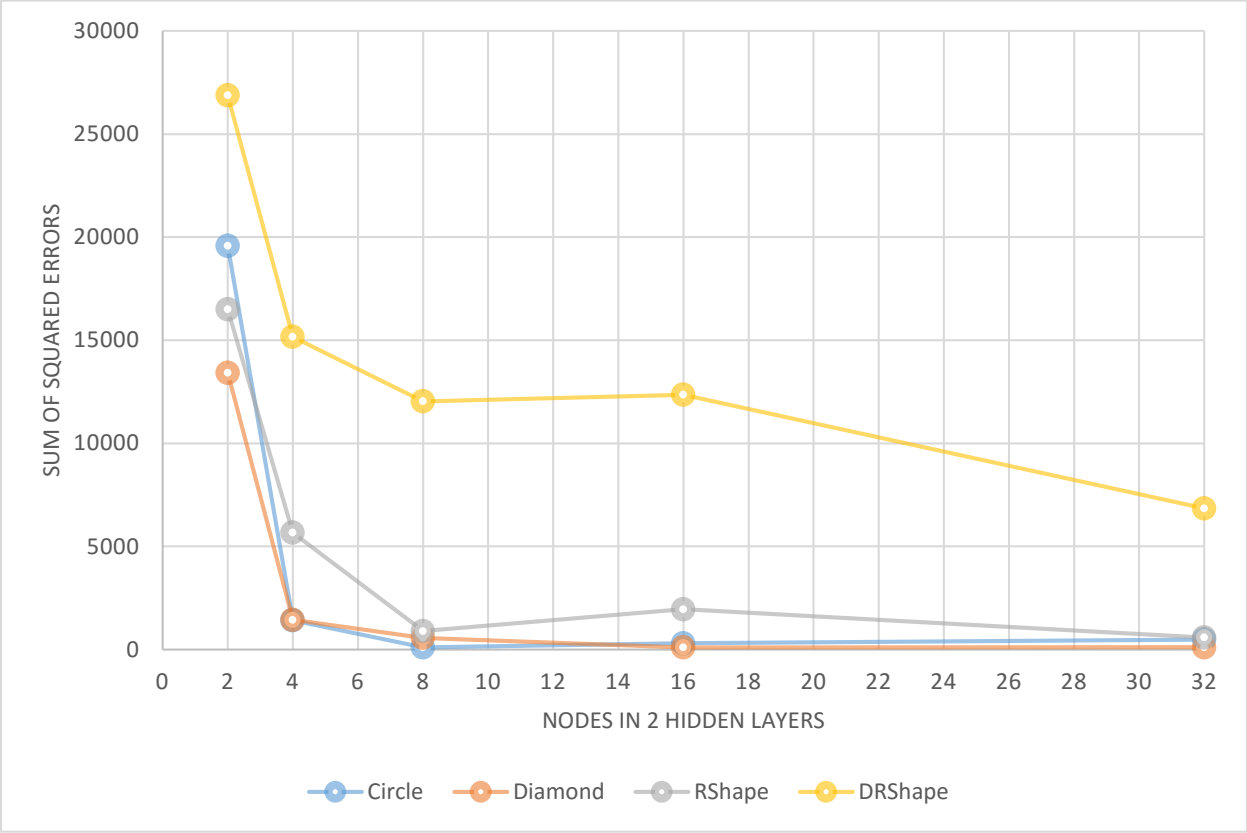
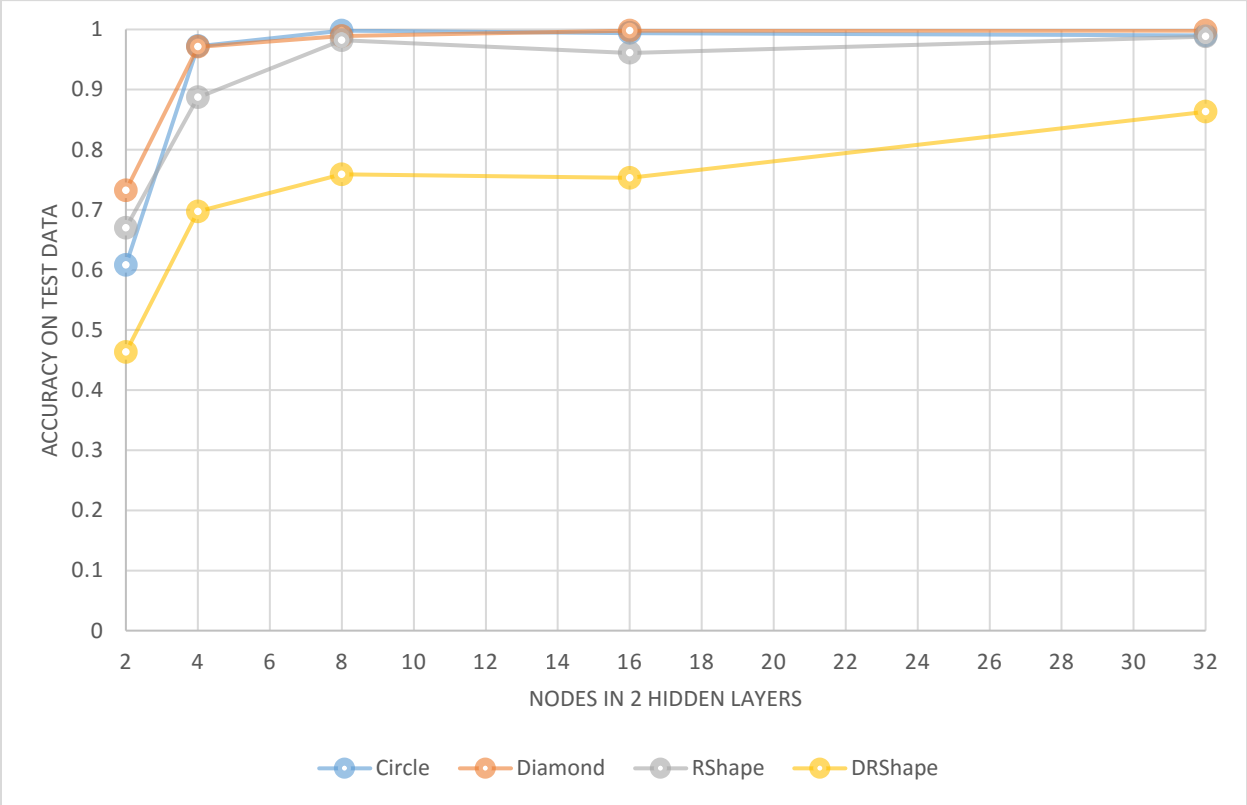
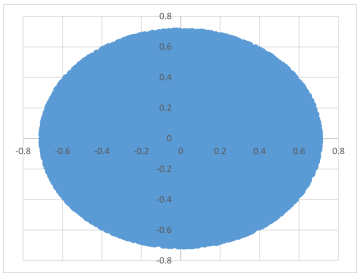


Fig 2: Accuracy With Two Hidden Layers

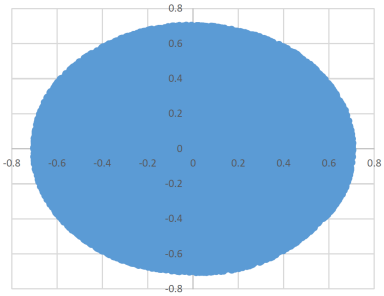


Circle Shape

Visualization of Truth Values for Testing Set

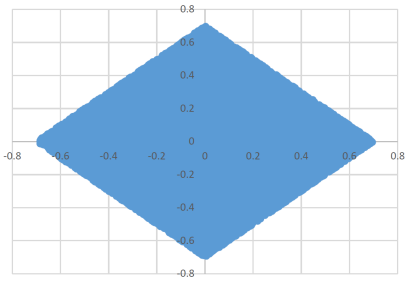


Visualization of Network Output with Two 8-Neuron Layers

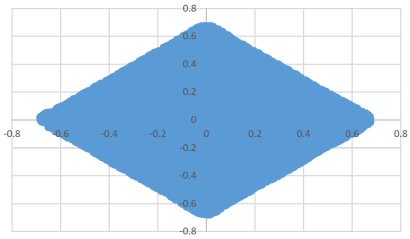


Diamond Shape

Visualization of Truth Values for Testing Set

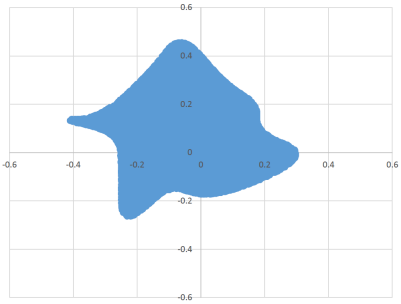


Visualization of Network Output with Two 16-Neuron Layers

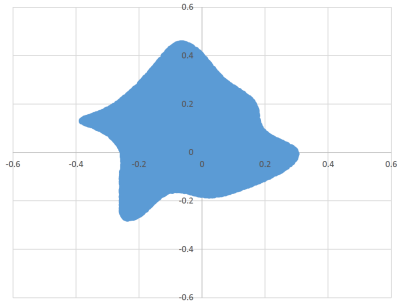


Random Shape

Visualization of Truth Values for Testing Set

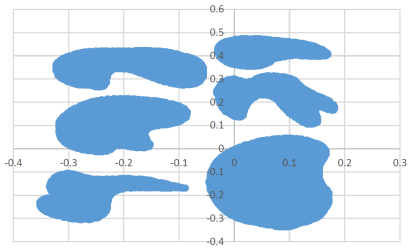


Visualization of Network Output with Two 16-Neuron Layers

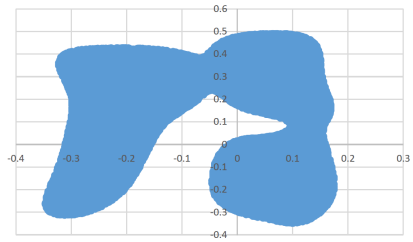


Disconnected Random Shape

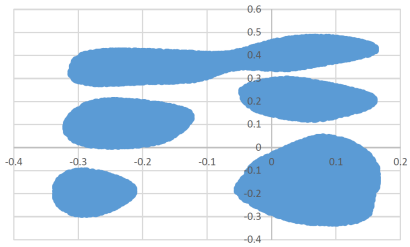
Visualization of Truth Values for Testing Set



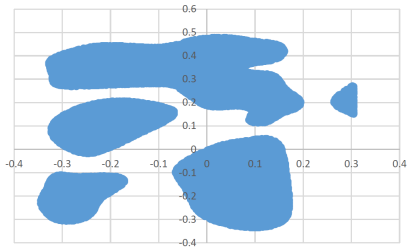
Visualization of Network Output with Two 32-Neuron Layers



Visualization of Network Output with Two 64-Neuron Layers



Visualization of Network Output with Two 128 and 64 Neuron Layers



Visualization of Network Output with Two 256-Neuron Layers