Latent Dirichlet Allocation for scientific topic extraction

Ivan Savov

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Abstract

We would like to automatically learn a topic model from a large collection of scientific articles using Latent Dirichlet Allocation. The data set is the entire pdf contents of the Cornell Physics pre-print archive arXiv.org for the `quant-ph` category. The goal is to meaningful clusters of the scientific research which can help with document discovery.

keywords: LDA, graphical model, arXiv, topic model, domain knowledge

1 Introduction

When I first learned about Latent Dirichlet Allocation I was totally amazed by the seemingly magical ability of this algorithm to automatically discern the topics underlying a collection of documents. Since then I have been thinking about how I can apply this method to

2 The data set

The good people who run the arXiv.org were kind enough to send me the entire collection of papers in the `quant-ph` repository. The papers contain nearly all the research in the physical sciences that is not particle physics.

```
ivan@flicker:/scratch/arxiv$ du -sh *
7.1G    pdf
2.1G    tex
ivan@flicker:/scratch/arxiv$ find pdf/ -type f | wc
31739   31739  730019
ivan@flicker:/scratch/arxiv$ find tex/ -type f | wc
21061   21061  470945
```

The `pdf/` directory contains the pdf versions of the papers and for some of these papers. For about 2/3 of these we also have the latex source code in the `tex/` directory.

Some more information about the dataset:

- Total number of documents: 31739
- Earliest date: 22 Dec 1994 (pdf/9412/9412002v1.pdf)
- Most recent: 30 Mar 2007 (pdf/0703/0703278v1.pdf)

2.1 Intended pre-processing

I plan to use the command `pdftotext` to convert the pdf documents to text files and then use the standard bag-of-words paradigm for each document.

I will do a first pass on the documents and remove stopwords. Given how large of a dataset is available I will try to run my algorithm without stemming in order to capture as much of the granularity of the data. If this proves to be ineffective then I will use stemming.

3 Project proposal

I will read the original 2003 paper by Blei, Ng and Jordan [BNJ03] and also perform a general literature review on topic models. In particular, I want to verify the results of the ICML09 paper [AWST] which state that all the different models of training LDA are equivalent and only differ by the setting of the hyper-parameters.

I will try to implement the Collapsed Variational Bayes technique of [TNW07].

The results I would like to obtain is some meaningful cluster structure over the scientific topics.

4 Next steps

I will need to move the data to powerful workstation where I can do the pre-processing of the documents and perform the word counts.

Then, I must look into the algorithm which I will use for training.

5 Questions

Is this a acceptable/viable term project for COMP-652?

Is the LDA training doable for such a large dataset on a desktop computer?

References

[AWST] A. Asuncion, M. Welling, P. Smyth, and Y.W. Teh. On Smoothing and Inference for Topic Models.

[BNJ03] D.M. Blei, A.Y. Ng, and M.I. Jordan. Latent dirichlet allocation. *The Journal of Machine Learning Research*, 3:993–1022, 2003.

[TNW07] Y.W. Teh, D. Newman, and M. Welling. A collapsed variational bayesian inference algorithm for latent dirichlet allocation. *Advances in neural information processing systems*, 19:1353, 2007.