Signal recognition and machine learning

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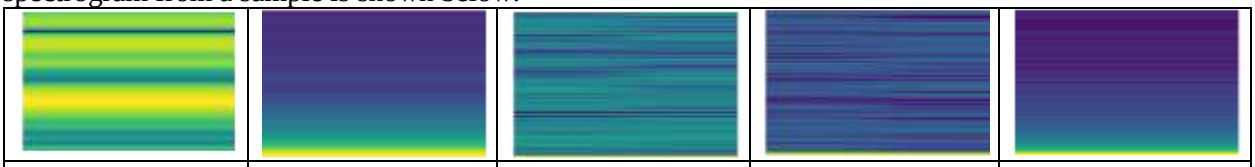
Introduction:

The final project is on the machine learning of signal recognition. As described in the data, the training set contains 10000 files. The total amount of samples is 105052 together with the background signal. Due to the limit of my device, only 20,000 data were chosen for the training. The data features are listed below.

	# Sample	Class 0	Class 1	Class 2	Class 3	Class 4
Full train data	*105,052*	*49,544*	*13,536*	*14,094*	*13,983*	*13,895*
Selected train data	*20,000*	*9,433*	*2,638*	*2,740*	*2,589*	*2,600*

Data treatment

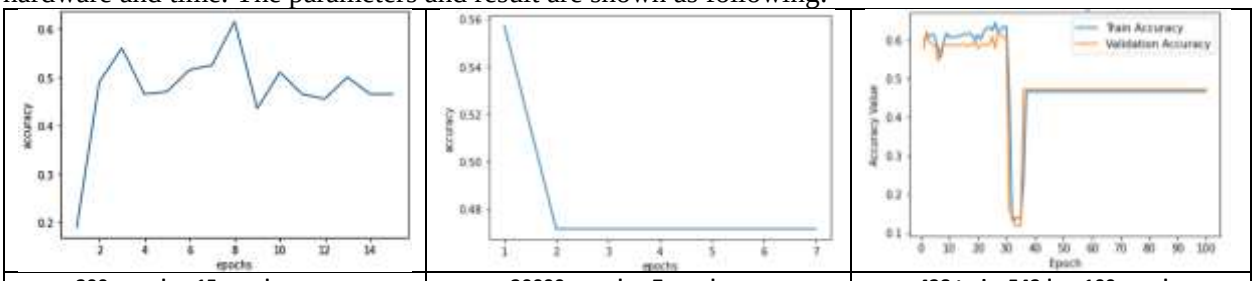
The univariate time series sample were normalized and transferred into a 3-dimensional data, and each 30 data was plotted into a spectrogram. Time runs from left (oldest) to right (youngest) along the horizontal axis. Each of the volcano and earthquake sub-groups of spectrograms shows 10 data. For each class, a spectrogram from a sample is shown below.



Class 0	Class 1	Class 2	Class 3	Class 4

Algorithm Description:

The conventional neural network (CNN) was used in this project to analyze the visual imagery from the treated univariate time series data. In this project, the rectified linear unit (ReLU) was used as activation function for the CNN. 3 convolutional layers were set followed by 3 pooling layers to reduce the dimensions of data by combining the outputs of neuron clusters at one layer into a single neuron in the next layer. Different combinations of parameters were tried to optimize the result with the limited resource, both in hardware and time. The parameters and result are shown as following:



200 samples, 15 epochs	20000 samples, 7 epochs	438 train, 543dev, 100 epochs

Results:

The error rate is calculated by comparing the disagreement between the prediction and the labeled result.

Accuracy rate	Data Set		
Algorithm	**Train**	**Dev Test**	**Eval**
CNN_image recoganization	0.65	0.58	-

Table 1. Accuracy rate of the training and devaluation dataset.

Conclusions:

Theocratically, the CNN together with the image processing should result in a great accuracy rate. However, my result is not as good. In order to further improve the result, it will be great to first segment the peaks and then resample the data again. Also, the time window for both training and prediction will influence the final result, which can be further improved.