The figure 1 visualizes the generation of the browsing sequence.

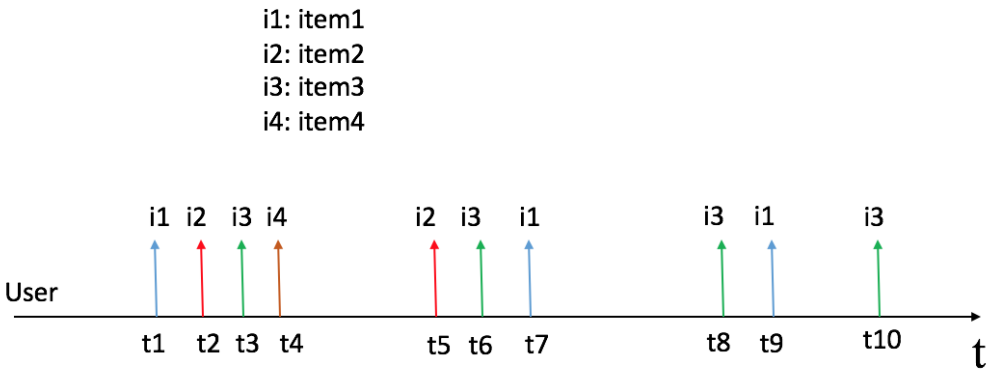


Figure 1: browsing sequence of a purchase of a user

We use a latent vector $u$ to represent a user and a latent vector $i$ to represent an item. The vector $u(t)$ means the user's preferences (aspect weights) at time $t$. On the other hand, the vector $i(t)$ means the item $i's$ attributes (aspect qualities), which is browsed at time $t$. We believe the attributes of browsed items can shape the user's preferences over time and a user's browsing history can be separated into several stages. In different stages, the influence of item's attributes on the user's preferences could be different, indicating different accepting patterns of items' attributes. To capture this dynamic patterns, we use $s_t$ to represent the user $u's$ accepting pattern at time $t$ and $\alpha_u^{s_t}$ to represent the value of accepting rate. Thus, at time $t$, the preference of a user $u$ can be represented as,

$$u(t) = u_0 + \sum_{t_j < t} \alpha_u^{s_{t_j}} i(t_j)$$

$\sum_{t_j<t}$ captures the sequential influence from previous events happening at $\{t_j < t\}$ on the current browsing behavior. And for time $t_j$, the corresponding accepting pattern is $s_{t_j}$, whose accepting rate is $\alpha_u^{s_{t_j}} \sim Gaussian(\mu, \sigma)$.

Given the current user's preferences $u(t)$ and items' attributes, the probability of browsing the item $k$ at time $t$ is

$$p(k) = \frac{exp(u(t)^T k)}{\sum_i exp(u(t)^T i)}$$

where $i$ is the item $i's$ latent vector of the item set.

One extension of the current model is: 1. The accepting pattern are shared across users. we can add a $HDP$ to model the phenomena that a sequence is composed of multiple patterns which shared across sequences.

Some problems are left to address: 1. How to evaluate the assumption that a sequence can be separated into multiple stages is valid through some experiments on $\alpha$? 2. Whether we need to assume the item's attributes are dynamic? Currently, we treat latent vector of an item $i$ is static

3. Whether the accepting rate should be modeled as a matrix? Currently, we treat it as a scalar, which means the accepting rate for every aspect is the same. Or should we treat $\alpha$ as a vector and change $\alpha_u^{s_{t_j}} i(t_j)$ into element-wise multiplication $\alpha_u^{s_{t_j}} \times i(t_j)$?