Latent Dirichlet Ideas

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Abstract

During the last semester I worked on a small research project on the LDA topic model on a data set of scientific papers. I feel my project was just scratching the surface and that there remain plenty of interesting research topics to be explored. Most importantly, I feel the LDA model is very powerful and computationally efficient so there has to *practical* applications which can be developed.

keywords: LDA, topic model, Gibbs sampling, applications, hierarchical

1 Introduction

document collections [BNJ03, BL09].

2 The current setup

preporcessing in python

LDA C programs by Newman [New].

3 The intended setup

If I am going to be working on this project I need to cleanup the code.

I want to refactor the whole code base into a self contained python library `liblda` with a simple API.

The user writes edits a config file which explains where the document collection lives and then the uses two-three simple commands to run an LDA experiment.

The results will be available (they already are kind of) as numpy arrays, so that more complex algorithms can be build on top of the basic LDA operations.

I want to follow the ideas of "loose coupling" and allow to swap out components like the underlying inference algorithm.

4 Ideas

This project has been a very good opportunity to learn about LDA and machine learning in general. I learned both theoretical facts about graphical models as well as practical consideraitons about programming inference algorithms, memory management and data pre-processing.

While I was able to extract reasonably good topics from the `quant-ph` archive, I think there is still a lot of interesting experiments to perform with this data set. In particular I would like to use the extracted topics in order to devlop an automated recommendation system or a "topic filter" which would help me keep track of which papers are posted on the arXiv every day that are relevant to my topics of research.

Some other ideas that I would like to pursue are the following.

4.1 Regular expressions counts

In text analysis we invariably use word counts as the main "features" of documents. Since we have the full power and flexibility of python during the pre-processing stage, we could use instead regular expressions as features.

For example we could quantify how many matches to the reg ex "`H(.*)`" there are in each document. Certainly, for papers that deal with information theory this will be a highly informative feature.

Another possible use of regular expressions is to have a digram model with synonyms taken into account. For example we could count how many matches there are to this reglar expression "`quantum (mechanics|physics)`" instead of trying to keep track of the two options separately.

4.2 Two data set correlations

I have not seen in the litterature any discussion about using LDA to automatically create links between two data collections. For example if we trained a topic model on wikipedia articles AND the arXiv, we would be able to automatically generate meaningful links between the two. As you browse the arXiv you could get suggested articles from wikipedia that cover similar topics.

4.3 Parallel LDA

MOST INTERESTING !

One aspect that I did not get a chance to look into deeper is the use of parallel algorithms for inference of the LDA model. One approach is to modify the Gibbs sampling or variational methods to permit loosely coupled parallel operation [NSS06, NASW07].

Another approach is to use GPU based computation which is highly parallel and vectorized. CUDA (Compute Unified Device Architecture) is a simple API which allows for GPU programming on NVIDIA grpahics boards. The speedups reported are very impressive [MHSO09, YBQ]. This research direciton would also be an excuse for me to buy an expensive graphics card.

4.4 Citation graph

One simple further step that can be taken to make use of the arXiv topic model is to extract the citation graph amongst the paper. This can be done with another regular expression of the form `quant-ph\d{7}` or from some third party source like Citeseer.

Having the citaiton graph would allows us to do a "page rank" type of calculation and extract a sense of importance for the papers in each topic.

4.5 Metadata

We should have the titles for each of these articles I think we need a little urllib2 script to get each of `http://arxiv.org/list/quant-ph/0003?show=1000` where 0003 corre-

sponds to my folder 0003

I feel this is more of a beginning than an end to this project. I have gotten acquainted with the software and the data set and hopefully I can produce some worthwhile results in the coming months. All the source code and results associated with this project are available here [Sav].

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