trivago Recsys 2019 Challenge

Robust Contextual Models for In-Session Personalization

- Layer 6 AI

2020.04.30 13기 조 상연

Volkovs, Maksims, et al. "Robust contextual models for in-session personalization." Proceedings of the Workshop on ACM Recommender Systems Challenge. 2019.

1. Introduction

Contextual = 해당 세션 내에서 보여지는 Impression 들 간의 문맥

따로 시간, 위치 정보를 의미 있게 사용 x

2. Dataset

6 item interactions

1. Clickout
2. Rating info
3. Image info
4. Deals info
5. item search

4 global interactions

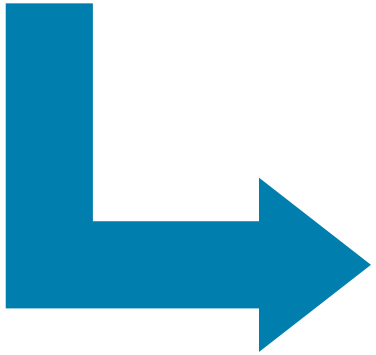
1. Sort
2. Filter
3. Destination search
4. POI search

Local	**Session Context** • Item actions that precede clickout • Non-item actions that precede clickout • Number of session steps • Time duration of session • Device used	**Session Context** • 클릭 전 시행된 item actions • 클릭 전 시행된 Non-item actions • 세션 스텝 수 • 세션 시간 • 사용한 디바이스
	Item Session Statistics • Price and price rank in impression • Rank position in impression • Previous actions on this item in current session • Item dwell time in current session • Item properties metadata	**Item Session Statistics** • 가격과 가격 순위 (in Impression) • 위치 순위 (in Impression) • 해당 item의 이전 액션들 (in current session) • 해당 item 체류 시간 (in current session) • Item 메타 데이터
Global	**Item Global Statistics** • Global item action counts across sessions • Impression statistics across sessions such as average position, price and price rank • Number of unique users that interacted with this item • Difference between current session and global statistics	**Item Global Statistics** • Item의 전체 액션 수 (across sessions) • 노출 통계 (across sessions such) - 평균 위치, 평균가, 평균 가격 순위 • 해당 item 관련 액션이 있는 유니크한 유저 수 • 현재 세션 통계와 전체 통계 간 차이
	Impression Items Statistics • Price summary across impression items • Metadata properties across impression items • Item similarity within impression • Global statistics summary across impression items	**Impression Items Statistics** • 가격 요약 (across impression items) • 메타 데이터 (across impression items) • 아이템 유사도 (within impression) • 전체 통계 요약 (across impression items)

3. Approach

reference	platform	city	device	current_filters	impressions	prices
109038	AU	Sydney, Australia	mobile	NaN	3400638|1253714|3367857|5100540|1088584|666916...	95|66|501|112|95|100|101|72|82|56|56|143|70|25...

1. Y라벨이 될 clickout 의 impression 리스트 가져온다.
2. 각 아이템 별로 펼쳐준다. (explode)
3. 결과) 각 아이템별 330개의 feature -> 0 / 1 binary



imp_list	price	Y
3400638	95	False
1253714	66	False
3367857	501	False
5100540	112	False
1088584	95	False
666916	100	False
54833	101	False
2922310	72	False
9711560	82	False
109038	56	True
666856	56	False
10077318	143	False
1431482	70	False
129343	25	False
6339822	71	False
6806806	162	False
1041528	73	False
109013	143	False
3909420	188	False
55088	118	False
3095758	77	False
109018	131	False
54885	143	False
1257342	49	False
2595006	165	False

➔ 총 1450만 개의 학습 데이터(6.5)와 180만 개의 Validation 셋(0.5)이 완성

➔ 우리의 경우 2일로 잡았을 때 약 600 만개로 추정할 수 있음

4. Modeling

1. GBM 이 제일 잘 나옴
    1. Normalization 안하는 건 큰 장점
    2. binary cross entropy 사용
    3. Softmax 도 해봤지만 독립 single 모델이 가장 우수

2. 딥러닝도 시도했지만 GBM 만큼은 아님

```
booster = gbtree
eta = 0.1
gamma = 0
min_child_weight = 1
max_depth = 10
subsample = 1
colsample_bynode = 0.8
scale_pos_weight = 1
bjective = binary:logistic
base_score = 0.1
seed = 3
lambda = 1 [version 1] or 4000 [version 2]
alpha = 0 [version 1] or 10 [version 2]
tree_method = hist [version 1] or exact [version 2]
```

Model Params

XGB model version	# of features	Early stopping rounds	Rounds	Runtime (hours)	AUC (valid)	MRR (valid)	MRR (test)
1	330	10	435	1	0.9238	0.6747	~0.683
2	330	20	2820	32	0.9254	0.6775	~0.685

Model Result

5. Experiment

Local

Session Context
- Item actions that precede clickout
- Non-item actions that precede clickout
- Number of session steps
- Time duration of session
- Device used

Session Context
- 클릭 전 시행된 item actions
- 클릭 전 시행된 Non-item actions
- 세션 스텝 수
- 세션 시간
- 사용한 디바이스

Item Session Statistics
- **Price and price rank in impression**
- **Rank position in impression**
- **Previous actions on this item in current session**
- Item dwell time in current session
- Item properties metadata

Item Session Statistics
- **가격과 가격 순위 (in Impression)**
- **위치 순위 (in Impression)**
- **해당 item의 이전 액션들 (in current session)**
- 해당 item 체류 시간 (in current session)
- Item 메타 데이터

Global

Item Global Statistics
- Global item action counts across sessions
- Impression statistics across sessions such as average position, price and price rank
- Number of unique users that interacted with this item
- Difference between current session and global statistics

Item Global Statistics
- Item의 전체 액션 수 (across sessions)
- 노출 통계 (across sessions such) - 평균 위치, 평균가, 평균 가격 순위
- 해당 item 관련 액션이 있는 유니크한 유저 수
- 현재 세션 통계와 전체 통계 간 차이

Impression Items Statistics
- Price summary across impression items
- **Metadata properties across impression items**
- Item similarity within impression
- **Global statistics summary across impression items**

Impression Items Statistics
- 가격 요약 (across impression items)
- **메타 데이터 (across impression items)**
- 아이템 유사도 (within impression)
- **전체 통계 요약 (across impression items)**
  - ex) 해당 위치에서의 Global 평균 가격 순위

Table 2: Top 20 most important features for the GBM model.

Feature	Gain (%)
Is target item in top position in impression (boolean)	42.7
Target item position in impression	9.8
Target item star rating ranking in impression	6.1
Price rank within items above target item in impression	4.2
Number of actions on target item in current session	3.3
Global average price rank for target item position in impression	3.1
Item-based neighbor similarity between user and target item	3.0
Average price rank of items with same star rating in impression	2.6
Difference in price rank between target item and last item that user interacted with before clickout	2.2
Price rank within items with same star rating in impression	1.7
Impression position of last item that user interacted with before clickout	1.5
Difference in position between target item and last item that user interacted with before clickout	0.9
Number of items with the same star rating in impression	0.8
Impression length	0.7
Number of actions between clickout and last item action	0.5
Time between clickout and last item action	0.4
Number of items with same user rating in impression	0.4
Number of previous impression lists in session that exactly match current impression list	0.4
Global same length impression list count	0.4
Target item price rank in impression	0.4

```
Impression Item Features
  * Item appearance rank
  * Item appearance rank within same star group
  * Item appearance rank within same rating group
  * Item price rank
  * Item price rank within same star group
  * Item price rank within same rating group
  * Item price rank within groups of higher appearance rank
  * Item price
  * Item price and median price difference
  * Item metadata properties
  * Global item action count, appearance rank, price rank, star/rating group information
  * Global item-item user action interaction scores
  * Global user-user user action interaction scores
  * Global item-item user impression interaction scores
  * Global user-user user impression interaction scores
  * Local and global item price count differences
  * Local and global item action count and rank differences
  * Local and global user action count and rank differences

Summarization-Over-Impression-Items Features
  * Mean appearance prices across top _k_ appearance rank items
  * Mean appearance price ranks across top _k_ appearance rank items
  * Mean of impression properties across impressions
  * Mean of global item counts across impressions
  * Entropy of counts
  * Entropy of properties

Session Features
  * Stats on last 2 item action interactions prior to clickout
  * Stats on last action interactions prior to clickout
  * Impression length at clickout
  * Step number at clickout
  * Device at clickout
  * Time duration between clickout and session start

Non-Item Features
  * Global user counts
  * Global rank counts
  * Global price rank counts
  * Global platform counts
  * Global city counts
  * Global device counts
```

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Number of items with same user rating in impression	0.4
Number of previous impression lists in session that exactly match current impression list	0.4
Global same length impression list count	0.4
Target item price rank in impression	0.4

6. Summary & Insight

1. GBM 모델을 무조건 사용하긴 해야하나 파라미터 튜닝에서 타협이 필요할 것 같다. (시간 – 성능)
2. 우리가 실제 상품을 고를 때 어떤 과정을 거치는 지 세세히 살펴볼 필요가 있다.
3. Lab