

numpy basics

Download the provided code skeleton from the E-learning site. It does nothing but provide the MNIST data in the structures `traind`, `trainl`, `testd` and `testl`. Generally, take advantage of the fact that numpy is very well documented online!! Before starting, reshape `traind` to have shape (60000,28,28)!

Array creation

Useful functions for array creation (look them up): `np.arange`, `np.linspace`, `np.random.uniform`, Python list comprehension. Nested Python lists are converted into numpy arrays in row-wise fashion!

- a) Create a 1D array with entries from 0 to 100 in steps of 2
- b) Create a 2D array with 3 rows and 3 columns, with row entries 1,1,1,..., 2,2,2,..., 3,3,3,...
- c) Create a 2D array with 3 rows and 5 columns that has the value 55 everywhere
- d) Create a 3D tensor with shape (5,4,3) with uniform random entries between 0 and 1.

Numpy basics and slicing

Generally: work on a copy of `traind` here!

- a) Slice out the 1000th sample into an array x and display it!
- b) Set the 5 topmost and the 5 lowermost columns of sample 1000 to 0 and visualize the result
- c) Generate the following variations of the 10th sample and display them in a single figure:
 - just keep every 2nd row
 - just keep every 2nd column
 - inverse all rows and all columns
 - invert rows, invert columns, just take every 2th row and every 2th column
- f) Apply the in-place transform

$$1 - x$$

to all samples (in a copy of `traind`) and display sample 2.

Broadcasting

Generally: work on a copy of `traind` here!

- a) create a 28-element vector with entries from 1 to 28, and add it to all rows of all sample using broadcasting. Visualize sample 100!

- b) create a 28-element vector with entries from 1 to 28, and add it to all columns of all samples using broadcasting. Visualize sample 100!

Fancy indexing and mask indexing

- a) create a 20-element vector with entries from 1 to 20, and copy out all elements that are smaller than 10 using mask indexing!
- b) create a 20-element vector with entries from 1 to 20, and set elements 1,5 and 19 to 0 using fancy indexing!
- c) Extract samples 1,5 and 19 from traind in a single operation and print out the shape of the resulting array!

Advanced stuff

- a) Copy out 10 random samples and visualize them! What do you observe when you repeat the exercise?
- b) Extract all samples whose class is 0, what is the shape of the resulting array?