6 WHATS LATER...

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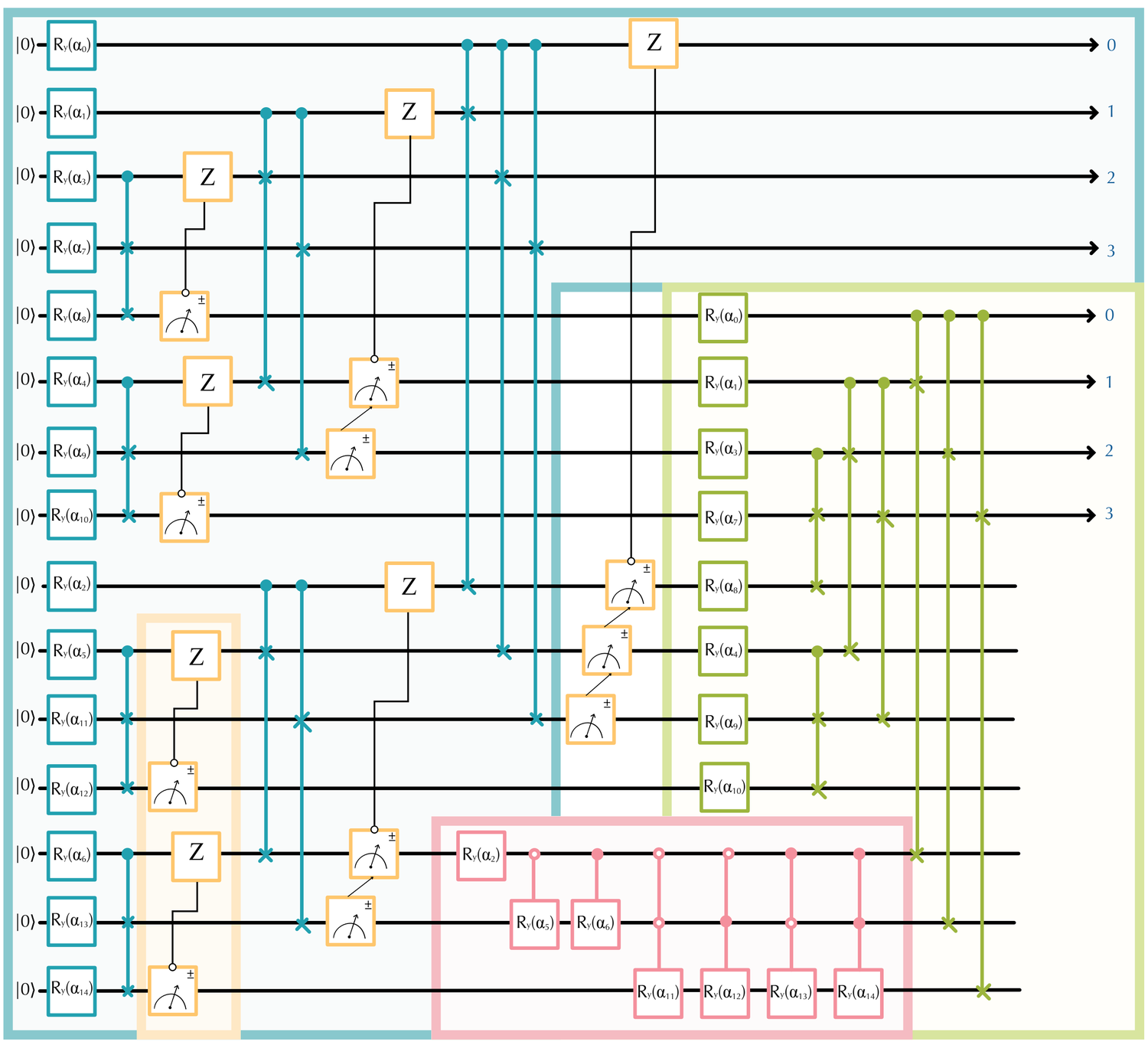
My PhD work so far in Quantum Algorithms, broken down into 6 questions.

What do you do?

I'm looking into algorithms that could run on a quantum computer. Certain problems are challenging for a classical computer, but have the potential to be performed significantly faster on a quantum one. I'm looking into problems for data analysis, so my main focus is on efficient ways to load that data into a quantum computer first.

What is the blue box meant to represent?

The blue section is the circuit diagram for a way of loading data called the divide and conquer method. Instead of doing each gate (R) one after another, they all done at once on individual quantum bits (qubits), and then the state is built back up, discarding extra qubits at each stage. Here, this circuit produces a state with 4 qubits. A related alternative approach will do this in a depth of 15 operations but will not need to discard any extra qubits. For these two methods, it is a choice between the depth of the circuit and the number of qubits you want to use.



What is the Green section under the Blue part?

This green part of the circuit represents what can be done to reuse the discarded qubits at the end of the divide and conquer method. The goal is that, if there is a way to reset the qubit after it is discarded from the original circuit, it can be reused in another circuit to make possible copies of the wanted state. Because of how quantum computers work, having multiple copies of the same state is beneficial.

What is the Pink box in the middle of Blue and Green?

Because of how the divide and conquer methods build up a state, you can substitute other encoding methods at the start of the divide and conquer circuit and then build from there. This creates hybrid circuits with properties from both the divide and conquer method and the other encoding method chosen.

What do the Yellow parts do?

In quantum mechanics, there is a phenomenon known as entanglement, meaning properties of one qubit are tied to another. Since we discard many qubits, we don't want qubits affected by the ones we don't need. We use the yellow operations to disentangle the discarded qubits after each stage.

What do the Purple triangles show?

We found that there happens to be a nice way to represent the circuit using triangles to represent operations between qubits. This allows patterns in structure and possible simplifications to be seen more easily, especially with larger circuits, that tend have a lot of qubits to keep track of.