Using the D-Wave 2X Quantum Computer to Explore the Formation of Global Terrorist Networks

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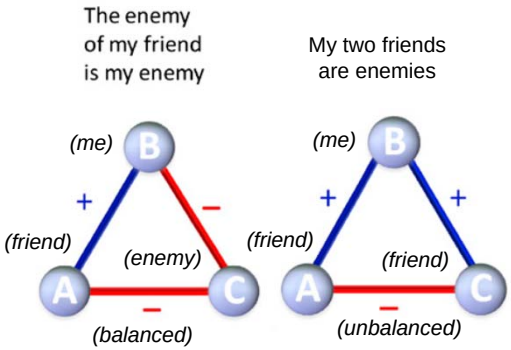
Using the D-Wave 2X to Explore Structural Balance Sensitivity in Radical Social Networks

- The D-Wave is a quantum annealing machine
- There is an area in the study of social networks called *structural balance*
  - Social network with signed edges
    - Bipartite nodes labeled by cohort
    - Signed edges: + for friendly, - for hostile
    - Edge rule: same cohort ⇒ +; different ⇒ -
    - Given the edge signs, what is the best cohort assignment to nodes that tries to follow the edge rule? → *NP-Hard problem*



- There is an Ising model equivalent to this problem
  - $H = \sum_{i,j}\left(1 - J_{ij}s_i s_j\right) \ni J_{ij}, s_i \in \{-1,1\}$

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Idea

- Use the D-Wave as an accelerator chip in a hybrid computation
  1. Given a social network with only edges assigned $\{J_{ij}\}$
  2. Find the node assignment $\{s_i\}$ and net imbalance (or "tension") (~H) in the ground state using the D-Wave (quantum step)
  3. Perturb the edge assignments, presume due to some outside influence (classical step)
  4. Return to (2)

- Evaluate and interpret in a radical social network context
  - Clustered, "radical" cohorts $\Rightarrow$ serious threat
  - Low degree of tension (balanced) $\Rightarrow$ stability

$\Rightarrow$ serious, long-term threat