

# **Maximizing the Spread of Influence through a Social Network**

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# Outline

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- Introduction
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- Related Work
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- Our work
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  - Our Framework

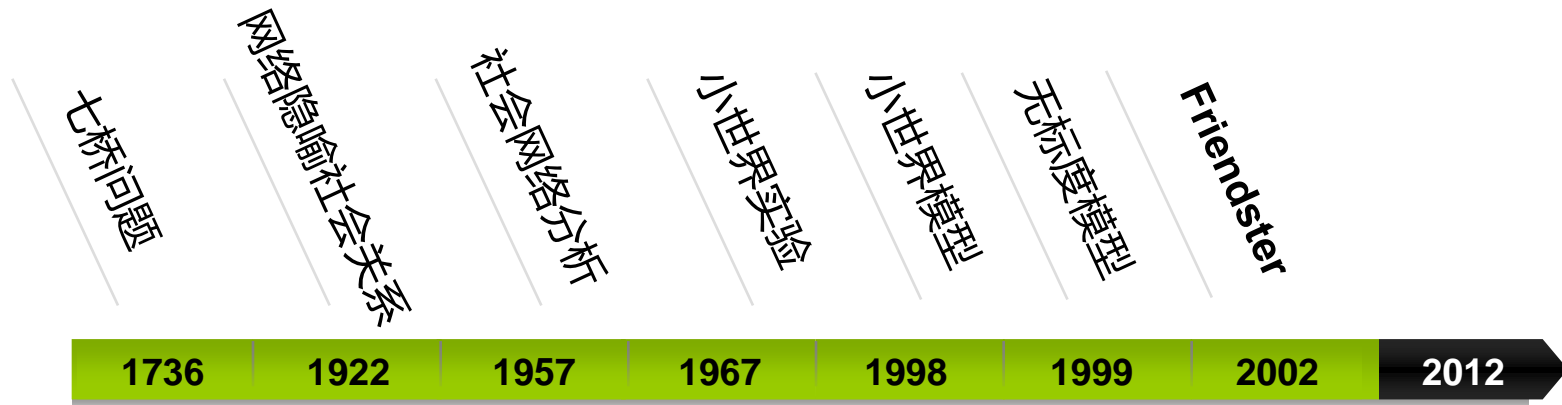
# Introduction

- What is a social network?
  - The graph of relationships and interactions within a group of individuals.



- Some Similar Concepts
  - Complex network
  - Social computing
  - Social media

# Introduction



*Social Network Development History*

# Background

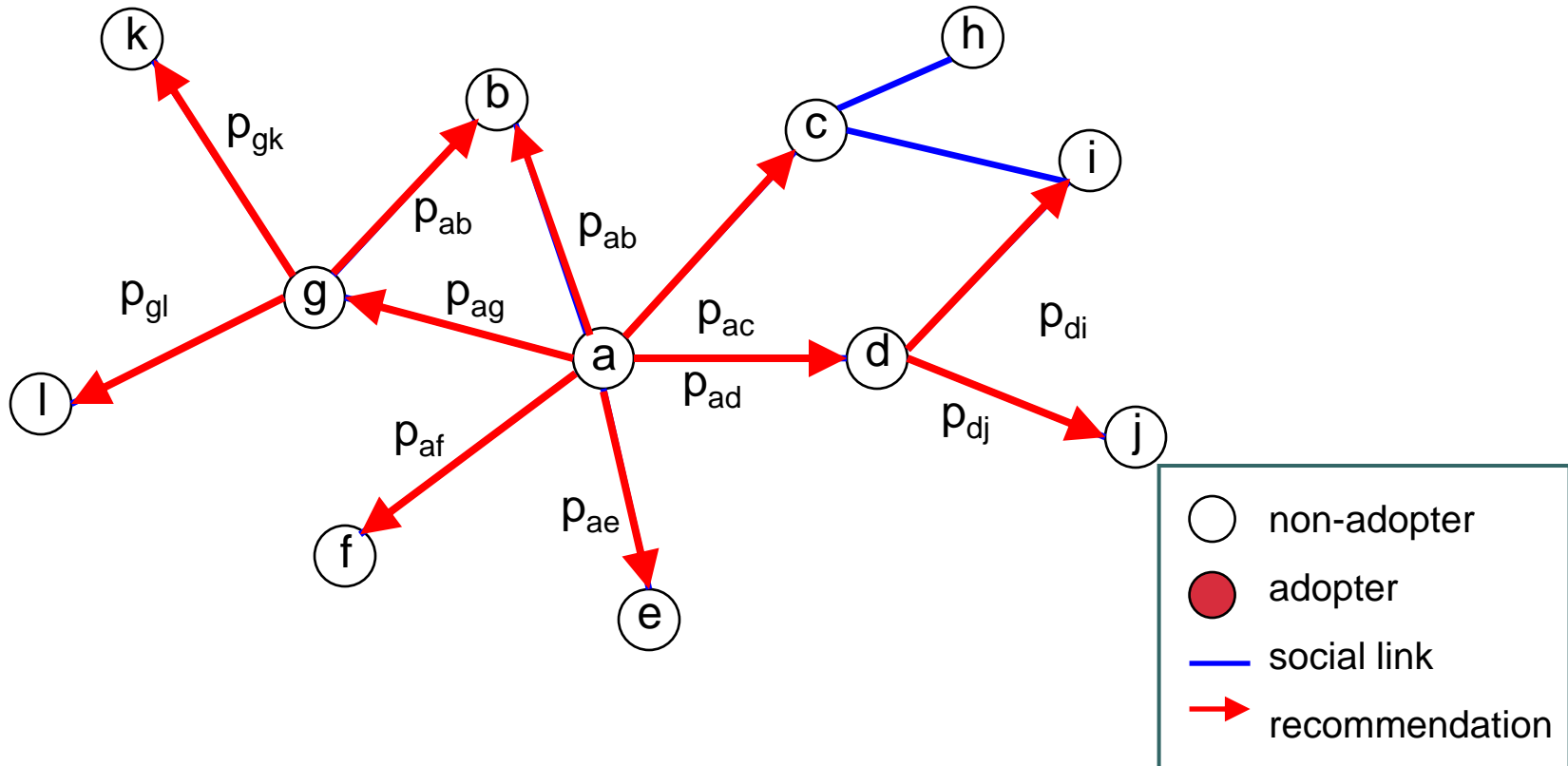
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- Word of Mouth and Viral Marketing
  - 68% of consumers consult friends and family before purchasing home electronics
  - Hotmail grew from zero users to 12 million users in 18 months on a small advertising budget.
- Social network plays a fundamental role as a medium for the spread of **INFLUENCE** among its members
  - Opinions, ideas, information, innovation...

# Problem Definition

- Influence maximization

- Given : a social graph, a diffusion model, *top-k* initial actived seeds
- Goal: trigger a large cascade of influence



# Problem Definition

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- Core question
  - How to calculate true influence probabilities?
- What we need
  - Models of influence diffusion in social networks.
  - Devise algorithm to maximize spread of influence.
  - Obtain data about particular network

# Related Work

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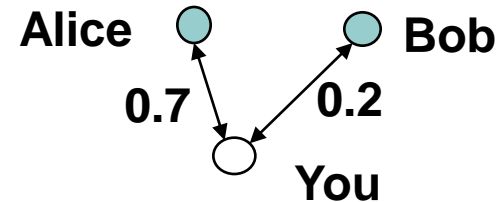
- *Richardson et al 2002*
  - Proposed Influence maximization first time
- *Kempe et al 2003*
  - Linear Threshold model
  - Independent Cascade model
  - Influence maximization is NP-hard
  - Greedy algorithm
- *Influence maximization based on community*
  - OASNET, CGA, CPWM, AMICS



# Two Basic Diffusion Models

- Linear Threshold Model
  - A node  $v$  is influenced by each neighbor  $w$  according to a *weight*  $b_{vw}$  such that

$$\sum_{w \text{ neighbor of } v} b_{v,w} \leq 1$$



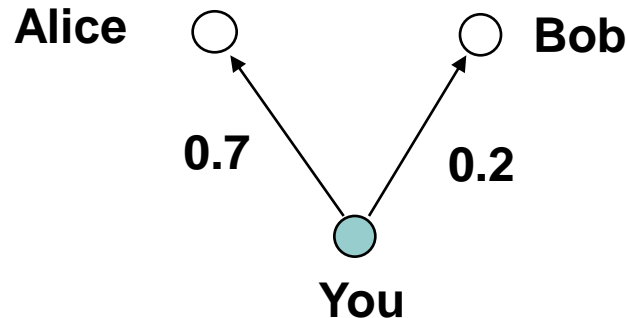
- A node  $v$  has random threshold  $\theta_v \sim U[0, 1]$

$$\sum_{w \text{ active neighbor of } v} b_{v,w} \geq \theta_v$$

# Two Basic Diffusion Models

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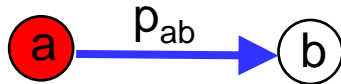
- Independent Cascade Model
  - When node  $v$  becomes active, it has a **single** chance of activating each currently inactive neighbor  $w$ .
  - The activation attempt succeeds with probability  $p_{v,w}$  --- a parameter of the system.



# Exist Problems

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- Lack of good methods to measure influence.
- Based on community but little use of properties of community.
- Diffusion models are too simple



- Lack of efficient algorithm for influence maximization

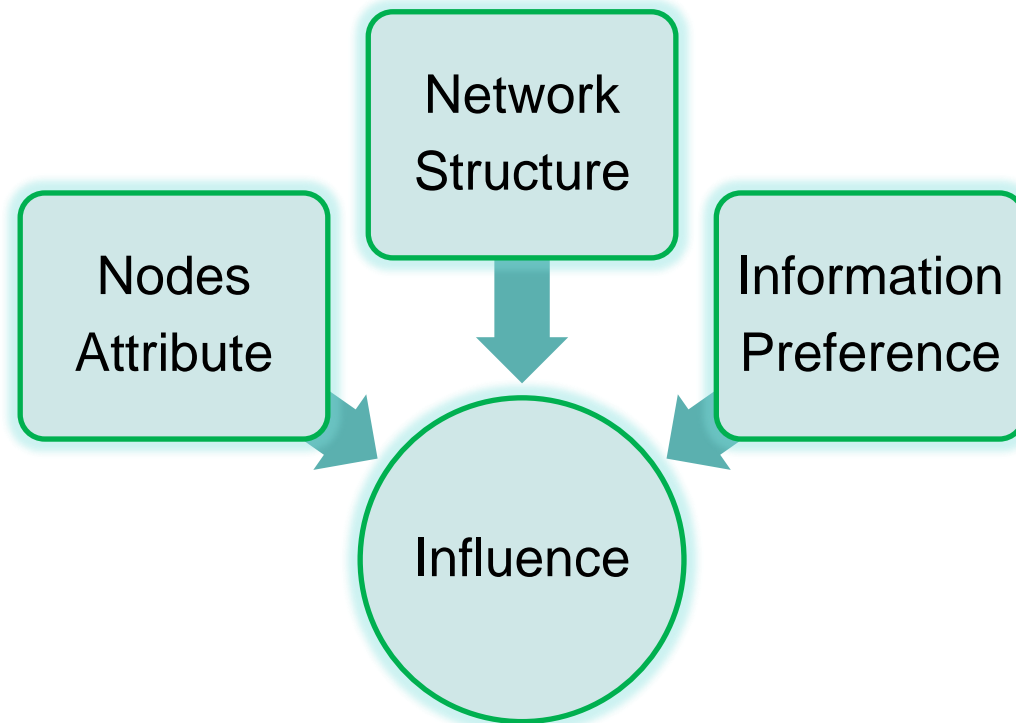
# Our work

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- Measure the influence of social network
- Develop a efficient algorithm for influence maximization
- Construct a influence diffusion model
- Visualize the dynamic process of influence (information) diffusion

# Influence Measurement

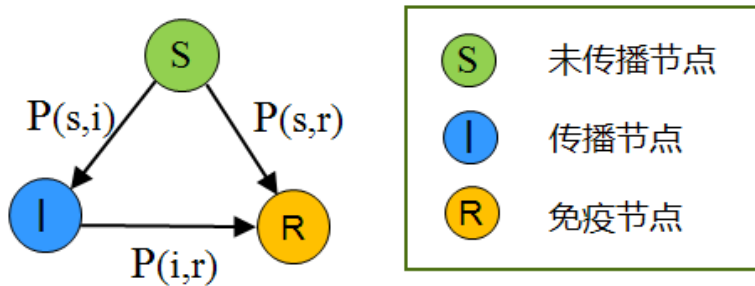
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$$\text{Inf}(A,B) = \alpha \times \text{Stru}(A) + \beta \times \text{Attr}(A) + \gamma \times \text{Pref}(B,i)$$

# Diffusion model

- *Node state*



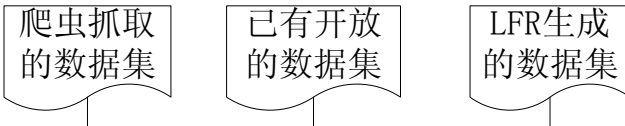
- *Reasonable Threshold or Probability*
- *Influence dynamic change*
- *Influence maximization*

# Our Framework

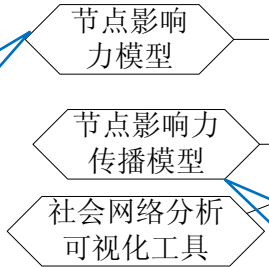
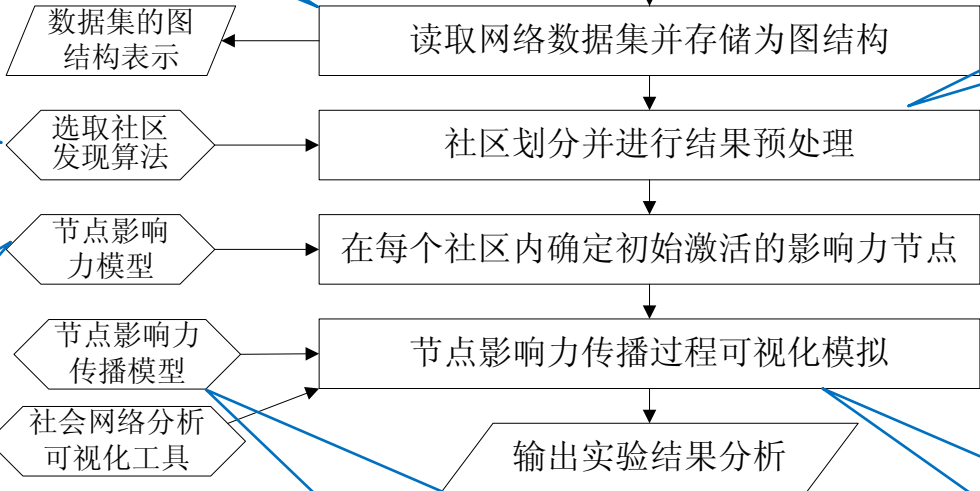
- 有向图&无向图
- 有权图&无权图
- 正影响&负影响

- 社区的重叠性
- 社区的大小分布
- 社区的主题

- 节点静态属性
- 节点行为属性
- 影响力的正负
- 弱势链优势理论



不改变原有的节点属性及社区性质情况下,根据选取的初始激活节点的个数,进行社区的合并和拆分



- 丰富节点状态,引入影响力“免疫节点”
- 根据节点影响力来初始化激活概率
- 节点交互的动态性带来的节点影响强度的动态变化

- ◆ 构造方法: 定性分析, 定量计算, 多变量最优化建模
- ◆ 难点: 尽量保证多变量因子的独立性, 控制时间复杂度

- ◆ 开发基础:
  - Prefuse库
  - Vizster可视化工具
- ◆ 可视化要求:
  - 社会网络图
  - 传播过程的动态演示

# scientific problems

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- *From characteristic to measurement*
- *General model or particular model?*
- *How to validate the model?*
- *Are there good methods for analyzing  
semanteme and topic of information context*



# Now and Future



**Thank You!**

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**Question?**

