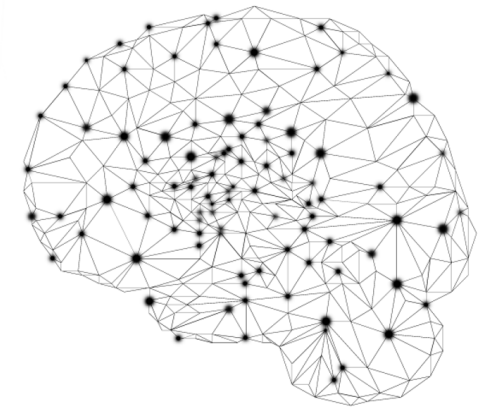

Neural Networks and Data Science

Lab #4

01.11.2023
Deadline: 08.11.2023, 12:10

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Problem 1

The cryptocurrency (or short: crypto) market is infamous for its volatility. Is it really that bad? To sort that out, I have compiled historical stock market data for ten popular cryptos including the most famous ones like Bitcoin or Ethereum, each in a separate CSV file. Furthermore, `crypto.zip` contains an auxiliary file `filenames.txt` that holds the filenames of all CSVs.

a) Use `filenames.txt` to load all CSV files into separate dataframes and store them in a dictionary `crypto` that allows you to access the dataframes via the currencies' short identifiers (ADA, BCH, ...).

b) Calculate the daily volatility for all cryptos as presented in the lecture notebook. Store your results in whatever data structure floats your boat: A new dataframe, a dictionary of dataseries, a list of dataseries, ...

c) Create a boxplot that shows the volatility of all ten currencies at a glance. How does the volatility of the cryptomarket compare to the volatility of gold?

Problem 2

`Tankerkönig` has been collecting gas prices at all German gas stations for more than nine years. The entire dataset weighs approximately 81 GB divided into 4000 `CSV` files, each holding gas prices of a single day. To access the data, mount the `nnds` network storage using the `mount /mnt/nnds` command. Use the provided example scripts to visualize the evolution of `E10` for either a selected month, OR an entire year, OR the full dataset.

Problem 3

Astronomical images of planets, galaxies or nebulae are famous for their brilliant colors. However, the instruments that take these pictures are typically color-blind CCD sensors that simply count photons. To get coloured images, astronomers take images through a set of three filters: A red filter, a green filter and and blue filter. Every image looks slightly different and superposing the images allows us to reconstruct the hidden color information. In this task, we will use `Pillow` and `Numpy` to combine three frames of the Whirlpool Galaxy M51 (see `m51_hubble_rgb.zip`).

a) Install the `Pillow` package (a fork of the `Python Image Library (PIL)`) via `conda install pillow`.

b) Import the library via `from PIL import Image` and use `img = Image.open(name).convert('L')` to load an image with the filename `name` into an object `img` in black-and-white mode. Apply that to all three images of M51. Convert all images into Numpy arrays via `imgArr = np.array(img)`. What are the dimensions of the array? Discuss the meaning of the array entries.

c) Use `plt.imshow(imgArr, cmap='gray')` to plot the three image arrays.

d) For a coloured 8-bit image, the image array entries must be between 0 and 255. Make sure that's the case. Then, to get a black background you need to invert the values, i.e. 0 must become 255, 1 shall turn 254, 2 shall be 253 and so on. Use a `Numpy` one-liner to do so and generate the inverted image arrays `imgArrInv`.

e) Generate a three-dimensional Numpy array `imgRGB = np.zeros([h, w, 3], dtype=np.uint8)]` where `h` is the height and `w` the width of the three frames and the last index denotes the colour channel. Assign the inverted image arrays to the correct layer, i.e. layer 0 shall be the red channel, layer 1 the green channel and layer 2 is the blue channel. Use `plt.imshow(imgRGB)` for a visual inspection of your image.