Multi-intent-aware Session-based Recommendation

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Code: https://github.com/jin530/MiaSRec.

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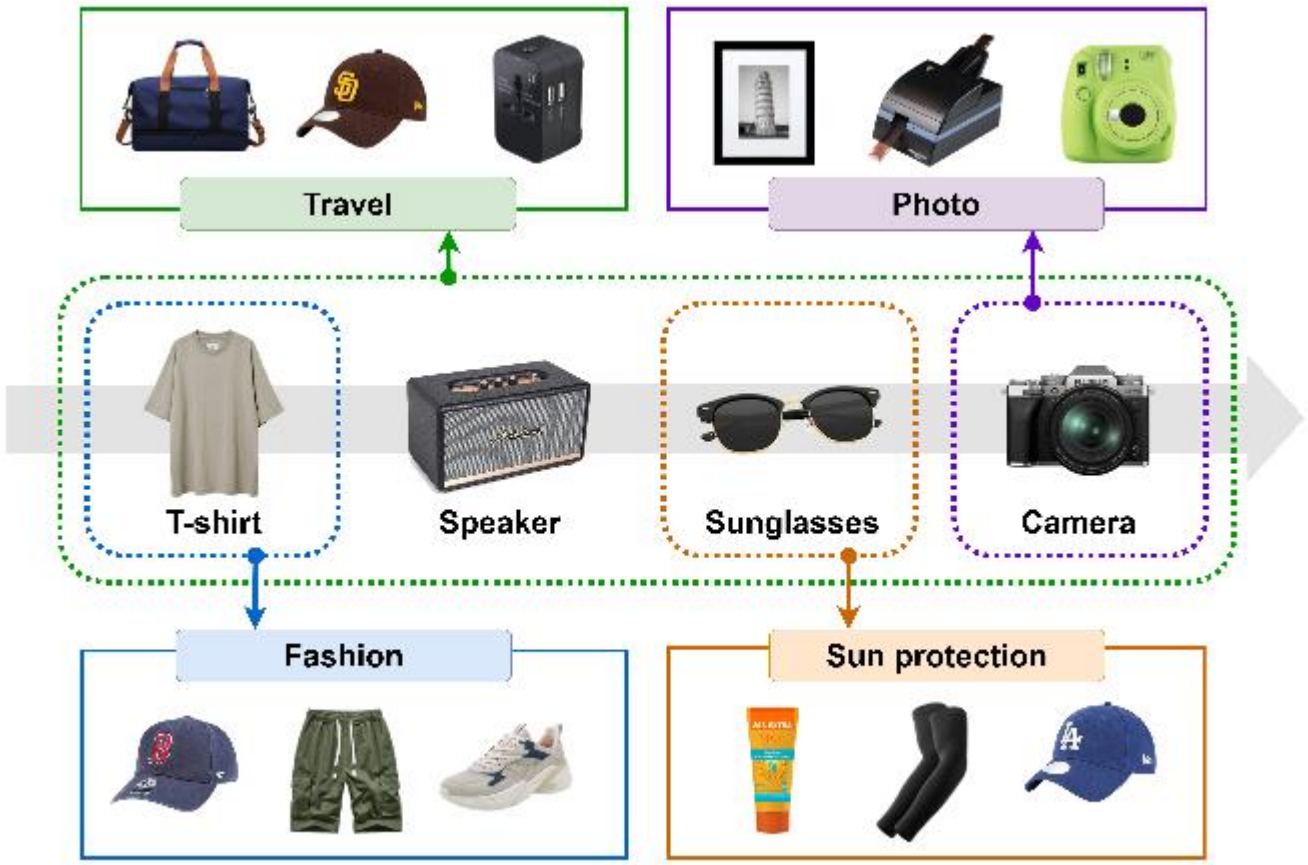
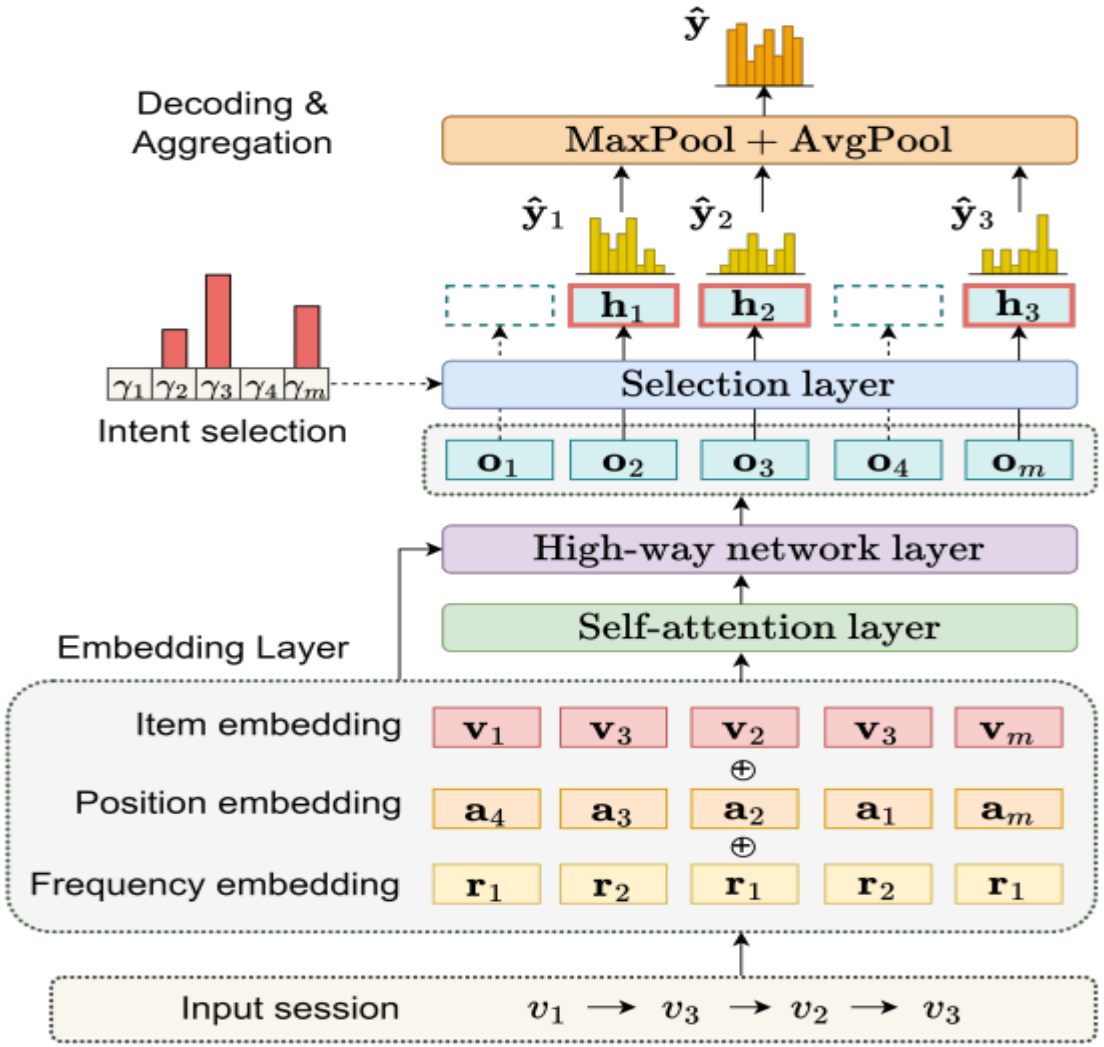
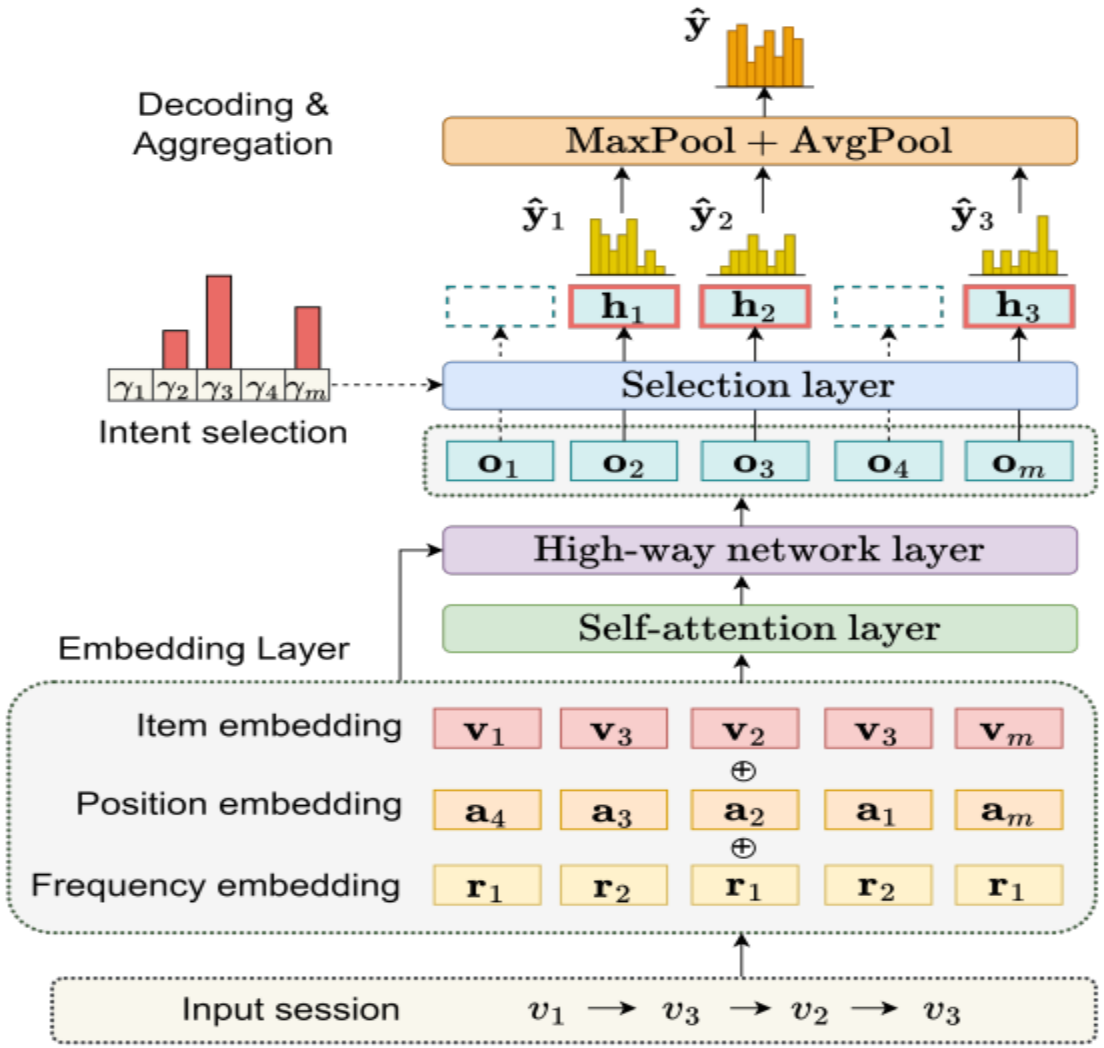
Introduction



Overview


$\hat{\mathbf{y}}$
Decoding & Aggregation
MaxPool + AvgPool
$\hat{\mathbf{y}}_1$
$\hat{\mathbf{y}}_2$
$\hat{\mathbf{y}}_3$
$\mathbf{h}_1$
$\mathbf{h}_2$
$\mathbf{h}_3$
γ_1 γ_2 γ_3 γ_4 γ_m
Intent selection
Selection layer
$\mathbf{o}_1$ $\mathbf{o}_2$ $\mathbf{o}_3$ $\mathbf{o}_4$ $\mathbf{o}_m$
High-way network layer
Self-attention layer
Embedding Layer
Item embedding
$\mathbf{v}_1$ $\mathbf{v}_3$ $\mathbf{v}_2$ $\mathbf{v}_3$ $\mathbf{v}_m$
Position embedding
$\mathbf{a}_4$ $\mathbf{a}_3$ $\mathbf{a}_2$ $\mathbf{a}_1$ $\mathbf{a}_m$
Frequency embedding
$\mathbf{r}_1$ $\mathbf{r}_2$ $\mathbf{r}_1$ $\mathbf{r}_2$ $\mathbf{r}_1$
Input session
$v_1 \rightarrow v_3 \rightarrow v_2 \rightarrow v_3$

Method

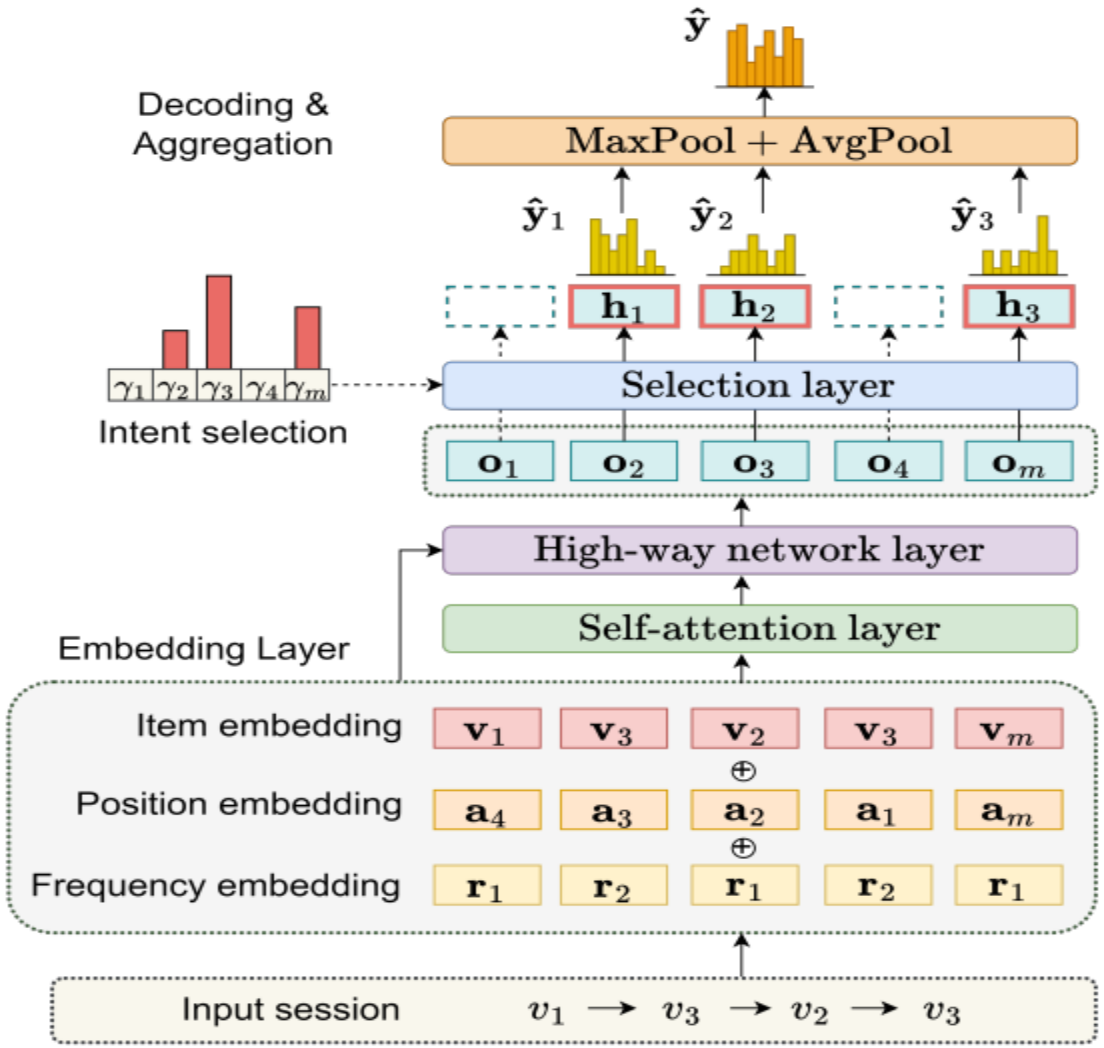


$$\mathbf{x}_i = \mathbf{v}_{t_i} + \mathbf{a}_i + \mathbf{r}_{f_i} \text{ for } i \in \{1, \ldots, |s|, m\}. \quad (1)$$

$$\mathbf{c}_1, \ldots, \mathbf{c}_{|s|}, \mathbf{c}_m = \text{Self-attention}([\mathbf{x}_1, \ldots, \mathbf{x}_{|s|}, \mathbf{x}_m])). \quad (2)$$

$$\mathbf{o}_i = \mathbf{g} \odot \mathbf{v}_i + (1 - \mathbf{g}) \odot \mathbf{c}_i \text{ for } i \in \{1, \ldots, |s|, m\},$$
$$\text{where } \mathbf{g} = \sigma(\mathbf{W}_g[\mathbf{v}_i; \mathbf{c}_i]^\top), \quad (3)$$

Method



$$\alpha\text{-entmax}(\mathbf{z}) = \underset{\mathbf{p}\in\Delta^l}{\operatorname{argmax}}\, \mathbf{p}^\top \mathbf{z} + H_\alpha^T(\mathbf{p}), \tag{4}$$

$$\gamma = \alpha\text{-entmax}(\mathbf{w} \cdot [\mathbf{o}_1; \ldots; \mathbf{o}_{|s|}; \mathbf{o}_m]^\top),$$
$$\{\mathbf{h}_1, \ldots, \mathbf{h}_k\} = \{\gamma_i \mathbf{o}_i | \gamma_i > 0, i \in \{1, \ldots, |s|, m\}\}, \tag{5}$$

$$\hat{\mathbf{y}}_1, \ldots, \hat{\mathbf{y}}_k = [\tilde{\mathbf{h}}_1 \tilde{\mathbf{V}}^\top, \ldots, \tilde{\mathbf{h}}_k \tilde{\mathbf{V}}^\top], \tag{6}$$

$$L(\mathbf{y}, \hat{\mathbf{y}}) = -\sum_{j=1}^{n} \mathbf{y}(j) \log\left(\frac{\exp(\hat{\mathbf{y}}(j)/\tau)}{\sum_i \exp(\hat{\mathbf{y}}(i)/\tau)}\right), \tag{8}$$

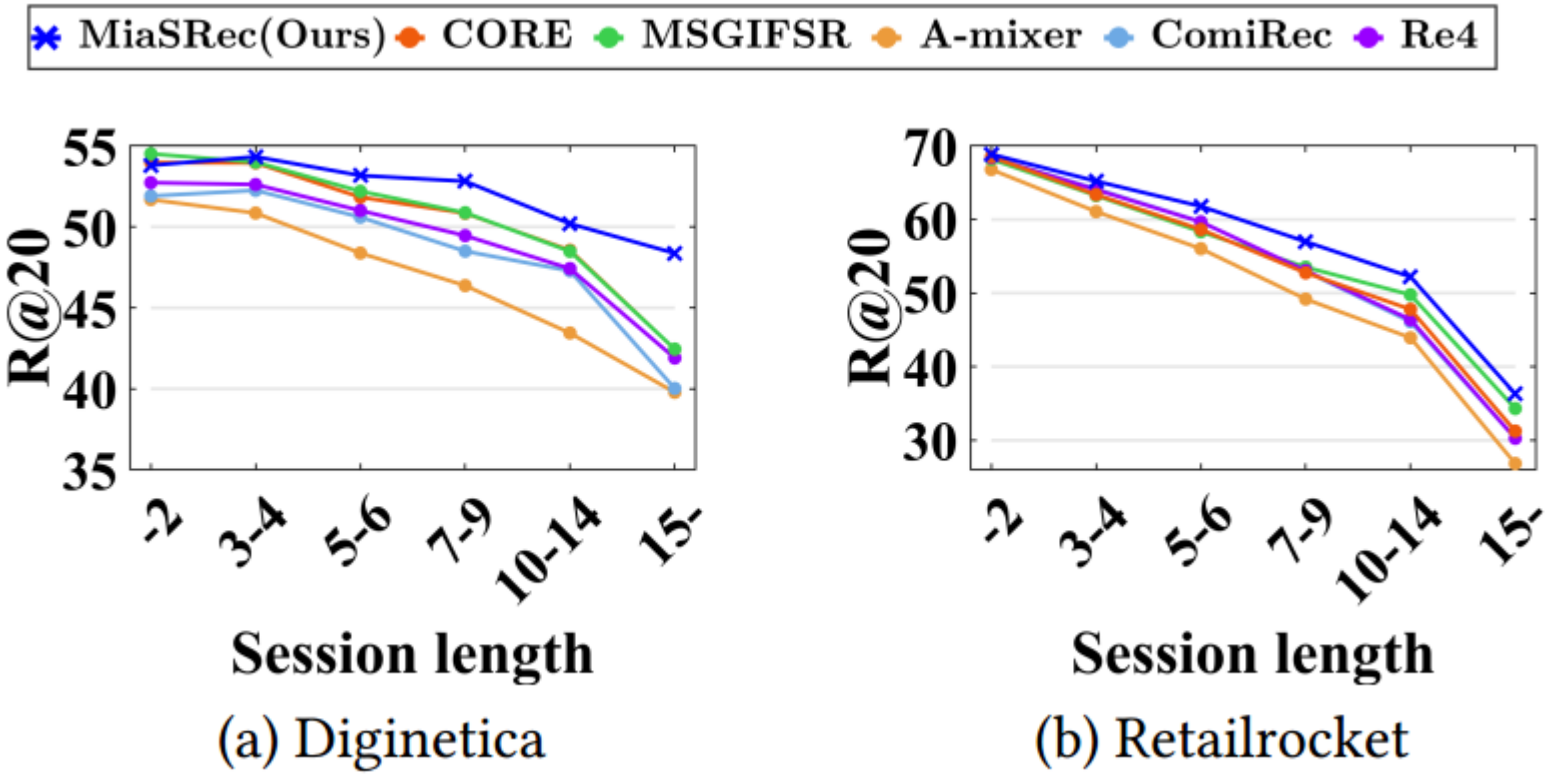
Experiments

Dataset	# Interacts	# Sessions	# Items	AvgLen
Diginetica	786,582	204,532	42,862	4.12
Retailrocket	871,637	321,032	51,428	6.40
Yoochoose	1,434,349	470,477	19,690	4.64
Tmall	427,797	66,909	37,367	10.62
Dressipi	4,305,641	943,658	18,059	6.47
LastFM	3,510,163	325,543	38,616	8.16

Experiments

Dataset	Metric	SASRec	SR-GNN	NISER+	SGNN-HN	DSAN	LESSR	CORE	SINE	ComiRec	Re4	A-mixer	MSGIFSR	MiaSRec	Imp.
Diginetica	R@20	49.86	48.01	51.11	50.60	52.06	48.70	52.89	46.45	51.22	51.59	49.84	53.20	**53.54**	0.65%
	M@20	17.20	16.60	18.21	17.28	18.25	16.96	18.53	16.10	18.35	18.47	17.07	18.37	**19.47**†	5.04%
Retailrocket	R@20	59.70	58.01	60.70	57.43	61.13	56.56	61.77	55.11	61.56	61.65	59.49	63.04	**63.37**	0.26%
	M@20	35.71	36.01	38.18	35.39	38.68	36.82	38.49	34.15	38.16	38.10	36.25	38.42	**39.23**†	1.41%
Yoochoose	R@20	63.64	62.28	63.50	61.60	63.73	62.78	64.64	57.50	63.13	62.67	63.73	65.20	**65.37**	0.26%
	M@20	28.66	28.36	29.06	27.97	29.23	28.84	28.25	25.07	28.29	28.00	29.32	30.02	**30.74**†	2.39%
Tmall	R@20	35.80	33.47	40.39	39.71	42.82	32.59	44.91	35.66	42.40	41.56	38.76	35.39	**55.94**†	24.56%
	M@20	25.08	24.75	29.48	24.16	30.85	24.19	31.59	22.41	28.43	28.56	28.52	22.19	**33.57**†	6.27%
Dressipi	R@20	37.18	36.10	38.19	38.35	37.77	37.71	38.14	38.18	39.60	39.15	37.75	38.43	**42.26**†	6.73%
	M@20	14.31	14.51	15.34	15.05	15.13	14.73	15.54	15.46	16.07	15.92	15.24	15.90	**16.70**†	3.92%
LastFM	R@20	20.53	21.80	22.50	22.72	22.47	22.31	22.75	22.17	22.13	23.02	22.93	22.73	**25.85**†	12.32%
	M@20	6.22	8.70	8.79	7.66	7.93	8.80	7.83	7.57	7.83	8.50	8.74	8.20	**9.95**†	13.06%

Experiments



(a) Diginetica (b) Retailrocket

Experiments

Model	Diginetica		Retailrocket		Yoochoose	
	R@20	M@20	R@20	M@20	R@20	M@20
MiaSRec	**53.54**	**19.47**	**63.37**	**39.23**	**65.37**	**30.74**
Variants for embedding layers						
w/o PE ($\mathbf{a}_i$)	51.36	18.15	61.06	37.51	61.13	26.51
w/o FE ($\mathbf{r}_{f_i}$)	53.48	19.23	63.28	38.92	65.15	29.91
Variants for intent selection						
mean ($\mathbf{o}_m$)	52.73	18.66	61.70	38.25	64.71	29.84
last 1 ($\mathbf{o}_{\|s\|}$)	52.34	18.37	61.90	37.79	64.10	30.05
last 3 ($\mathbf{o}_{\|s\|-2:\|s\|}$)	53.08	19.20	62.07	38.68	64.77	30.34
last 5 ($\mathbf{o}_{\|s\|-4:\|s\|}$)	53.38	19.29	63.01	38.90	65.13	30.51

Thanks!