

Chart Pattern Matching in Financial Trading Using RNN

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What Technical Traders Are Looking For

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Diversity Of The Pattern - All Downtrend

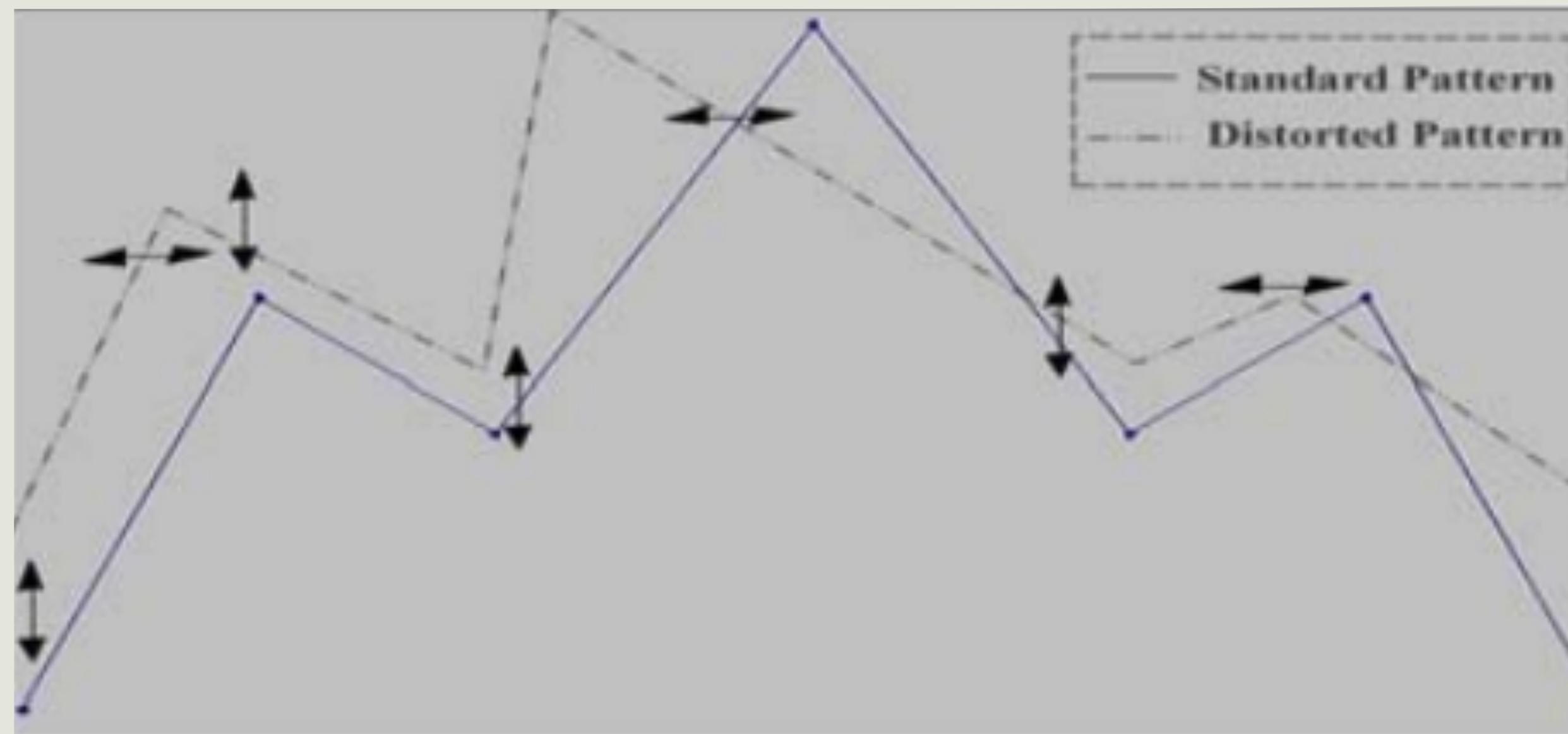
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Problem And Needs - Fuzzy Pattern Recognition

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- **Fuzzy Pattern Recognition for everyone**
 - Generalization (no hand crafted features)
 - Multiple time series (OHLC price + indicators)
 - Time scale, value scale, distortion

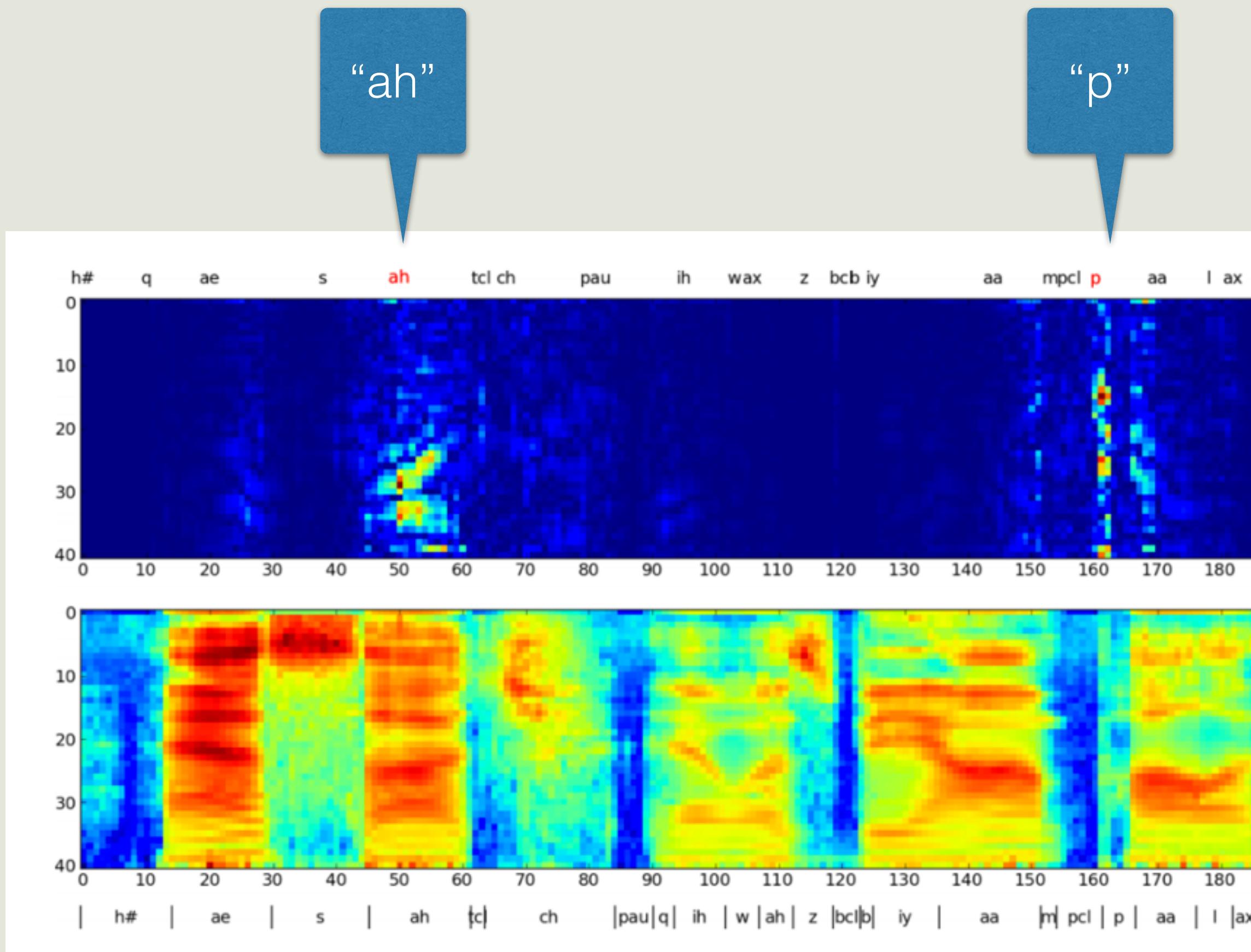


Broadening Bottoms	Broadening Formations, Right-Angled and Ascending	Broadening Formations, Right-Angled and Descending	Broadening Tops
Broadening Wedges, Ascending	Bump-and-Run Reversal Bottoms	Bump-and-Run Reversal Tops	Cup with Handle
Diamond Bottoms	Diamond Tops	Double Bottoms	Double Tops
Head-and-Shoulders, Top	Head-and-Shoulders, Bottoms	Triangles, Ascending	Triangles, Descending

James N.K. Liu *, Raymond W.M. Kwong : Automatic extraction and identification of chart patterns towards financial forecast, 2006

How To Solve The Problem?

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SPEECH RECOGNITION WITH DEEP RECURRENT NEURAL NETWORKS,
Hinton, et al. 2013

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Interactive Training Data Collection & Training

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EUR/USD

5M



Our Approach - Fuzzy Pattern Recognition without Programming

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- **Train by what you see & judge**
 - **No programming** nor conditional setting, but purely from charts like traders do
- **Multi-dimensional input**
 - Not only the single time-series data of price movement but also **various indicators altogether**



Experiments Deep Learning Based Approach

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• Network

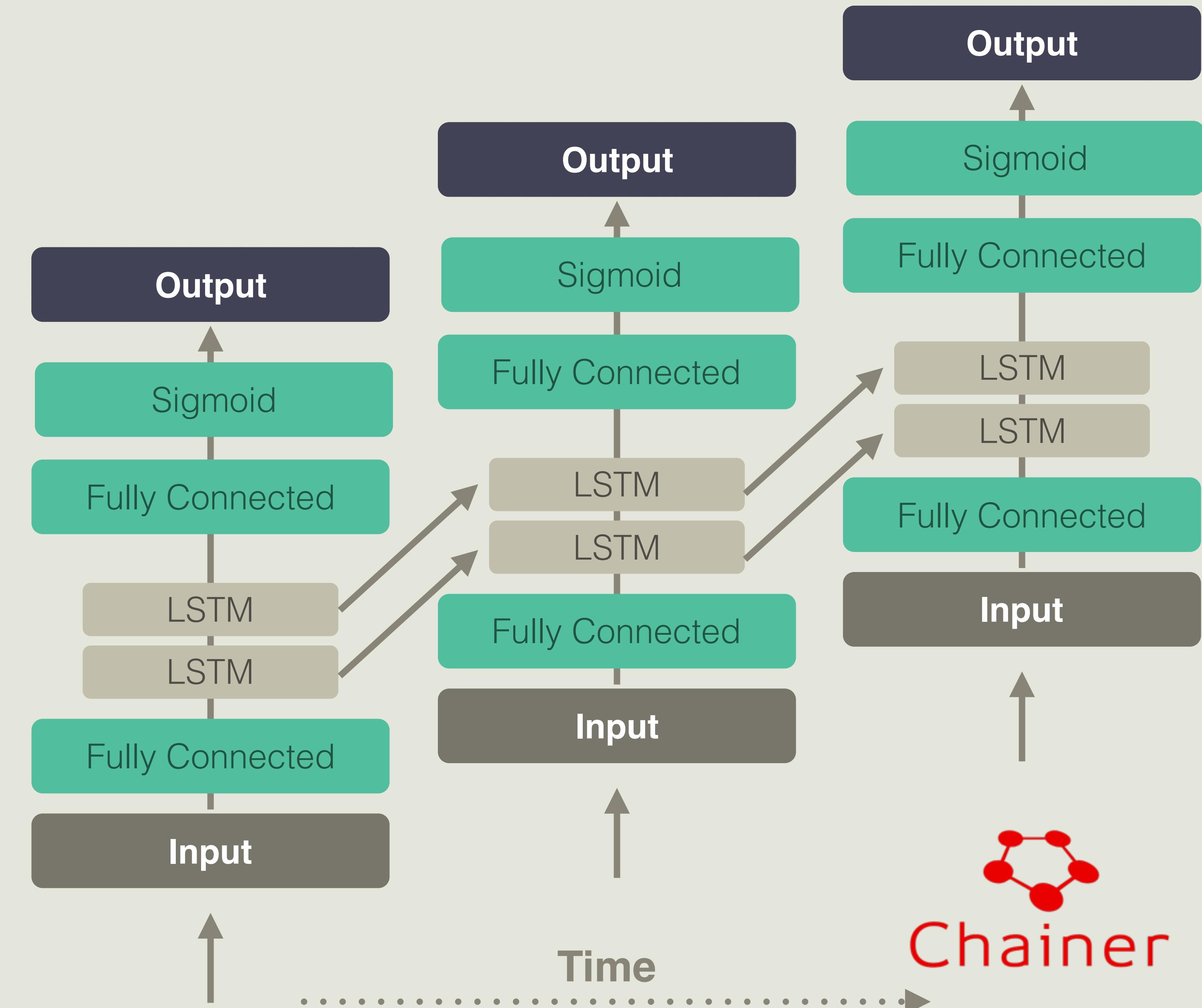
- **Input:**
 - N-dim Fully Connected Layer
 - LSTM Layer x 2 or 4 (x250 units)
 - Fully Connected Layer (x250 units)
 - Dropout
 - Sigmoid
- **Output:**
 - 1-dim confidence level

• Training

- Align with fixed number of candles
- Mean squared error for loss
- AdaDelta for optimizer
- BPTT through aligned length

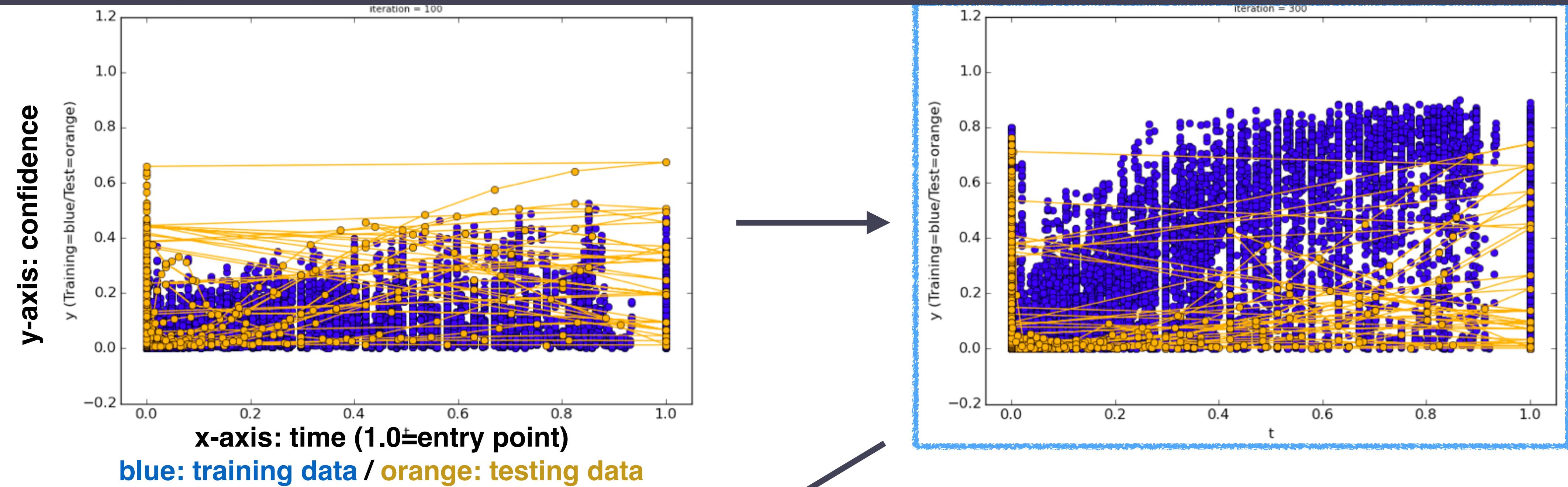
• Data

- 1k+ samples collected by experts
- about hundred instances for each strategy



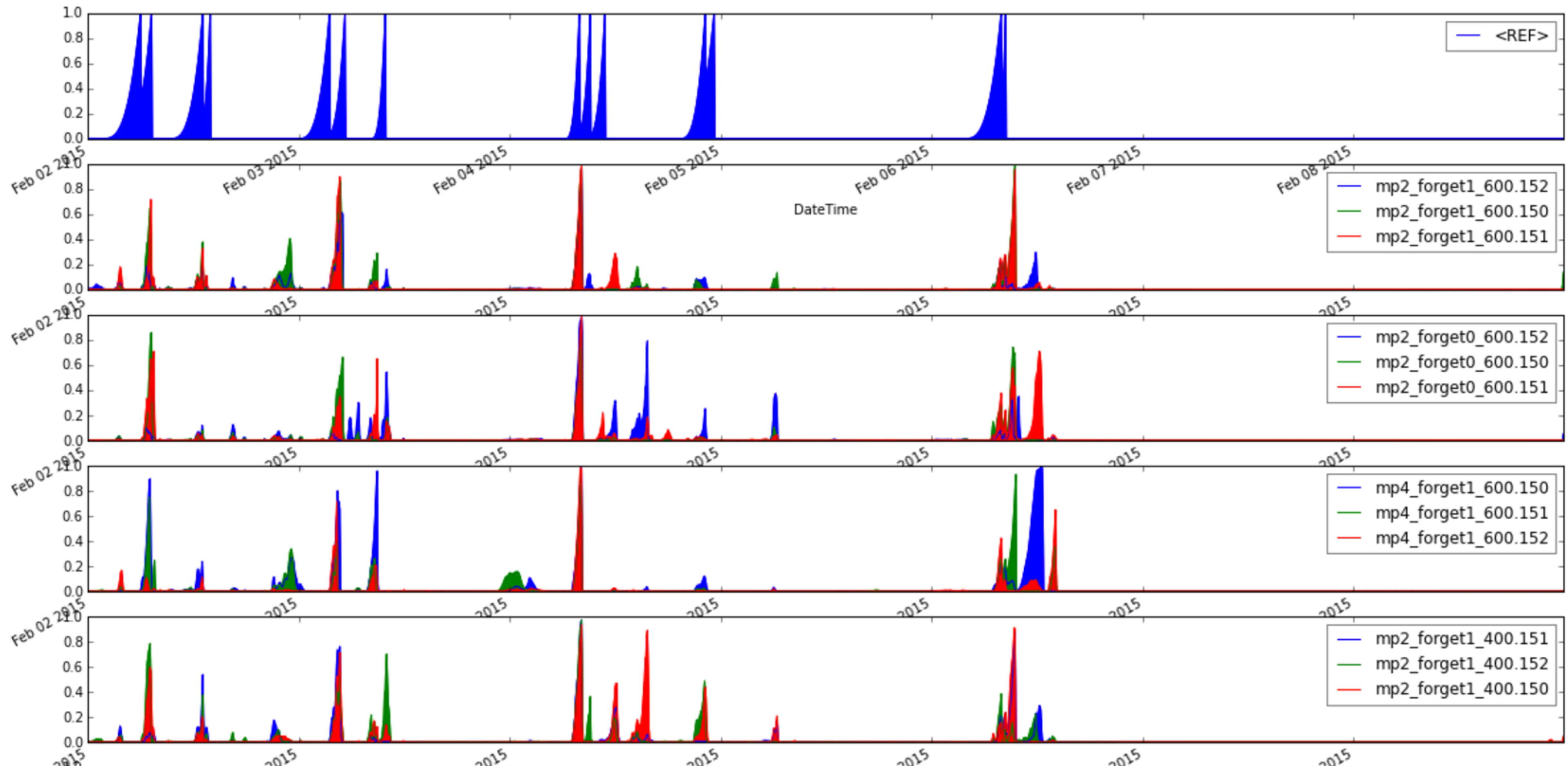
Experiments Fitting Reasonably

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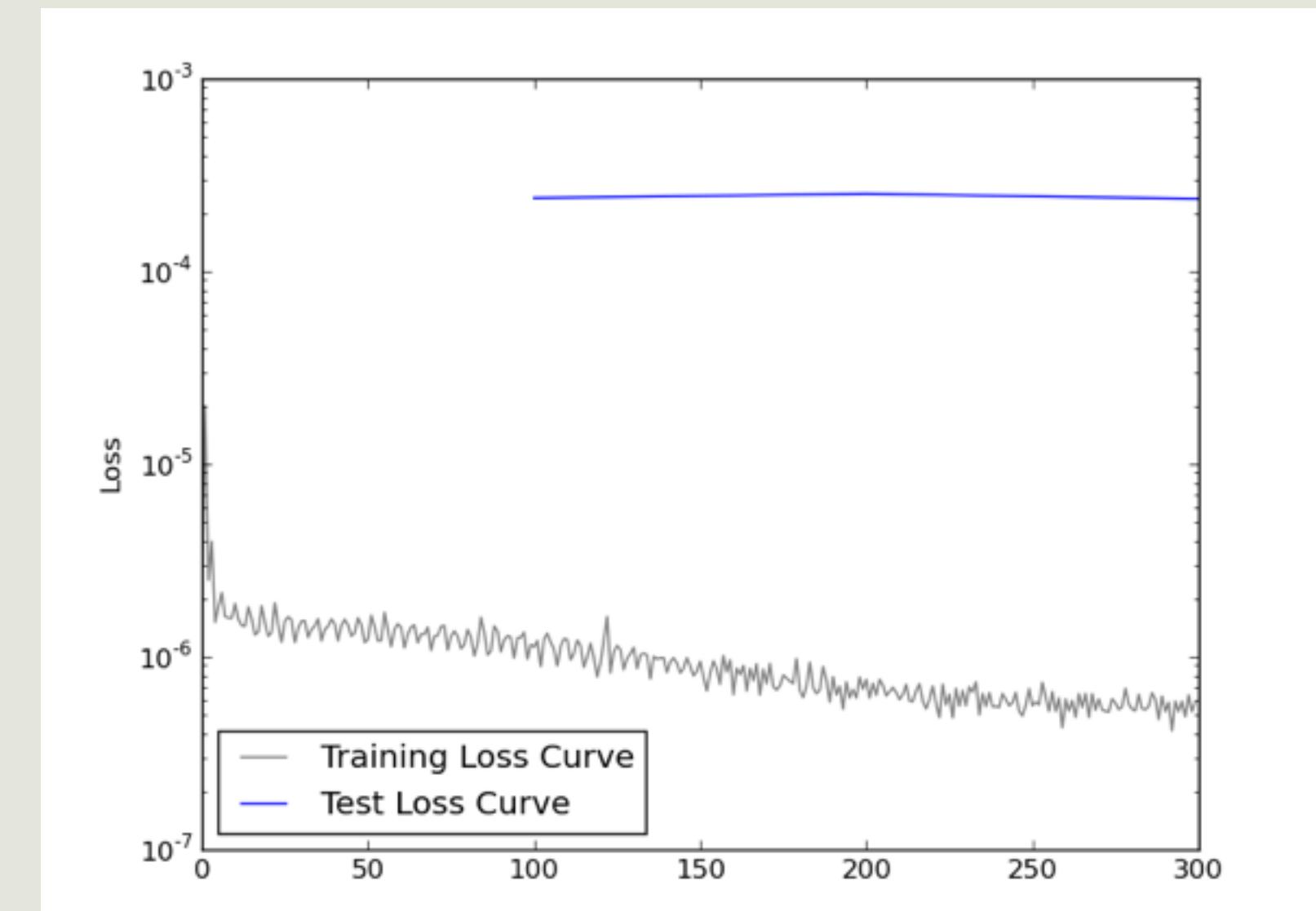
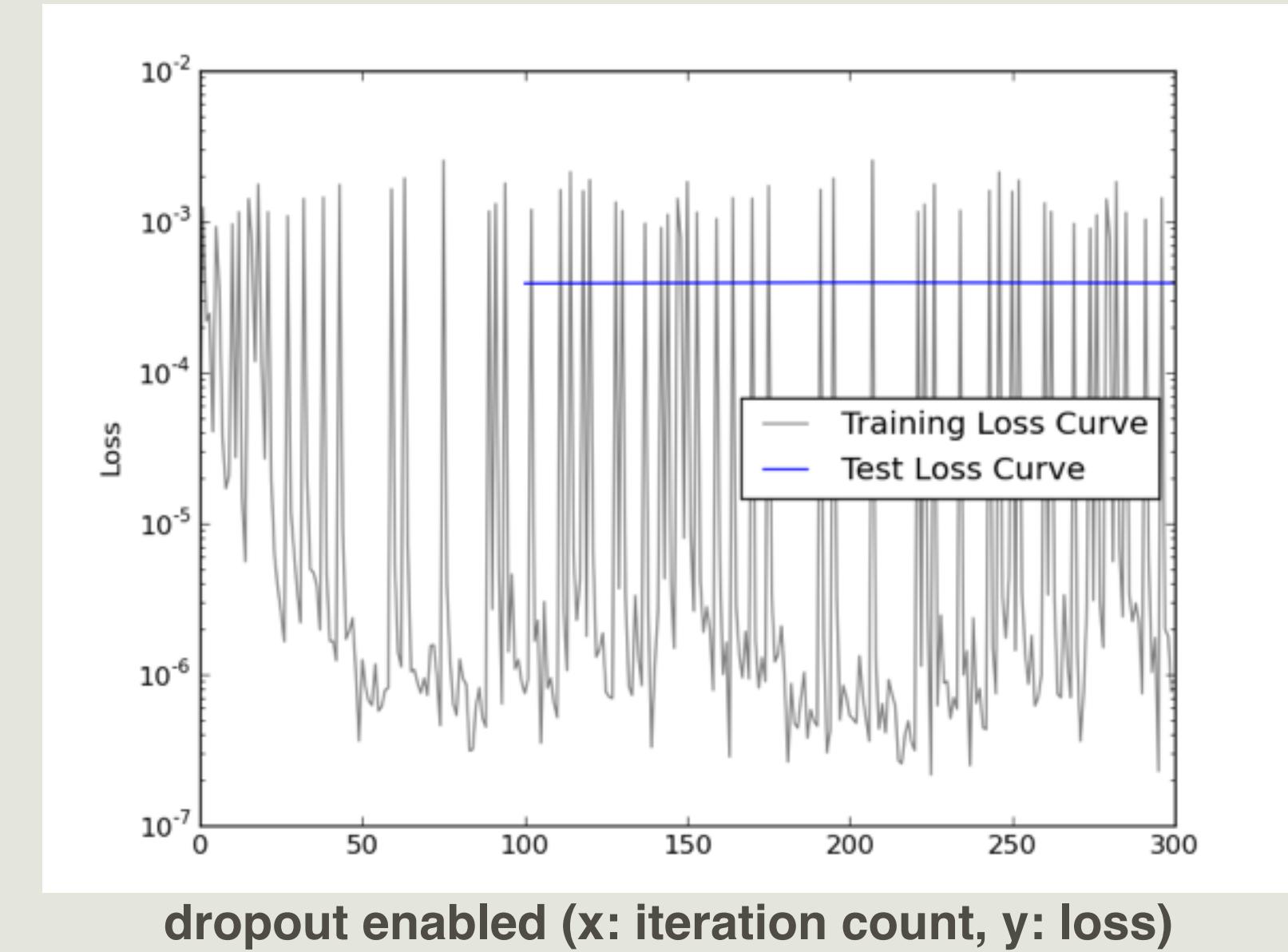
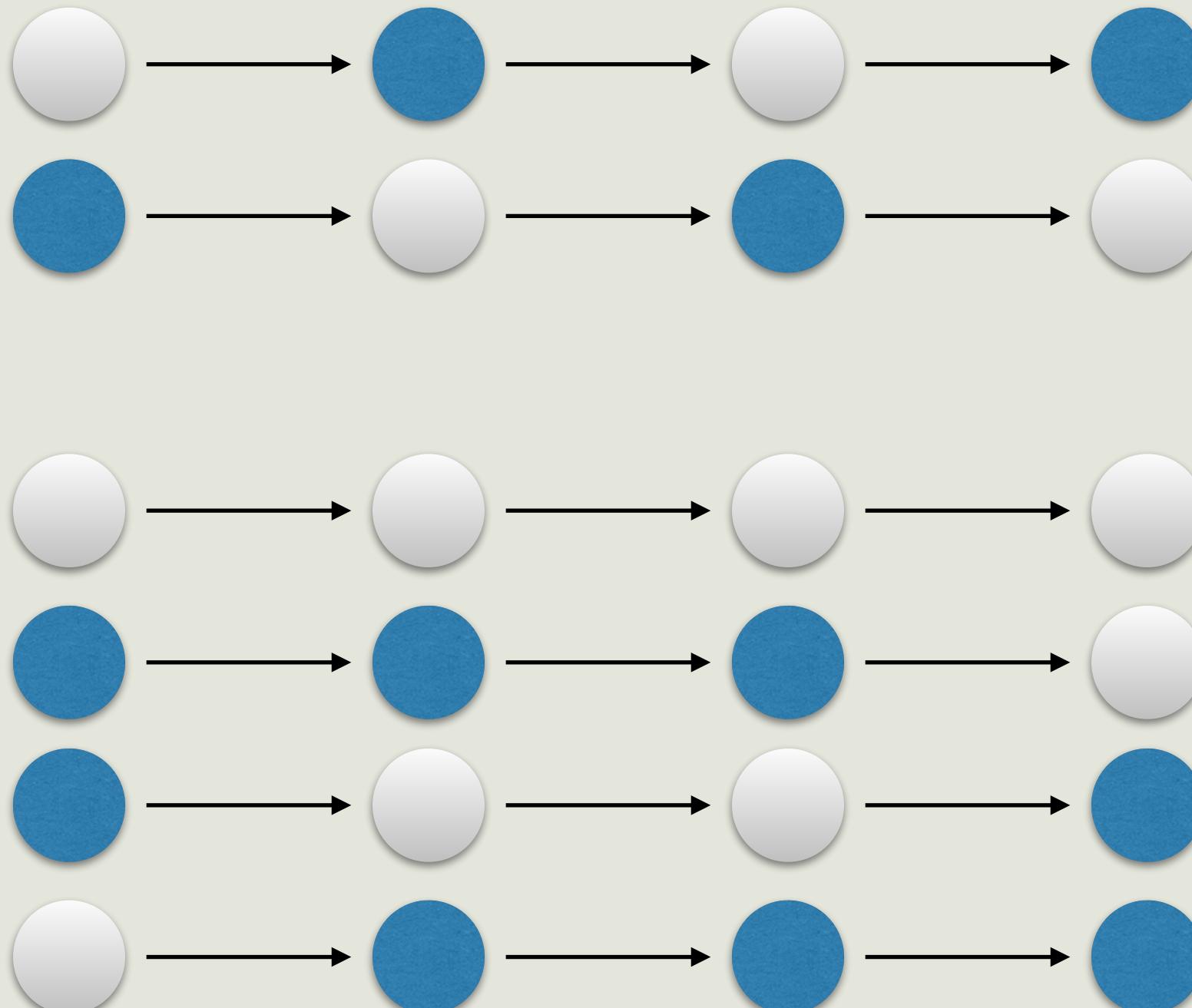


Experiments Framework

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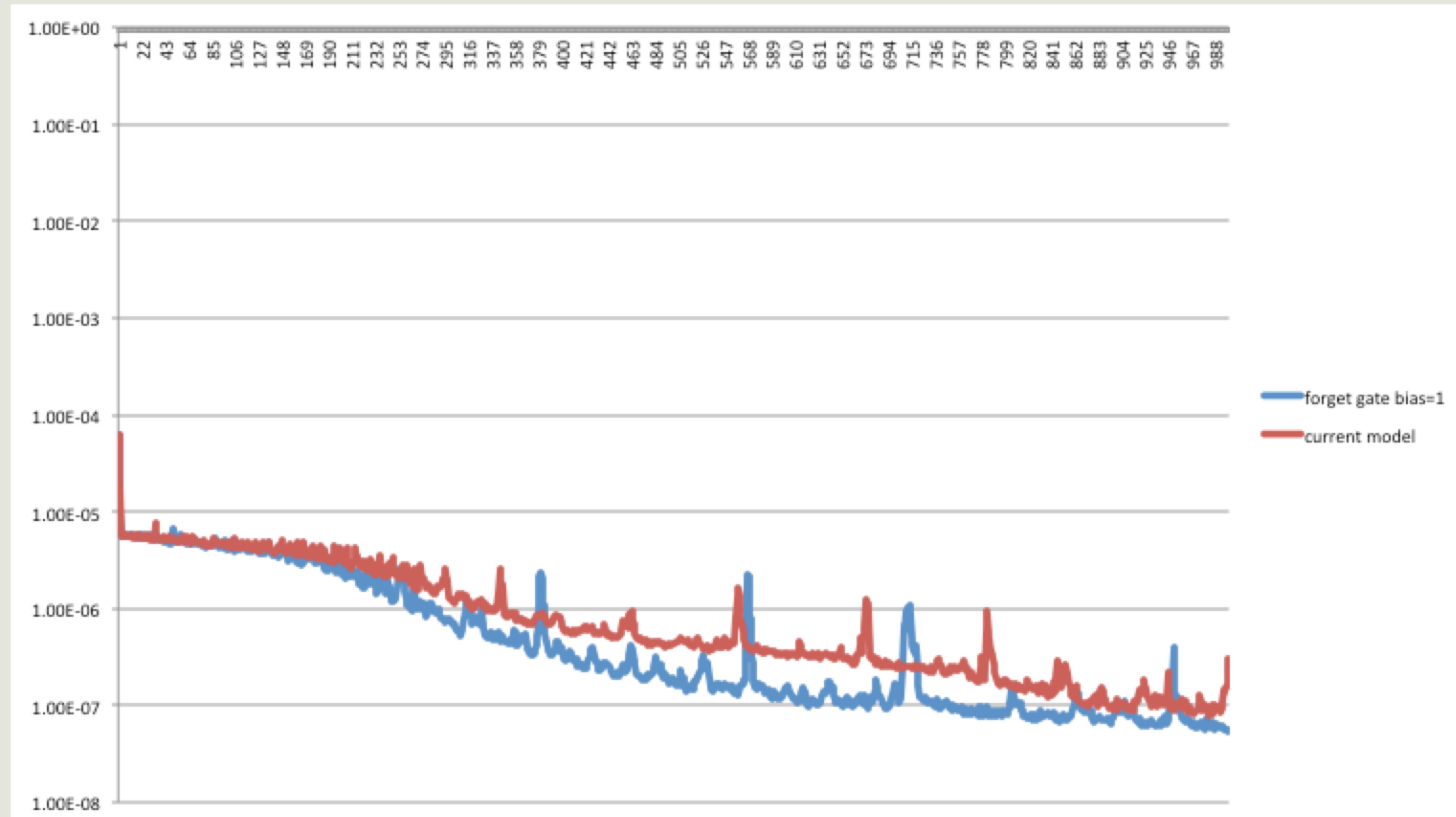


- **Dropout vs # of training samples**
 - Bigger Mini-Batches by looping samples
 - Made it Adaptive depending on importance



Forget Gate Bias (Learning To Forget: Continual Prediction With Lstm, Felix Et Al.)

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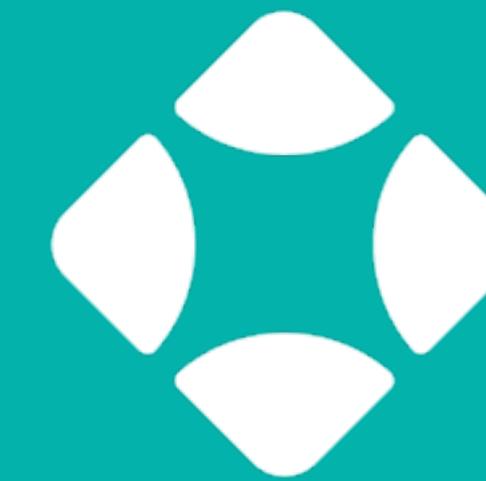


- **Dynamic Dropout**
- **Dynamic Batchsize**
- **Multi-GPU Training**
- **Other Frameworks like Keras**
- **GRU**
- **IRNN**
- **Lot more...**



- Previous studies have limitations to difficulty of feature crafting.
- LSTM based deep neural network fits well with individual patterns.
- LSTM-variant doesn't make much difference, but forget-gate bias, normalization, preprocessing, and modeling etc. matter
- Build better base model by pre-training
- Reinforcement Learning using profit and risk preference
- Visualize and rationalize LSTM decision making
- Generative Model

QUESTIONS AND ANSWERS



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CONVOLUTIONAL, LONG SHORT-TERM MEMORY, FULLY CONNECTED DEEP NEURAL NETWORKS

- **Model Training**

- **Takes around 10 minutes on a single GPU core**
- **Requires 2GB of GPU RAM**



- **Backtesting**

- **Calculate various metrics over the historical data**



- **Livetesting**

- **Thousands of models need to monitor live candles and update the state of LSTM**

Need For Distributed Computation

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