

Steering information diffusion dynamically against user attention limitation

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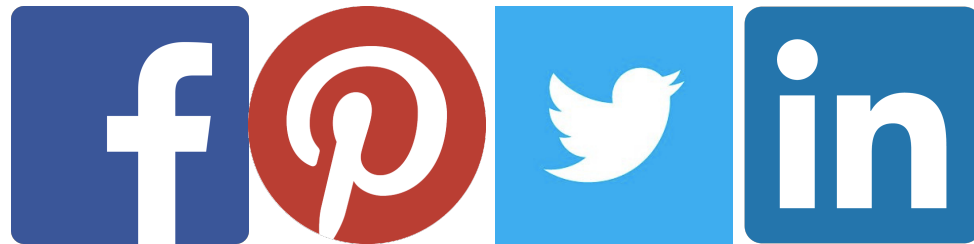
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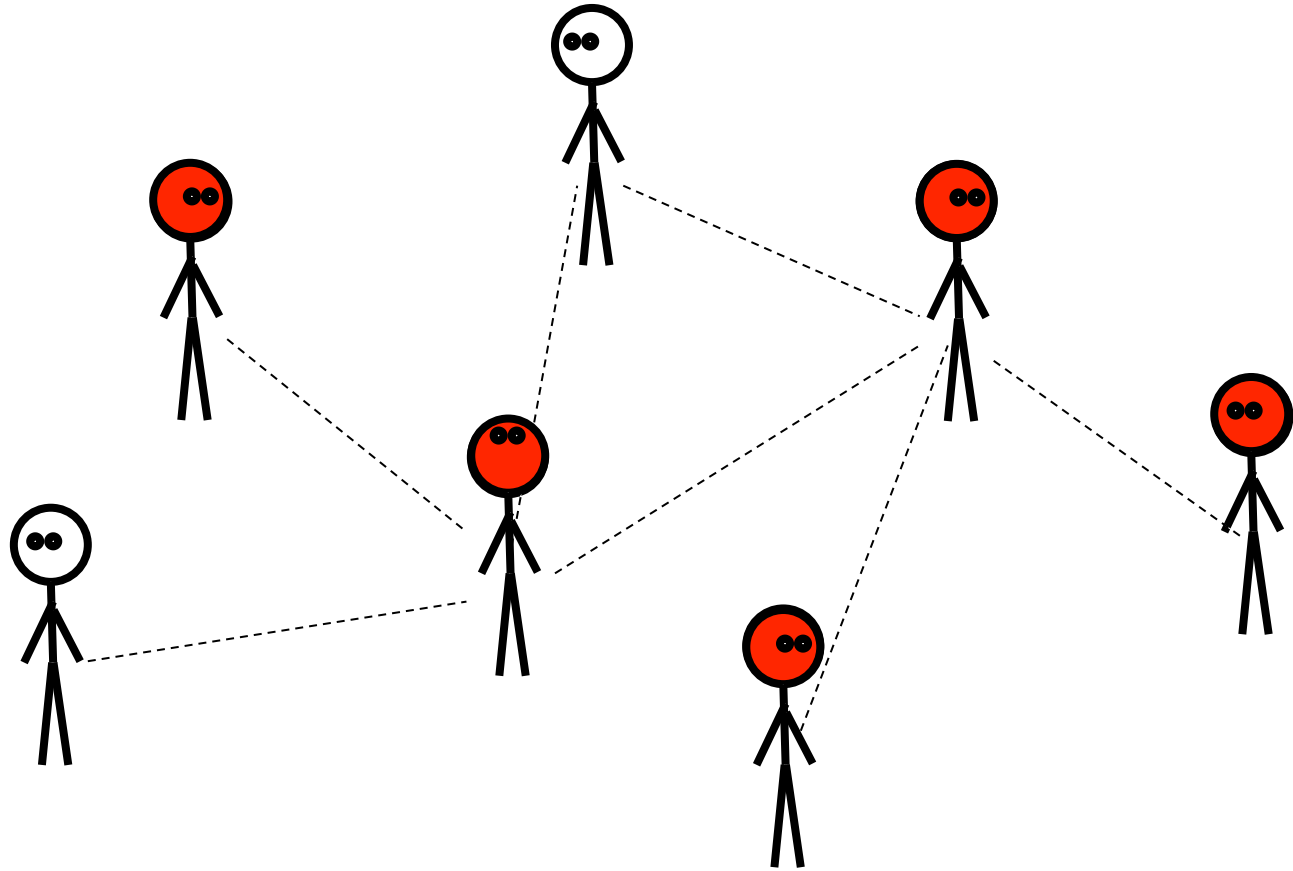
Outline

- Motivation
- Problem definition
- Algorithm
- Experiment

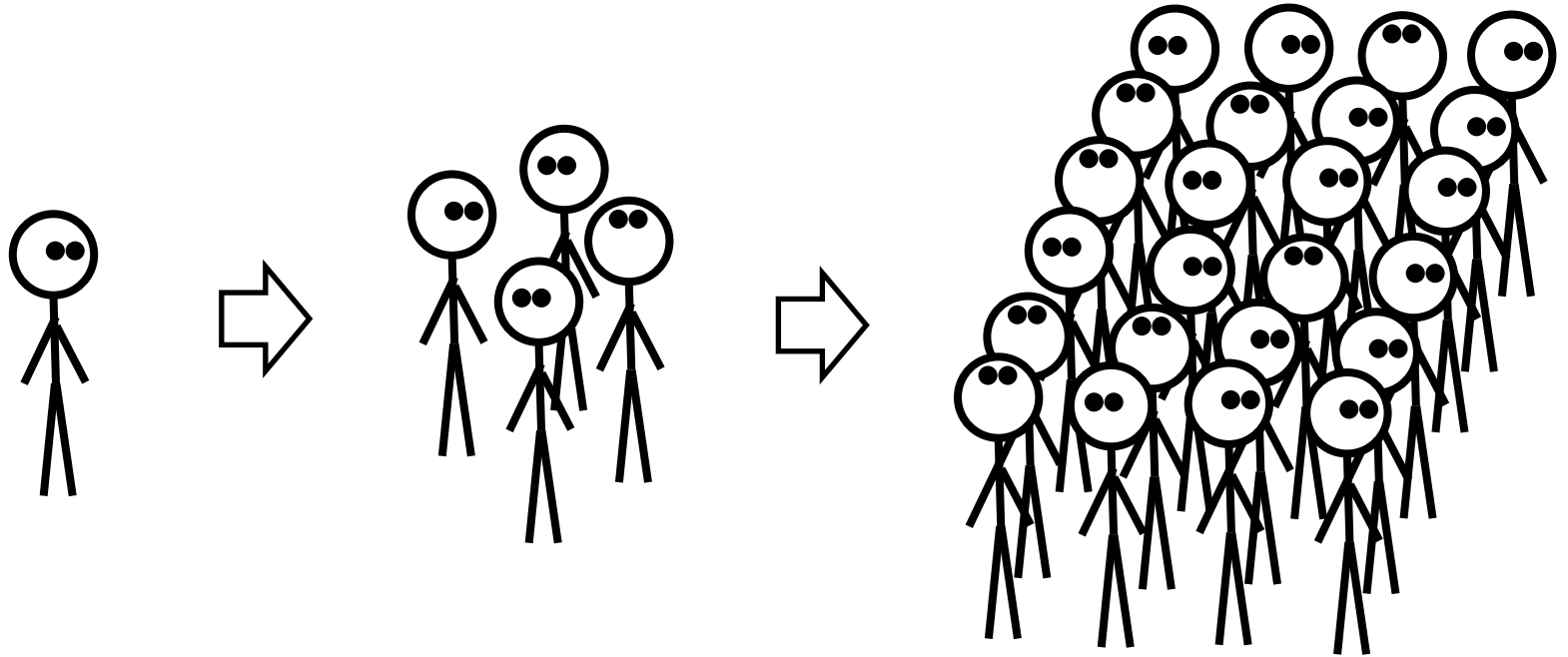
Information diffusion in social network



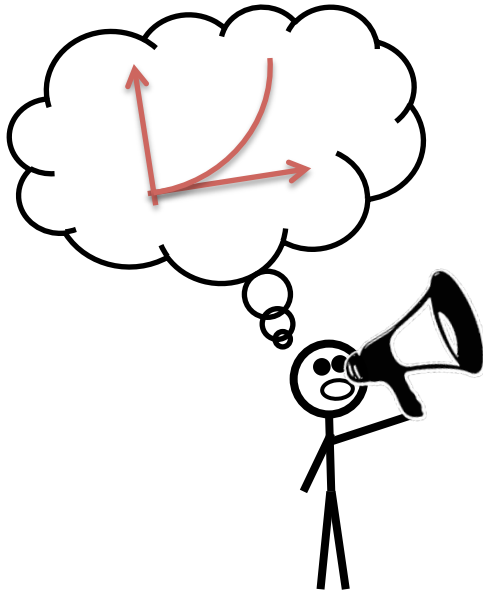
Information diffusion in social network



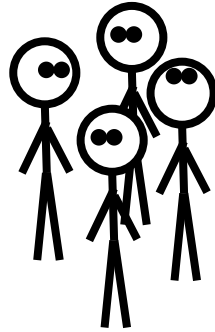
Information diffusion in social network



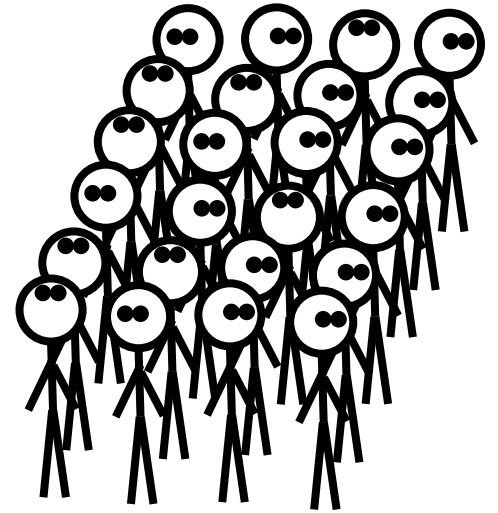
Viral marketing



companies

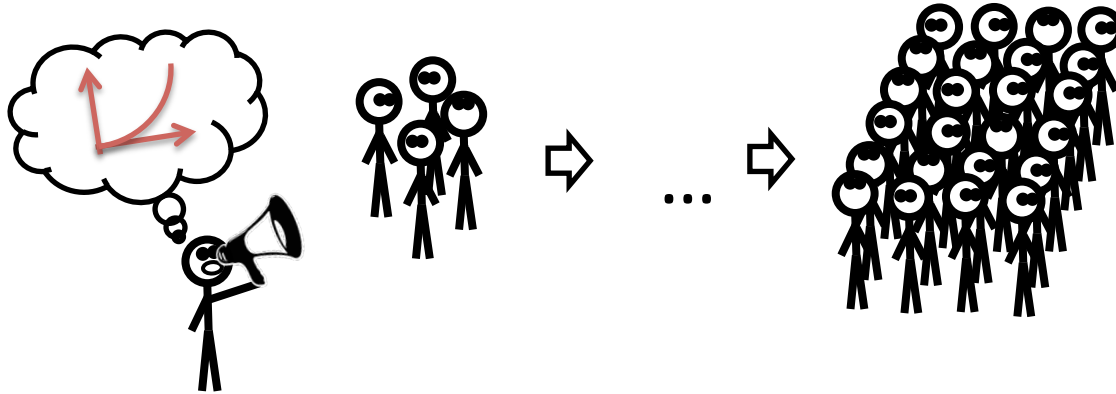


...



users

Influence maximization problem

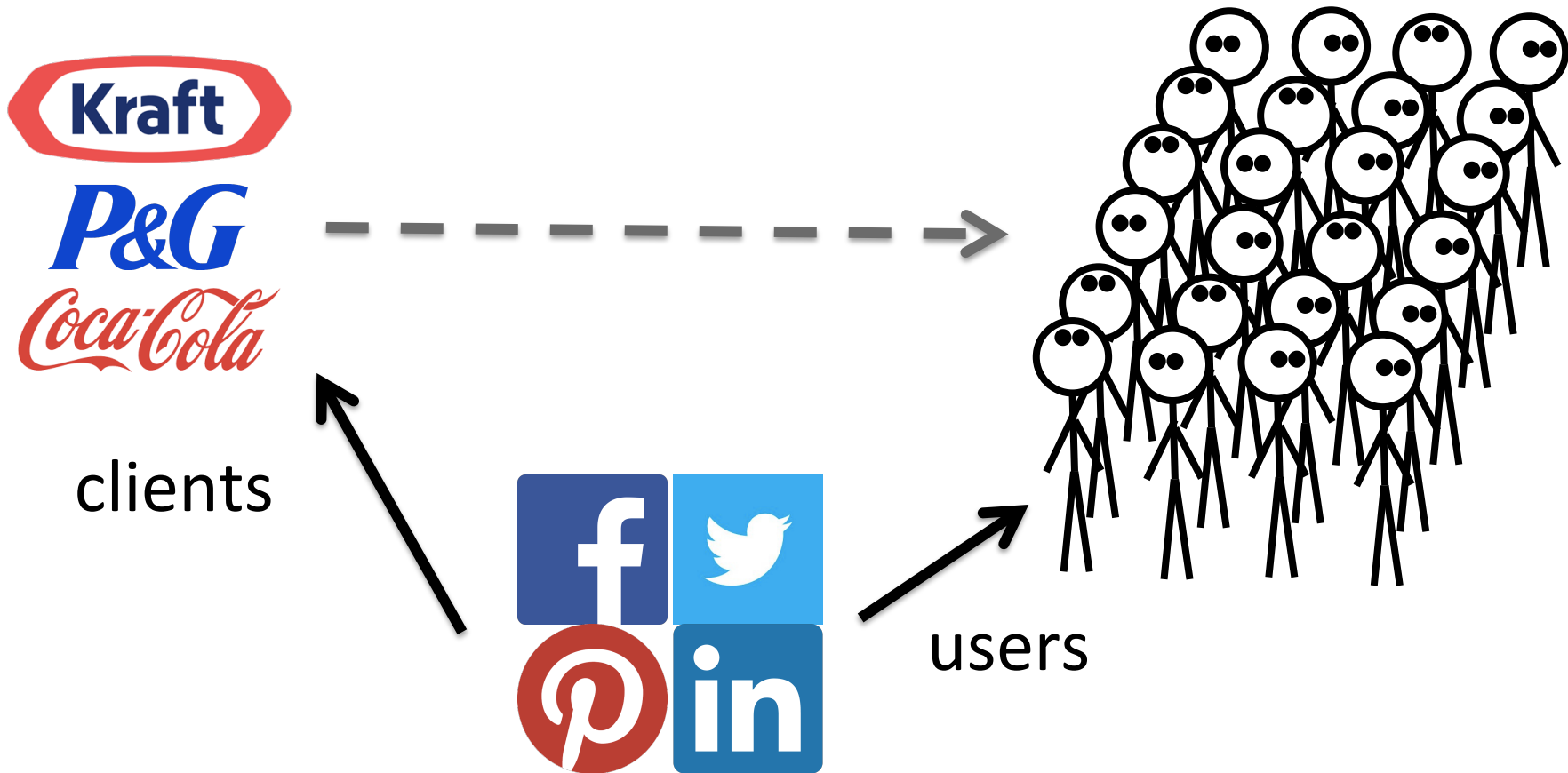


How to find best seed users, so that the number of active users when the information diffusion process ends is maximized?

- What is missed?
 - social network service providers



Viral marketing



Dynamic influence maximization

from the perspective of social network service providers (websites)

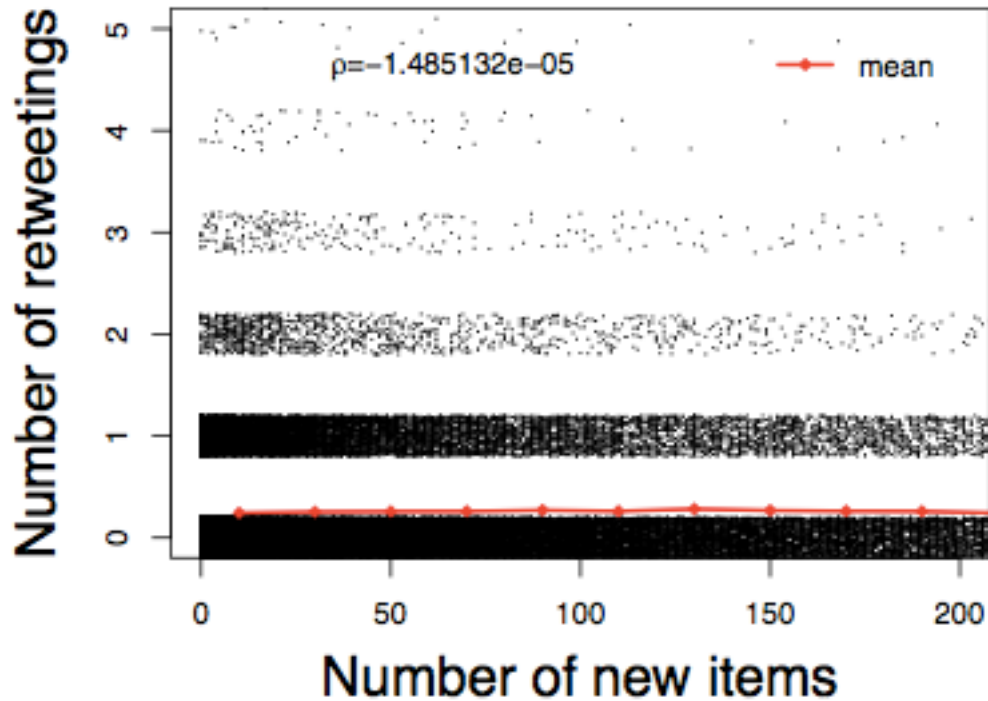
- What can websites do?
 - Not only select seed nodes, but can also partially control the diffusion of information.
- How?
 - By “pushing” items to users.

Dynamic influence maximization from the perspective of social network websites, based on a “push-driven” cascade model.

Push-driven cascade model

- User attention is limited.
 - They will not read every item.
- Websites can bring items into the attention of users by “pushing” items to users
 - Put items on the top of user news feed.
 - Send notification to users.

Limited user attention



Relation between the “show number” and the number of retweets

Push-driven cascade model (cont'd)

- When being pushed an item to, whether a user becomes active is decided by:
 - Preference of that user.
 - Influence from her friends.

Study of user behavior

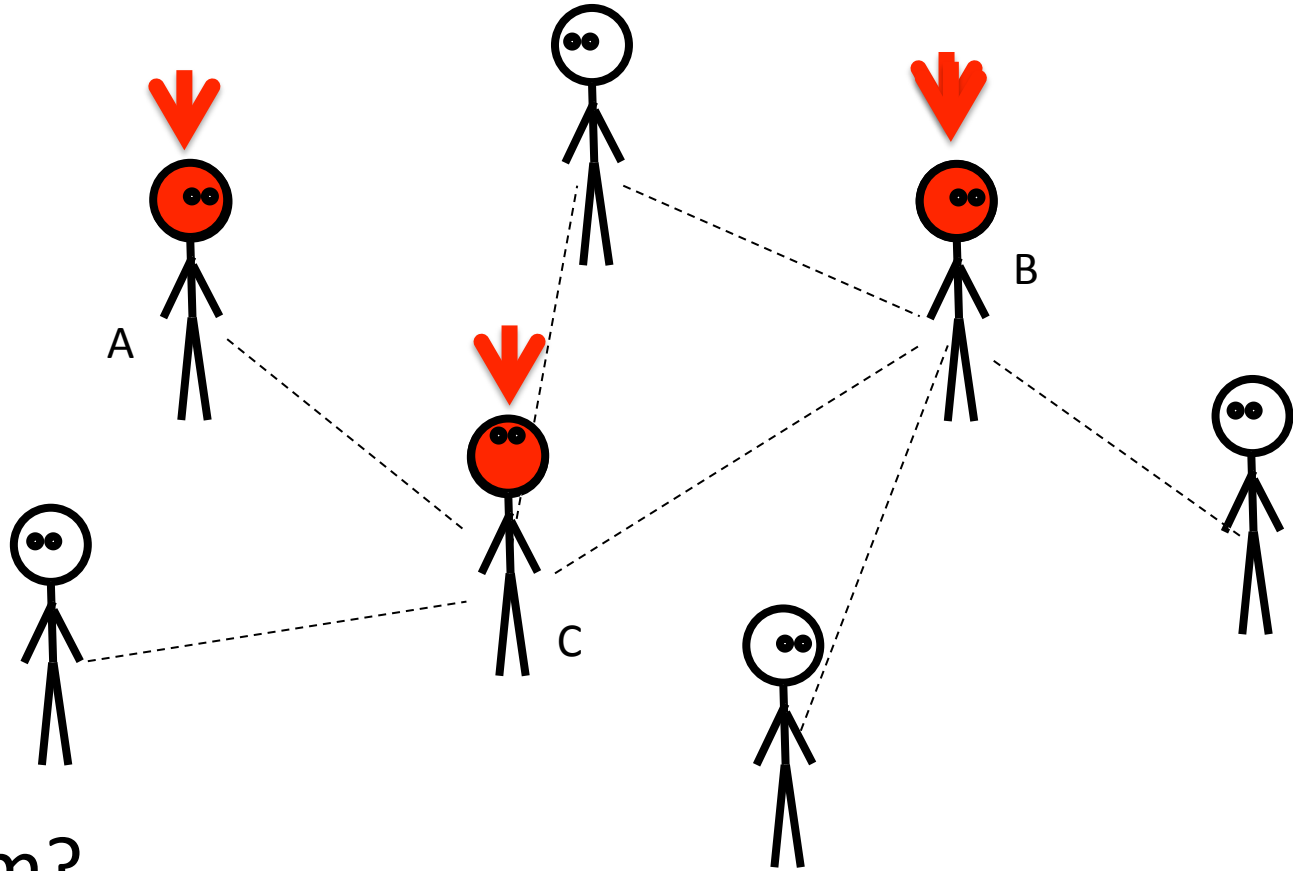
Model	Equation	MSE	<i>rank</i>
bias only	$\mu + b_u + d_i$	0.01200	0.24934
social influence	$\mu + b_u + d_i + \sum_{v \in N(u)} w_{vu} a_{ui} i$	0.01131	0.20091
user preference	$\mu + b_u + d_i + p_u^T q_i$	0.00950	0.13805
full model	$\mu + b_u + d_i + p_u^T q_i + \sum_{v \in N(u)} w_{vu} a_{ui} i$	0.00939	0.13777

Push-driven cascade model (cont'd)

- When being pushed an item to, whether a user becomes active is decided by:
 - Preference of that user.
 - Influence from her friends.

$$q(u) = b_u + \sum_{v \in N_u} W_{vu} a(v)$$

Push-driven cascade



- Whom?
- When?

Dynamic influence maximization problem

- Given
 - a social network
 - a PDC model on the social network
 - a **push budget** Lfind a **policy**, so that the influence spread is maximized.

It's an FH-MDP (finite-horizon Markov decision process).

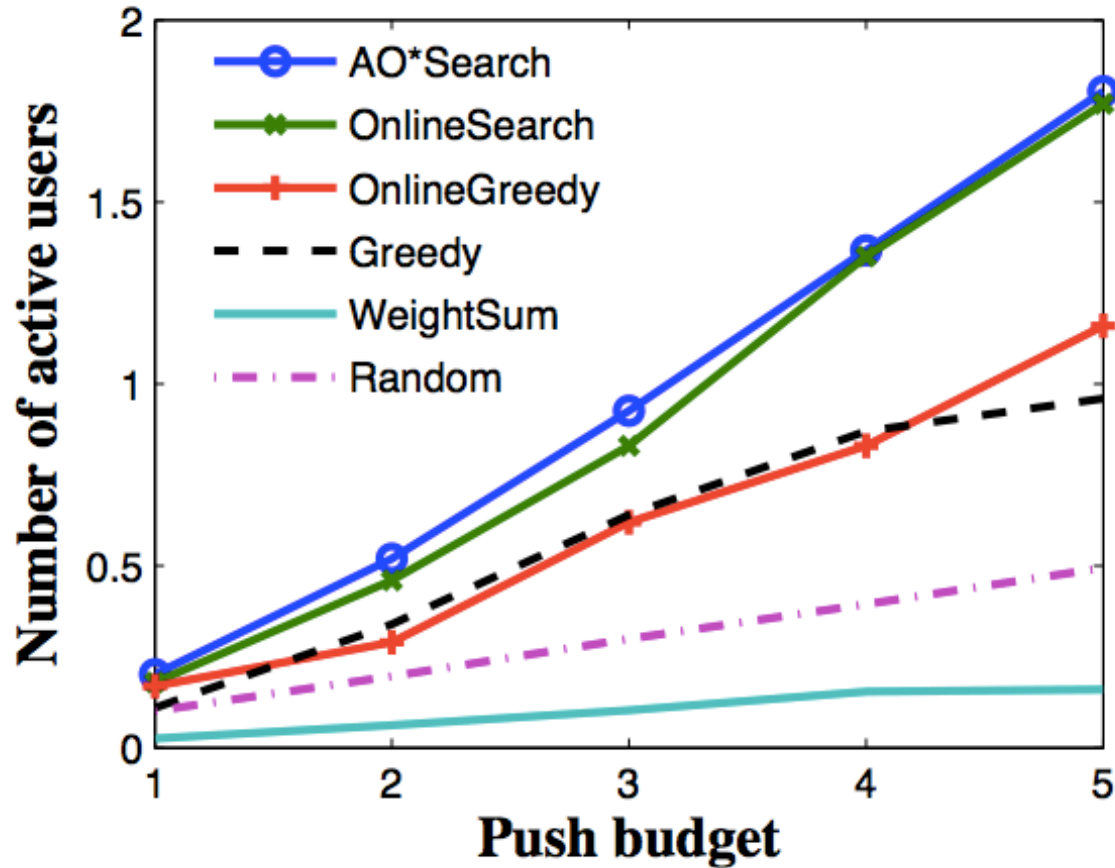
Search algorithm to find optimal policy

- Brute-force search
 - $\binom{|V|+1}{L}^{|V|}$ different policies.
- AO* search
 - Use an heuristic function to direct search.
 - With admissible heuristic function, guaranteed to find an optimal policy.
- Online search algorithm
 - With inadmissible heuristic function.
 - Fast. No guarantee to find optimal policy. But practically good.

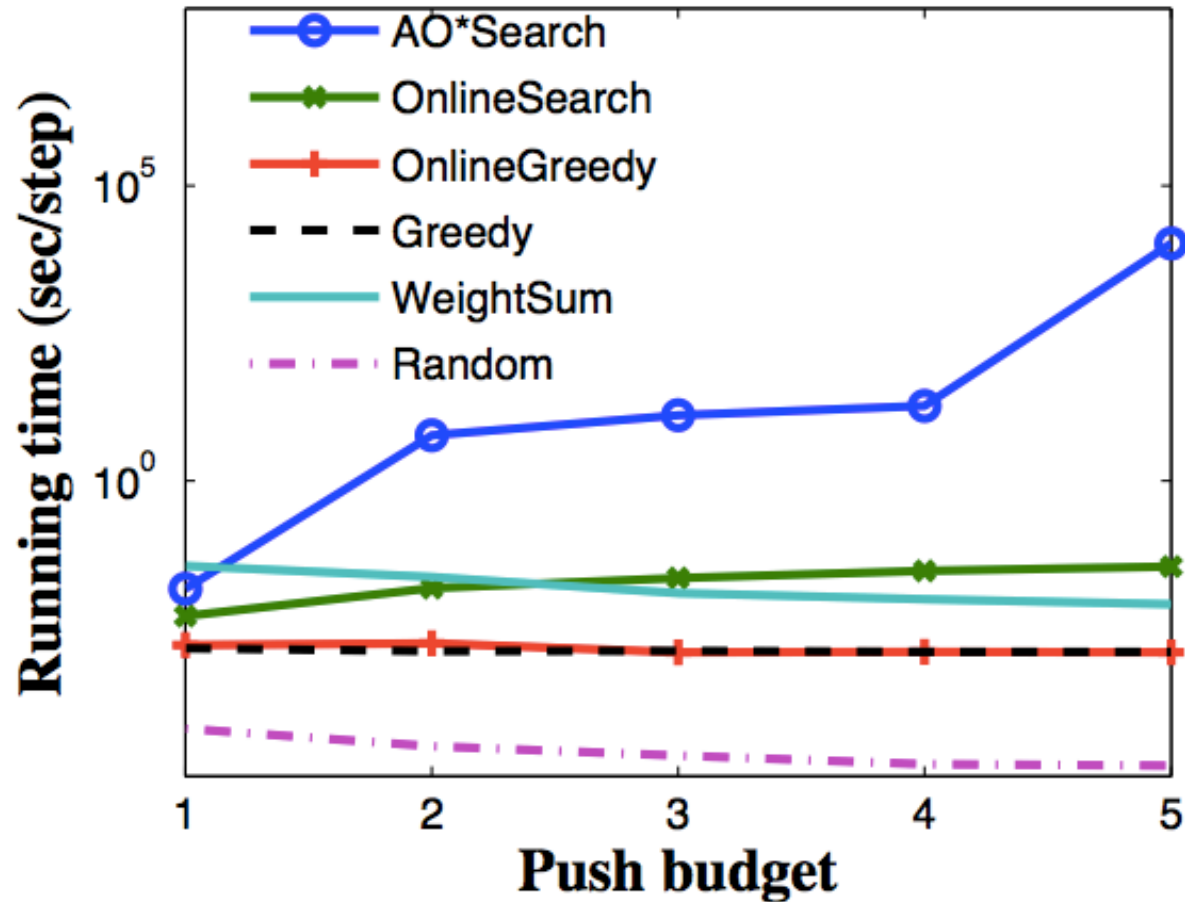
Experiment

- Datasets
 - Twitter
 - Two datasets (Twitter-friends, UIC-followers)
 - Foursquare
 - Slashdot
- Algorithms
 - AO*Search
 - OnlineSearch
 - Baselines: OnlineGreedy, Greedy, WeightSum

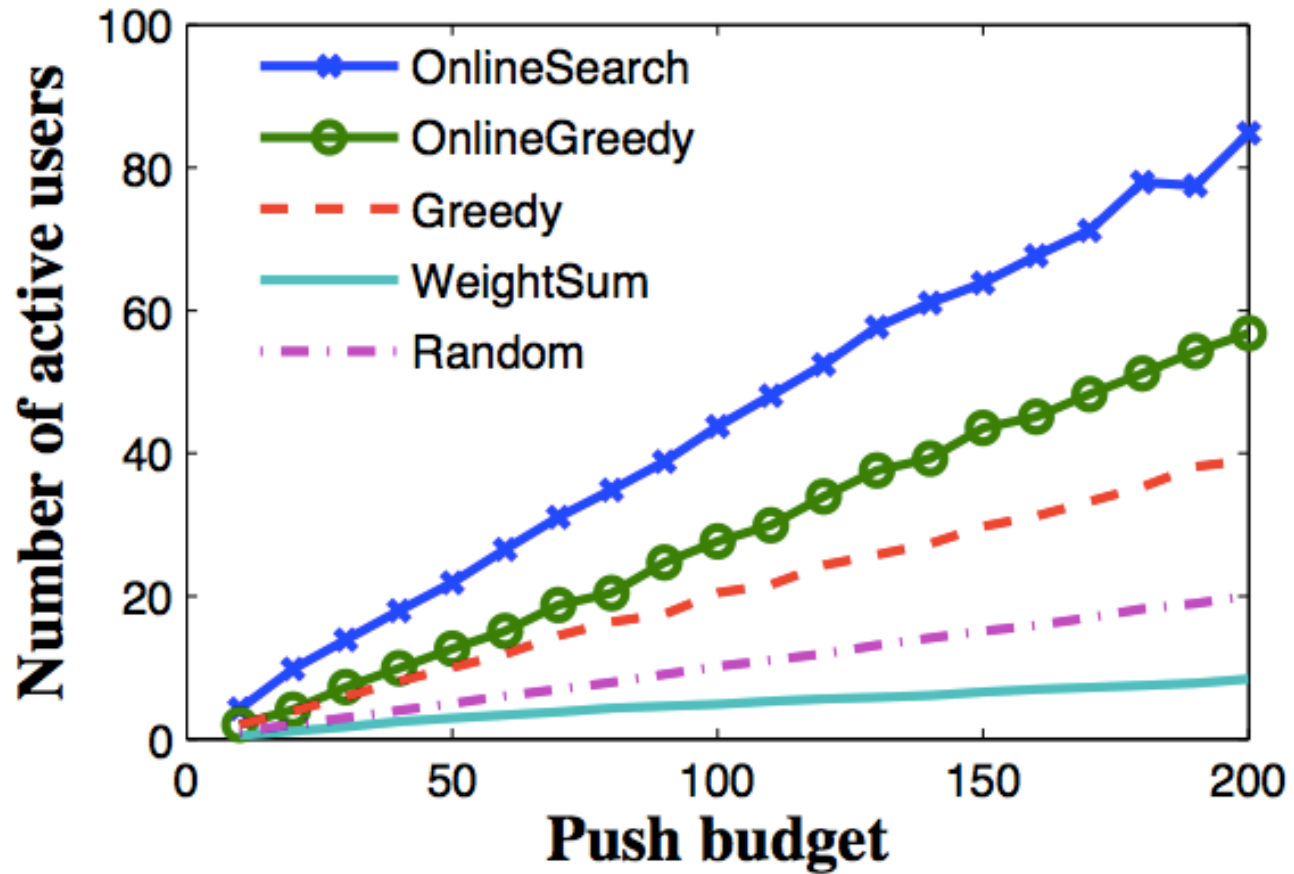
Influence spread with small budget



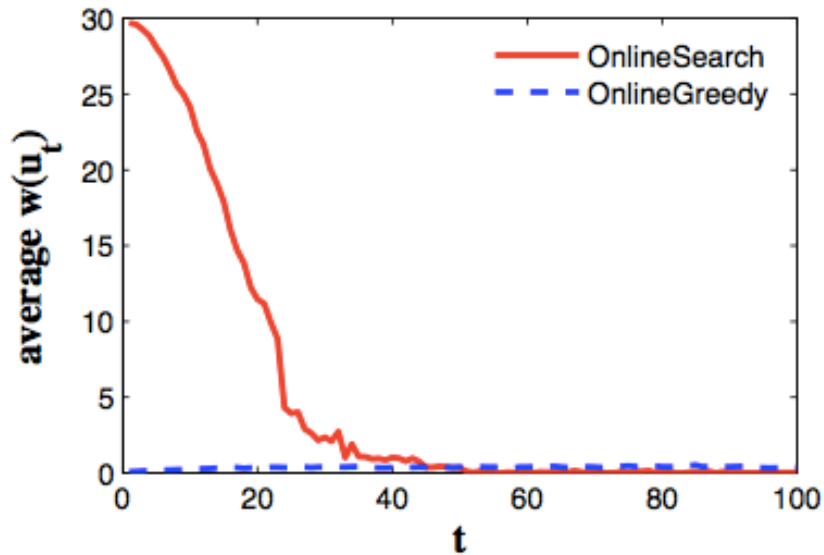
Running time with small budget



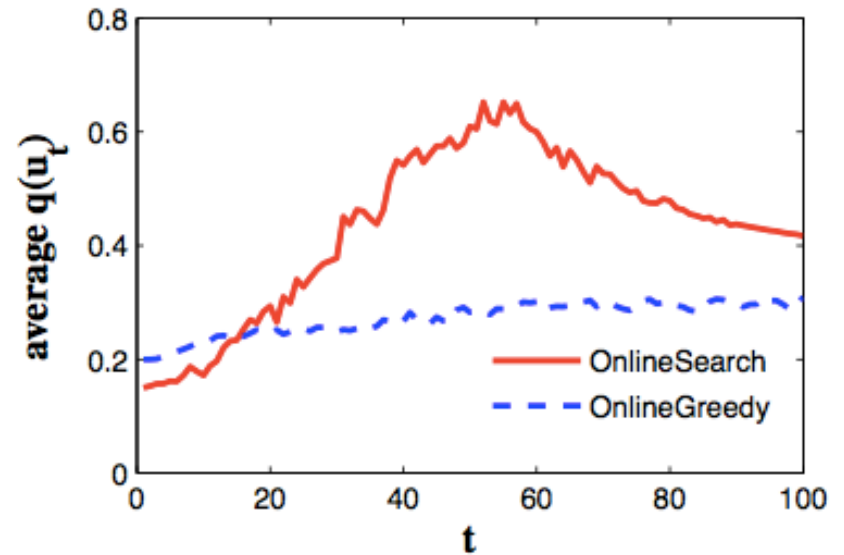
Influence spread with large budget



Understand the strategy



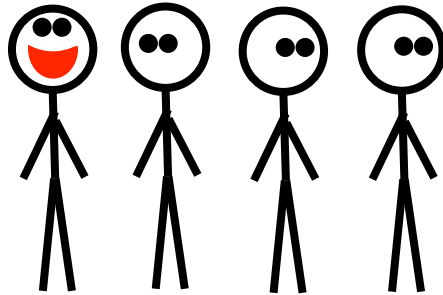
(c) $L = 100$, average $w(u_t)$



(d) $L = 100$, average $q(u_t)$

Conclusion

- Information diffusion process from the perspective of social network websites.
- A novel push-driven cascade (PDC) model, which combines the user preference and social influence.
- Dynamic influence maximization problem on the PDC model.



Thank you!