

# Homework 3

July 17, 2019

Due: 7.17 24:00

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Please include your name, codes, results

## Programming part

**Problem 1:** Use CNN to classify the MNIST dataset and report all the details, including the codes, training process details and results (the graph of test accuracy vs epoch).

**Problem 2:** Use CNN to classify the CIFAR10 dataset and report all the details, including the codes, training process details and results (the graph of test accuracy vs epoch).

## Theoretical part

**Problem 3:** Choose some continuous functions  $f \in C([0,1])$ . For each  $f$ , plot  $f$  and  $B_n(f)$  (Bernstein polynomial) for some  $n$ .

**Problem 4:** For  $DNN_1$ , prove it reproduces identity map, i.e.,  $x \in DNN_1(\sigma)$ .

**Problem 5:** Prove  $DNN_1 \subset DNN_2$ .

**Problem 6:** For  $\phi \in DNN_l$ ,  $\phi$  is a continuous and piecewise linear function.  $\mathbb{R}^d = \bigcup_i \bar{D}_i$ .  $D_i$  is a polyhedron.  $\phi$  is linear on  $D_i$ . Plot some of these functions for  $d = 2$ .

**Problem 7 (Optional):** Prove that any continuous piecewise linear function (w.r.t. polyhedrons) can be written as a DNN function. ( $d = 1$ )