Topic Classification using Latent Dirichlet Allocation

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Abstract

LDA, Gibbs sampling, topic classification of documents, datasets used, results and their meaning, conclusions

1 Introduction

Introduce topic classification of documents. Then transition into formal definitions of LDA and Gibbs Sampling.

Elkan's lecture notes [1]

1.1 Latent Dirichlet Allocation

Latent Dirichlet Allocation (LDA) is

$$p(\gamma|\alpha) = \frac{1}{D(\alpha)} \prod_{s=1}^{m} \gamma_s^{\alpha_s - 1} \tag{1}$$

$$D(\alpha) = \int_{\gamma} \prod_{s=1}^{m} \gamma_s^{\alpha_s - 1} \tag{2}$$

$$D(\alpha) = \frac{\prod_{s=1}^{m} \Gamma(\alpha_s)}{\Gamma(\sum_{s=1}^{m} \alpha_s)} \tag{3}$$

1.2 Gibbs Sampling

$$p(z_i = j|\bar{z}', \bar{w}) \propto \frac{q'_{jw_i} + \beta_{w_i}}{\sum_t q'_{jt} + \beta_t} \frac{n'_{mj} + \alpha_j}{\sum_k n'_{mk} + \alpha_k} \tag{4}$$

2 Design and Analysis of Algorithms

Discuss how we're implementing LDA and Gibbs Sampling.

	Classic400			KOS		
Rank	**Topic 1**	**Topic 2**	**Topic 3**	**Topic 1**	**Topic 2**	**Topic 3**
1	patients	boundary	wing			
2	case	layer	mach			
3	ventricular	velocity	supersonic			
4	system	field	effects			
5	research	solution	ratio			
6	scientific	plate	wings			
7	fatty	problem	shock			
8	nickel	free	numbers			
9	acids	heat	jet			
10	aortic	cylinder	lift			

Table 1: Ten most commonly occured words for each topic classification for the classic400 and KOS datasets. Rank corresponds to how frequently a word appears in each topic (1=most occurred).

3 Design of Experiments

3.1 Datasets

Two datasets: classic400 and KOS blog posts (from UCI Machine Learning database). KOS dataset was reduced from 3430 documents to 400 documents (vocabulary unchanged from original 6906 words).

3.2 Hyperparameters

$\alpha = 50/K$ and $\beta = 0.01$ where K is the number of topics. For all experiments we set $K = 3$ and therefore $\alpha = 16.67$. Suggested originally by Griffiths and Steyvers (2004). May want to try other values.

Recall: large α for many topics per document and large β for many topics per word. We only use 3 topics so α will probably be small.

3.3 Convergence of Gibbs

When do we decide to stop Gibbs

3.4 Results

3.4.1 Clustering

Clustering of documents into three topics (reference simplex plots).

3.4.2 Most Common Words Per Topic

Ten most common words (in tables).

4 Findings and Lessons Learned

Thoughts on: LDA as a model, Gibbs Sampling as a training method, performance issues, results of the experiments

References

[1] C. Elkan, "Text mining and topic models," February 2013.