Quantum Generative Adversarial Network with Noise

Project Name: Quantum Generative Adversarial Network with Noise

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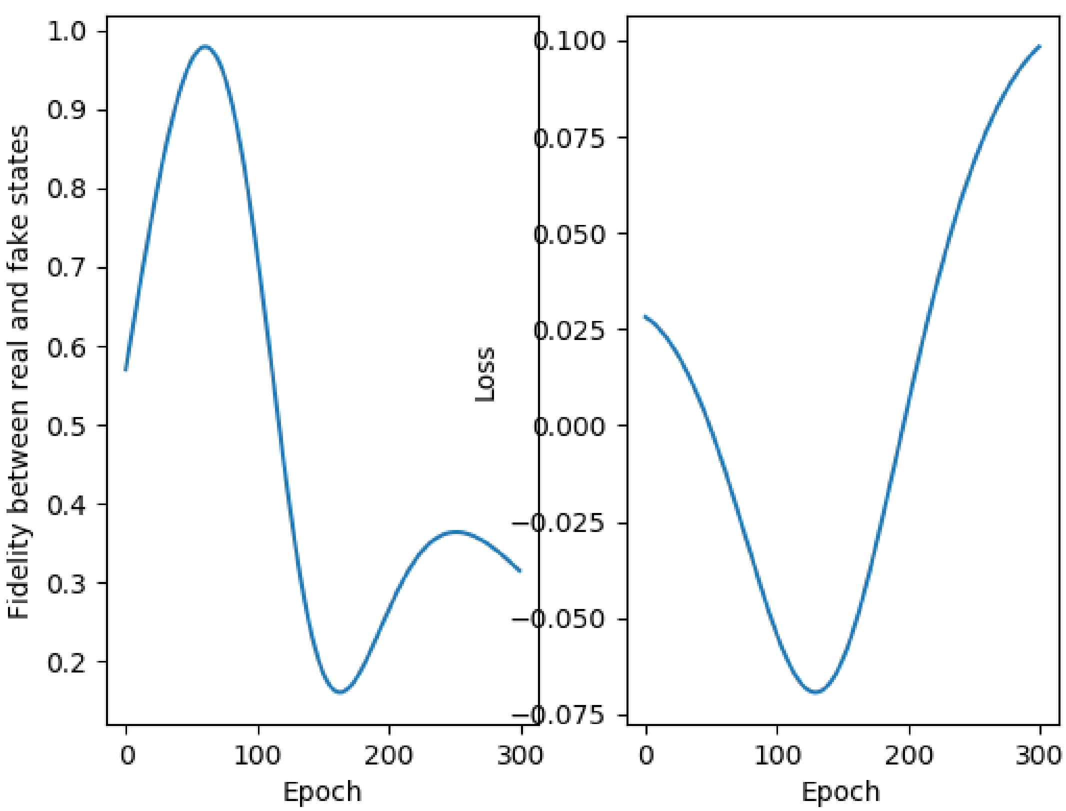
1 Experiment

In oreder to reproduce the article adversarial quantum circuit learning for pure state approximation [1],I write some code to simulate quantum circuits. The author only use a layout as a building block for generator and discriminator by two-qubits unitaries.In this layout every two-qubits unitaries can be efficiently implemented with three CNOT gate and fifteen parametrized single-qubit rotations.
when I use single-qubit gate and two-qubits gate,I had some trouble in how to build a quantum circuit by two-qubits gate [2].A quantum circuit only use single-qubit gate $R_n(\theta)$ and two-qubits gate $CNOT$.Every single-qubit gate is one-parametrized gate which have a formula like $R_n(\theta) = e^{-i\sigma_n\theta/2}$ .Each single-qubit gate place in a line of qubit and have a parameter θ.But $CNOT$ gate don't need a parameter.In my mind,to complete a quantum circuit,I need a list to save every single-qubit gate's paramter.And the sequence of paramter should be a fixed sequence.$CNOT$ gate don't need a paramter.So I don't know how to code $CNOT$ gate into quantum circuit.Because $CNOT$ gate don't have a paramter in paramter's list when I need a matrix representation by paramter's list.In this context,I choose a way to compromise.I fixed the generator and discriminator's quantum circuit in only one condition that the system number was fixed.
By using section A's method,the minimax game can be written as minmax $V(\theta,\phi)$ with loss function

$$V(\theta,\phi) = tr[E_0 D(|\psi_t><\psi_t| \otimes |0><0|)]P(t) - tr[E_0 D(G|0><0|G^\dagger \otimes |0><0|)]P(g)$$

and the partial derivatives and $\frac{\partial V}{\partial \theta_l}$ and $\frac{\partial V}{\partial \phi_k}$.
The result is not good.

2 Results



3 Next Plan

P: 1 finished quantum circuit code

2 checking gate gradient descent

4 Reference

References

[1] Benedetti, M., Grant, E., Wossnig, L., and Severini, S. Adversarial quantum circuit learning for pure state approximation. *New Journal of Physics 21*, 4 (2019), 043023.

[2] Shende, V. V., Markov, I. L., and Bullock, S. S. Minimal universal two-qubit controlled-not-based circuits. *Physical Review A 69*, 6 (2004), 062321.

5 Appendix

A Source Code

just add core codes