Abstract

We study sequential recommendation problem as the order of interaction implies that sequential patterns play an important role on user’s next action.

Under such setting, sequential patterns should be carefully modeled, in both point-level and union-level.

We propose a Convolutional Sequence Embedding Recommendation Model (Caser) to model the above two types of sequential patterns.

The experiments on public data sets demonstrated that Caser consistently outperforms state-of-the-art sequential recommendation methods.

Sequential Recommendation

Given a user’s sequences $S_u$, recommend a list of items that maximize her/his future needs, by considering both general preferences and sequential patterns.

General Preferences: represent user’s long term and static behaviors and are unlikely to change in a short period of time.

Sequential Patterns: represent user’s short term and dynamic behaviors and come from a close proximity of time.

Related Works and Motivations

Existing works model sequential pattern in point-level, fail to model sequential pattern in union-level.

- point-level: each of the previous actions influence the target action individually, instead of collectively.
- union-level: several previous actions jointly influence the target action.

Find the existence of union-level sequential pattern.

When we mine sequential association rules of the form $(S_i^{-1}, \cdots, S_i^{-2}, S_i^{-1}) \rightarrow S_i^U$.

With confidence=50% and support=5, most of the resulting rules have the length larger than 1 ($L > 1$), indicating the existence of union-level influences.

The network architecture of Caser

- Convolutional Neural Network (CNN) is used to capture both point-level and union-level sequential patterns.
- By incorporating Latent Factor Model (LFM), Caser is also able to capture user's general preferences.

Capture Union-level Sequential Pattern with Horizontal Convolutional Filters

- Borrow the idea of using CNN in text classification, we use convolutional filters to search for sequential patterns.
- Sliding horizontally (from top to bottom), the horizontal convolutional filters are used with different height (multiple union sizes) but same width (same to the latent dimension).
- Max pooling operation on the result for extracting the most significant feature from a particular pattern.

Capture Point-level Sequential Pattern with Vertical Convolutional Filters

- Sliding vertically (from left to right), the vertical convolutional filters have same height (i.e., $L$) and same width (i.e., $T$).
- Vertical convolutional filters are learned to aggregate the latent embeddings of previous items.
- In other words, they are performing weighted sum over previous items’ latent representations, thus capture point-level sequential pattern.

Network Training

- Extract every L item as input, and the next T items as targets.
- Sigmoid Negative Log-Loss with random negative sampling is used as optimization criterion.

Codes and Data are available at: http://www.sfu.ca/~jixiat/