Introduction to Deep Learning DSECOP Module

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Introduction to Deep Learning
Overview

Deep Learning is playing an increasingly major role in Physical Sciences, in particular, in topics that have been traditionally computationally intensive, such as Molecular Dynamics, Cosmological N-body simulations, computational Biophysics (e.g., proteomics), Biomedicine, and Astronomy.

The goal of this module is to introduce the fundamental concepts of Deep Learning, specifically Neural Networks to Physics students.

Overview

Readers and practitioners are expected to be familiar with Calculus, Differentiation and differential equations, and Matrix Algebra.

In addition, they should be familiar with

- Base python - variables/functions/loops/data structures
- Core functionalities of Numpy, Pandas, and Matplotlib
- Basics of working with git and Github
- Elementary statistics knowledge

Overview

- Includes 12 **Problem-solving Lectures**

  - 8 lectures discussed the basic concepts of deep learning with homework at the end, (each takes 15 – 30 minutes to be fully covered)

  - 2 lectures are project-based (solving them may takes 2-10 hours, depends on the coding knowledge of students)

  - 2 is the solution of all projects and homework

  - could be included in any Statistics/data-related course such as computational phyiscs

Introduction to Deep Learning
Overview

- Introduction to Neural Network   **What is the neural network**

- Logistic Regression   **Question: how we can find the type of exoplanets (hot-Jupiter or not)?**
- Loss and Cost Functions

- Gradient Descent   **Answer: use Binary Classification methods.**

- First Project: **Gradient Descent over All Elements in Training Set**

Introduction to Deep Learning
Overview

- Deep Neural Network   **The Structure of deep neural network**

- Parameters vs. Hyperparameters

- Two major problems in Deep Learning-Regularization and Vanishing Gradient

                                                    Practical consideration in deep learning

- Activation Functions

- Final Project: **Using Deep Learning to Find Hot-Jupiters**
  - Based NASA Exoplanet Archive Data provided in the module

Conclusion

Students learns:

- the basic concepts of Deep Learning,

- how to implement the neural network for a problem,

- how to use the data science techniques to solve a scientific problem.

Thank you

Please let us know your feedback: bit.ly/DSECOP-feedback