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"Forecasting Wavelet Transformed Time Series with Attentive Neural Networks" - Zhao et. al (2018)

This approach is inspired by the idea that stock price time series are complex, and need more than just time-domain information to predict. Frequency-domain information is also useful here. Fourier Transform is a common tool used for this, but it assumes data is stationary, which financial time series are not. Thus, Wavelet Transform is used, which is a process similar to Short Term Fourier Transform, but capable of analyzing different signals at different frequencies. By using a Wavelet Transform, one can then use all time-frequency data, rather than just time data, to inform a predictive model trained on financial time series data.

The wavelets used here take the form $h_{a,\tau} = \frac{1}{\sqrt{|a|}} h(\frac{t-\tau}{a})$, where a represents scale (determining whether to expand or contract 'mother' wavelet), while τ controls location of the wavelet (shifts along time axis). A Continuous Wavelet Transform then just maps the original series onto a function of a and τ defined by $\frac{1}{\sqrt{a}} \int x(t) \overline{h}(\frac{t-\tau}{a}) dt$. Through this process, the original time series is mapped into scalogram (absolute value of CWT of a signal, by time and frequency) form through wavelet transformation.

This paper then used an Attentive Neural Network to predict future stock prices. Their Attentive Neural Network has four components: a CNN to extract local time-frequency features, an LSTM to learn long-term trends, an attention module (figure out importance of local features from the CNN), and a fusion/prediction step (that combines local and global features based on importance). They also provided standard Wavelet+LSTM, Wavelet+CNN, and Wavelet+LSTM/CNN ensemble methods for comparison.

The dataset used can be found at [this Github link](); it appears to have been taken from another paper, for which the link provides the Github repository used. The data includes High, Low, Close, Volume, Adj Close, and Open prices with daily resolution on the ten-year period between 2007 to 2016. It generates predictions for Apple, as well as 49 other major stock tickers.