

Personalized Graph-Based Recommendation system<sup>1</sup>

[1] Athanasios N. Nikolakopoulos and George Karypis. RecWalk: Nearly Uncoupled Random Walks for Top-N Recommendation. February 2019.

## EMiGrE: a Framework for Explaining Missing Graph Recommendations<sup>2</sup>

[2] Hervé-Madelein Attolou, Katerina Tzompanaki, Kostas Stefanidis, Dimitris Kotzinos. Why-Not Explainable Graph Recommender. IEEE 40th International Conference on Data Engineering, May 2024, Utrecht (Netherlands), Netherlands. (hal-04364920v2)

A **Why-Not explanation** is a set of edges  $A^* \subseteq A$ ,  $A \in \{A^+, A^-\}$ , with  $A^+ = \{a^+ \mid a^+ = (u, i) \notin E, i \in I\}$ , and  $A^- = \{a^- \mid a^- = (u, i) \in E, i \in I\}$ , such that  $G' = (V, E', \theta)$ , with  $E' = E \cup A^+ \setminus A^-$ , outputs WNI as the top-1 recommendation.

## Phase 1: Explanation Search Space

Sort candidate edges using their contribution to the recommendation in two modes.

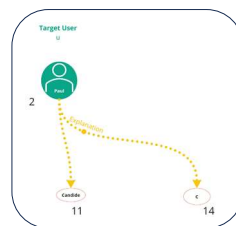
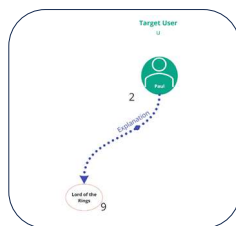
### Add Mode

Suggests **NEW ACTIONS**

$$contribution_{add}(n_i) = PPR(n_i, WNI \mid A) - PPR(n_i, rec \mid A)$$

$$A^+ = \{(2, 9)\}$$

"If Paul reads *Lord of the Rings*, the recommendation will be *Harry Potter*"



### Remove Mode

Pinpoints **PAST ACTIVITY**

$$contribution_{rmv}(n_i) = W(u, n_i) \cdot (PPR(n_i, rec \mid A) - PPR(n_i, WNI \mid A))$$

$$A^- = \{(2, 11), (2, 14)\}$$

"If Paul had not read *Candide* and *C* the recommendation, would have been *Harry Potter*"

## Phase 2: Why-Not Explanation Computation

Compute the explanation from the candidate edges based on the following heuristics.

### Top-1 Comparison

Compares the ranking of the *WNI* and *rec*.

### Exhaustive Comparison

Compares the ranking of *WNI* and **ALL** target items.

### Incremental

### Explanation Heuristics

### Powerset

Targets more **COMPLETE** solutions.

Targets **FASTER** solutions by increasing the size of the explanation on each iteration.

Targets **SHORTER** solutions by exploring more widely the solution space.

## Evaluation

### Experimental Process:

- Target users: 100 random "normal" users from an Amazon Dataset
- Graph: 4-radius subgraph around the target user node
- Why-Not item: items ranked 2 to 10 in the recommendation list

Method	(a)	(b)	(c)
add_Incremental	6,54	8,31	5,78
add_Powerset	57,55	133,96	8,19
add_ex	21618,32	23924,37	14646,56
remove_Incremental	9,07	8,20	9,15
remove_Powerset	287,91	15,32	315,31
remove_ex	173,44	24,48	190,13
remove_ex_direct	25,14	21,81	25,38
remove_brute	908,73	22,37	1008,07

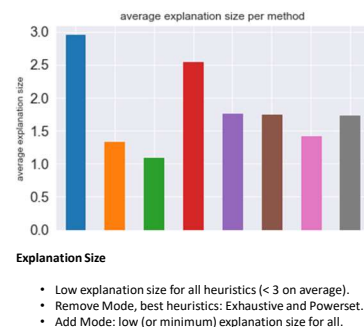
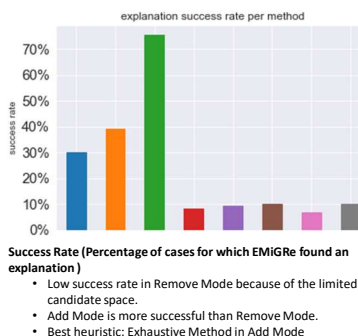
Average runtime in seconds per method (a) in the general case, (b) when an explanation is found, and (c) when no explanation is found.

### Computation Time

- Most methods are time consuming.
- The Exhaustive Comparison method in Remove Mode is comparable to brute force.
- Incremental Methods give fast results, both in Add and Remove Modes.

### Baselines:

- Brute force** (remove mode): to evaluate the computation time and explanation size
- Exhaustive Comparison Direct**: to evaluate the need for the check step (the computation stops after the first result is provided)



### Acknowledgments

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