Resources

This document serves as a guide to all the resources that may be helpful to learn ML, especially with relevance to the UTOPIA Phytoplankton Classification Model. Keep in mind that this is NOT a comprehensive list, just a handful of resources that were relevant to us. Readers are encouraged to explore these topics on their own!

Note: These resources are for the *absolute beginner*. You don't need any prior knowledge to learn the basics of ML from these resources

UTOPIA

These resources give information about us -- who we are, what we do, and where to learn more

- Github: https://github.com/ifcb-utopia/plankton-CNN-DEMO
    - Has all the files and instructions to test the CNN Classification Model yourself
    - Includes the final paper summarizing the findings of the model with its impact on oceanography and education
- APL: https://www.apl.washington.edu
    - The lab that houses the UTOPIA Project
    - Can check out other work in oceanography
- UW eScience Institute: https://escience.washington.edu
    - A group at the University of Washington dedicated to apply data science techniques (machine learning, data visualizations, and cloud computing) to a variety of fields

Phytoplankton Imagery References

These resources give a background on phytoplankton, why their so valuable for our ecosystem, and the tools researchers use to study and classify them

- Importance of Phytoplankton: https://www.youtube.com/watch?v=H7sACT0Dx0Q
    - Fun video about phytoplankton and their importance in the ecosystem
- IFCB: https://mclanelabs.com/imaging-flowcytobot/
    - Gives information about the "Imaging FlowCyclobot" (IFCB), the device used to collect plankton image data
- Raw Phytoplankton Data: https://ifcb-data.whoi.edu/timeline?dataset=mvco
    - An open-source website to explore what the phytoplankton image data looks like
- https://www.annualreviews.org/doi/abs/10.1146/annurev-marine-041921-013023
    - Published paper about ML and its transformative impact on phytoplankton study

Machine Learning Resources

These resources give a mathematical introduction to machine learning, as well as the diverse areas where ML can be applied

- * 3Blue1Brown Intro to ML: https://www.youtube.com/watch?v=aircAruvnKk&list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi
    - Gives a great general introduction into neural networks, outlining the math of how they work

    - Walk through building a simple densely-connected neural network to recognize handwritten digits
- MIT's Intro to Deep Learning (2022): https://www.youtube.com/watch?v=7sB052Pz0sQ&list=PLtBw6njQRU-rwp5__7C0oIVt26ZgjG9NI
    - An online course by MIT about deep learning and its varying techniques
    - Gives a general exposure to many types of ML (but does not walk though any in detail)
- * Simple MNIST Digit Recognition Model on Keras: https://keras.io/examples/vision/mnist_convnet/
    - Simple script in Python that takes black-and-white images and tries to recognize digits
- Convolution:
    - * Math of Convolutions: https://betterexplained.com/articles/intuitive-convolution/
        - Builds an intuitive understanding of the mathematical definition of a convolution, with applications
    - Guide to CNNs: https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53
        - Visual guide to how Convolutional Neural Networks work on a conceptual level
- Book about Deep Learning: http://neuralnetworksanddeeplearning.com

    - Free, online book about Neural Networks and Deep Learning
    - For readers who want a clear, thorough introduction to the concepts and applications of deep learning

Python Machine Learning Tutorials/Models

These resources provide a more practical introduction to ML, with tools about how to get started programming in python, and tutorials that walk through programming a deep-learning model

- * Python programming tutorial: https://swcarpentry.github.io/python-novice-inflammation/
    - Tutorial created by the eScience Institute to teach the basics of python programming
    - Start with the "Setup" link with info on installing Python and Jupyter
- * Building a Simple MNIST Neural Network from Scratch: https://www.youtube.com/watch?v=w8yWXqWQYmU
    - Online tutorial that walks you through the math and programming of building a simple digit recognition neural network from scratch, using Python
- Tinker with a Neural Network: https://playground.tensorflow.org
    - Website that allows you to tweak layers and neurons in a neural network and visualize the effects