

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?