Pricing Strategies for Viral Marketing on Social Networks

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Motivation

Social Network Monetization

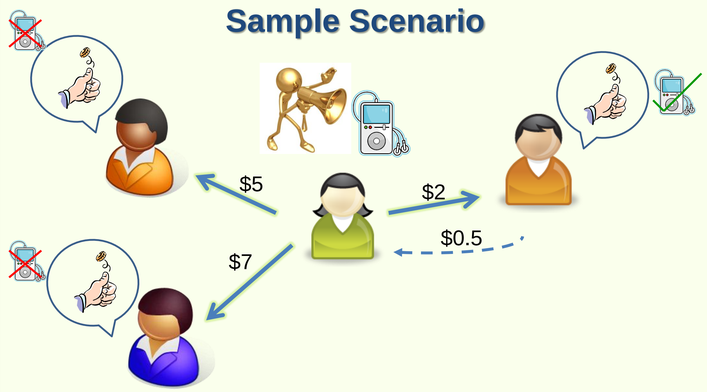
- Current monetization model:
  - Advertising
  - Leaves huge gap between potential and current revenue
    - Facebook:
      - 2007 valuation – $15 billion
      - 2008 revenue (estimated) – $300 million
- Proposed scheme:
  - Sell products through personal recommendations
  - Incentivize users to participate using cashback
  - Leverages network structure through trust on friends!

Viral Marketing

Model

- Seller marketing a product on a social network 
- Each new buyer:
  - recommends the product to her friends
  - is promised a cashback for each friend that purchases the product
- Seller chooses price for each recommendation
- Each receiver:
  - buys the product with probability as a function of price
  - is more likely to buy a product if more friends recommend it

Sample Scenario



Results

Problem Objective

- Find seller strategies that optimize expected revenue
  - Seller strategy – choose prices for potential buyers
  - Why expected? – people buy probabilistically
  - Assume that we start with a single initial buyer (seed)

Seller Strategies

- Two types of strategies are possible:
  - Adaptive: choice of price for a receiver depends on history of choices
  - Non-adaptive: prices are fixed before the process even starts!
- Theorem: Finding optimal non-adaptive seller strategies is NP-hard.
- Adaptive strategies can be strictly better, but computational hardness unknown

Theoretical Guarantee

- Theorem:
  E[revenue of Max-Leaf] ≥ c × E[revenue of optimal strategy]

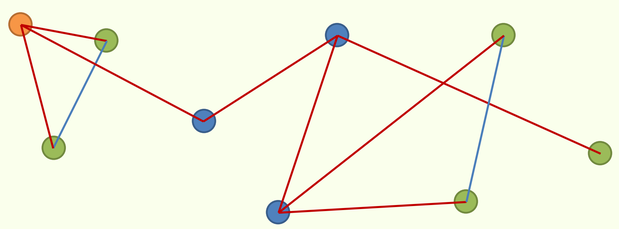
For some positive constant c < 1, where c depends on the probability model. This guarantee holds for very general probability functions.

Proof Sketch

1. Reduce social network to a graph with minimum degree 3
   - Need to ensure revenue from degree 1 and 2 nodes is constant
2. Find a max-leaf spanning tree on this reduced graph
   - This graph has a linear number of leaves
3. Optimal strategy can have at most linear revenue

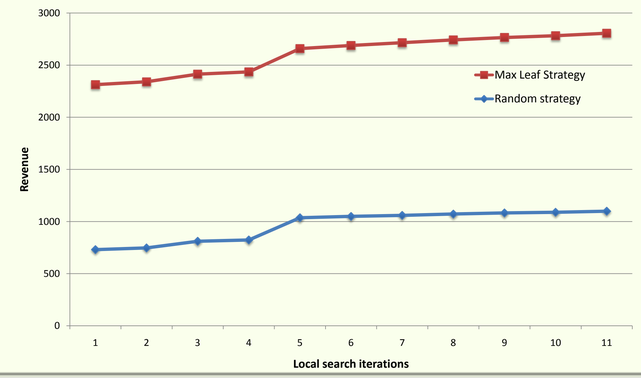
Algorithm

- Max-Leaf strategy:
  - Find the Maximum Leaf Spanning Tree for the network, rooted at seed
  - Give the product to the interior nodes for free
  - Charge some (optimal) price from the leaves



Simulation on YouTube graph

- Comparison with random choice of prices
- Additional enhancement – locally improving pricing decisions



Conclusions

- Adaptive strategies do not offer a big advantage
- Simple influence-and-exploit non-adaptive strategies work well
- Trying to improve solution through local search may be beneficial in practice

Open Questions

- Incorporating cost of sending recommendations (spamming friends)
- What if buyers are non-myopic?
- Can we implement this on Facebook/Orkut?

The paper is available for download from http://arxiv.org/abs/0902.3485
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