

# Genre-topic model for meaning change

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## 1 The model

We extend the model proposed by Lea to include genre meta-data. This is inspired by the author-topic model<sup>1</sup>. In this setting, instead of having a single probability distribution over meanings at each time, we have  $G$  different probability distributions, one for each genre. This makes it possible to leverage available genre information to improve inference and answer a set of additional research questions. For instance, we can find the genre most likely associated to a meaning, the most unusual meaning for genre, and which genres have the most similar meanings.

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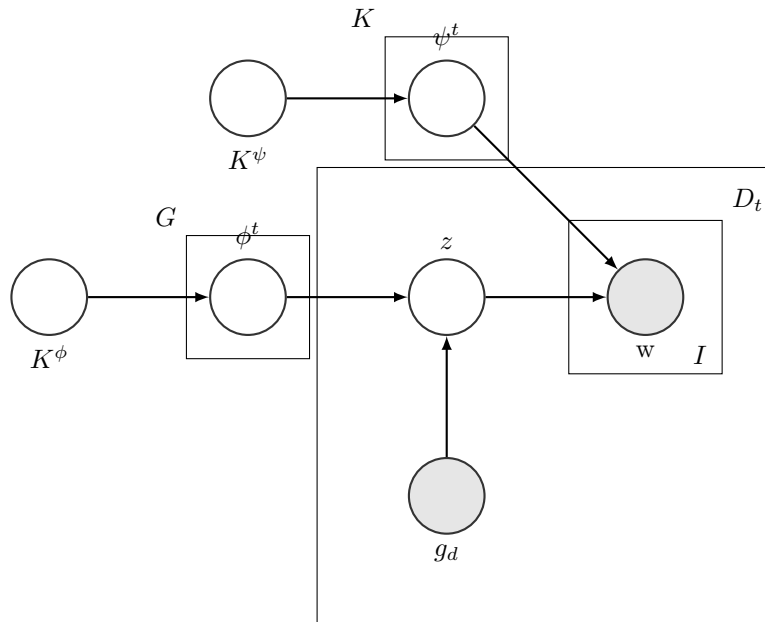
**Algorithm 1:** Generative model

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Draw  $K^\phi \sim \text{Gamma}(a, b)$ ;  
for time  $t = 1, \dots, T$  do  
  for genre  $g = 1, \dots, G$  do  
    | Draw sense distribution  $\phi_g^t \mid \phi_g^{-t}, K^\phi \sim N(\frac{1}{2}(\phi^{t-1} + \phi^{t+1}), K^\phi)$   
  end  
  for sense  $k = 1, \dots, K$  do  
    | Draw word distribution  $\psi_g^t \mid \psi_g^{-t}, K^\psi \sim N(\frac{1}{2}(\psi^{t-1} + \psi^{t+1}), K^\psi)$   
  end  
  for document  $d = 1, \dots, D$  do  
    | Draw genre  $x^d \sim U(\{g_1, \dots, g_G\})$ ;  
    | Draw sense  $z^d \mid x^d \sim \text{Mult}(\phi_g^t)$ ;  
    | for context position  $i = 1, \dots, I$  do  
      | | Draw word  $w^{d,i} \sim \text{Mult}(\psi^{t,z^d})$ ;  
    | end  
  end  
end
```

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## 2 Marginal graphical model at each time $t$



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<sup>1</sup> <https://mimno.infosci.cornell.edu/info6150/readings/398.pdf>

### 3 Inference

Lea's inference with the following adaptations:

- Sample the distribution over senses *for each genre*  $g = 1, \dots, G$
- Sample the sense assignments conditioned on the observed genre:

$$p(z^d \mid g^d, \mathbf{w}, t, \phi, \psi) \propto p(z^d \mid g^d, t) p(\mathbf{w} \mid t, z^d) \phi_g^t \prod_{w \in \mathbf{w}} \psi_w^{t, z^d}$$

**Note:** inference is simpler than in the author-topic model. In that case, while the authors are observed, they still need to sample to author assignment for each word. In our case, we observe one genre and assume all words come from that genre, hence we have no genre assignment to sample.