Evaluating machine learning models for earthquake phase picking

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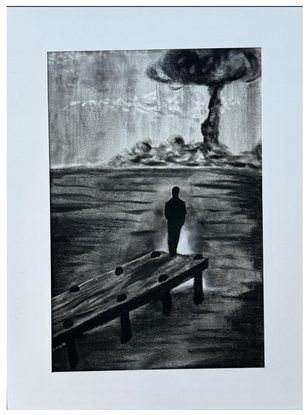
ABOUT ME

- Major: Sophomore in Geology
- Career Goals: While I'm still exploring careers in my field of study, my time in the fellowship inspired me to do something that makes a difference.
- I chose a fellowship at LLNL because it offered me a unique opportunity to learn and work on research problems relating to seismology and machine learning with passionate researchers on real world-problems.
- Interests: Drawing, painting, and traveling

Photos taken by Raymond



Charcoal drawing by Raymond

SUMMER RESEARCH

- Abstract: Machine learning methods are widely used in seismology, so quality-controlled benchmark datasets are essential for fair evaluation. Models also need to be implemented within a common framework to enable consistent comparison. In this project, I compare several ML-based earthquake phase-picking algorithms using a control dataset from the *2020 M6.5 Monte Cristo* earthquake sequence. The goal is to understand why different algorithms produce different picks when applied to the same earthquake data.

- Overview:
  - Use SeisBench as a common framework to test multiple ML-based earthquake phase-picking model.
  - Run each phase-picking model to compare predicted P-wave and S-wave arrival times under identical conditions.
  - Evaluate differences related to magnitude, event location, depth, distance, noise level, or station quality.
  - Use the results to identify why different models produce different picks and assess how those differences may affect downstream products such as event location.

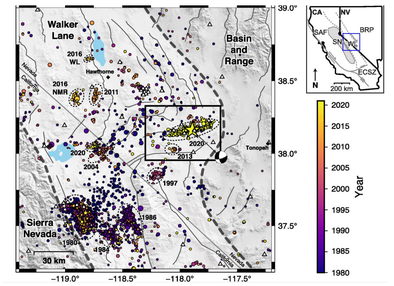


Fig 1: Regional seismotectonic map showing the location of the M6.5 Monte Cristo Range mainshock

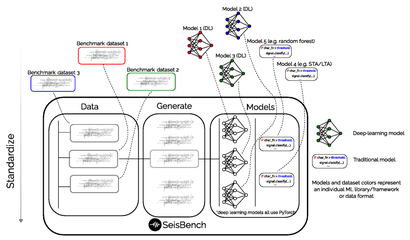


Fig 2: Schematic of SeisBench which acts as a unifying framework for developing models and applying them to seismic data.

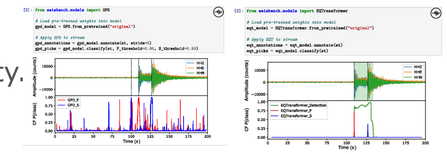


Fig 3: Example code blocks, which download a seismic waveform then loads a pretrained deep-learning picking model and applies the model to predict on the seismic stream using either one of two ML architectures (GPD and EQTransformer).

LLF AWARD

- I have been very fortunate to have been accepted into this fellowship, which has provided invaluable research experience and professional development. The experience has taught me how to code with Python, experience applying computational methods to scientific research, and developed a greater understanding of seismology and basic machine learning.
- I am mainly using my LLF funds for basic living costs like housing, groceries, and gas, as well as my education. In addition, I use it to explore the Bay Area, from Sacramento to San Francisco

Photo taken by Raymond

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