Activity 1

Deep Learning Lab

September 20, 2019

1 Preparation

1. Using Google Colab, run the example in Slide 18.
2. Install Python to your personal computer.
3. Using pip, install the packages numpy, matplotlib, and tensorflow 1.12. Optionally, install these packages in a virtual environment (see Slide 10).
4. Run the example in Slide 18 using your personal computer.
5. Use SSH to connect to `hpc.ics.usi.ch` using the credentials provided during the lecture.
6. Run the example in Slide 18 using the ICS cluster: adapt the script in Pg. 12 as needed, and remember to use *sbatch*.

2 Background

1. If you are not familiar with Python, read the Python tutorial. Quickly.
2. Follow the NumPy quickstart tutorial. You should be able to:
   - Create multidimensional arrays and inspect their shapes.
   - Perform elementwise arithmetic operations between arrays.
   - Perform arithmetic operations between arrays and scalars.
   - Perform matrix multiplications using *np.dot*.
   - Perform unary operations on arrays (e.g., *max*, *sum*).
   - Apply functions elementwise to an array (e.g., *np.sqrt*).
   - Index elements, slice arrays, index using lists of elements, and index using Boolean arrays.
   - Ravel and reshape arrays. Important: you should be able to predict the result of any reshaping operation, even when the arrays involved have three dimensions or more. This requires some practice.
3. Read about NumPy broadcasting. You should understand how operations between arrays of different shapes are interpreted.

3 Exercise

Complete the following exercise first using NumPy and then using TensorFlow.

1. Consider the system of linear equations represented by $\mathbf{Ax} = \mathbf{b}$, where $\mathbf{b} = [1, 2, 3]^T$ and
$$\mathbf{A} = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}.$$
Find $\mathbf{x}$, using a function to invert $\mathbf{A}$ (NumPy: *np.linalg.inv*, TensorFlow: *tf.matrix_inverse*). Note: *np.dot* interprets one-dimensional arrays as column matrices, whereas *tf.matmul* does not.