Motif-oriented influence maximization for viral marketing in large-scale social networks

Authors: Mingyang Zhou, Weiji Cao, Hao Liao and Rui Mao

Shenzhen University

zmy@szu.edu.cn(M.Y. Zhou) , haoliao@szu.edu.cn(H. Liao)

10/29/2024

Motivation

Examples:

a. A motif of k friends dine together and choose a if more than half users agree.

b. When determining whether to purchase a KFC Family Bucket, every family member must consent to consume KFC.

c. Farmigo platform offers services for group customers when a specific number of members purchase the foods.

(a)

(b)

(c)

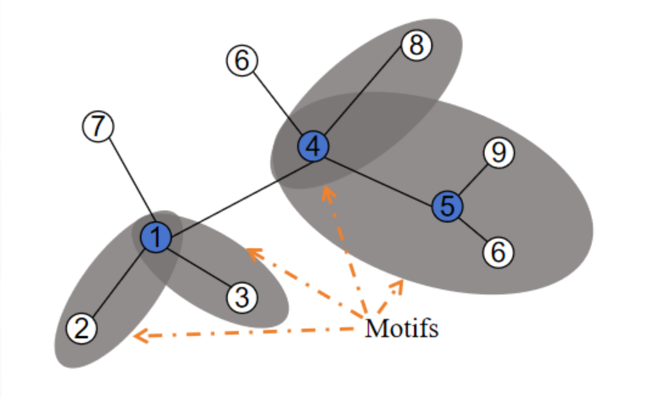

Fig. 1: Motif-level influence maximization(IM).

Motif activation: A motif is activated if more than r_i nodes in the motif are activated; otherwise the motif is inactive.

Problem Definition: Given a graph G, a cascade model $\mathbb{C}$, and an integer k, the **M**otif-**O**riented **I**nfluence **M**aximization (MOIM) asks for a size-k seed set with the largest expected activated motifs, i.e.,

$$S_k = argmax_{S:|S|=k} \mathbb{I}_{\mathbb{C}}^{\mathcal{G}}(S).$$

Method

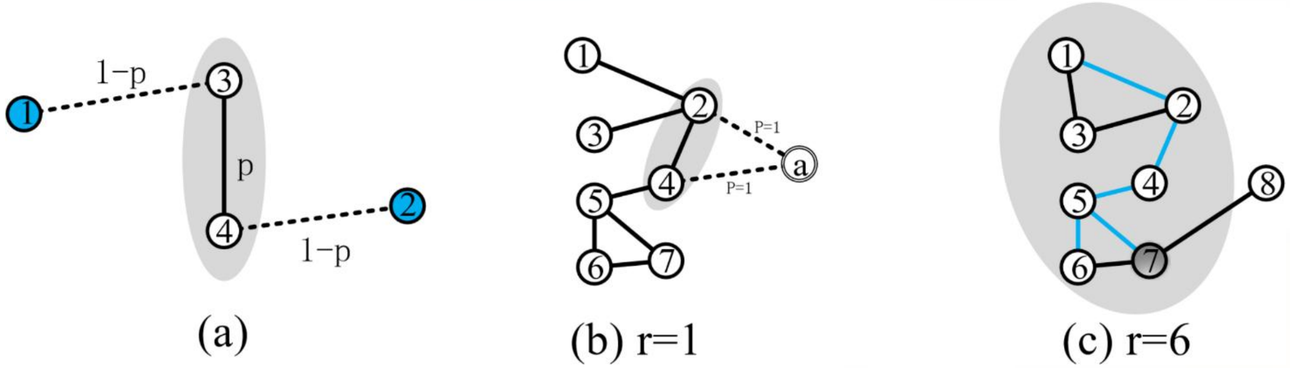

Fig. 2 : (a) An example of a graph containing only one motif. (b) A super node example(labeled a) . (c) 5-spanning tree example (see blue edges).

Algorithm 1: NodeSelection (G, θ, k).

```
Initialize a node set S*_k = ∅;
for i = 1 : θ do
    Randomly choose a super node v with probability w_v / η;
    Generate a RR set R_i starting from node v;
    Insert R_i to 𝓡;
end
for i = 1 : k do
    Identify the node v that maximizes the marginal coverage of 𝓡, F_R(S*_k ∪ {v}) − F_R(S*_k);
    Insert v into S*_k;
end
return S*_k;
```

Method ($r_i = 1$): Add a super node T_i connecting each motif.

Expectation of activated super nodes ($r_i = 1$)

$\bar{f}(S) = \mathbb{I}^{\mathfrak{g}}_{\mathbb{C}}(S) = \mathbb{E}_{\mathbb{C}}[\sum_{a \in T} \omega_i \cdot \mu(a)]$.

Lower bound ($r_i > 1$): $\underline{f}_2(S) = \tau \cdot \bar{f}(S)$, τ is a constant.

Upper bound ($r_i > 1$): $\bar{f}(S)$.

Proof: see the manuscript.

Results

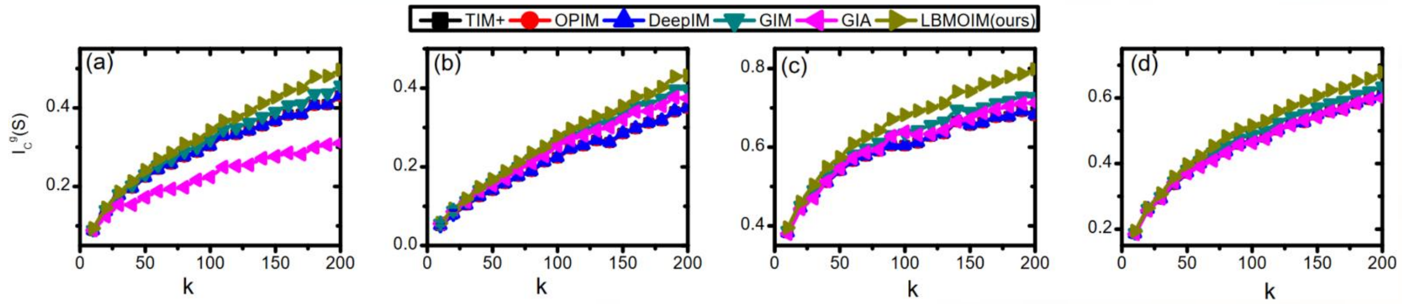

Fig. 3: Expected motif influence vs. k under LT model, r_i = 1 and motif size being 2.

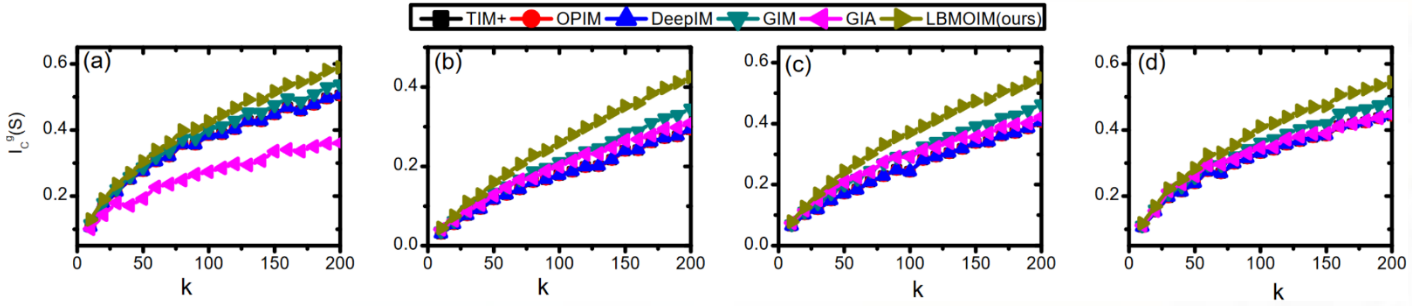

Fig. 4: Expected motif influence vs. k under LT model, r_i = 1 and motif size being 3.

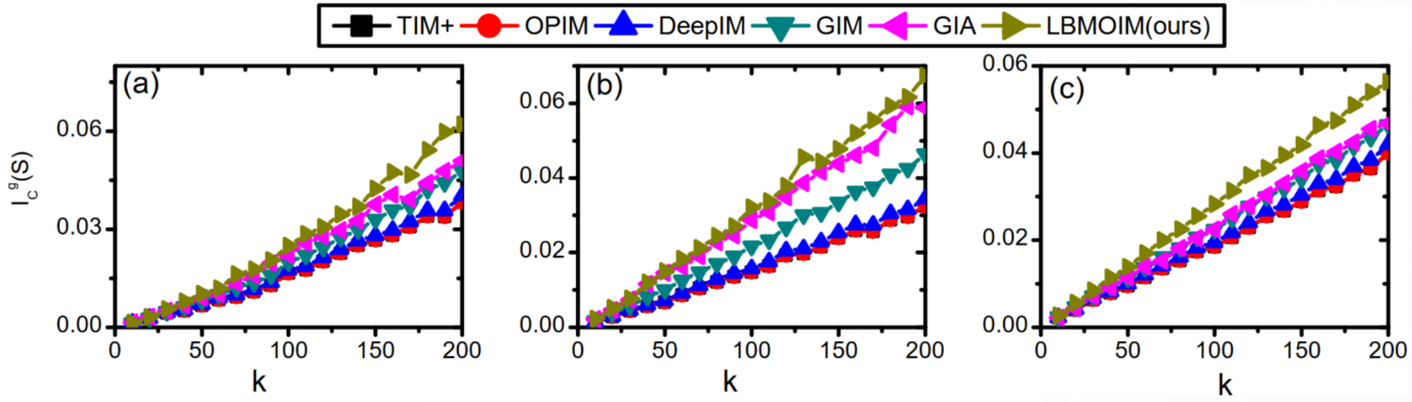

Fig. 5: Expected motif influence vs. k under LT model. (a) Motif size 2 and r_i = 2. (b) Motif size 3 and r_i = 3. (c) Half motifs have size 2 and r_i = 2, whereas the other half motifs have size 3 and r_i = 3.

Thank you!

zmy@szu.edu.cn(M.Y. Zhou) , haoliao@szu.edu.cn(H. Liao)