JG|U
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Machine Learning - Sheet 8
16.06.2017
Deadline: 23.06.2017 - 23:55

Task 1: Handwritten Digit Recognition (Part 2)   (12 Points)

We now want to experiment with an actual implementation of the backpropagation algorithm. We will use TensorFlow to train a tiny neural network that is supposed to classify MNIST digits.

(1) Read the TensorFlow's MNIST tutorial .

(2) Use TensorFlow Python API to implement the network sketched in Figure 1.

(3) Visualize the weights $W^{(1)}$ as follows: right after the training, take a few (at least 10) columns of the matrix $W^{(1)}$, reshape each 784×1 column into a 28×28 matrix, and render it as a little image.

(4) Train the neural network on the MNIST dataset. Experiment with different settings for the gradient descent, vary the dimensions of the hidden layer.

(5) Report your results ($*$).

($*$) *Neural networks can take more than just a few minutes to train, so it will not be possible to re-run your code. Therefore, submitting only code is not sufficient: a short PDF document with the relevant code snippets and a few plots is expected instead.*
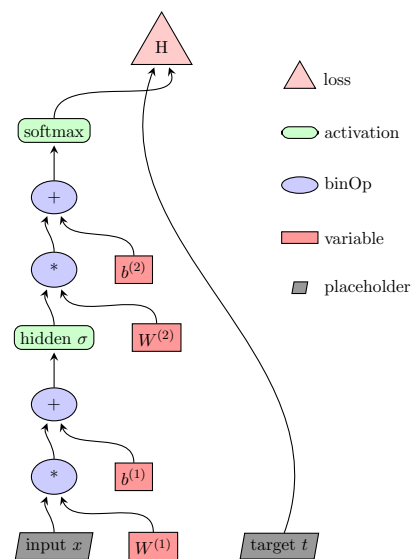

Figure 1: Simple ANN for handwritten digit classification (softmax and cross-entropy loss are shown as separate nodes, in the actual implementation they should be merged).

Task 2: Voronoi Diagram   (8 Points)

Given are the following instances (attributes from $\mathbb{R}^2$, class label from $\{\oplus, \ominus\}$):

$$(1,2)\oplus, (4,8)\ominus, (8,3)\ominus, (3,9)\ominus, (6,2)\oplus, (2,4)\oplus, (7,2)\oplus, (7,8)\ominus, (5,1)\oplus, (9,5)\ominus.$$

(1) Draw the points in the $[0, 10] \times [0, 10]$ square.

(2) Draw the Voronoi diagram associated with the set of points.

(3) Draw the decision boundary between the two classes.

If you want, you can automate some of the steps. Here is the data as Java code snippet:

```
int[][] points = {
  {1,2}, {4,8}, {8,3}, {3,9}, {6,2},
  {2,4}, {7,2}, {7,8}, {5,1}, {9,5}
};
boolean[] labels = {
  true, false, false, false, true,
  true, true, false, true, false
};
```