Homework and Further Reading

Submission and Deadline

Submission is not required. Finish the reading before the first quiz. (You may fail the quiz if you do not read the matrix calculus.)

Homework

Setup Python, Jupyter, TensorFlow and Keras.

1. Install Python 3.3 or greater. Do not use Python 2.X
2. Install Jupyter notebook: [**guide**]
3. Install TensorFlow: [**guide**]
4. Install Keras: [**guide**]
5. Make sure Keras has been properly installed: [**run the code**]

Further Reading

Self-study matrix algebra by reading the following articles:

1. **Matrix Calculus**. (Required. Print and bring it to the quiz.)
2. Appendix A of **Convex Optimization** (Optional. It is available online; Google it.)
3. Chapters 1 and 2 of **The Matrix Cookbook**. (Optional. It is available online; Google it.)

Sample Questions

Basic matrix algebra and vector/matrix differentiation are parts of the first quiz and the final. Here are some sample questions.

1. $\mathbf{a} = [\mathbf{3}, \mathbf{-5}, \mathbf{0}, \mathbf{0}, \mathbf{-1}]$ is a vector. Calculate the values of the following vector norms:
   – the squared ℓ_2-norm: $\|\mathbf{a}\|_\mathbf{2}^\mathbf{2}$,
   – the ℓ_2-norm: $\|\mathbf{a}\|_\mathbf{1}$,
   – the ℓ_∞-norm: $\|\mathbf{a}\|_\infty$.
2. Let $\mathbf{I_5}$ be the 5×5 identity matrix. Calculate the following values:
   – the largest eigenvalue: $\lambda_{\max}(\mathbf{I_5})$,
   – the smallest eigenvalue: $\lambda_{\min}(\mathbf{I_5})$,
   – the trace: $tr(\mathbf{I_5})$,
   – the squared Frobenius norm: $\|\mathbf{I_5}\|_\mathbf{F}^\mathbf{2}$.
3. What is the derivative of $f(\mathbf{x}) = \|\mathbf{Ax} + \mathbf{b}\|_\mathbf{2}^\mathbf{2} + \|\mathbf{x}\|_\mathbf{2}^\mathbf{2} + \mathbf{c}^\mathbf{T}\mathbf{x} + \mathbf{d}$ with respect to the vector $\mathbf{x}$? Here, $\mathbf{A}$ is a matrix, $\mathbf{b}$ and $\mathbf{c}$ are vectors, and d is a scalar.
4. $\mathbf{x} = [\mathbf{x_1}, \mathbf{x_2}, \mathbf{x_3}]$ is a 3-dimensional vector. What is the derivative of $f(\mathbf{x}) = \mathbf{e}^{\mathbf{x_1}} + \mathbf{x_2^4} + \mathbf{x_2 x_3} + \mathbf{5} \cdot \cos(\mathbf{x_3})$ with respect to the vector $\mathbf{x}$?