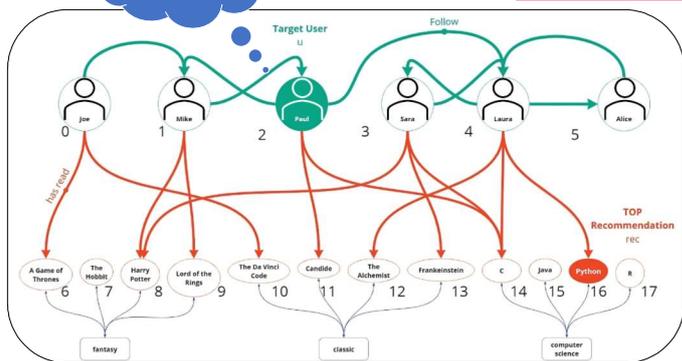




Why Not Harry Potter?



Personalized Graph-Based Recommendation system¹

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

Motivation

Why-Not Question: Why is an item not recommended ?

Goal:

- Explain the absence of certain items from a user's recommendation list.
- Provide **personalized, and causal, actionable explanations** for missing results using user activity.

Challenges: Vast Search Space

- Optimize for Time.
- Optimize for Explanation Size.

EMiGR: a Framework for Explaining Missing Graph Recommendations²

[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.

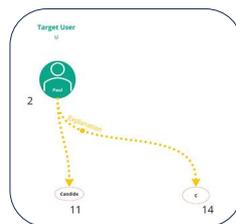
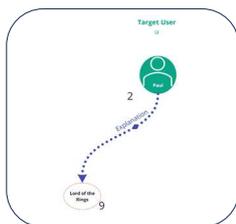
Add Mode

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 *Candidate* 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.

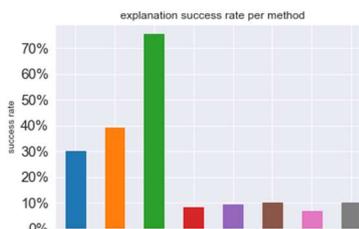
Computation Time

- 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.

- add_Incremental
- add_Powerset
- add_ex
- remove_Incremental
- remove_Powerset
- remove_ex
- remove_ex_direct
- remove_brute

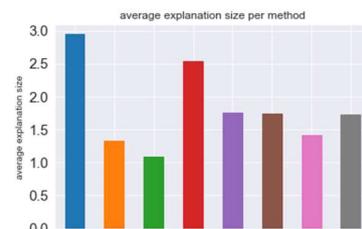
Baselines:

- **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)



Success Rate (Percentage of cases for which EMiGR found an explanation)

- Low success rate in Remove Mode because of the limited candidate space.
- Add Mode is more successful than Remove Mode.
- Best heuristic: Exhaustive Method in Add Mode



Explanation Size

- Low explanation size for all heuristics (< 3 on average).
- Remove Mode, best heuristics: Exhaustive and Powerset.
- Add Mode: low (or minimum) explanation size for all.

Acknowledgments

This work is partially supported by the National French Agency, under the EXPIDA - ANR-22-CE23-0017 project.