User-artist-song Model (draft)

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1 Motivation

Listening to music is different than reading articles. The artist of a song is of higher importance than the author of a scientific paper for a given user perusing their library.
We aim to capture this intuition using latent variables representing artist-level topics β_a, song-level topics β_s, and user preferences x_u as shown in Figure 1. This model can be extended, for example by connecting the artist-level β_a node to the song-level β_s node, or the artist-level rating r_{ua} to the song-level rating r_{uai}.

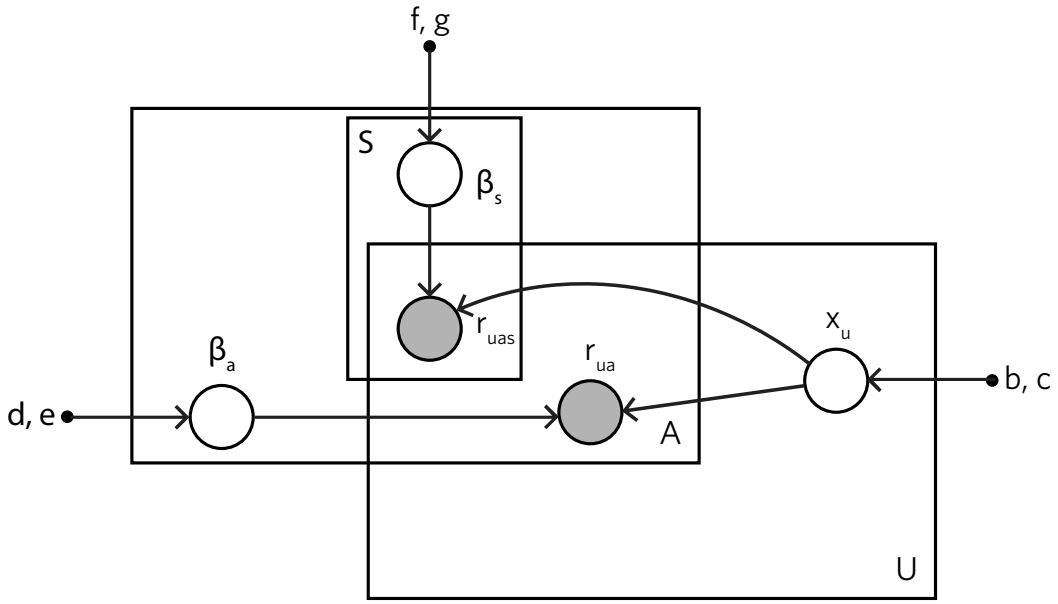

Figure 1: The graphical representation of the user-artist-song model, for U users listening to A artists, and each artist having S songs.

2 Generative Process

The generative process for the observed ratings is partially inspired by content-based Poisson factorization [1]:

1. Draw user preferences $x_u \sim \text{Gamma}(b, c)$
2. Draw artist-level topics $\beta_a \sim \text{Gamma}(d, e)$
3. Draw song-level topics $\beta_i \sim \text{Gamma}(f, g)$
4. Draw user-artist rating $r_{ua} \sim \text{Poisson}(x_u^T \beta_a)$
5. Draw user-song rating $r_{uai} \sim \text{Poisson}(x_u^T (\beta_a + \beta_i))$

3 Inference

Structured Stochastic Variational Inference (SSVI) was recently introduced [2] as a method to add some dependencies between global and local parameters (as opposed to mean-field inference where there are no such dependencies). Here we derive SSVI first for Poisson factorization [3], and then for the user-artist-song model (Figure 1).

4 Experiments

SSVI was used to fit Poisson factorization to the million song data set [4]. The precision was 8.5% (compared to 5.2% for content-based Poisson factorization from last semester).

References

[1] PK Gopalan, L Charlin, and DM Blei. "Content-based recommendations with Poisson factorization". In: *Advances in Neural Information Processing Systems* (2014). URL: `http://papers.nips.cc/paper/5440-content-based-recommendations-with-poisson-factorization`.

[2] MD Hoffman and DM Blei. "Structured Stochastic Variational Inference". In: *arXiv* (Apr. 2014). URL: `http://arxiv.org/abs/1404.4114`.

[3] PK Gopalan, JM Hofman, and DM Blei. "Scalable Recommendation with Poisson Factorization". In: *arXiv* (Nov. 2013). URL: `http://arxiv.org/abs/1311.1704v3`.

[4] D Liang. *Deep collaborative Poisson factorization*. 2014. URL: `https://github.com/dawenl/deep%5C_content%5C_cf`.