



Kent State Computer Science/Physics Update

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What is *stochastic diffusion model*

A *stochastic diffusion model* for a social graph $G=(V,E)$ specifies the randomized progress of generating **active** sets S_t for all $t \geq 1$ given the initial seed set S_0 .

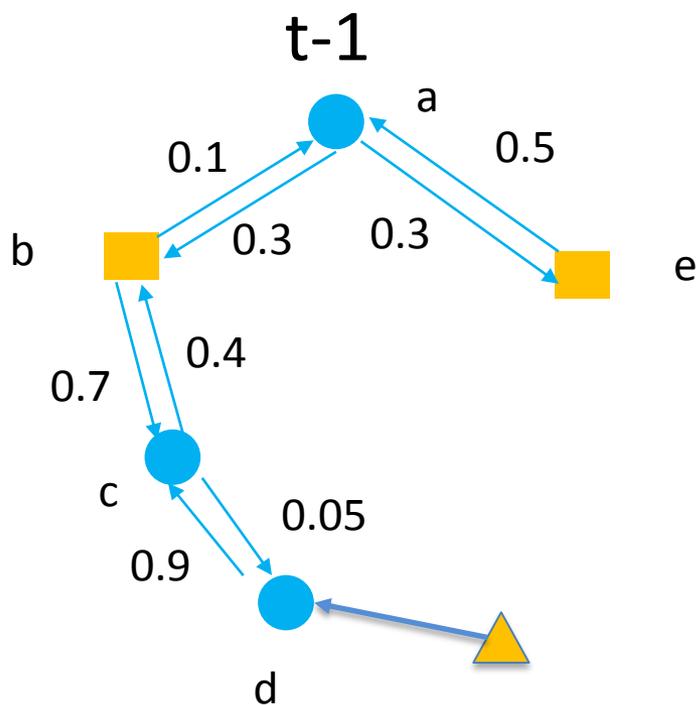
If all $t \geq 1$, $S_{t-1} \subseteq S_t$, nodes only go from inactive to active, we call it **progressive process**.

What is *influence spread*? Definition

$\Phi(S_0)$ is the *final stable activated* set of nodes in stochastic process of diffusion model, with seed set S_0

$\sigma = E(|\Phi(S_0)|)$ is the expectation of this set (amount of nodes), called influence spread

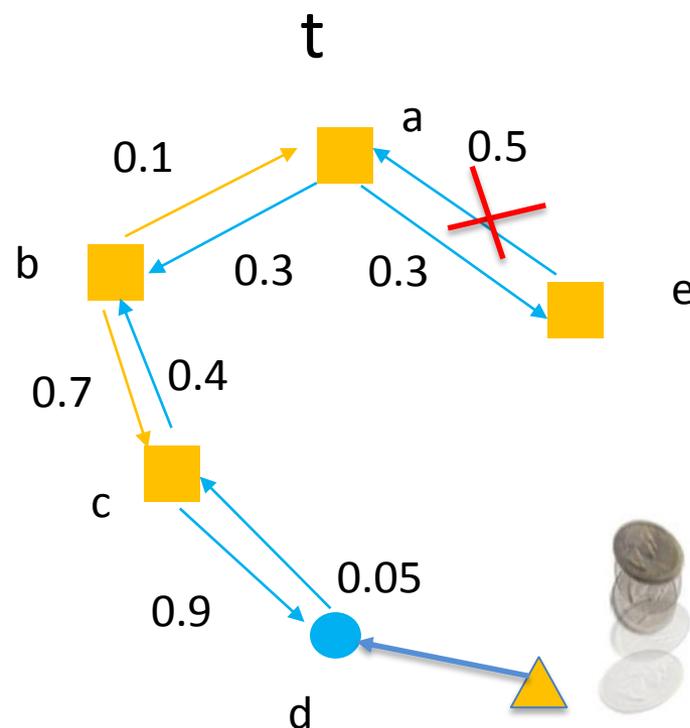
Example—Independent Cascade Model



Just activated sets = { }

Inactive sets = { }

Old activated sets = { }

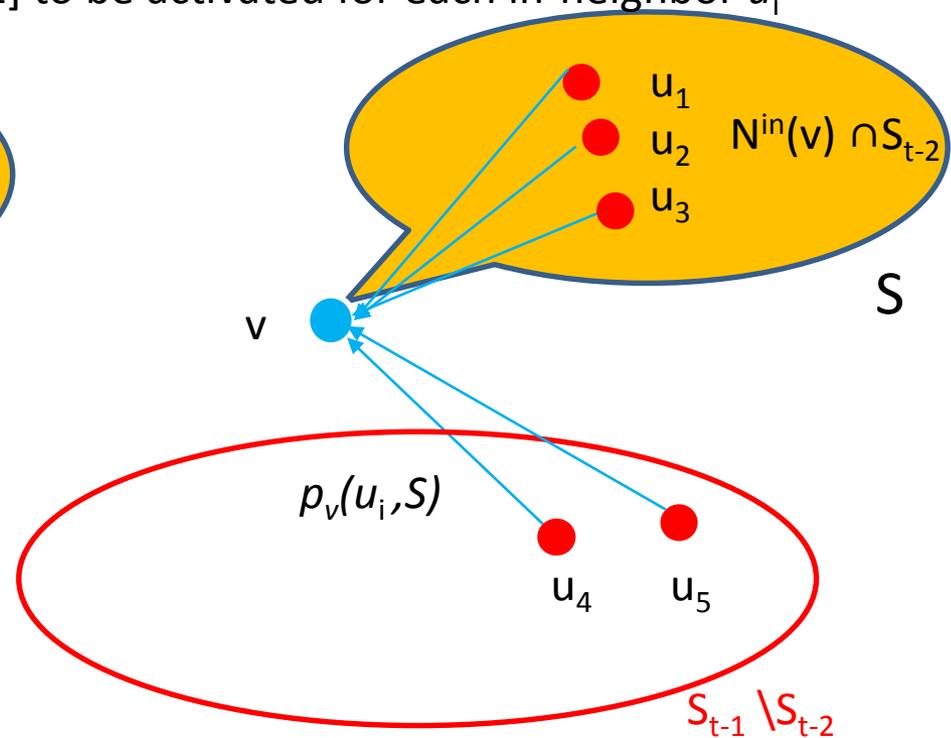
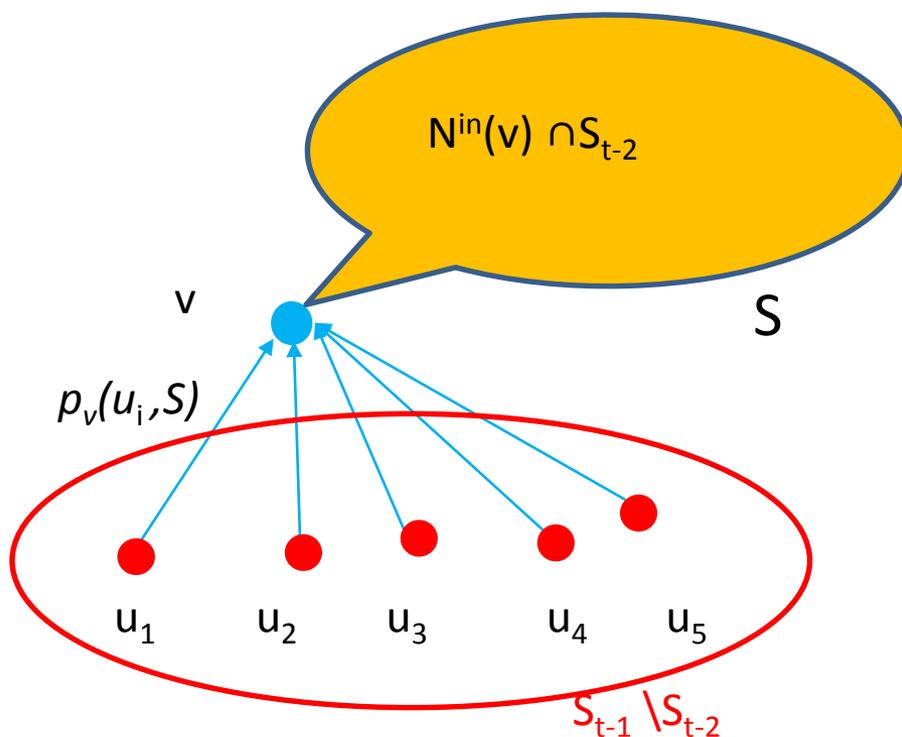


General Cascade Model the model makes more sense :

If inactive node v at **time $t-1$** has *just activated* in-neighbors sets $\{u\} = N^{\text{in}}(v) \cap (S_{t-1} \setminus S_{t-2})$, nodes in $\{u\}$ will activate v one by one

If part of the nodes set u , $\{u_1, u_2, \dots, u_{i-1}\}$ failed to activate v . They will form a set $S = (N^{\text{in}}(v) \cap S_{t-2}) \cup \{u_1, u_2, \dots, u_{i-1}\}$

The node v has a probability $p_v(u_i, S) \in [0, 1]$ to be activated for each in-neighbor u_i



Propagation of American Express Promotions

The American Express allow their card members sync their twitter accounts with their American Express credit card.

Amex Offers you easy ways to save on shopping, dining and more when you tweet.

 Sign in with Twitter

Sign in to Twitter and connect your Card to get offers today!

Once the twitter account @Americanexpress posted a hashtag such as #AmexStaples, then those cardmembers can tweet the exactly same hash tag to get the promotions when they shopped with their Amex-express card.

The @AmericanExpress posts promotions



American Express @AmericanExpress · Aug 5
Tweet #AmexOrvis, get \$20 back 1x on purchs totaling \$100+ at Orvis
w/cnctd Amex Card! RegLtd Exp 9/19/15 Terms:amex.co/1lbh9dw

ORVIS

Orvis - Spend \$100+, Get \$20 Back

Valid in-store and online. Valid at any participating location in the US. Not valid at outlet locations. Tweet #AmexOrvis to get started!

sync.americanexpress.com

User @3.141592653....
got the promotion as his
retweet contains the hash
tag #AmexOrvis

 3.141592653589793238 retweeted



American Express @AmericanExpress · Aug 5
Tweet #AmexOrvis, get \$20 back 1x on purchs totaling \$100+ at Orvis
w/cnctd Amex Card! RegLtd Exp 9/19/15 Terms:amex.co/1lbh9dw

ORVIS

Orvis - Spend \$100+, Get \$20 Back

Valid in-store and online. Valid at any participating location in the US. Not valid at outlet locations. Tweet #AmexOrvis to get started!

sync.americanexpress.com

- Once a user was confirmed to get the promotion, another account, @AmexOffers will mention the card member in a tweet. If it failed, it will tell the reason.



Amex Offers @AmexOffers · Jul 20

@scott_fia_li Thx for enrolling in [#AmexBestBuy](#) offer. Spend w/connected Card & receive credit. Terms: amex.co/1UApDni



[View summary](#)

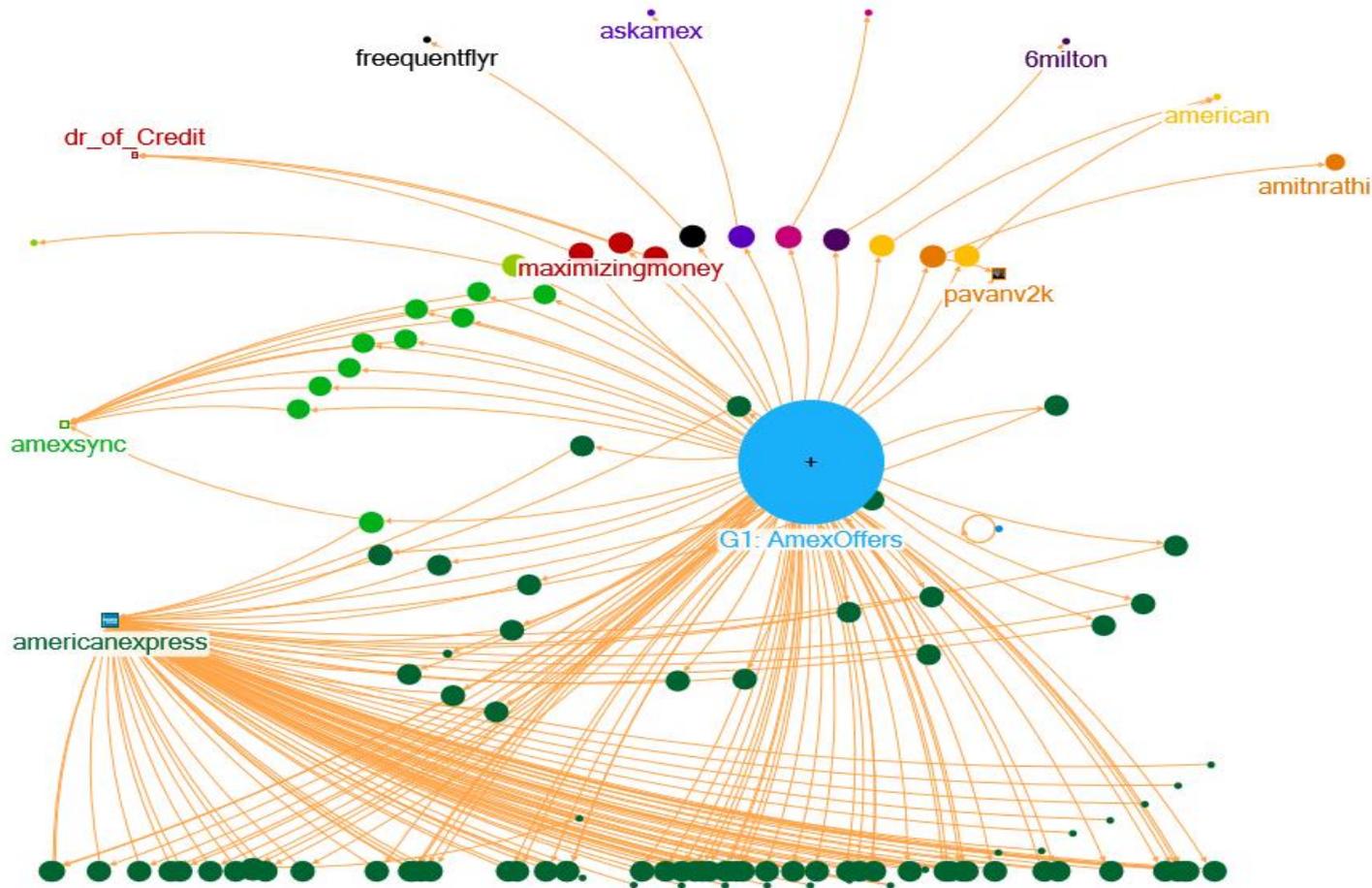


[Amex Offers](#) @AmexOffers · Jul 23

@948_bc_bao Sorry, max # of Card Members have enrolled in [#AmexHP](#) offer. Visit amex.co/faves for more offers



Visualization about the process of promotion





Why this model

- The promotions appears randomly and face to all the card holders. So every card member have a potential to make one or two purchase. This could be interpreted as they have some probability to be activated.
- Once a credit card member add the promotion, he doesn't have to cancel that promotion. This event satisfies the definition of progressive process.



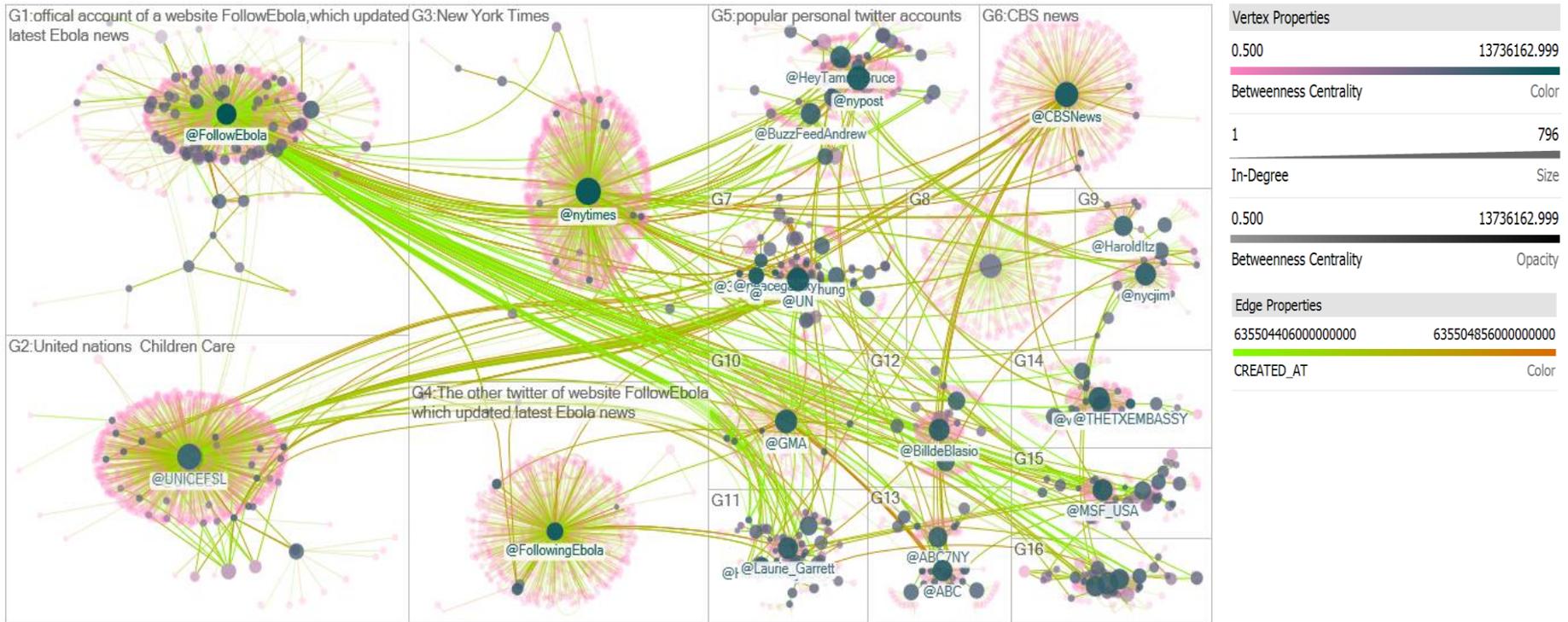
To do list

- Build more sophisticated math models to describe the promotion activity online , not just the American Express promotion. And prove its correctness.
- Develop a good algorithm to maximize the influence spread, which means to find a better way of advertisement.
- Define the entropy in the propagation process.
- Incorporate the development into the open source tool in Kent State.

Thank you for your attention!

Comments/suggestions are welcome!

Begins with the spread of Ebola news on twitter



Data is provided by HDMA at Santiago State University.