MIDTERM PROGRESS PRESENTATION

Implementing EQTransformer and creating a simpler model for earthquake detection in Indian subcontinent

GROUP 4

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Project Overview

The proposed project was as follows:

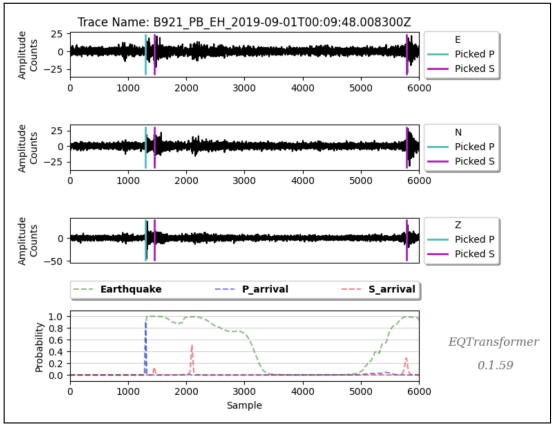
1. Implementing the EQTransformer package on labelled international data and replicating its claimed results.
2. Testing the pre-trained model's performance on an Indian dataset of in-plate cluster earthquakes.
3. Tuning the model's hyper-parameters to improve its performance for the Indian dataset.
4. Training a new classification model, where the training data is optimized for Indian data using domain knowledge and trying to approach EQT's efficiency for the Indian subcontinent.

Note: Our MidSem goals included the first three points, along with the relevant literature review.

Midsemester Progress

1. Extensive literature review completed, focused on two aspects:
   - Domain knowledge: Learning the principal *features* used for the manual annotation of seismic waveforms.
   - EQTransformer: Learning the logic behind the codes in the EQT package.
2. Numerous (yes, numerous 🥲) dependency clashes resolved in the installation of the EQTransformer package.
3. EQTransformer applied successfully on international data on the Lingaraj system, positive results successfully replicated.
4. We are in the process of obtaining the novel labelled Indian dataset on the Palghar cluster in-plate earthquakes from Dr. Pathikrit's Lab, at the *School of Earth and Planetary Sciences, NISER*.

Obtained Results



- This open-source data was obtained from B921 seismic station in California, (collected on *September 9, 2019*).
- The adjoining data is a 60-second strip of the entire data where the EQT model has been implemented.
- The cyan and magenta lines show the times of arrival of the P and S waves, respectively.
- The bottom-most graph shows the probability of arrival against time, i.e. the confidence the model has in its prediction.

Future Plans

1. Testing the efficiency of the trained EQT model on the obtained Indian cluster earthquake data.
2. Tuning the hyper-parameters to improve efficiency for the Indian data. *(We may need to over-sample, if needed, due to scarcity of Indian data points).*
3. Considering it as the golden standard, developing another classification-based model and trying to approach the efficiency of the optimized EQT, especially for the Indian (here, Palghar, Maharashtra) context.

References

References:

1. Earthquake transformeran attentive deep-learning model for simultaneous earthquake detection and phase picking, SM Mousavi, WL Ellsworth, W Zhu, LY Chuang, GC Beroza, Nature Communications 11 (1), 1-12.
2. Earthquake detection and P-wave arrival time picking using capsule neural network. Saad, and Chen. IEEE Transactions on Geoscience and Remote Sensing, 59(7), 6234-6243.
3. A machinelearning approach for earthquake magnitude estimation, SM Mousavi, GC Beroza, Geophysical Research Letters 47 (1), e2019GL085976.
4. Attention is all you need. A Vaswani et. al. *Google Research*, Aug 2017, https://doi.org/10.48550/arXiv.1706.03762.