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A Simple Convolutional Generative Network for Next Item Recommendation

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THE TIMES
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2018
SCOTTISH
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OF THE YEAR

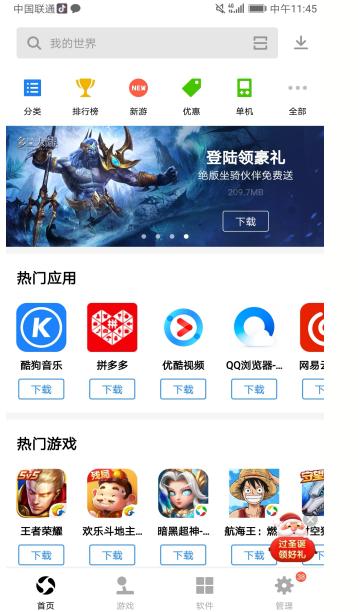
Session-based Recommendation

- Session-based recommendation Apps:
Short-form mobile video (Tik Tok, Weishi, Yoo Video)
Music (Tencent music, Yahoo! Music) & News



Tencent 腾讯 Static Recommendation

- Scenario: weak sequential property
Ads recommendation, Google app store



This screenshot shows a Baidu search results page for '成人教育' (Adult Education). The top result is an ad for '深圳 2018年成人教育' (Shenzhen Adult Education 2018) from '广东自学报名中心' (Guangdong Self-study Registration Center). The ad includes a QR code and text about self-study registration. Below the ad, there are several organic search results for '成人教育 报名入口' (Adult Education Registration Portal) and '成人教育 学信网可查' (Adult Education, Checkable on China Education Ministry's Website).

- Related work:
- **Markov chain:** Long long ago
- **RNN/LSTM:** GRURec[1, 2] 2016,2017
- **CNN :** Caser [3], NextItNet [4] 2018
- **Attention :** Transformer [5] 2017, 2018

[1] session-based recommendations with recurrent neural networks. ICLR 2016

[2] Personalizing Session-based Recommendations with Hierarchical Recurrent Neural Networks. arXiv2017

[3] Personalized Top-N Sequential Recommendation via Convolutional Sequence Embedding. WSDM2018

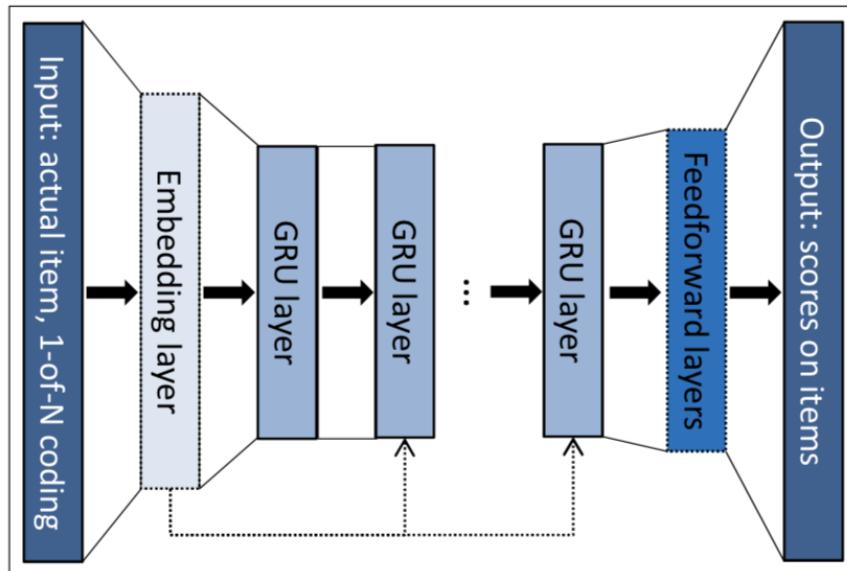
[4] A Simple Convolutional Generative Network for Next Item Recommendation. WSDM2019

[5] Next Item Recommendation with Self-Attention. ICDM2018

- Session-based rec: Top-n item recommendation
- Offline: NDCG, MRR, MAP, Pre@10, Rec@10
- Online: UV, VV, PV, CTR

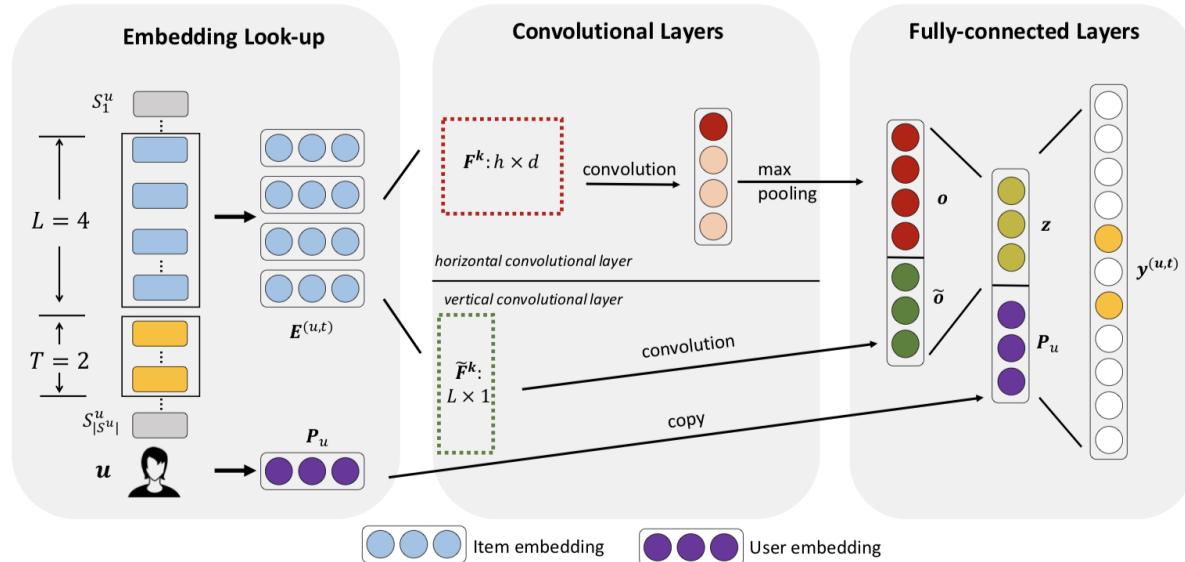
Session-based Recommendation

- RNN/LSTM: GRURec[1]



pros: good for modelling seq
cons: bad for utilizing GPU

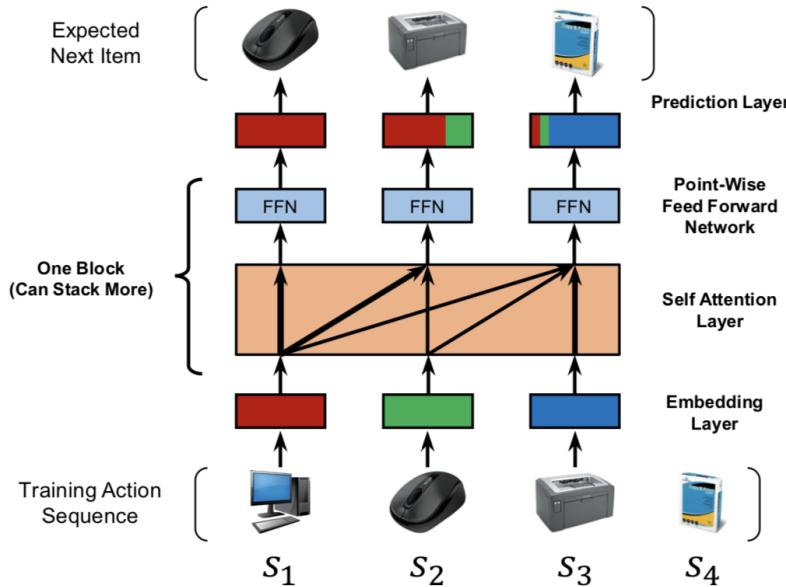
- CNN: Caser[1]



Pros: good for using GPU
Cons: max pooling loses much information, shallow layers

Session-based Recommendation

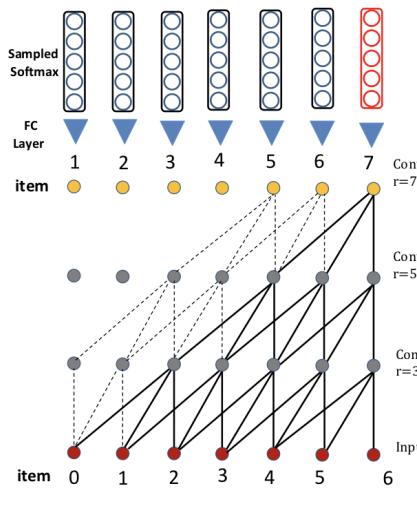
- Attention[1]



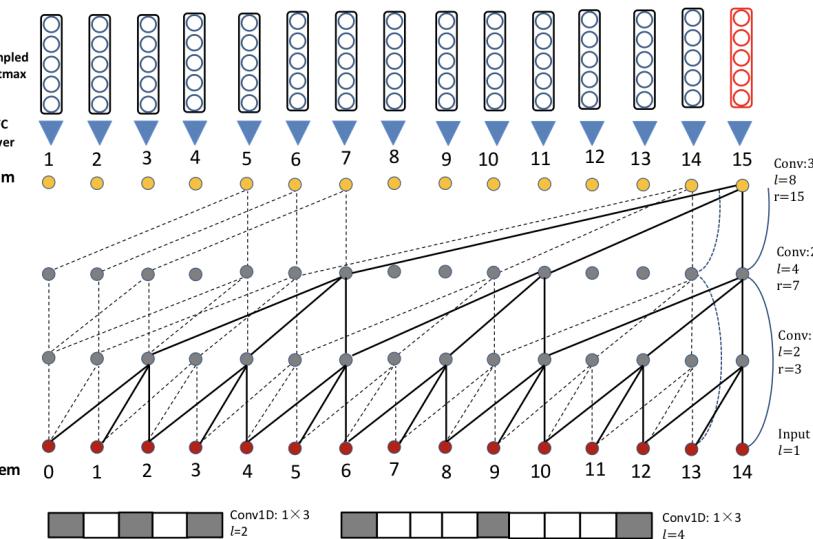
Pros: better for utilizing GPU

Cons: quadratic complexity, particularly for longer sequences

- CNN: NextItNet[1]



(a) Standard CNN



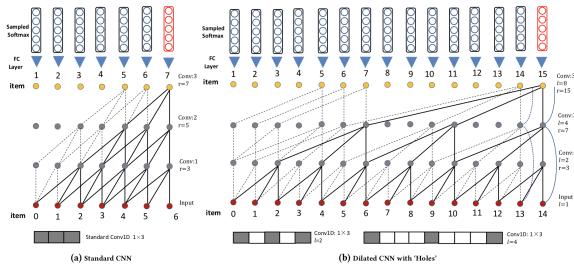
(b) Dilated CNN with 'Holes'

Pros:

CNN structure-model parallelism
Residual block: deeper and stronger
Dilated CNN: longer and better

Session-based Recommendation

- CNN: NextItNet[1]



Pros: simple, no additional features, strong sequential property, remember longer , training faster

$$\begin{aligned}
 & \text{Caser/GRURec : } \underbrace{\{x_0, x_1, \dots, x_{14}\}}_{input} \Rightarrow \underbrace{x_{15}}_{output} \\
 & \text{Ours : } \underbrace{\{x_0, x_1, \dots, x_{14}\}}_{input} \Rightarrow \underbrace{\{x_1, x_2, \dots, x_{15}\}}_{output}
 \end{aligned} \tag{2}$$

Predicting:

Input: 0 1 2 3 4 5 6 7 8 9

Output: 1 2 3 4 5 6 7 8 9 10

Next

Input: 0 1 2 3 4 5 6 7 8 9 10

Output: 1 2 3 4 5 6 7 8 9 10 11

Next...

Input: 0 1 2 3 4 5 6 7 8 9 10 11

Output: 1 2 3 4 5 6 7 8 9 10 11 12

Caser/GRURec sub-session - 1 : $\{x_{-1}, x_0, \dots, x_{13}\} \Rightarrow x_{14}$

Caser/GRURec sub-session - 2 : $\{x_{-1}, x_{-1}, \dots, x_{12}\} \Rightarrow x_{13}$

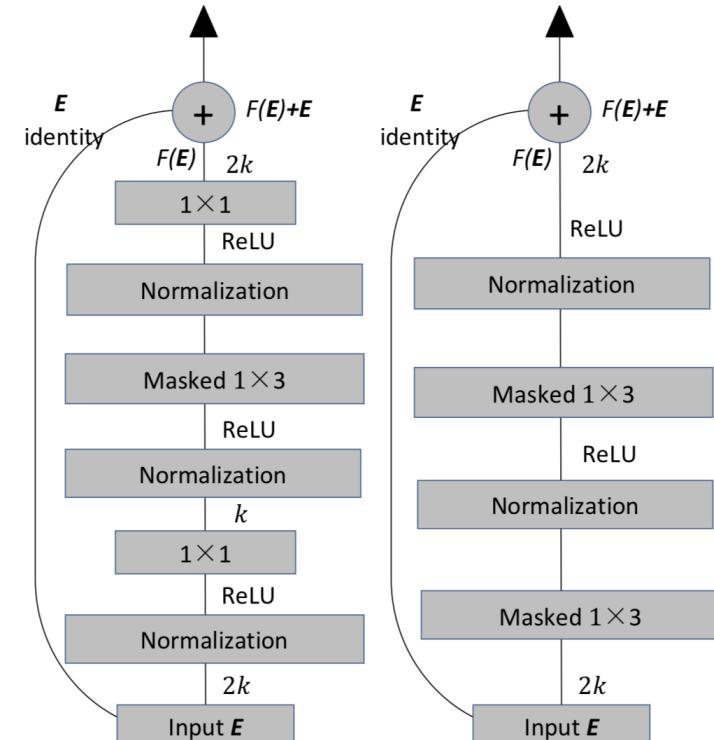
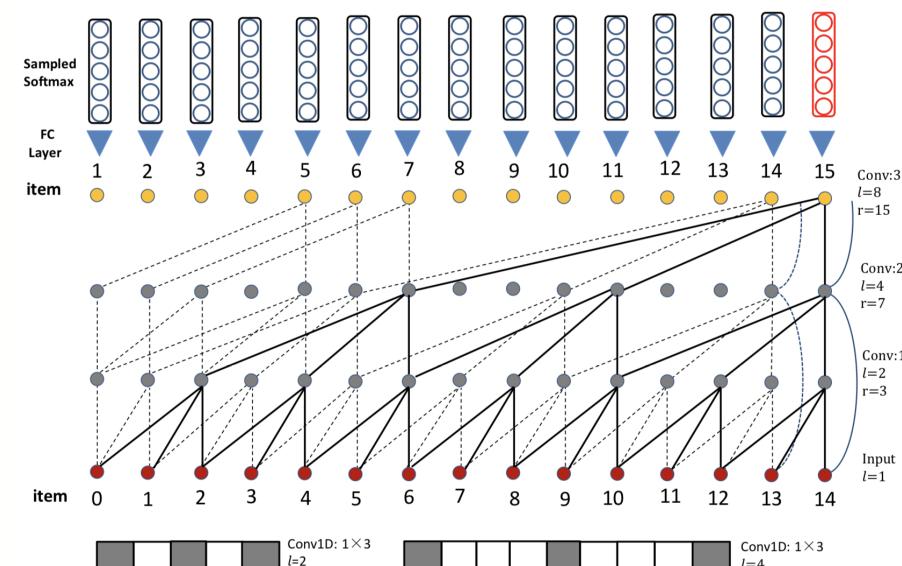
.....

Caser/GRURec sub-session - 12 : $\{x_{-1}, x_{-1}, \dots, x_2\} \Rightarrow x_3$

Session-based Recommendation

Residual blocks

- CNN: NextItNet[1]



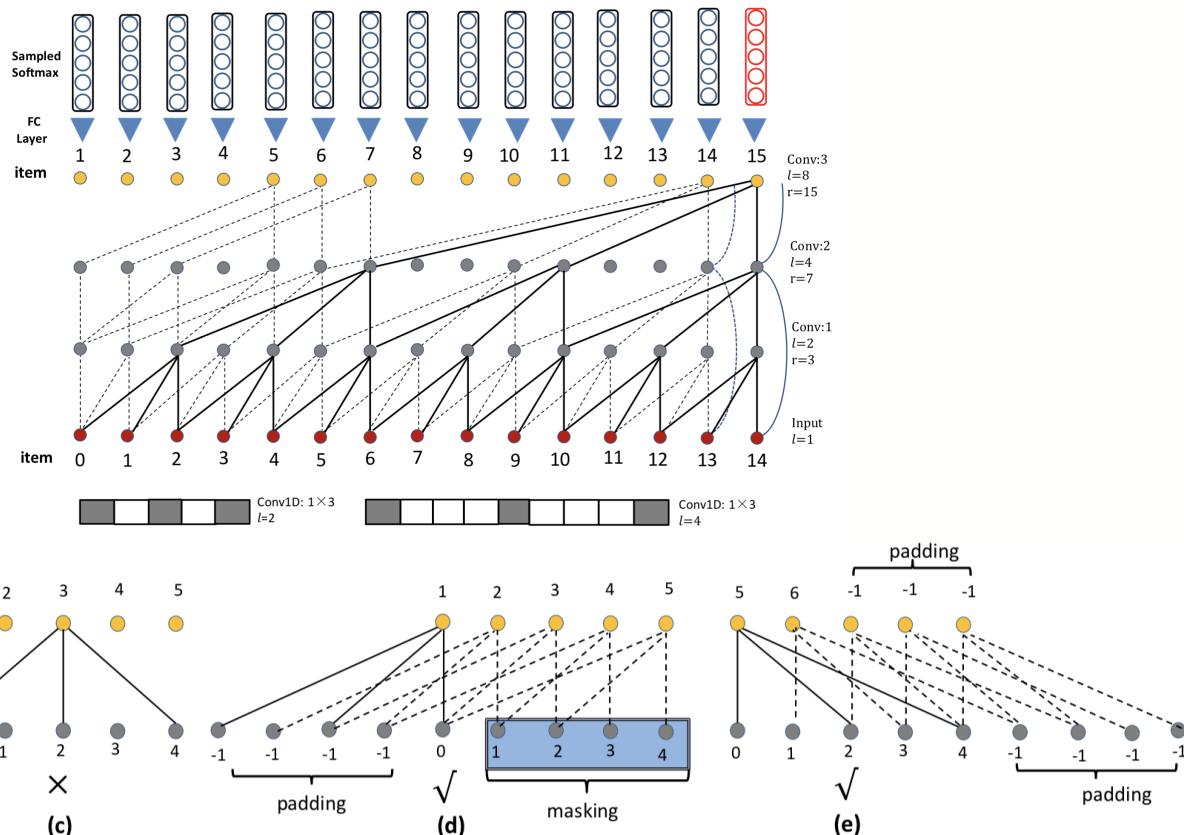
(a)

(b)

Session-based Recommendation

Mask Design

- CNN: NextItNet[1]



Session-based Recommendation

Experiments

- Weishi Data

	MostPop	Caser	NextIt
MRR@5	0.005	0.055	0.080
NDCG@5	0.008	0.067	0.093

- Buying data, Lastfm music

Table 2: Accuracy comparison. The upper, middle and below tables are MRR@5, HR@5 and NDCG@5 respectively.

DATA	YOO	MUSIC_M5	MUSIC_L5	MUSIC_L10	MUSIC_L20	MUSIC_L50	MUSIC_L100
MostPop	0.0050	0.0024	0.0006	0.0007	0.0008	0.0007	0.0007
GRURec	0.1645	0.3019	0.2184	0.2124	0.2327	0.2067	0.2086
Caser	0.1523	0.2920	0.2207	0.2214	0.1947	0.2060	0.2080
NextItNet	0.1715	0.3133	0.2327	0.2596	0.2748	0.2735	0.2583
MostPop	0.0151	0.0054	0.0014	0.0016	0.0016	0.0016	0.0016
GRURec	0.2773	0.3610	0.2626	0.2660	0.2694	0.2589	0.2593
Caser	0.2389	0.3368	0.2443	0.2631	0.2433	0.2572	0.2588
NextItNet	0.2871	0.3754	0.2695	0.3014	0.3166	0.3218	0.3067
MostPop	0.0075	0.0031	0.0008	0.0009	0.0010	0.0009	0.0009
GRURec	0.1923	0.3166	0.2294	0.2258	0.2419	0.2197	0.2212
Caser	0.1738	0.3032	0.2267	0.2318	0.2068	0.2188	0.2207
NextItNet	0.2001	0.3288	0.2419	0.2700	0.2853	0.2855	0.2704

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