# Learning basis gates for one qubit using microwave pulses

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Quantum computing is a field with growing interest. Instead of using classical bits, we use quantum systems – qubits – to represent data and operations. Recent developments hint at the enormous potential behind quantum computing; however, today's technology unfortunately lacks fidelity and scaling capabilities. Furthermore, quantum algorithms are incredibly difficult to design. Instead of designing these algorithms, our group has proposed that we instead train these algorithms with machine learning techniques. We have shown that this approach results in transformations that are more robust against noise and decoherence. As of now, this model is implemented using the gate model, where specific qubit operations can be performed through compositions of already known basis gates. Another implementation of this model is to train the parameters of microwave pulses – the physical implementation of qubit basis gates – to realize our desired transformation. Here we use the Python libraries Qiskit Dynamics and PyTorch to show that it is possible to train microwave pulses to mimic single qubit gates, specifically the X and SX gates. We were able to use IBM's quantum computer ibmq_armonk as a model for our simulator to reproduce these gates. As the one-qubit case shows promise, we hope to explore using machine learning to train pulse parameters on multi-qubit systems and benchmark the efficiency and efficacy of this model compared to the gate model.