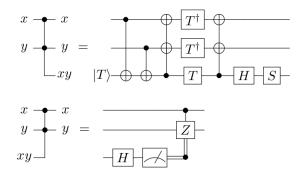
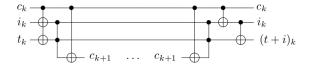
## Quantum Programming Languages CSCE 790 Section 008 Homework 5

- 1. (4 points) Implement an *n*-qubit teleportation function in Proto-Quipper.
- 2. Gidney's paper "Halving the cost of quantum addition" describes the following two circuits.



The top circuit computes the conjunction of x, y. It uses an ancilla in the "magic" state  $|T\rangle = 1/\sqrt{2}(|0\rangle + e^{\pi/4i}|1\rangle)$ . The bottom circuit uncomputes the conjunction.

- (a) (2 points) Implement the logical And circuit (the top circuit).
- (b) (2 points) Implement the inverse of logicalAnd (the bottom circuit).
- 3. (8 points) We can define addition using Gidney's logicalAnd, via the following circuit scheme.



Note that  $c_k$  represents the k-th input carry,  $i_k$  and  $t_k$  are the k-th input bits that we are adding,  $c_{k+1}$  is the output carry, and  $(t+i)_k$  represents the sum of  $c_k, i_k, t_k$ . Use this circuit scheme to define an addition function in Proto-Quipper.