Quantum Model Learning Agent

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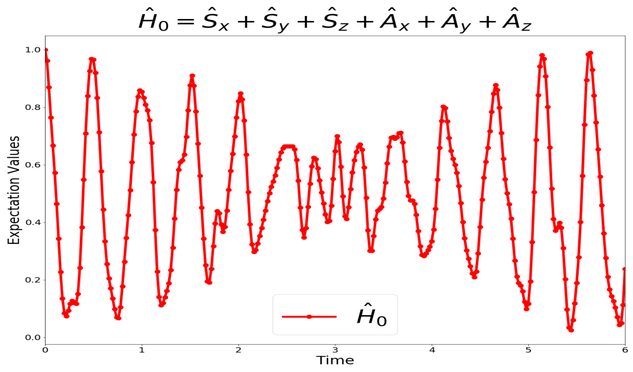
arXiv:2002.06169: *Learning models of quantum systems from experiments*

Context

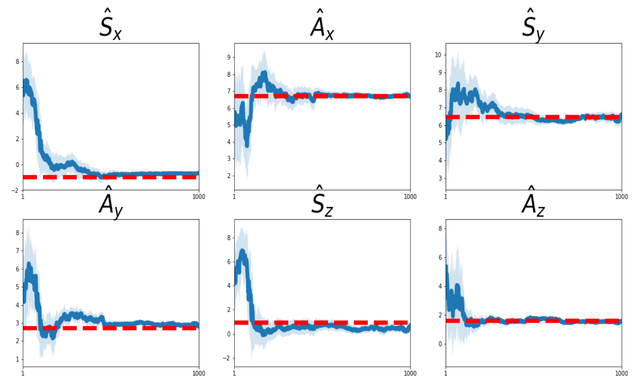
- *Hamiltonian* $\hat{H}_0$, determines the evolution of a quantum system.
- *Quantum Model Learning Agent*: machine learning protocol to infer which *Hamiltonian model* generates observed data.
  - By comparing the output of quantum systems with quantum simulations.

Quantum Hamiltonian Learning

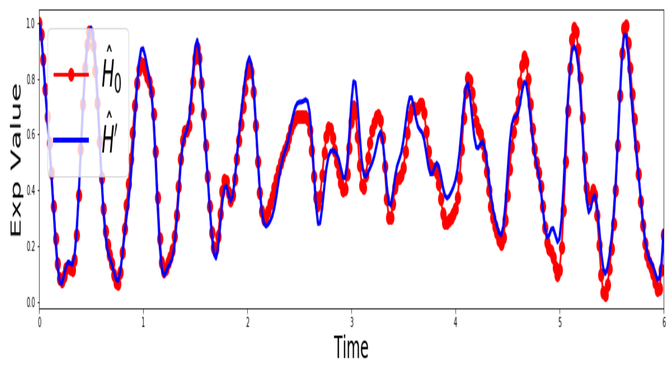
Expectation values for H



QHL: Learn parameters for H'



Reproduced dynamics



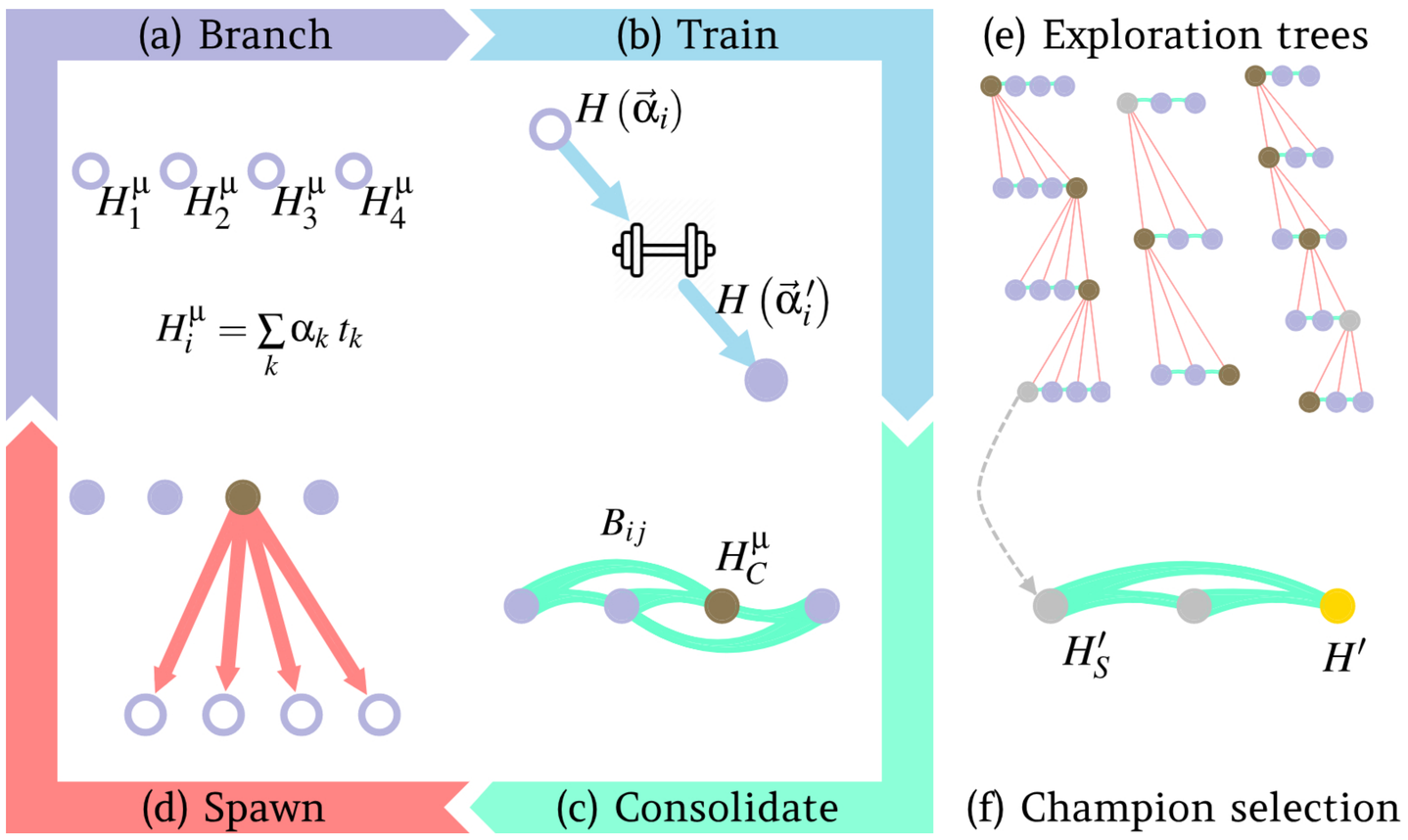
Quantum Model Learning Agent

- Framework for identifying approximate model of quantum systems

(i) Train candidate models with QHL

(ii) Find best models

(iii) Spawn new candidates



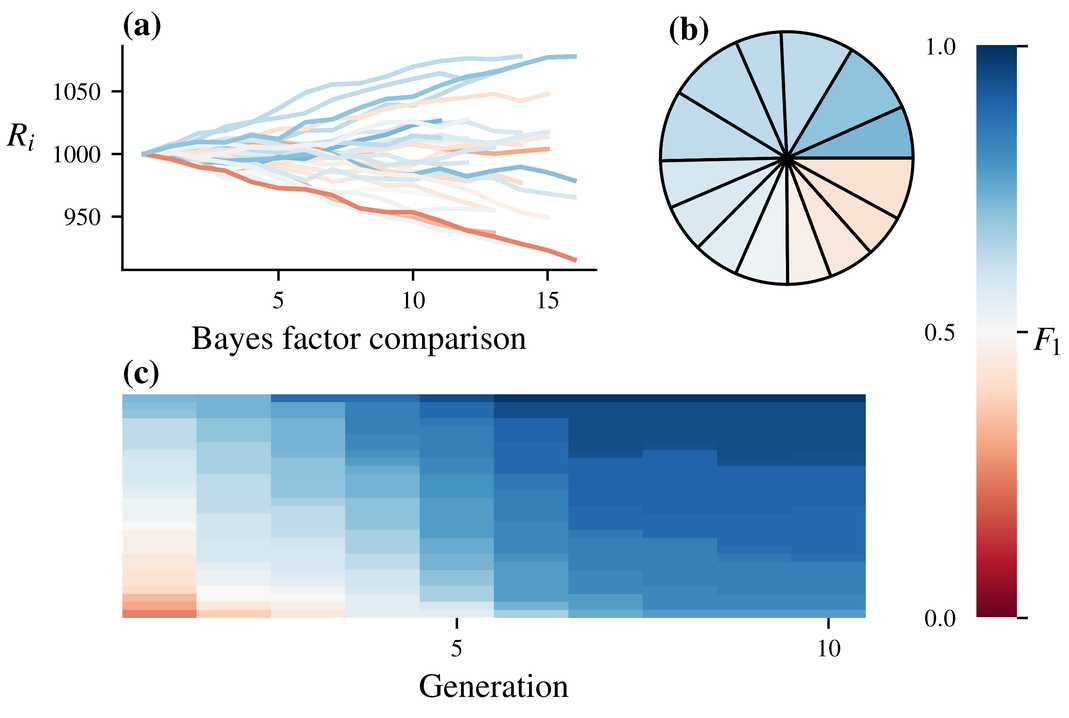
Results

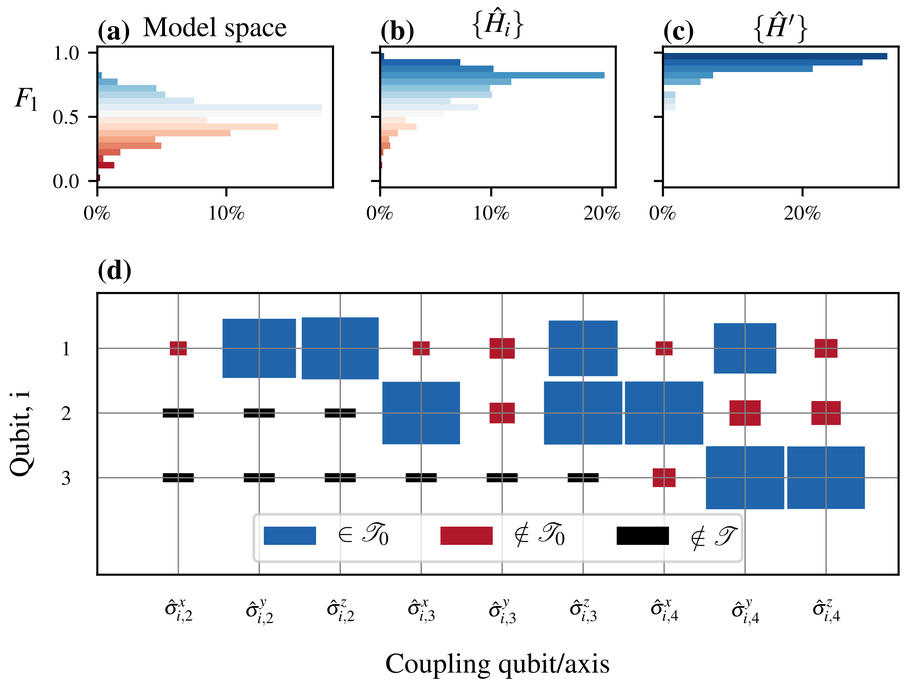
- Genetic algorithm for model generation

(a) individuals models relative ratings

(b) models' reproduction probability

(c) Gene pool across generations





- Run 50 independent instances

(a) F_1-score of all available models

(b) Models explored by QMLA

(c) Approximate models identified by QMLA

(d) Rate of identification for all terms considered