1 Exercise 1: Minimal failing configurations.

What are the (minimal) weight $d/2$ error configurations leading to a failure under the optimal decoder for the Toric code. How many such error configurations are there (as a function of $d$ or $n$)?

2 Exercise 2: Smallest toric code

Argue that an $L = 3$ Toric code can protect against arbitrary single qubit errors. Discuss how one would construct an optimal decoder for this code (no need to give a full table).

3 Bonus: Syndromes as Anyons.

Braiding two particles is the process of moving two particles around each other without having them touch in such a way that they return to their initial position. Show that the action of braiding an isolated $Z$ syndrome (the endpoint of a string) and an isolated $X$ syndrome is non-trivial. Is the braiding abelian; i.e. does it make a difference what direction the syndromes are braided in (clockwise or anti-clockwise)?