Strategic Formation of Credit Networks
Why should we care about credit networks?

- They allow for modeling of malicious attacks by users.
  - Play money markets
  - Real money markets with a low barrier of entry.
- They allow us to model peer interactions in applications.
  - Peer to Peer applications (Bit Torrent, Freecast etc.)
  - Money Lending within a social network.
What is a credit network?

- Method for modeling trust between agents in a crediting network.
- Nodes represent participating agents
- Edges represent existing trust while the edge weight the max capacity of that relationship
Centralized Credit Networks

- This model can be used to represent government issued money.
Centralized Credit Networks
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Whitewashing Attacks
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Whitewashing Attacks
Whitewashing Attacks
Sybil Attacks
Sybil Attacks
Sybil Attacks
Decentralized vs. Centralized Networks

- Trust is determined by an agent’s social network vs a central agent.
- Decentralized model is resistant to Whitewashing and Sybil attacks.
- Decentralized model grants a similar degree of liquidity to that available in centralized models.
Importance of Decentralized Model Research?

- Will decentralized networks be practical?
  - If so, switching to them could allow certain applications to resist malicious agents.
- How do agents balance risk and reward in a network?
  - This will give a better sense of how to optimize practical decentralized networks.
Risk Models

- **Dichotomous Risk**
  - Each agent divides other nodes into trusted and untrusted groups.
  - Assume Trust is symmetric among pairs.
  - Credit never extended to non-neighbors.
  - No agent ever defaults.

- **Global Risk**
  - Each agent has an publicly known chance to default.
  - Can extend credit to any agent in graph.
Risk Models Continued

- Graded Risk
  - Agents are constructed from social networks in the same way as in the dichotomous risk model.
  - Agents have a private default chance.
  - Agents receive “noisy” default probabilities for all agents in the network.
  - Agents considered neighbors receive more informative messages about one another.
Empirical Game-Theoretic Analysis

- Old fashioned Theoretic Analysis does not provide many solid conclusions for these models.
  - These games must be heavily constrained to remain tractable for a Theoretic Approach.
  - What is modelable in Theoretic Analysis may not hold true when constraints are lifted.
- The research team decided to alter their focus to empirical Analysis in order to allow for more informative results.
Empirical Method

- Begins with a set of strategies (briefly explain strategy for issuing credit)
  - heuristically derived
  - parametrized by key strategy features
- Determines a payoff observation to be added to payoff database
  - sample drawn from simulation
  - compiled into payoff matrix
- This matrix is then used to identify dominated strategies and equilibria.
- These methods alone can still produce an intractable problem
How can we simplify the game?

● Complete Subgames
  ○ We model all responses for all strategies for a small section of the game
  ○ We allow a single player to choose a strategy outside this subgame
  ○ This allows us to determine the effectiveness of the Subgame strategy without simulating the rest of the choices.

● Player Reduction
  ○ We reduce the 61 players to 6, who “control” a set of the original players
  ○ These players can be viewed as 6 instead of 61.
Empirical Algorithm

- Identify maximal complete sub games
- Check other possible choices for a preferred action.
- If none exist, we have a SMSNE (symmetric mixed-strategy Nash Equilibria)
- Otherwise we move on to the next sub game