



TRAINING A NEURAL NETWORK CAPABLE OF PREDICTING A FINANCIAL MARKET

Individual Project Presentation

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BACKGROUND INFORMATION



ARTIFICIAL INTELLIGENCE

Programs with the ability to learn and reason like humans

MACHINE LEARNING

Algorithms with the ability to learn without being explicitly programmed

DEEP LEARNING

Subset of machine learning in which artificial neural networks adapt and learn from vast amounts of data

MACHINE LEARNING & NEURAL NETWORKS

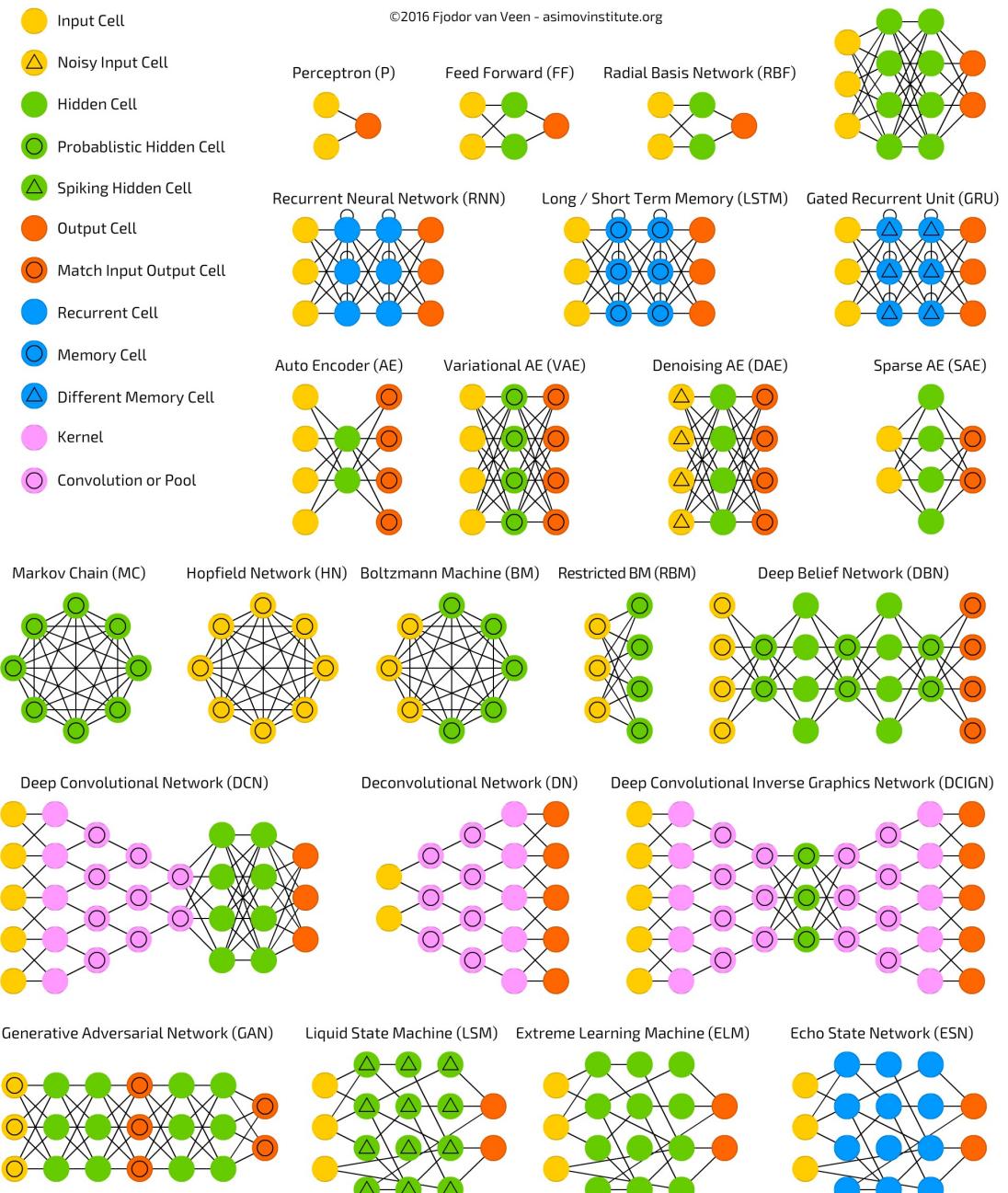
- “AI” - Gets Thrown Around a Lot!
- What is an (*Artificial*) Neural Network?
- A Network of “Weighted” Nodes.
- A Trained Prediction Model.

A mostly complete chart of

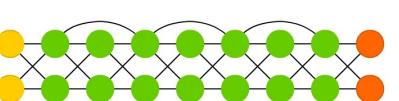
Neural Networks

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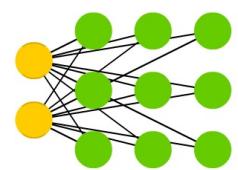
- Backfed Input Cell
- Input Cell
- △ Noisy Input Cell
- Hidden Cell
- Probabilistic Hidden Cell
- △ Spiking Hidden Cell
- Output Cell
- Match Input Output Cell
- Recurrent Cell
- Memory Cell
- △ Different Memory Cell
- Kernel
- Convolution or Pool



Deep Residual Network (DRN)

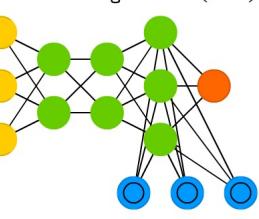


Kohonen Network (KN)



- A Large Selection of Topologies.
- Layers can be Mixed and Matched.
- Feed-Forward vs Recurrent Structure.

Neural Turing Machine (NTM)



MACHINE LEARNING & NEURAL NETWORKS

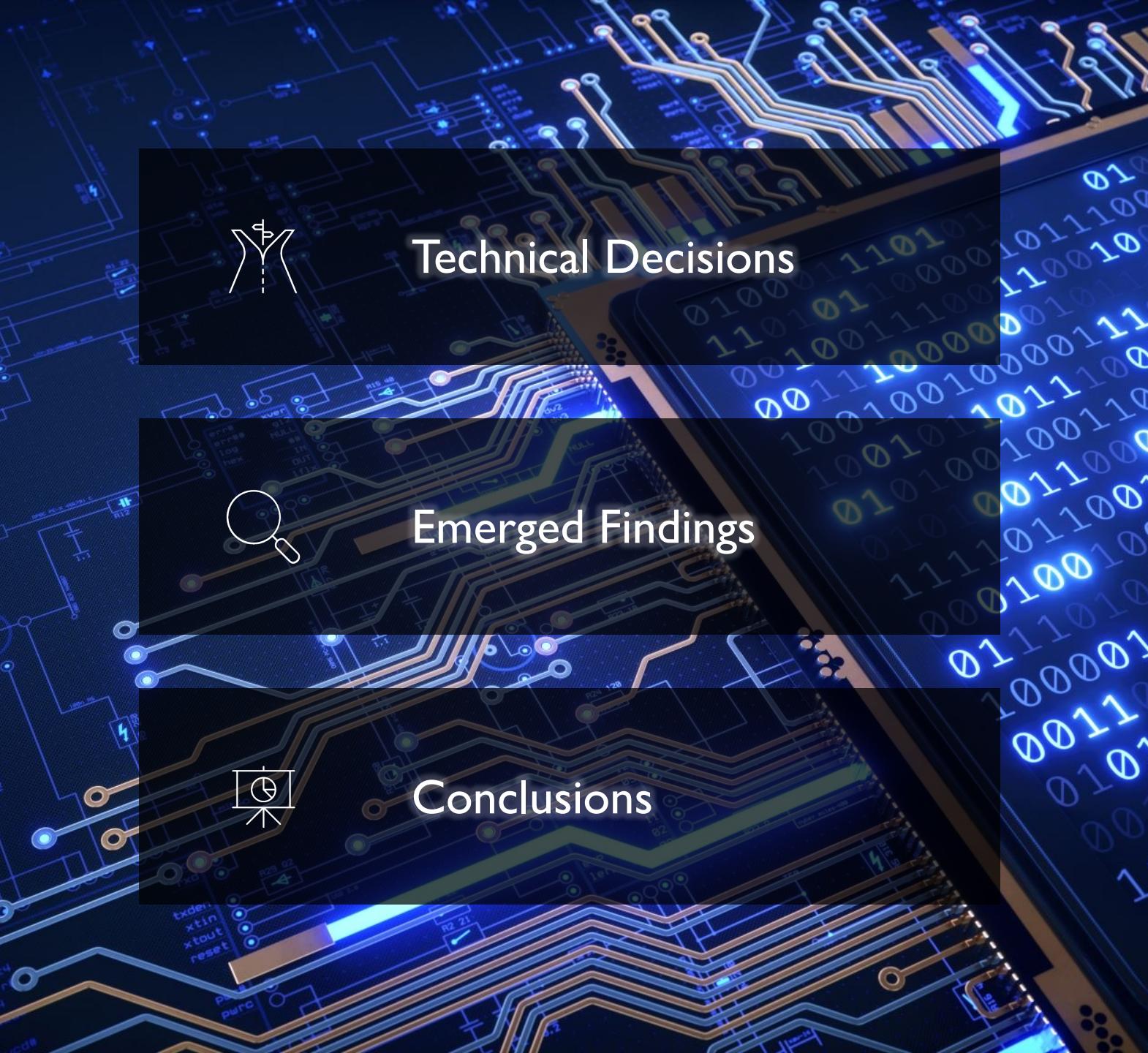
Financial Markets Overview



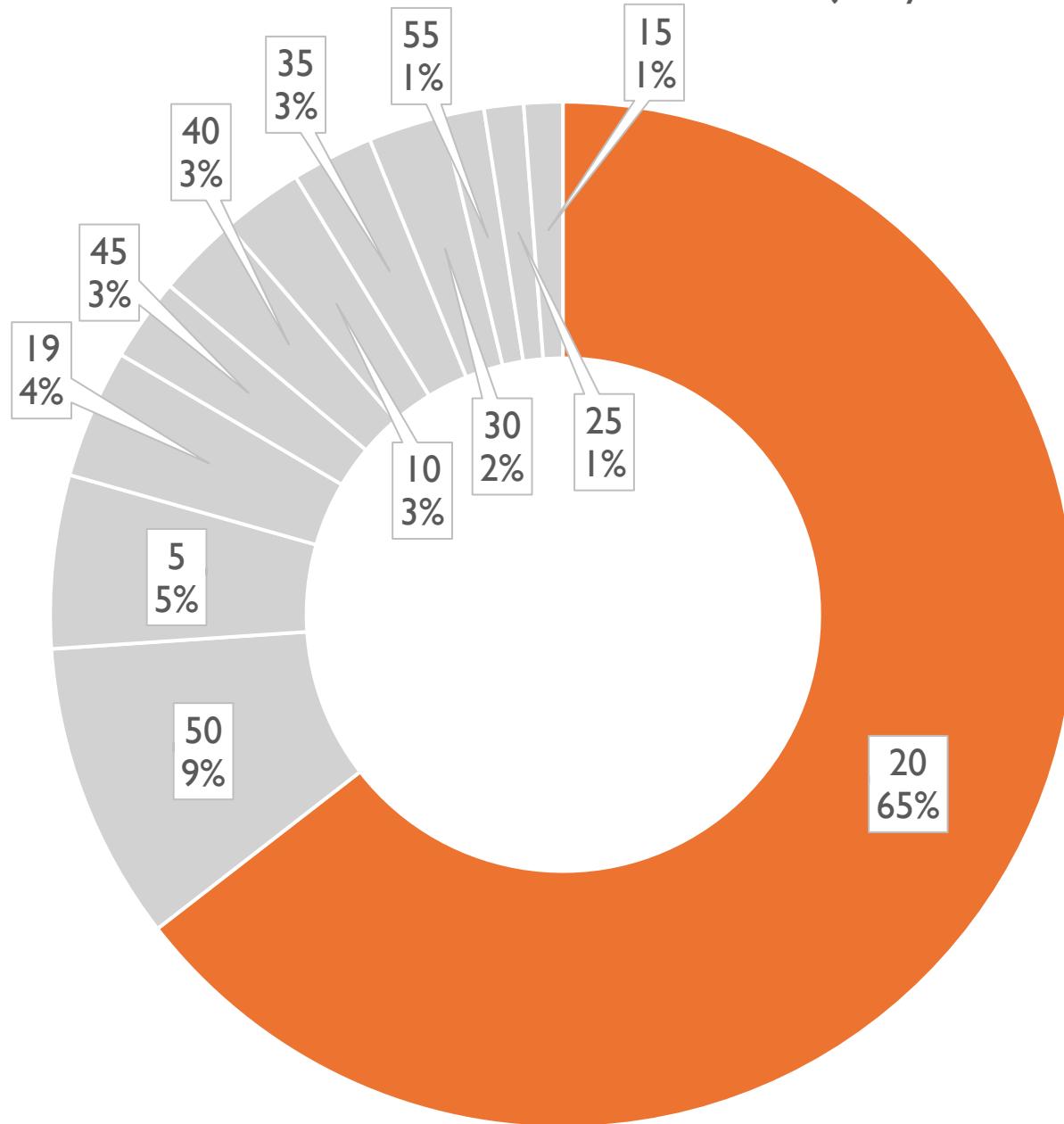
FINANCIAL MARKETS

- Not Just Stock Markets!
- Countless Exchanges Exist All Across the Globe.
- Speculation vs Investment.

PROJECT INFORMATION



Dataset Period: **20 Years** Accounts for the Majority of Tests.



TECHNICAL DECISIONS

I. PROJECT DECISIONS

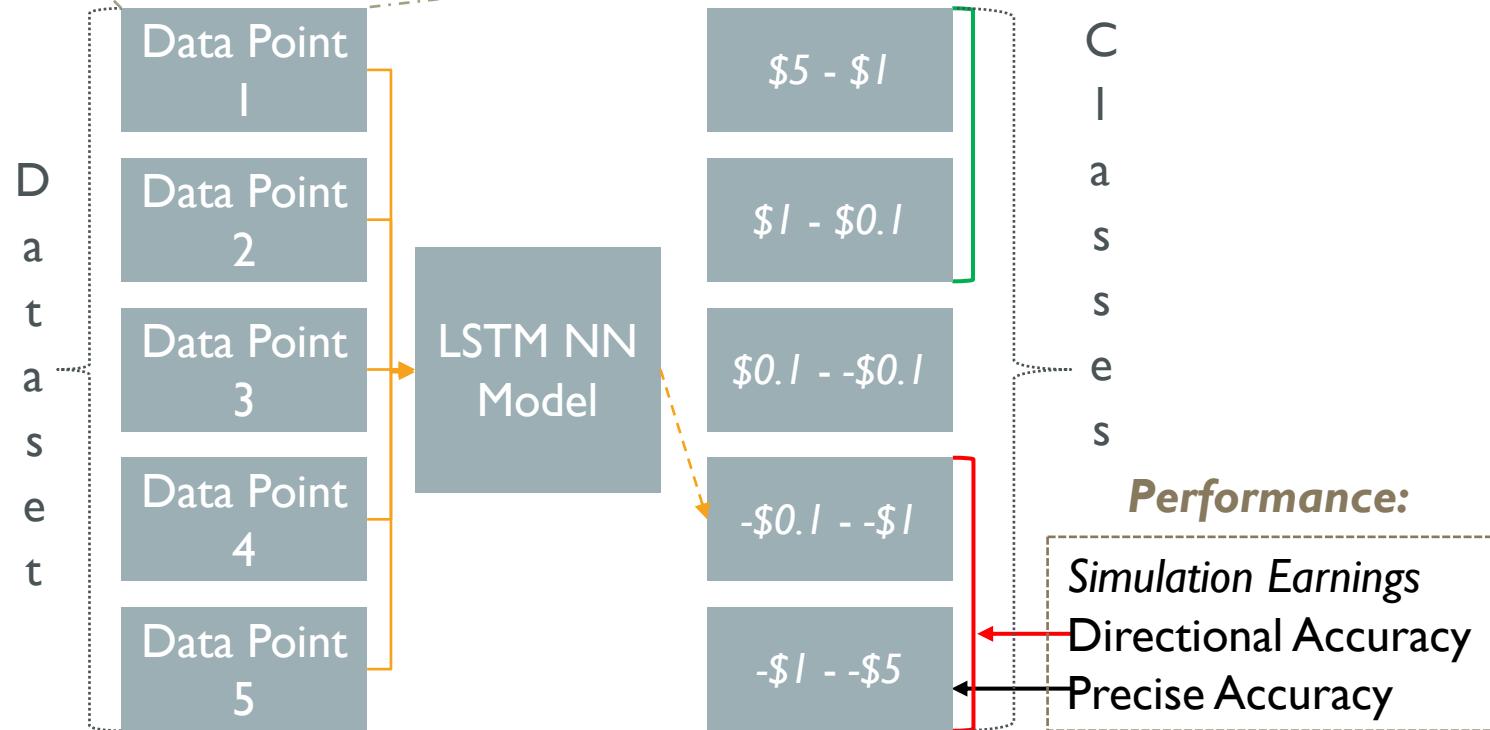
- MATLAB Environment.
- *Long Short-Term Memory* Architecture.
- Training Data from *Yahoo Finance*.

Sample Data Point:

	1 Var590	2 Var591	3 Var592	4 Var593	5 Var594	6
1 Year	2003	2003	2003	2003	2003	
2 Month	12	12	12	12	12	
3 Day	1	2	3	4	5	
4 EUR=X-\$Change	0.0048	-0.0088	-0.0023	0.0027	-0.0074	
5 EUR=X-\$Volatility	0.0067	0.0113	0.0036	0.0068	0.0085	
6 EUR=X-Open	0.8310	0.8361	0.8271	0.8251	0.8280	
7 EUR=X-Close	0.8358	0.8272	0.8249	0.8278	0.8206	
8 CAD=X-\$Change	0.0064	-0.0073	0.0034	0.0113	-0.0081	
9 CAD=X-\$Volatility	0.0077	0.0124	0.0072	0.0142	0.0123	
10 CAD=X-Open	1.2978	1.3039	1.2967	1.3001	1.3110	
11 CAD=X-Close	1.3042	1.2966	1.3001	1.3114	1.3029	
12						

Symbol

Window

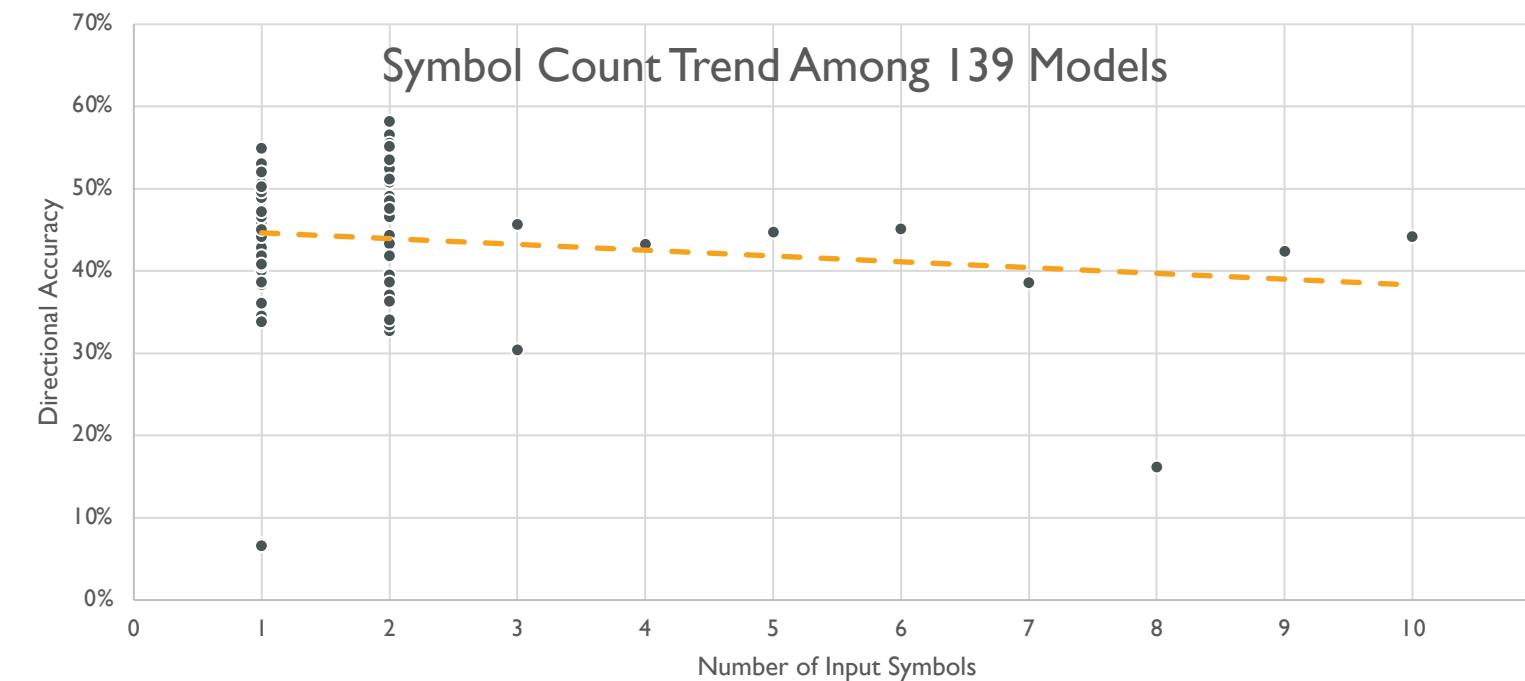
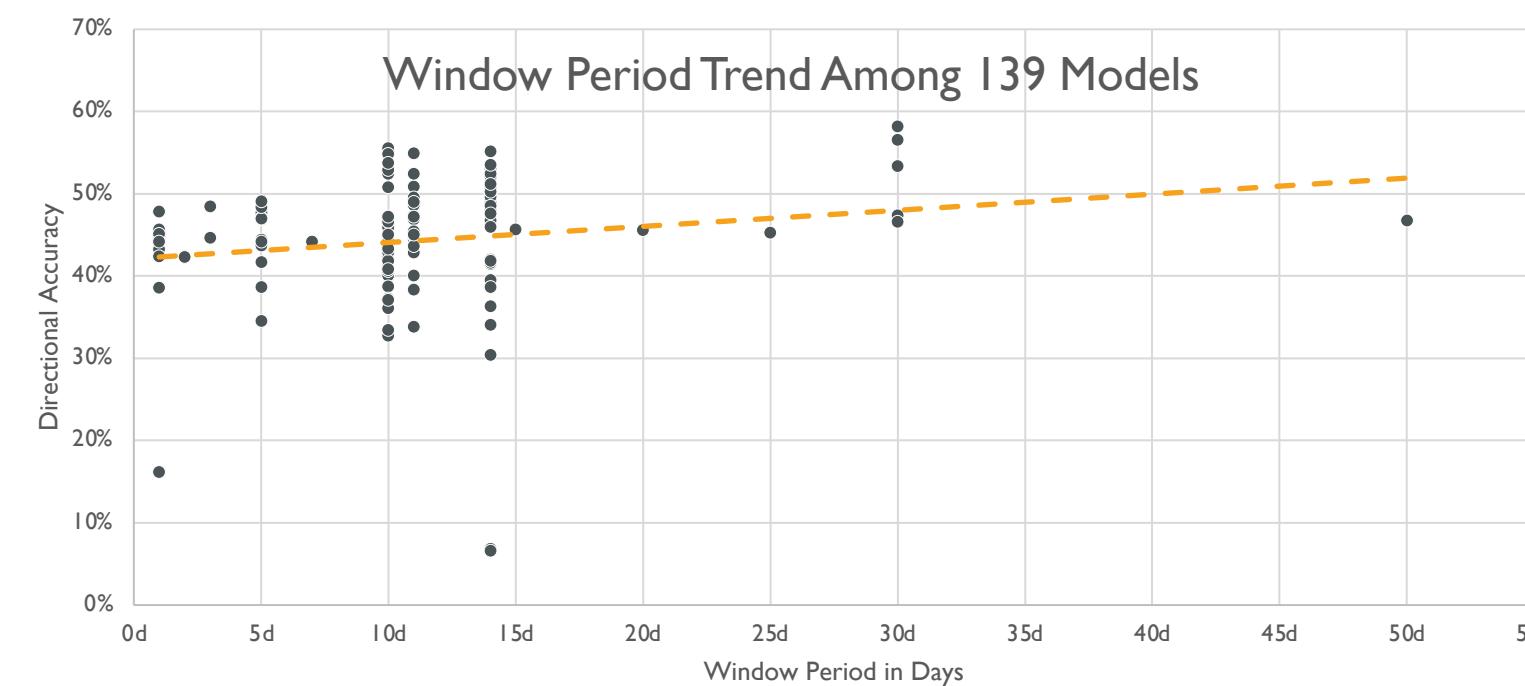


TECHNICAL DECISIONS

2. PERFORMANCE ASSESSMENT

- Precise Accuracy
- Directional Accuracy
- Simulation Earnings

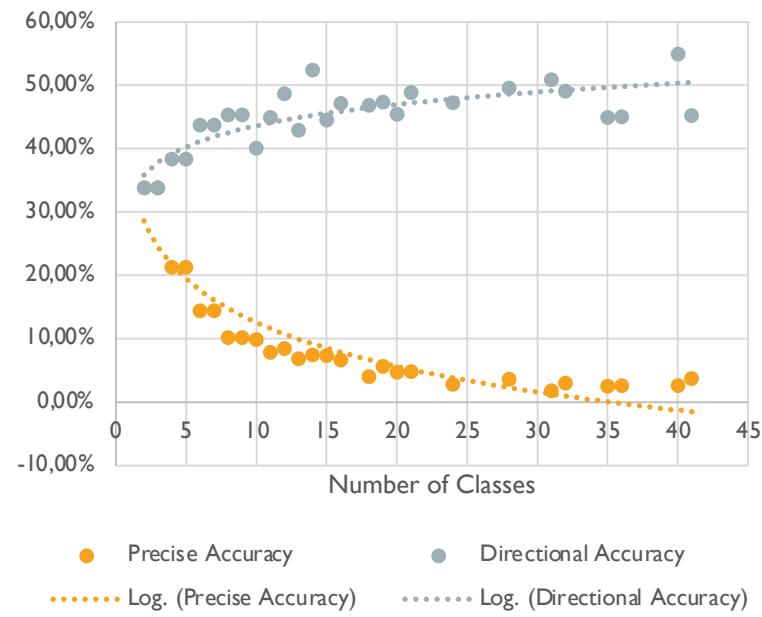
EMERGED FINDINGS



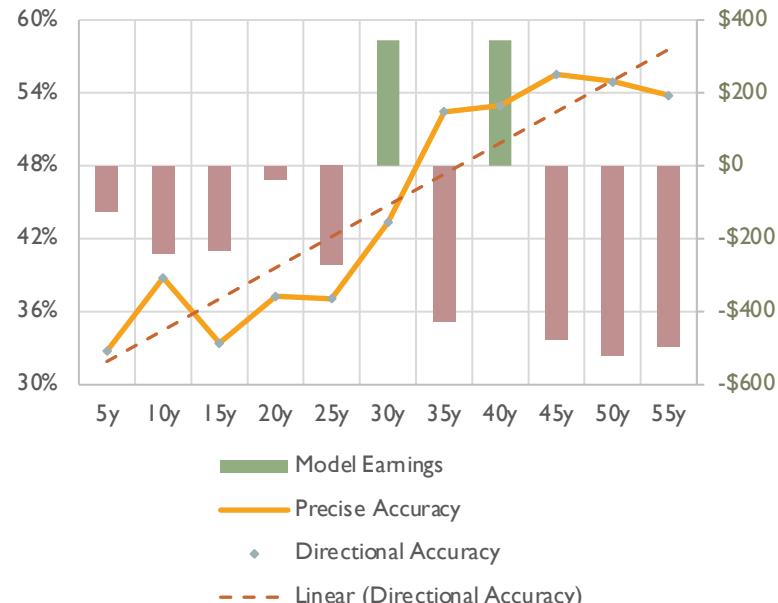
I. DATA POINT FINDINGS

- Dedicated *Window Period* Tests Indicated **3-14 Days** Perform Best.
- Symbol Count* Test Revealed **No Visible Change**.
- Overall Trends **Conflicted**.

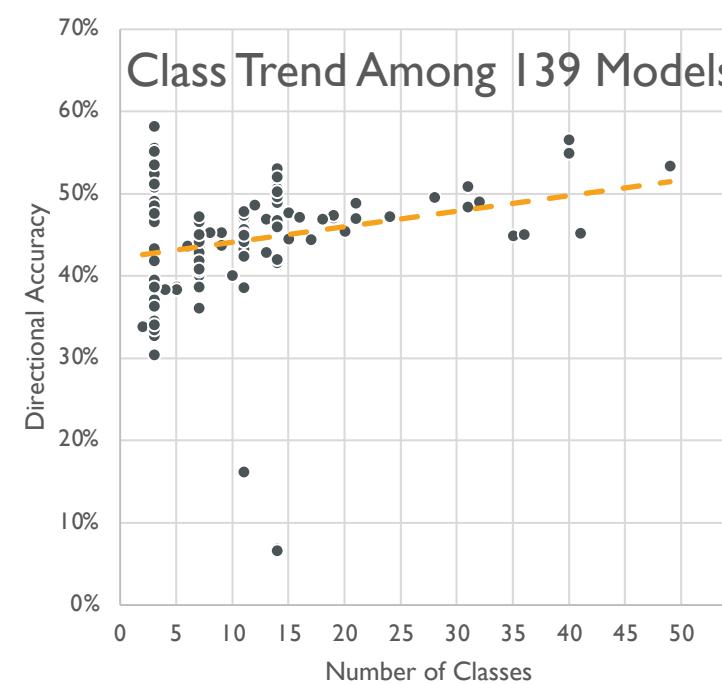
Dataset Class Test 2



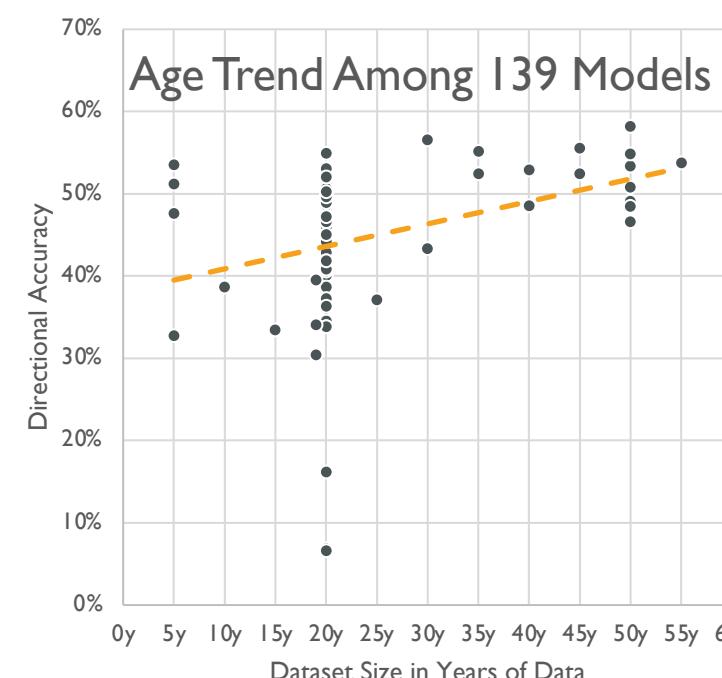
Dataset Size/Age Test



Class Trend Among 139 Models



Age Trend Among 139 Models

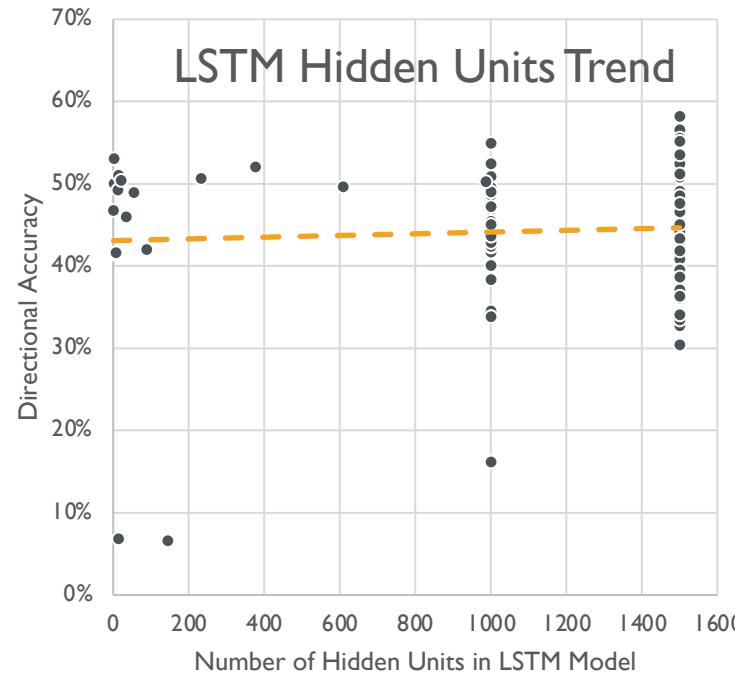
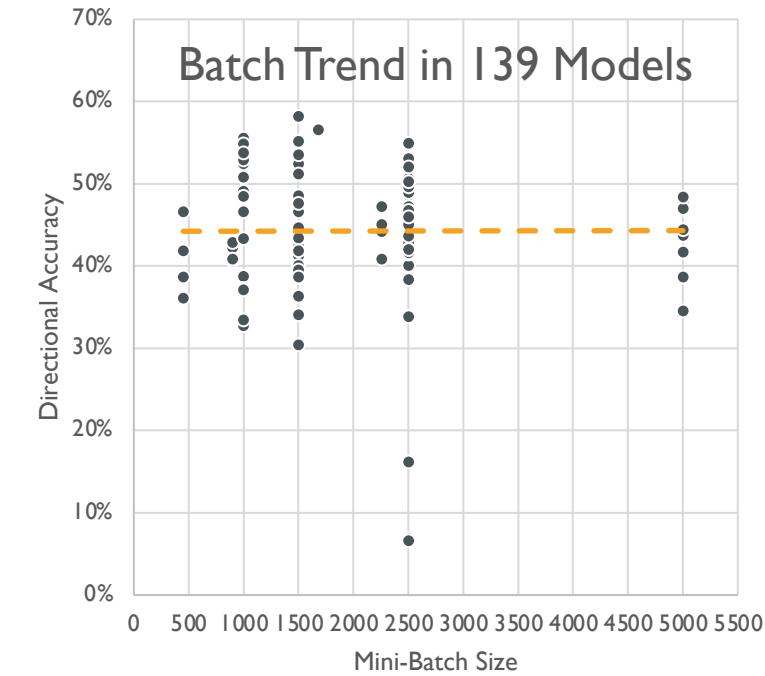
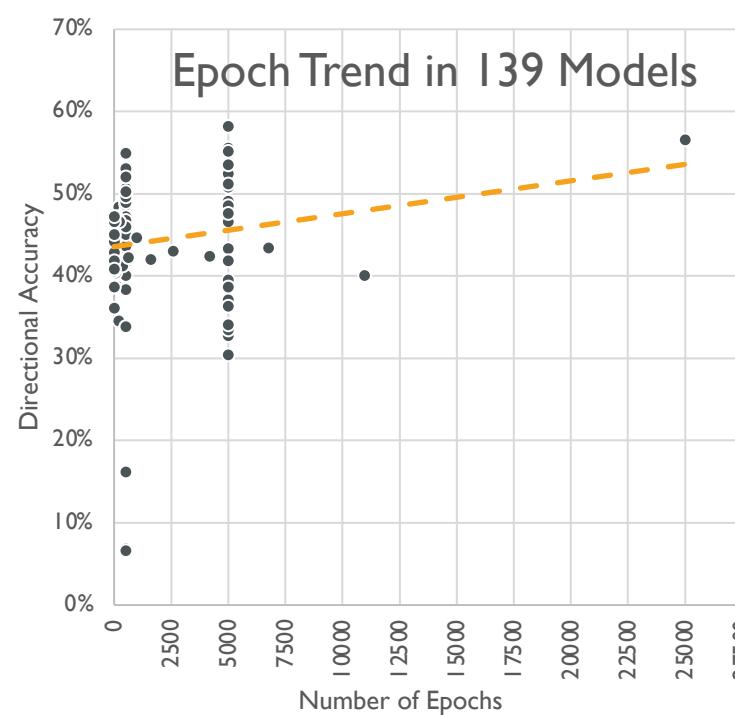
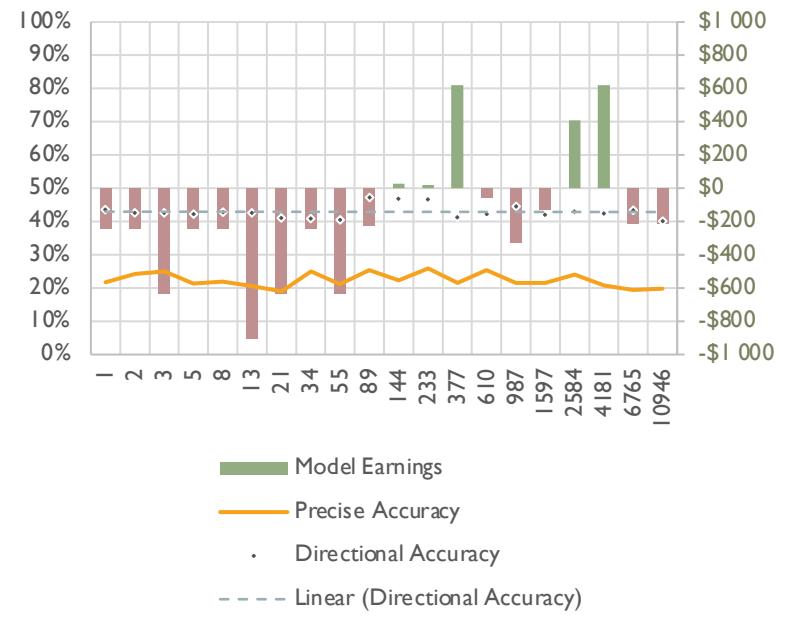


EMERGED
FINDINGS

2. DATASET FINDINGS

- Most of the *Number of Classes* Tests Indicated that **More is Better**.
- The Dedicated *Dataset Size/Age* Test Revealed that **Larger/Older Datasets Improve Models**.
- Overall Trends **Confirmed**.

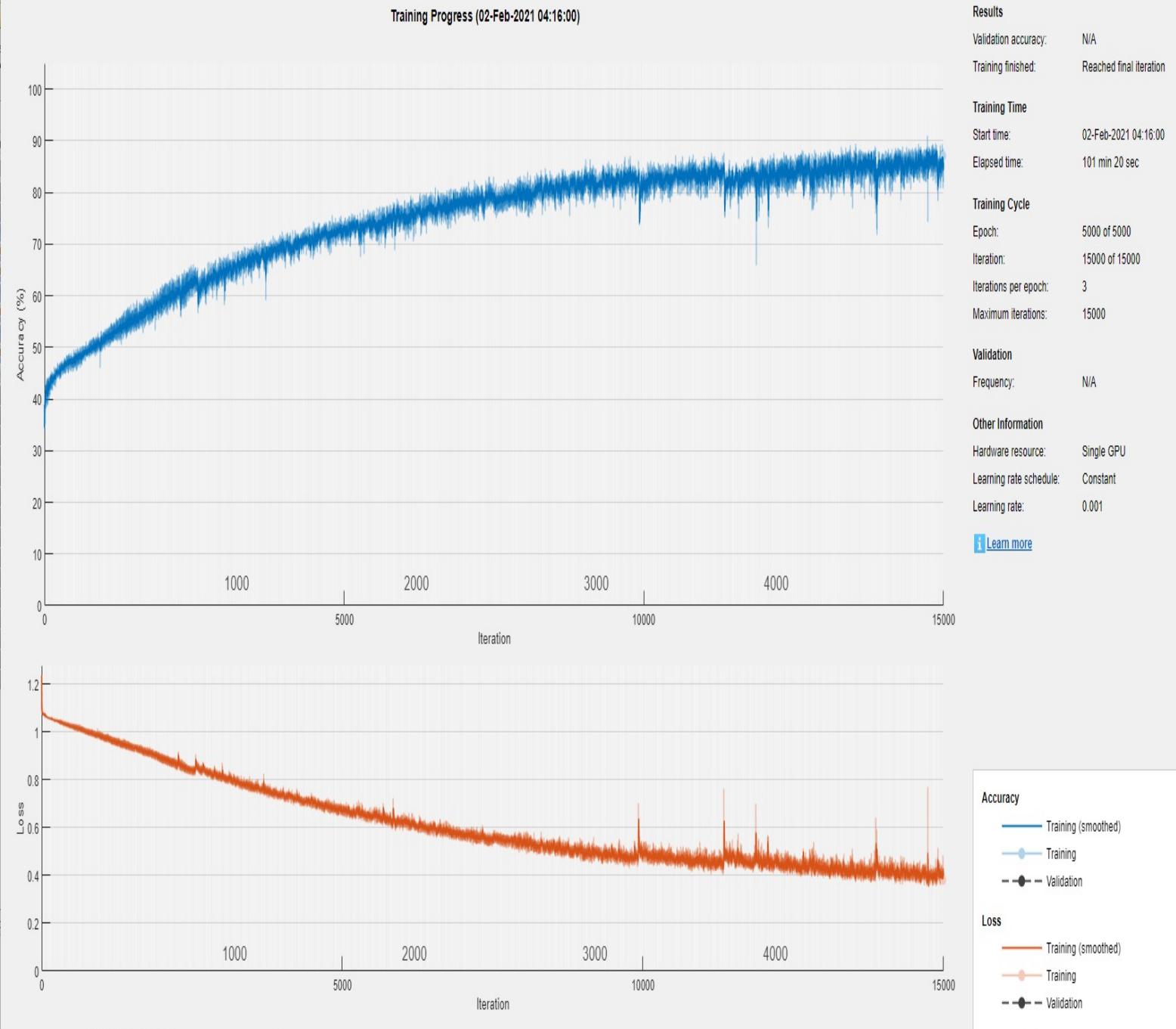
Epoch Test



EMERGED FINDINGS

3. MODEL TRAINING FINDINGS

- *Epoch Test Indicated Higher Earnings and the General Trend Confirmed.*
- *Experiments with Batch Size and LSTM Hidden Units Did Not Reveal Any Visible Changes.*
- *Batch Trend Confirmed, Very Minor Conflict with Hidden Units.*



CONCLUSIONS

I. TEST CONCLUSIONS

- *Input Window & Symbol Count* Require Further Investigation.
- *Large & Widely Classified Datasets* Create Better Models.
- *Batch Size Does Not Matter* at the End, but Increased *Epoch* is Vital.
- *Hidden Units* Remains Unclear.

No	Precise Accuracy	Directional Accuracy	Model Earnings
Top 5	110	58,17%	58,17% \$125,33
	109	4,41%	56,55% -\$112,55
	125	55,53%	55,53% -\$475,45
	128	55,14%	55,14% \$404,21
	59	2,65%	54,92% -
Average	106,2	35,18%	56,06% -\$14,62
Bottom 5	72	6,72%	6,59% -
	66	6,85%	6,85% -
	30	11,34%	16,17% -
	133	30,65%	30,41% -\$0,02
	117	32,77%	32,77% -\$124,84
Average	83,6	17,67%	18,56% -\$62,43

CONCLUSIONS

2. PROJECT CONCLUSIONS

- So... Can We Build a NN to Predict a Financial Market?
- Cliché Conclusion: Yes & No.
- “*The determining trait of the enterprising investor is his willingness to devote time and care...*” – B. Graham



THANK YOU

Questions?

Comments?

Suggestions?