Graphs, planes & surfaces

- Project in **computational topology** (efficient **algorithms** for testing whether given network is **planar**; or related **combinatorics** and **topology**)
- **Practical Motivation:** Planarity (whether a graph can be drawn in the plane, without crossing edges) is a useful condition in applications because it allows efficient solutions to generically hard problems like the travelling salesman problem (TSP)
- Direction 0: Analyze and/or improve known algorithms for **other surfaces**, or directly try to find new algorithms

Strong Hanani-Tutte conjecture

- **Sub-History:** A theoretical result known as the **strong Hanani-Tutte conjecture**
  - Conjecture: "0 mod 2" drawing implies 0 crossings drawing
  - Application: Gives planarity testing algorithm based on "**finger-moves**" linear algebra over F_2
  - Direction 1: Try extending "finger-moves" algorithm to surfaces besides sphere
- Direction 2: Try proving or disproving the strong Hanani-Tutte conjecture for surfaces besides sphere & projective plane
- Direction 3: Algebraic topology or higher dimensions