Kate suggested plan

Week 1: Introduction and Basics

Lab Orientation

- Introduction to the team and an overview of ongoing projects.
- Orientation to lab tools and infrastructure, including BioWulf and code repositories.
  Foundational Knowledge
- Basic statistics and probability relevant to computational biology.
- Introduction to genomics: DNA, genes, regulatory elements, and mutation-related diseases.

Week 2: Deep Learning Fundamentals

Neural Networks and PyTorch

- Introduction to neural networks: concepts, structure, and function.
- Overview of the PyTorch library: installation, basic operations, and model building.
  Deep Neural Networks
- Concepts of deep neural networks, overfitting, and regularization techniques.
- Practical session: Training a simple neural network on a sample dataset.

Week 3: Genomics and DNA Sequence Data

Genomics Basics

- Overview of DNA, genes, and types of mutations.
- Introduction to tools for DNA sequence analysis, such as Biopython.
  Data Preparation
- Techniques for one-hot encoding DNA sequences.
  Case Study
- Practical session on predicting regulatory elements using deep learning.

Week 4: CNNs for Genomic Data

Introduction to CNNs

- Understanding Convolutional Neural Networks (CNNs) and their applications in image and sequence data.
  Building and Implementing CNNs
- Building CNNs for DNA sequence analysis.
- Practical session: Implementing a CNN to predict regulatory regions in the genome.
  Model Evaluation
- Evaluation metrics for assessing model performance.

Weeks 5-7: Transformer-Based Models for Mutation Prediction

Sequential Data Analysis

- Introduction to Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks.
- Applications of RNNs in analyzing sequential data.
  Advanced Architectures
- Introduction to Transformer models and their advantages over traditional RNNs.
  Practical Sessions
- Implementing Transformer-based models for mutation prediction.
- Reviewing and replicating recent research papers on deep learning applications in genomics.

Weeks 7-8: Model Interpretation, Validation, and Wrap-Up

Model Interpretation

- Techniques for interpreting deep learning models, focusing on models predicting regulatory elements.
  Presentation
- Preparing and presenting findings and potential research questions.
  Feedback and Future Directions
- Feedback session to discuss the learning experience and potential future projects.

Resources

- **ML/DL Course Using PyTorch:**
  - YouTube Course: Comprehensive course covering Tensors, deep learning basics, and practical applications using PyTorch, scikit-learn, and Jupyter notebooks.
- **Model Repositories and Tutorials:**
  - Hugging Face: Platform for uploading and downloading models, with a wealth of tutorials and resources for adapting pre-trained models to specific tasks.