Inter-Session Modelling for Session-Based Recommendation

Deep Learning for Recommender Systems (DLRS) - 2017

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Outline

- Introduction
- Inter-Session Modelling
- Experiments and Results
- Conclusion

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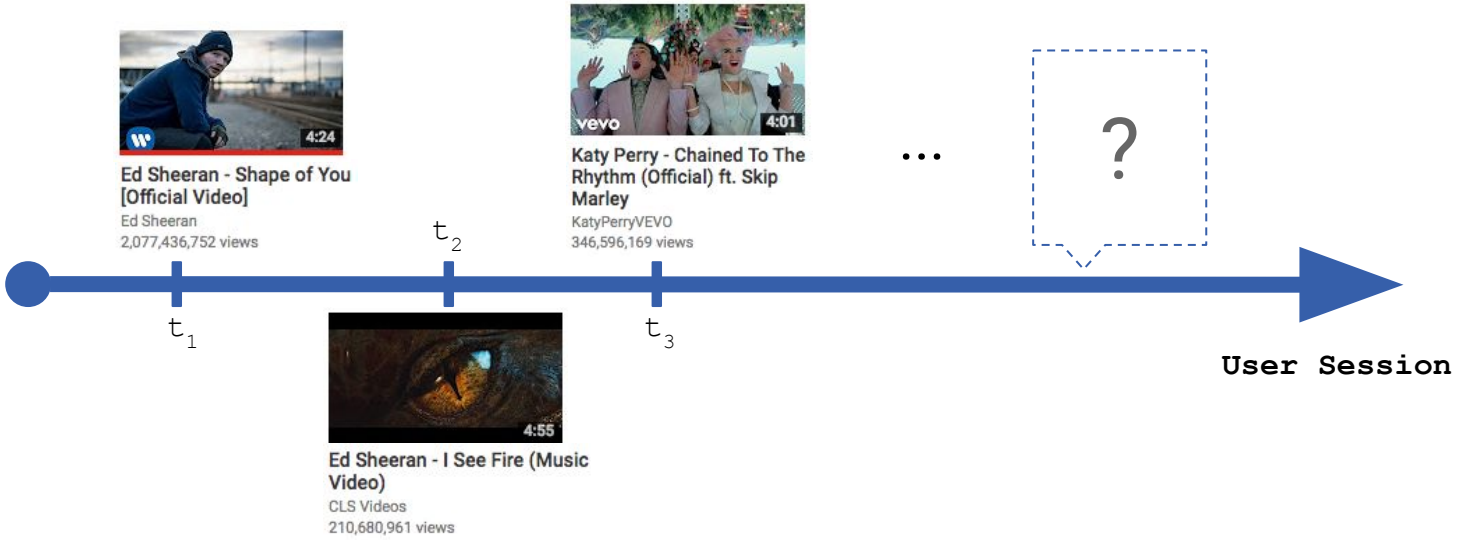
Introduction

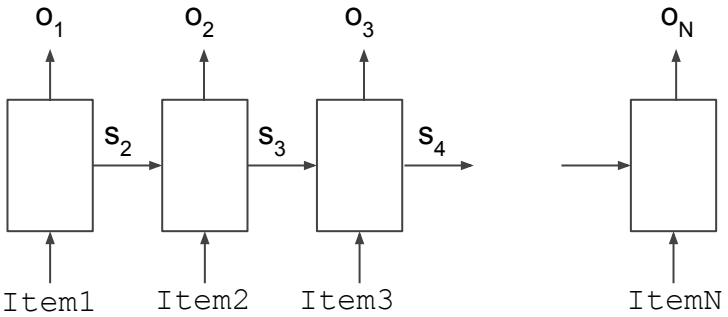
Intro: *Session-Based Recommendation Problem*

- Many e-commerce site do **not track** users **visits**
- **Users identification** sometimes possible but **not reliable**
- Permanent **cold-start** problem

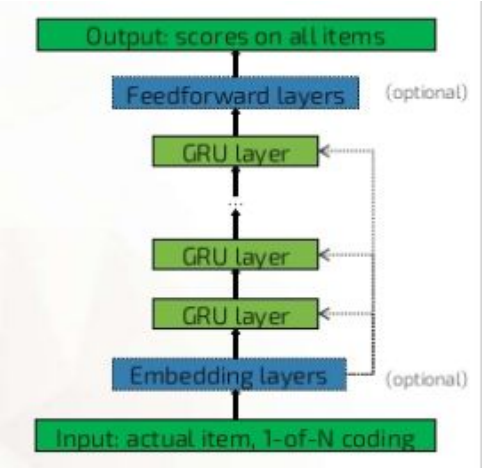


Intro: *Session-Based Recommendation Problem*

- **RNN** suitable for Session-Based Recommendation*:
  - *Sessions*: sequence of events
  - **GRU-Based** RNN
  - **Input**: *actual state/item of the session*
  - **Output**: *item of the next event in the session*



Session Representation



* **Session-based recommendations with recurrent neural networks [ICLR 2015]**
B. Hidasi, A. Karatzoglou, L. Baltrunas, and D. Tikk.

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Inter-Session Modelling

Inter-Session Modelling: *Motivation*

- **Previous** approach only consider **current session**
- **User History** is sometimes available
- How to **learn** from **previous session**
- Needs of **learning long-term** dependencies **between actions** from **different sessions**

Inter-Session Modelling

- Baseline: *The Intra-session RNN*:

Inter-Session Modelling

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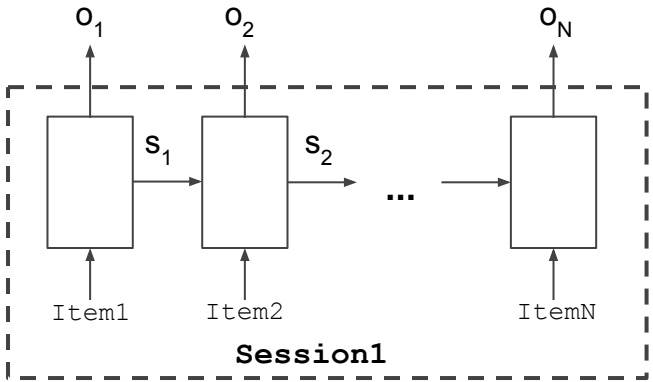
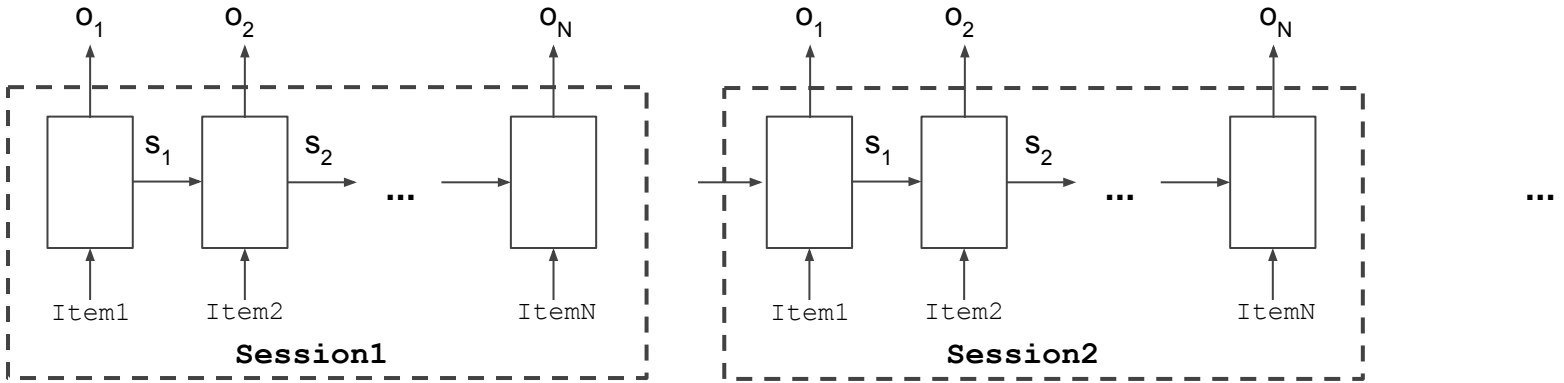


Intra-Session RNN

Inter-Session Modelling

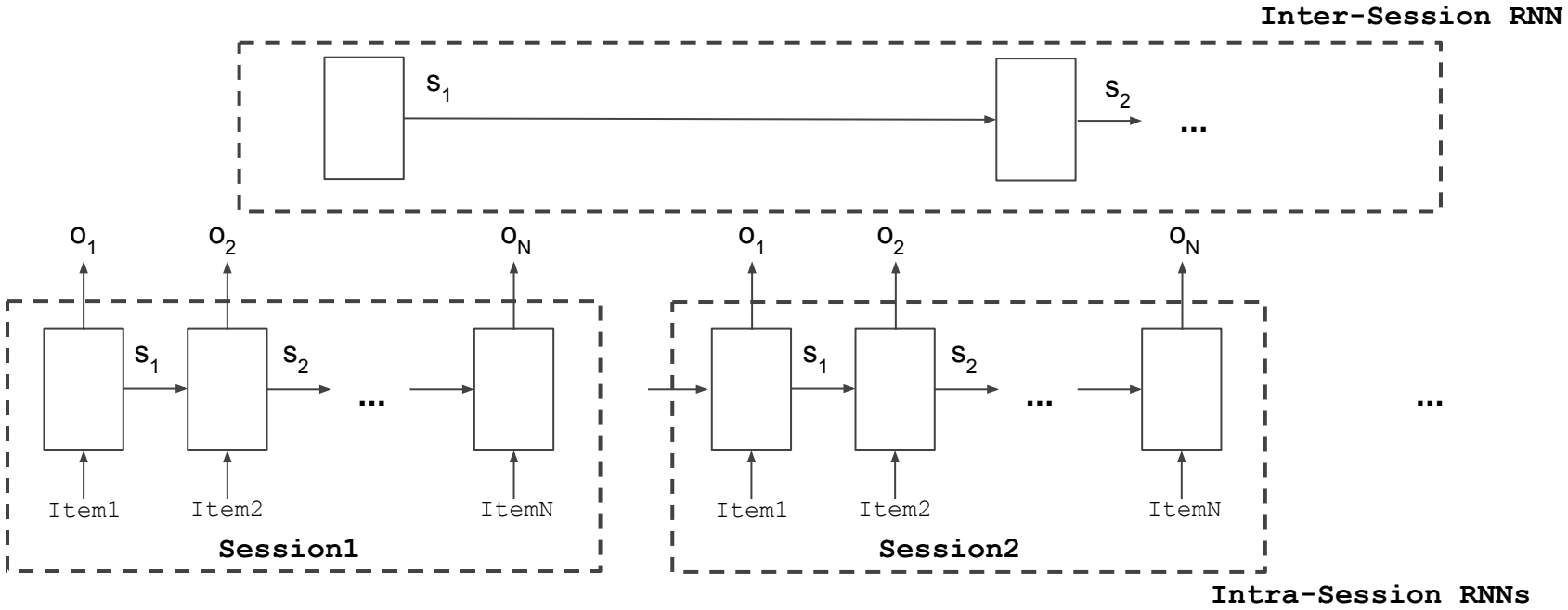
- Baseline: *The Intra-session RNN*:



Intra-Session RNNs

Inter-Session Modelling

- The **II-RNN-LHS** (***I**ntra- **I**nter-Session*, ***L**ast **H**idden **S**tate*) Model:



Inter-Session Modelling

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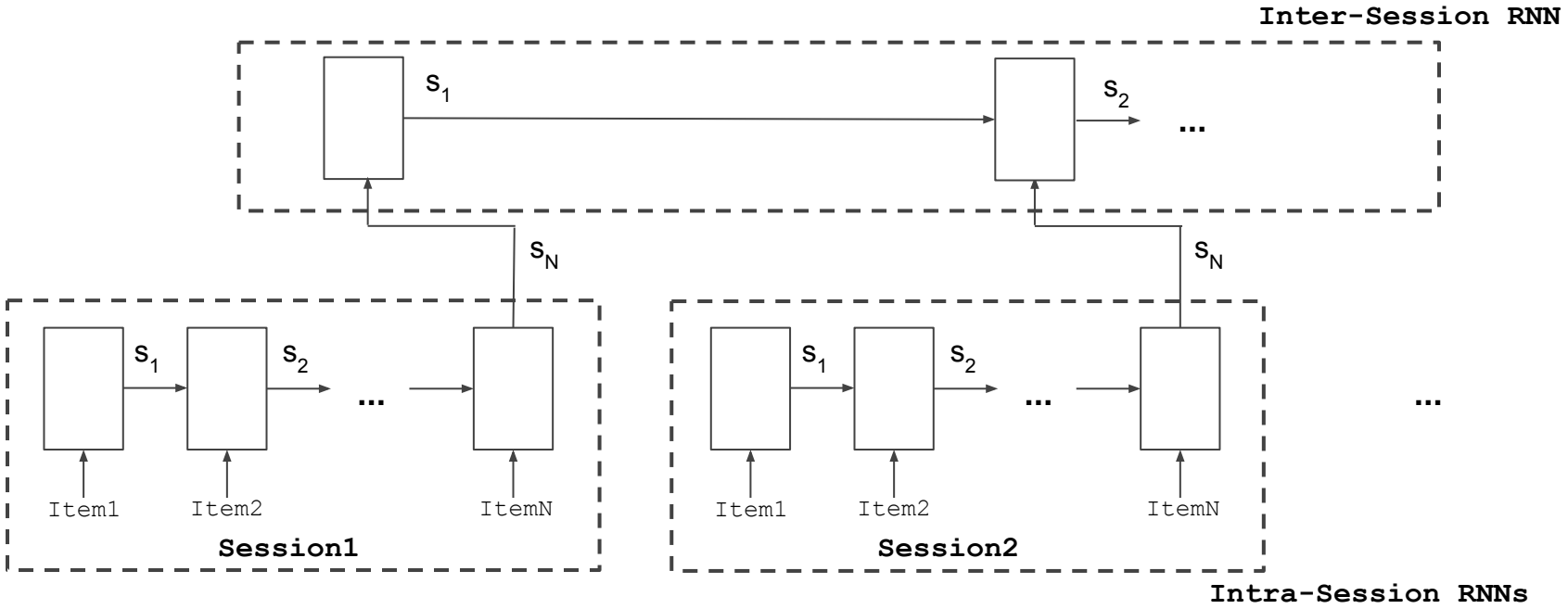

Inter-Session Modelling

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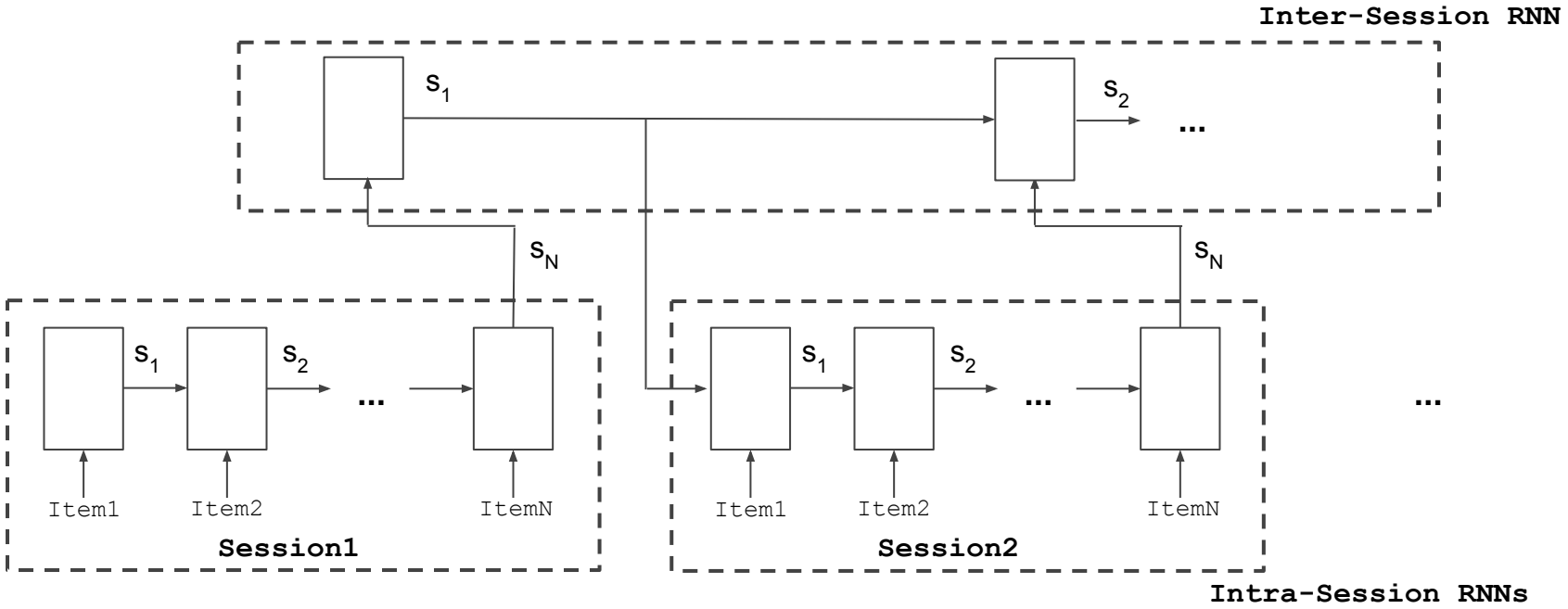
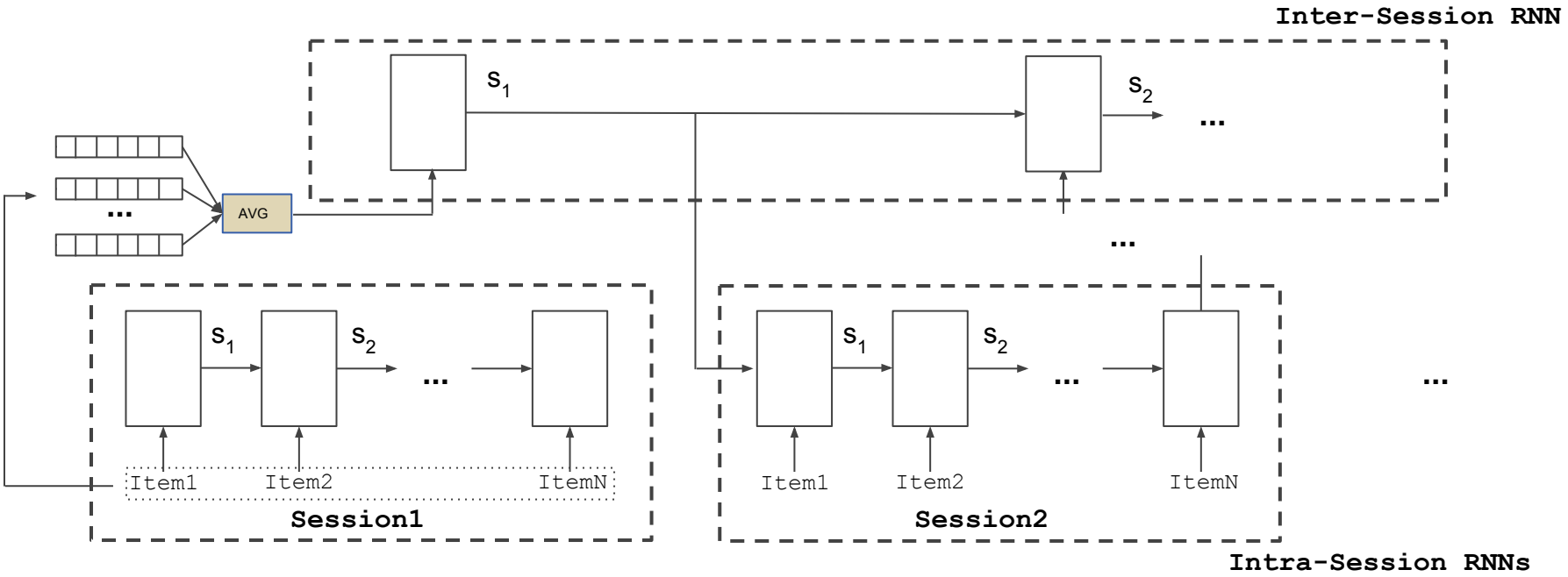


Inter-Session Modelling

- The **II-RNN-AP** (*Intra- Inter-Session*, *Average Pooling*) Model:



Experiments and Results

Experiments

- Dataset
  - **Reddit Dataset**
    - `<username, subreddit, timestamp>` tuples related to a user comment
    - *#Users*: **18K**, *#Items*: **27K,** Average Session Length: **3.0**
    - Task: *Next Subreddit recommendation*
  - **Last.Fm Dataset**
    - `<user,timestamp,artist,song>` tuples related to the listening habits of users
    - *#Users*: **1K**, *#Items*: **94K**, *Average Session Length*: **8.1**
    - Task: *Next artist recommendation*
- *Baseline*
  - **Most Popular**
  - **Most Recent**
  - **Item-kNN**: Item-to-Item CF
  - **BPR-MF**: Bayesian Personalized Ranking - Matrix Factorization

Results

- Model Effectiveness: ***Reddit Dataset***

Model	Recall@5	Recall@10	Recall@20	MRR@5	MRR@10	MRR@20

Results

- Model Effectiveness: ***Reddit Dataset***

Model	Recall@5	Recall@10	Recall@20	MRR@5	MRR@10	MRR@20
RNN	0.3372	0.4173	0.5004	0.2436	0.2542	0.2600
II-RNN (last hidden state)	**0.4476 (+32.7%)**	**0.5344 (+28.1%)**	**0.6180 (+23.5%)**	**0.3213 (+31.9%)**	**0.3329 (+31.0%)**	**0.3388 (+30.3%)**
II-RNN (avg.-pooling)	0.4361 (+29.3%)	0.5168 (+23.8%)	0.5963 (+19.2%)	0.3202 (+31.4%)	0.3309 (+30.1%)	0.3364 (+29.4%)

- The standalone intra-RNN methods **outperform** all the baselines

Results

- Model Effectiveness: ***Last.fm Dataset***

Model	Recall@5	Recall@10	Recall@20	MRR@5	MRR@10	MRR@20
RNN	0.1350	0.1843	0.2478	0.0867	0.0932	0.0976
II-RNN (last hidden state)	0.1439 (+6.6%)	0.2018 (+9.5%)	0.2776 (+12.0%)	0.0891 (+2.8%)	0.0968 (+3.9%)	0.1020 (+4.5%)
II-RNN (avg.-pooling)	**0.1478 (+9.5%)**	**0.2048 (+11.1%)**	**0.2788 (+12.5%)**	**0.0930 (+7.3%)**	**0.1005 (+7.8%)**	**0.1056 (+8.2%)**

- The standalone intra-RNN methods **outperform** all the baselines

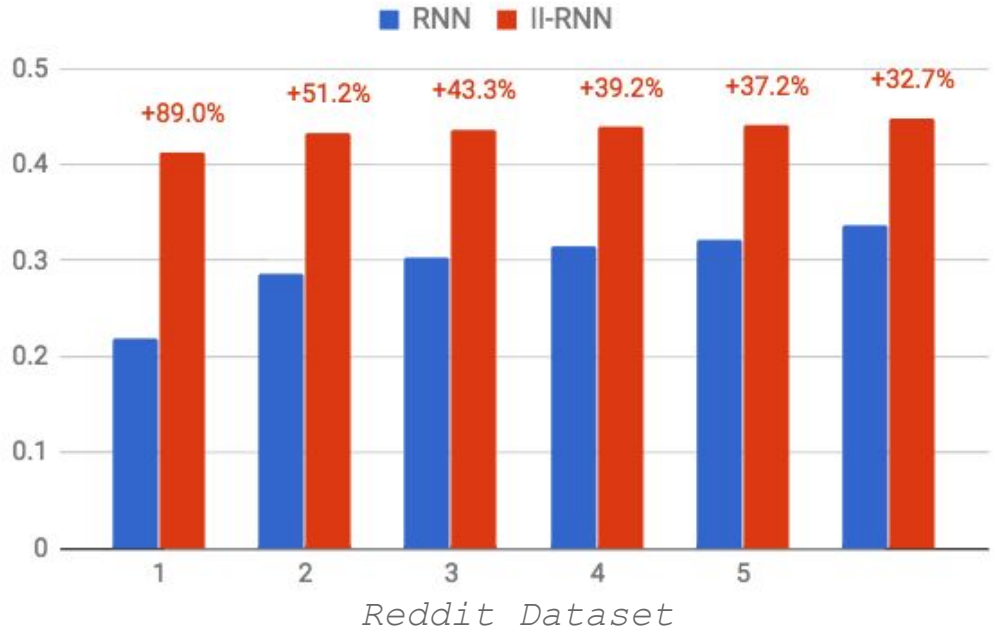
Results

- Impact on **Session Cold start** problem:

Reddit Dataset

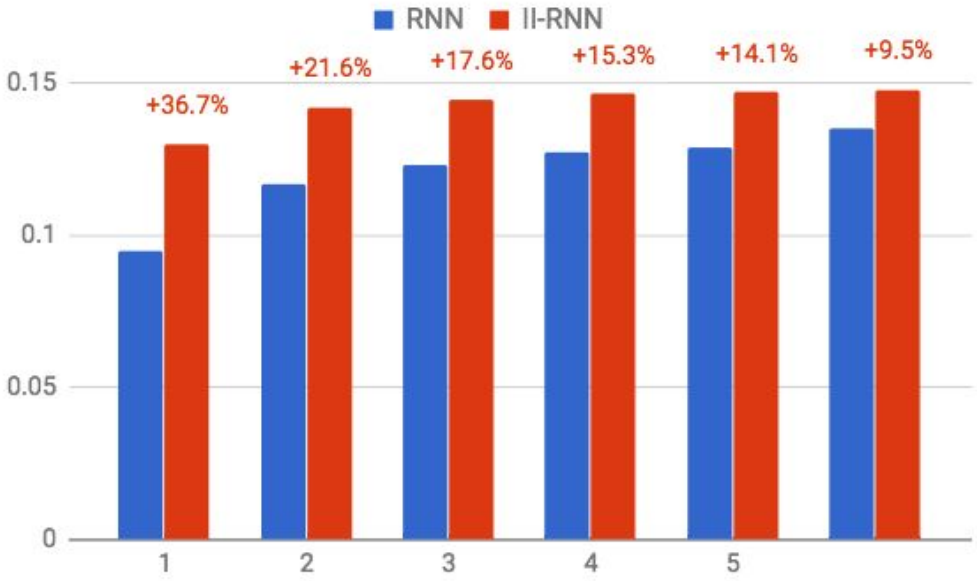
Results

- Impact on **Session Cold start** problem:



Results

- Impact on **Session Cold start** problem:



Last.fm Dataset

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Conclusion

Conclusion and Future Work

- Novel RNN-based architecture modelling **dependencies** between **items** over **user sessions**
- **Outperform** the original RNN based model
- Experiments over **different datasets**
- The II-RNN model **alleviate** the **cold-start** problem **within** a **session**
- Simple way to **represent** a session
- **Time-difference** between session is not explicitly **modelled**

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Questions?

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