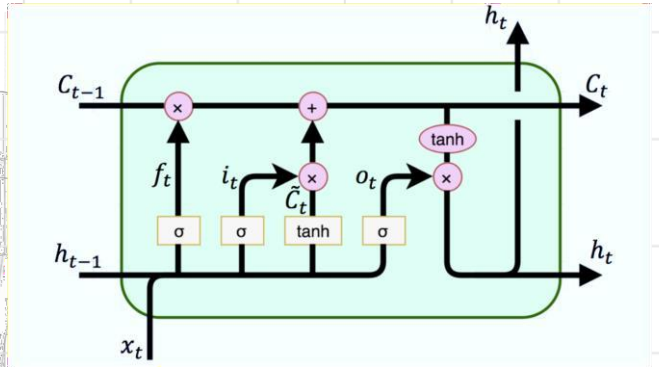
#38 Hybrid algorithm for predicting stock prices



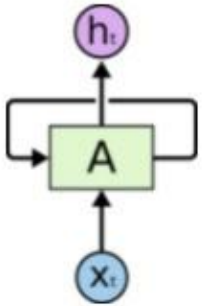
Qiskit Advocate Mentorship Program - Spring 2022

Mentor: Alberto Maldonado

Co-Mentor: Robert Laredo

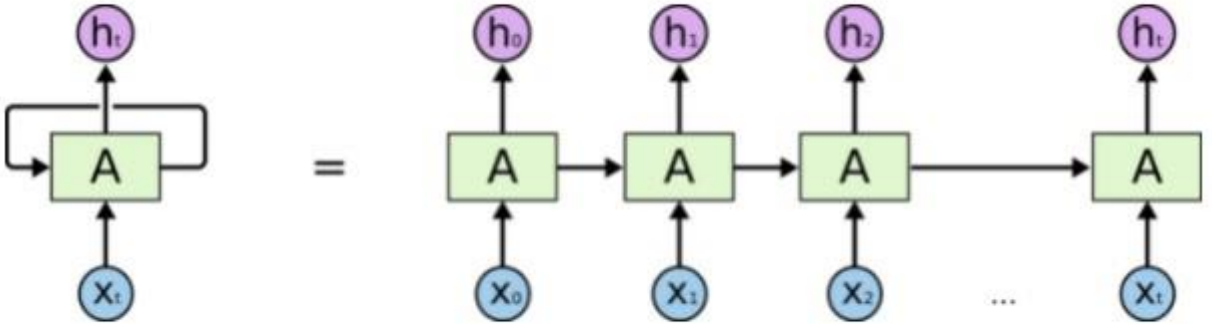
Mentees: Siddhartha Morales

Recurrent Neural Networks



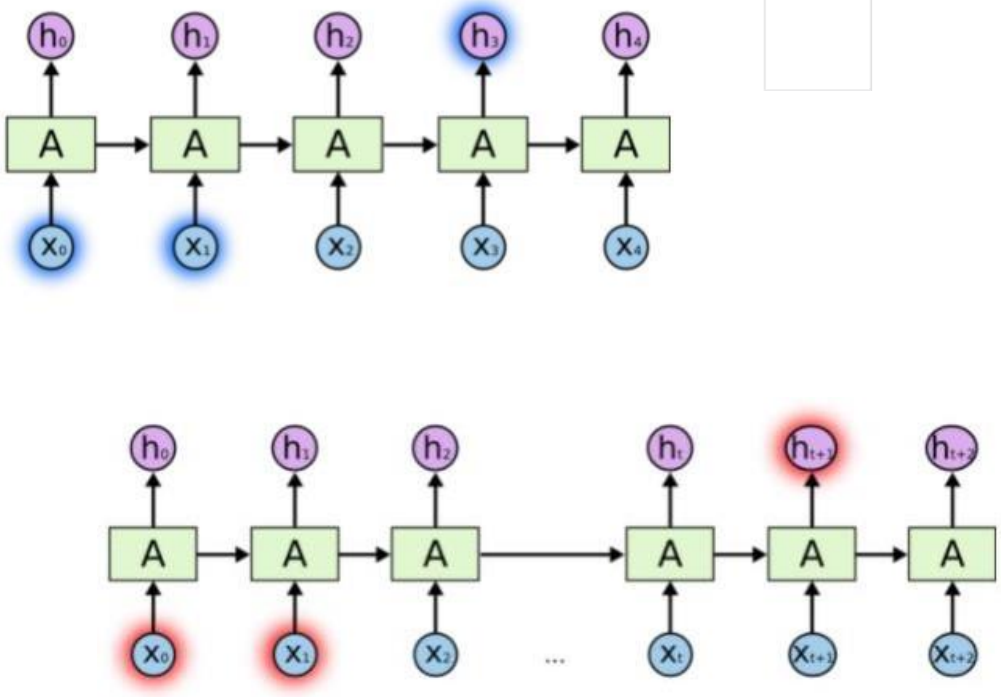
I live in Brazil… I speak fluent *Portuguese*

Recurrent Neural Networks have loops.

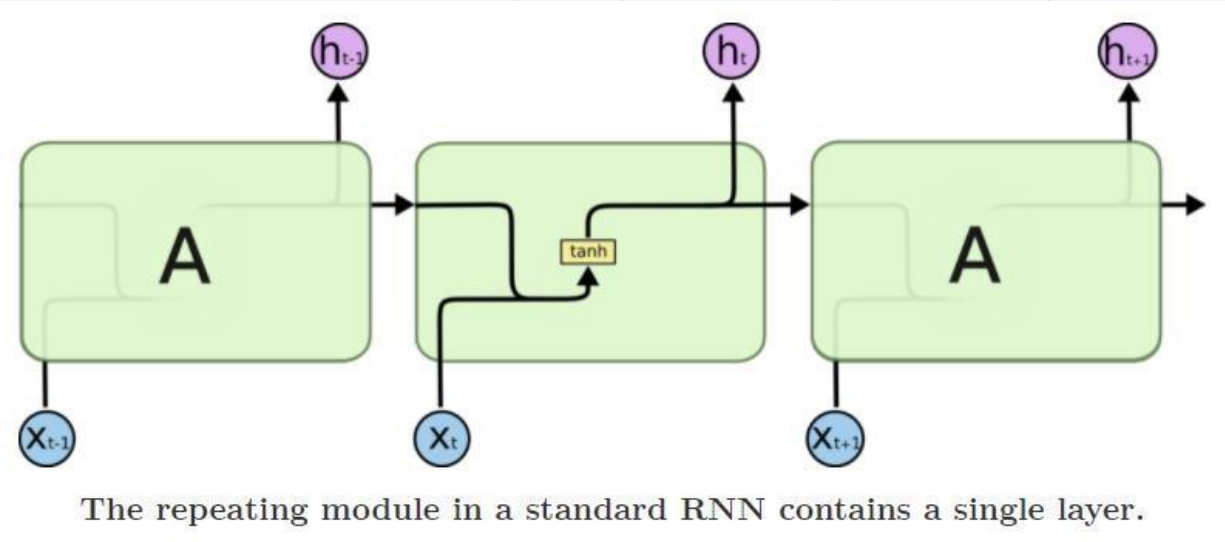


An unrolled recurrent neural network.

Recurrent Neural Networks



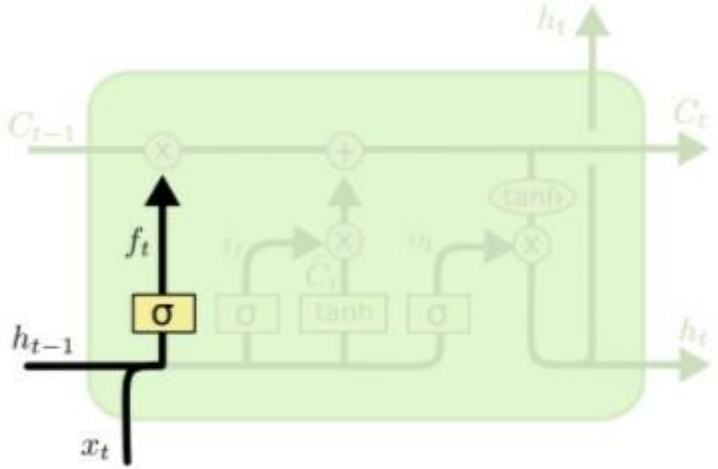
Long short-term Memory



The repeating module in a standard RNN contains a single layer.

Hochreiter & Schmidhuber (1997)
http://www.bioinf.jku.at/publications/older/2604.pdf

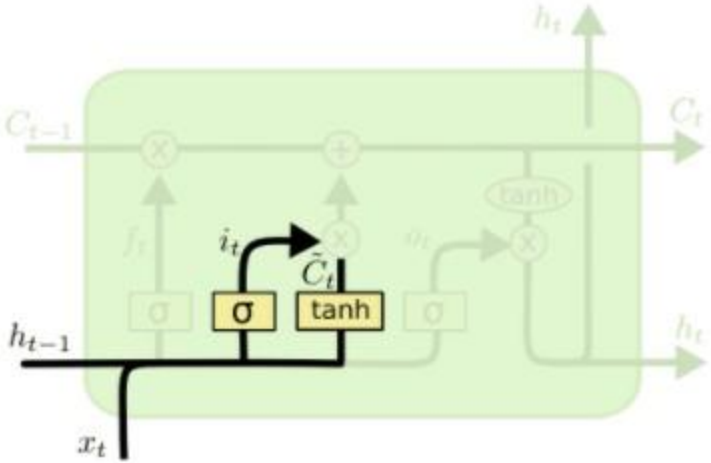
Long short-term Memory: forget layer



$$f_t = \sigma\left(W_f \cdot [h_{t-1}, x_t] \; + \; b_f\right)$$

Hochreiter & Schmidhuber (1997)
http://www.bioinf.jku.at/publications/older/2604.pdf

Long short-term Memory: update cell state

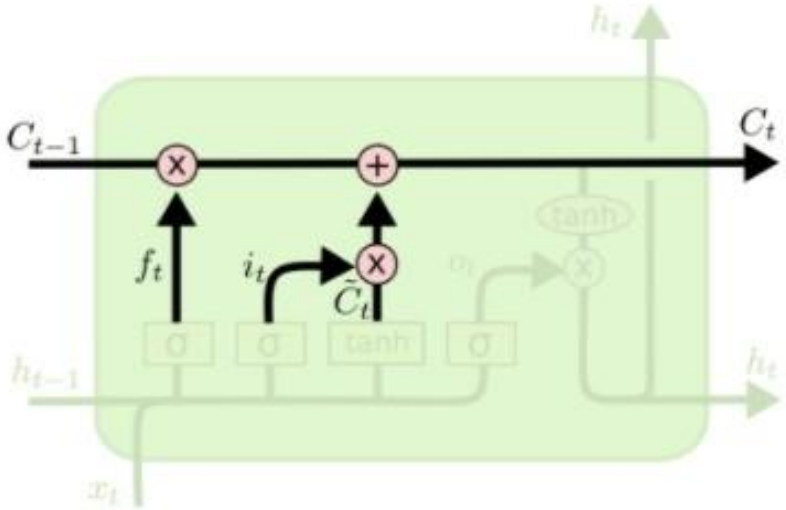


$$i_t = \sigma\left(W_i \cdot [h_{t-1}, x_t] \; + \; b_i\right)$$

$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] \; + \; b_C)$$

Hochreiter & Schmidhuber (1997)
http://www.bioinf.jku.at/publications/older/2604.pdf

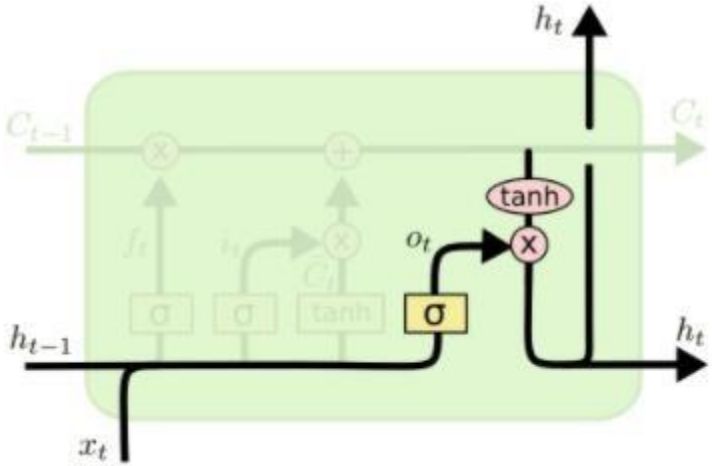
Long short-term Memory: update cell state



$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

Hochreiter & Schmidhuber (1997)
http://www.bioinf.jku.at/publications/older/2604.pdf

Long short-term Memory: output

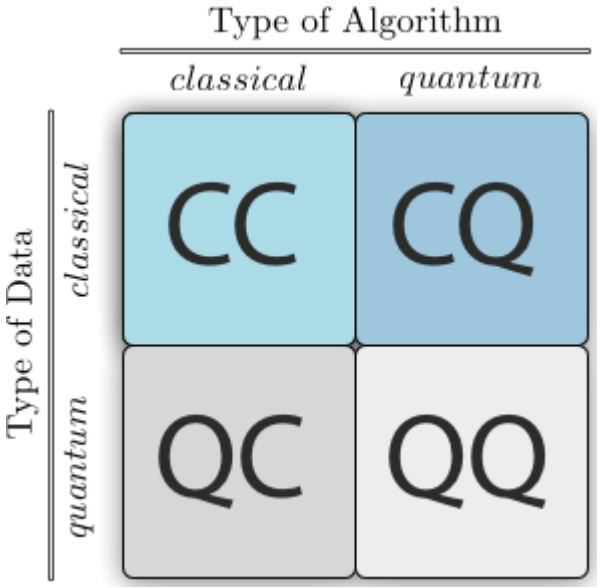


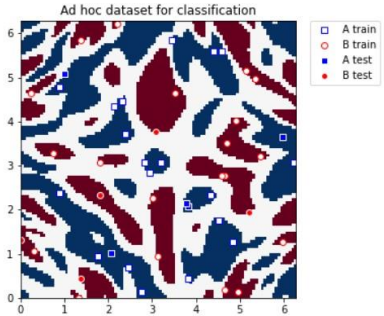
$$o_t = \sigma\left(W_o\left[h_{t-1}, x_t\right] + b_o\right)$$

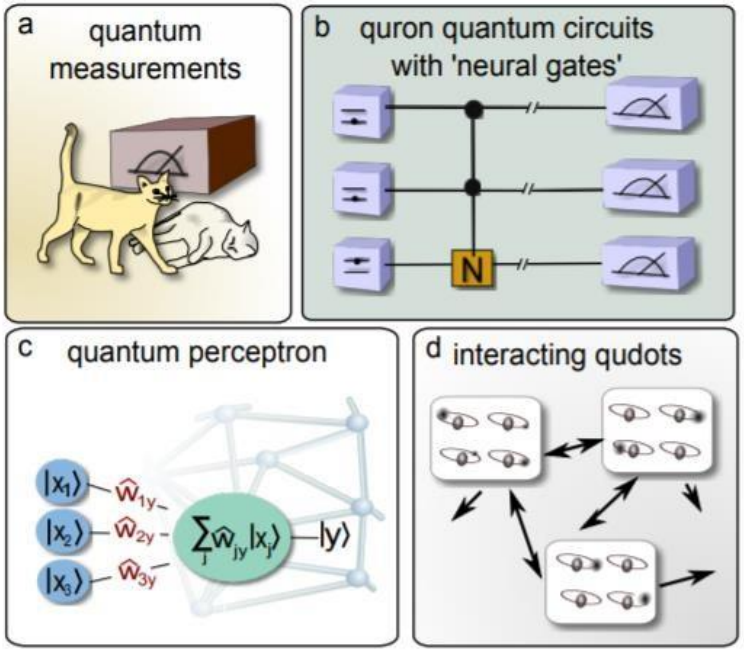
$$h_t = o_t * \tanh\left(C_t\right)$$

Hochreiter & Schmidhuber (1997)
http://www.bioinf.jku.at/publications/older/2604.pdf

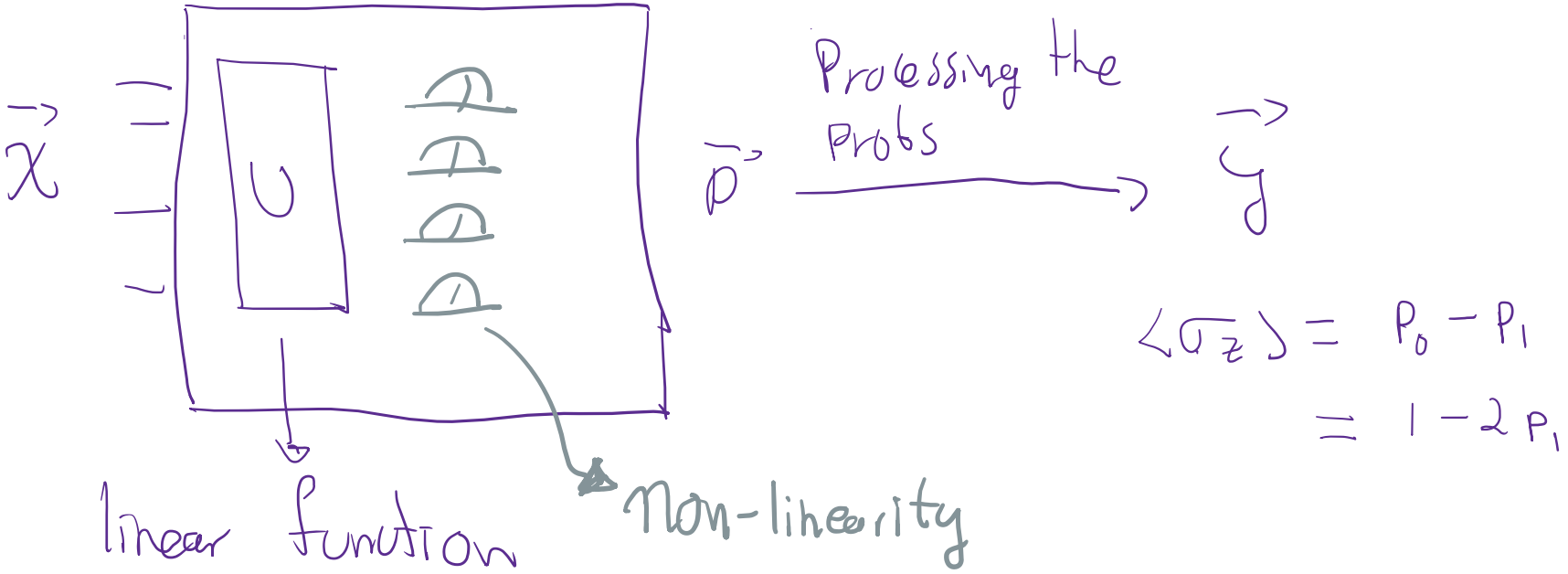
Quantum Machine learning







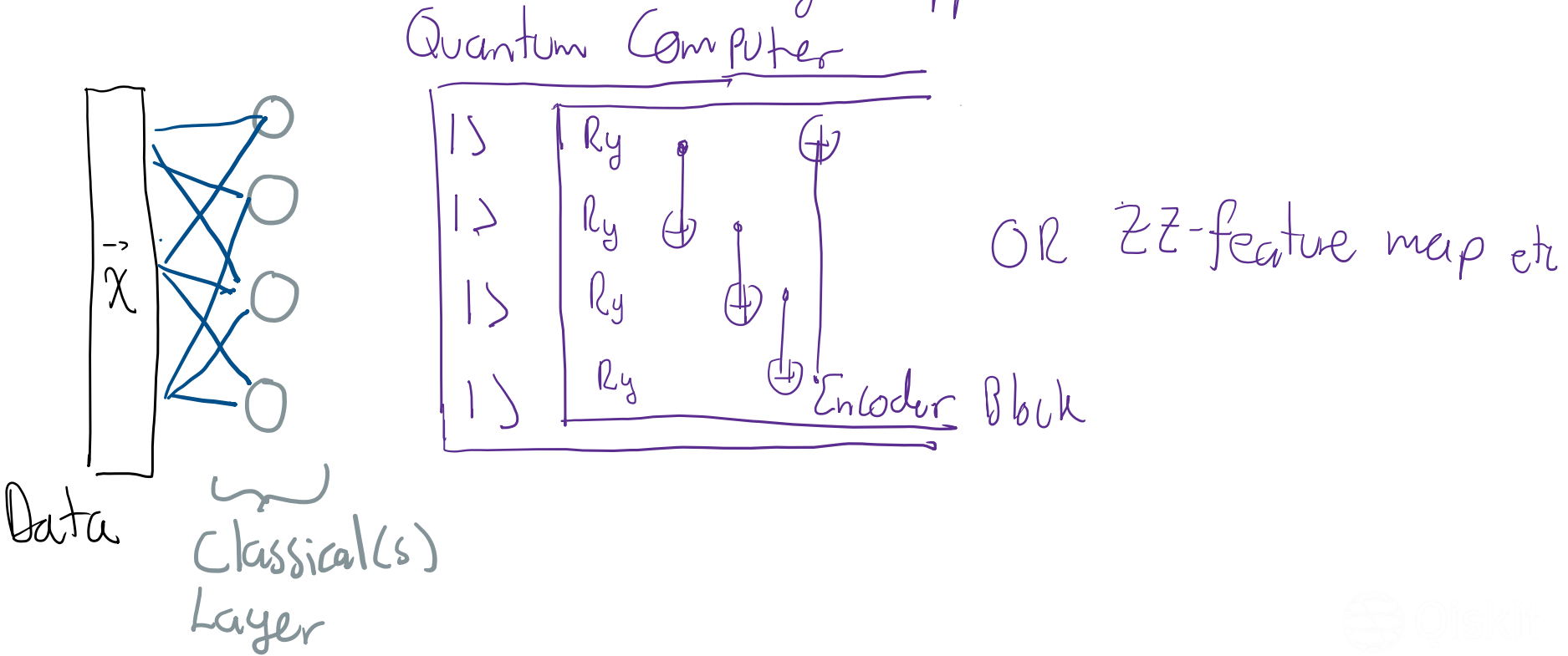
The Idea of a Quantum Perceptron



$$\langle \sigma_z \rangle = p_0 - p_1$$
$$= 1 - 2p_1$$

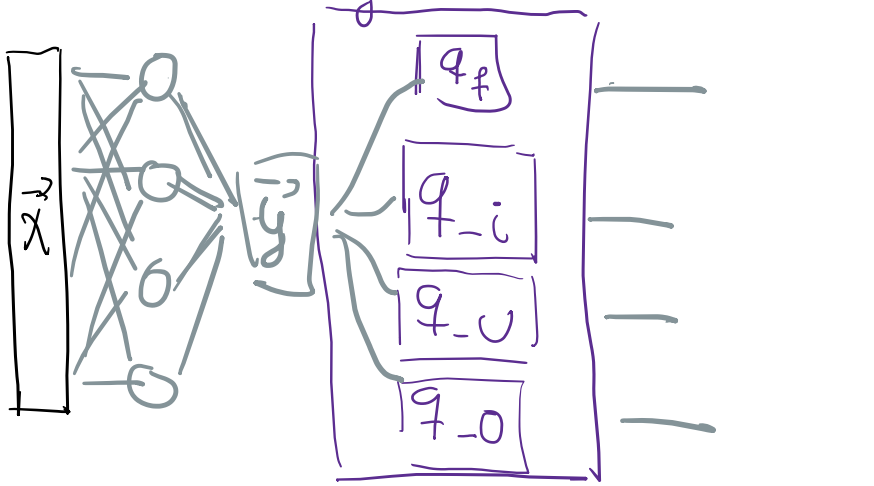
Encoding Classical Data

A Machine Learning Approach



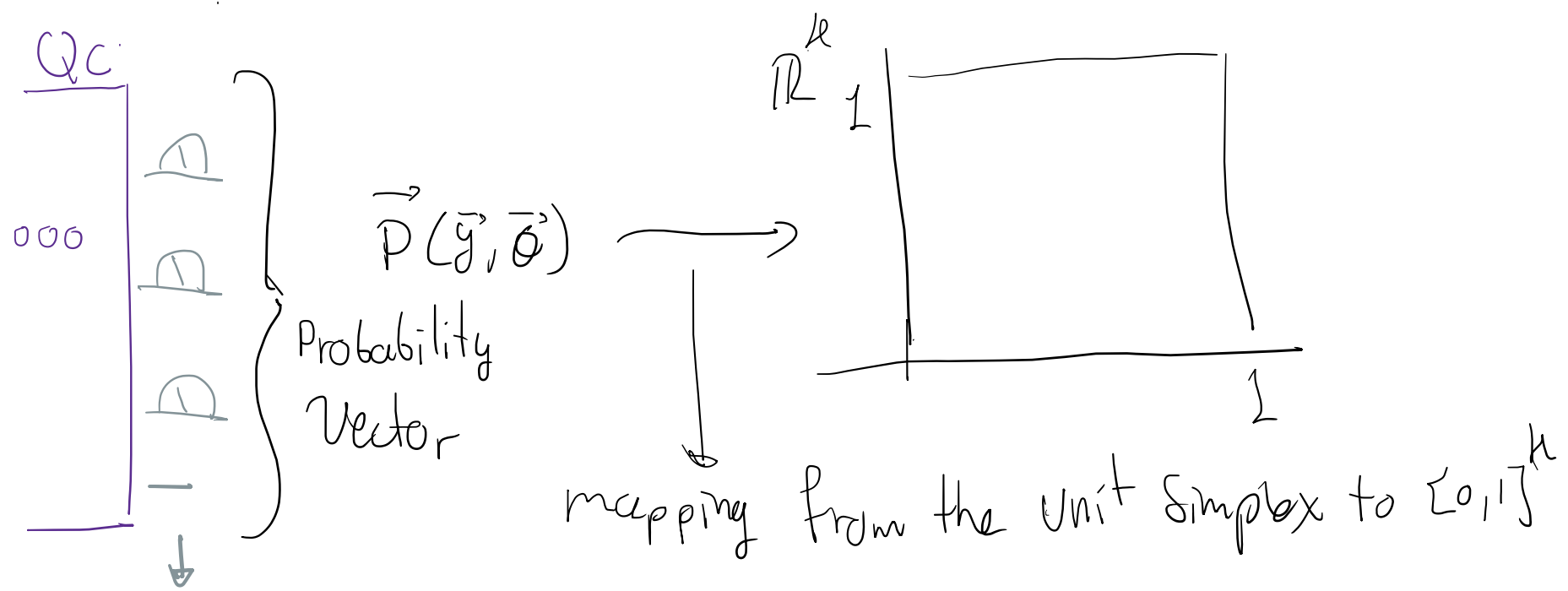
Encoding Classical Data

- Since all quantum layers have the same encoder and ansatz, we can use the same classical layer for encoding.

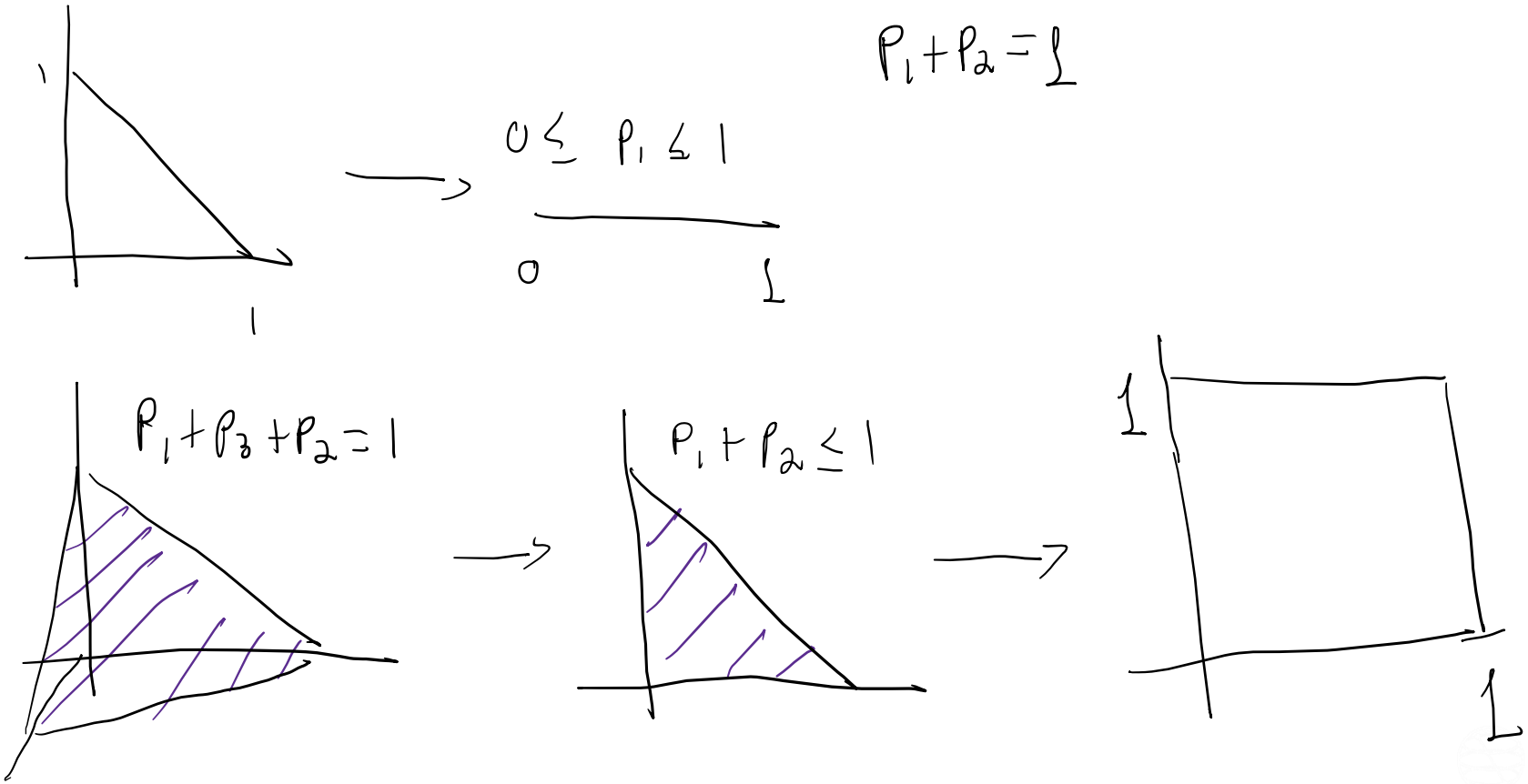


Quantum LSTM Block

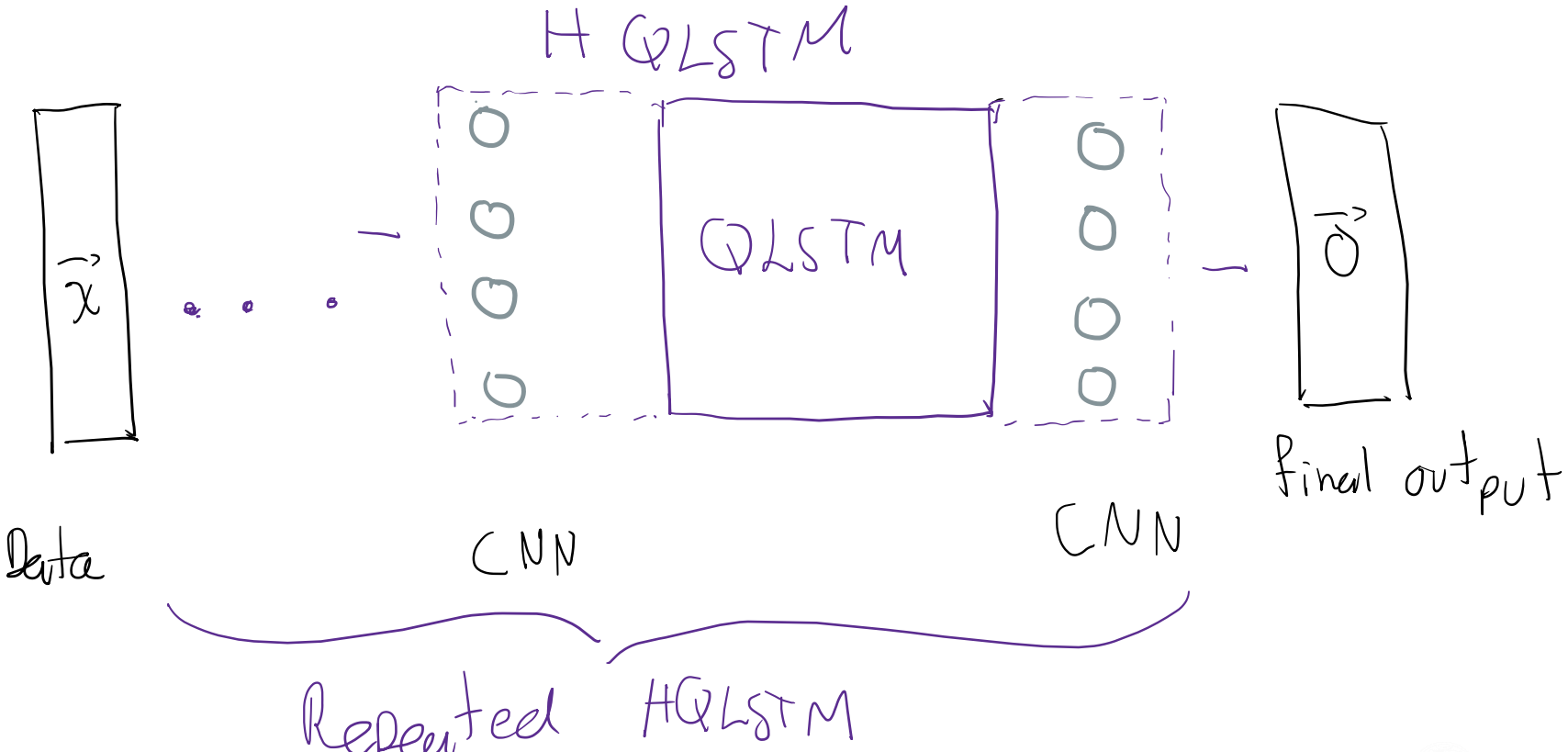
Extracting the information



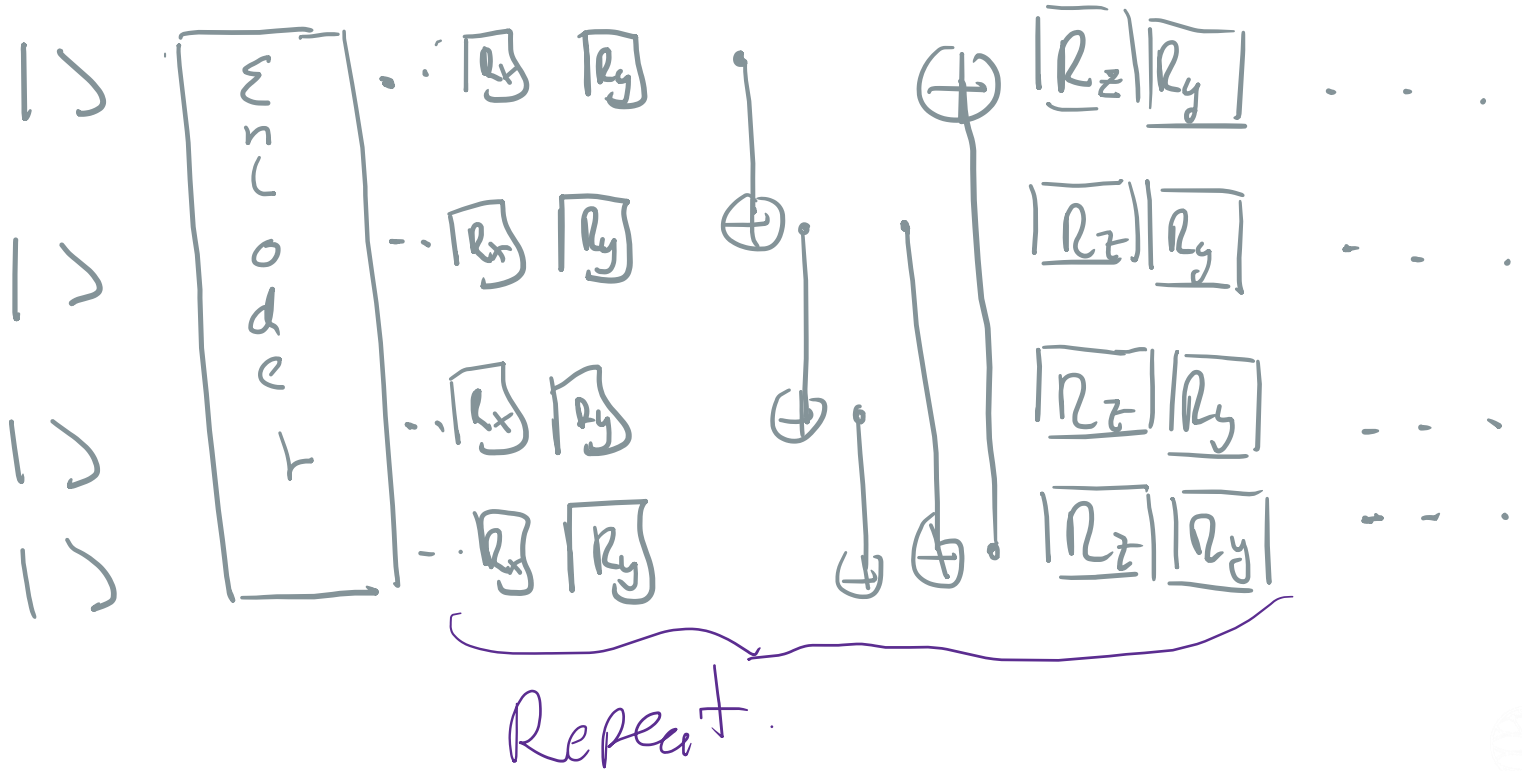
Extracting the information



Final Output

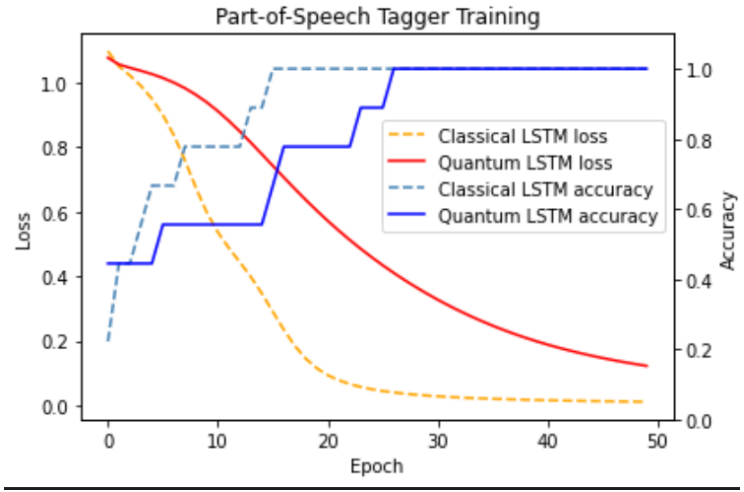


Ansatz



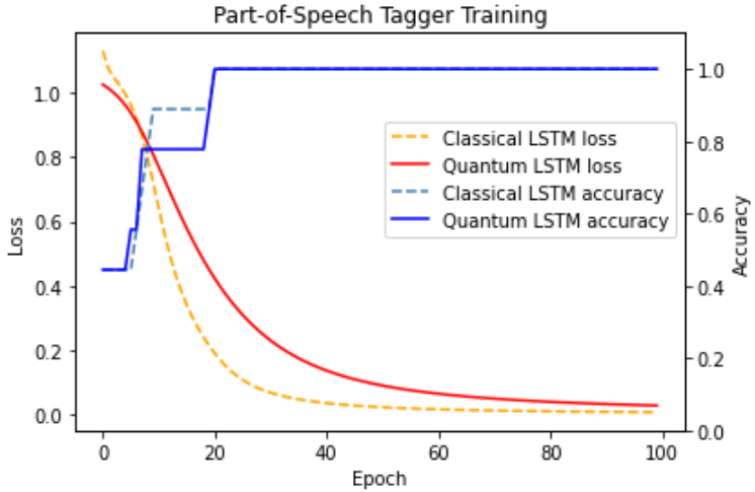
Some results

3 qubits



~ ½ # classical params

4 qubits ~



~ 1 # classical params


Stock price
Data
Training Prediction (LSTM)
Cost (USD)
Days

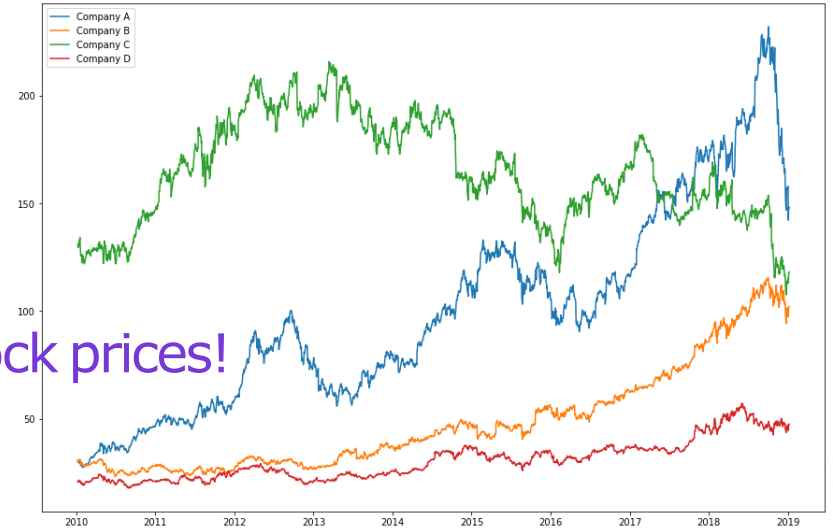

Training Loss
Loss
Epoch


Stock price
Data
Training Prediction (LSTM)
Cost (USD)
Days


Training Loss
Loss
Epoch

Future Work

- Create an efficient encoding for classical data into a quantum computer.
- Test and play with different outputs
- Make the algorithms faster.
- Test is on an actual device.
- Create a LSTM NN to predict stock prices!



Thank you!

Looking for collaborators!