Latent Dirichlet Allocation

Ivan Savov
ivan.savov@gmail.com

McGill CS

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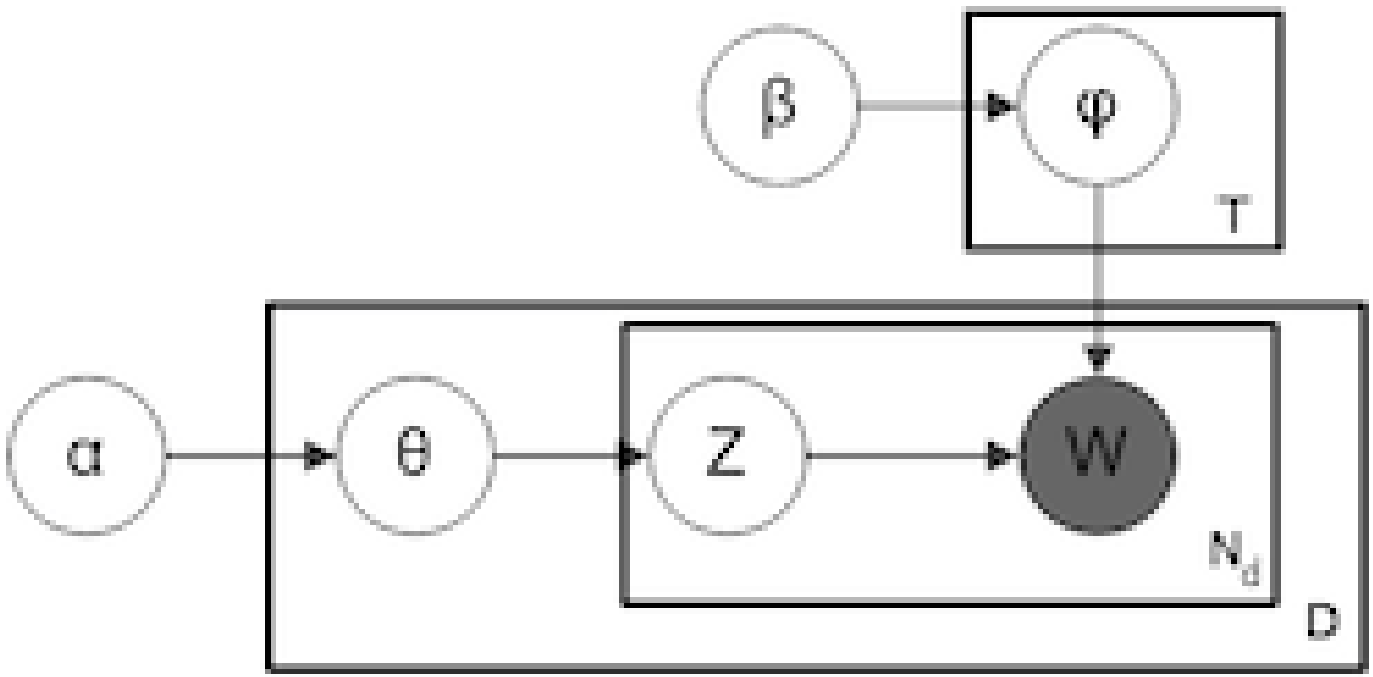
Latent Dirichlet Allocation

- Blei, Ng, Jordan 2003
- Extract multiple topics from documents
- Unsupervised method
- Documents as bags of words

The model



$$P(W) = \prod_{k=1}^{T} P(\varphi_k; \beta) \prod_{j=1}^{D} P(\theta_j; \alpha) \prod_{w=1}^{N_d} P(Z_{j,w}|\theta_j) P(W_{j,w}|\varphi_{Z_{j,w}})$$

Inference method

- Gibbs sampling
- Want to learn two probability distributions
  - $\varphi(w|t)$ words-given-topic
  - $\theta(t|d)$ topics-given-document
- Efficient
- Updates involve word count aggregates
- Guarantee on convergence?

Data set

- science papers from arXiv.org quant-ph
- preprocessing...
- D=20000 documents
- W=10000 words in vocabulary
- N=40 000 000 words in corpus
- Dave Newman `topicmodel` code

Results 1 (top words in topics)

- T=200, NITER=50
- (t86) key bob alice eve security protocol secret attack secure bits bit information ...
- (t175) alice bob protocol communication protocols bit bobs alices commitment shared party sends ...
- (t10) entropy von neumann log information mutual shannon entropies measure theory relative defined ...
- (t131) quantum physics vol review physical arxiv letters press university http quant york ...
- (t200) theory universe physics nature brain reality experience consciousness matter science human conscious ...

Results 2

- runtime between 10 mins and 4 hours depends on
  - number of Gibbs iterations NITER
  - number of topics T
- memory usage between 700MB and 900MB
- perplexity
  - $pplex(\mathcal{D}) = exp\left(-\frac{1}{N}\sum \log p(w|d)\right)$
- perplexity decreases with more topics
- perplexity does not decrease after NITER 50

Future work

- combine results from different runs
  - subtopics
  - correspondances
- recommender system
- combine with citation information

References

- D.M. Blei, A.Y. Ng, and M.I. Jordan. Latent dirichlet allocation. The Journal of Machine Learning Research, 3 993–1022, 2003.
- T.L. Griffiths and M. Steyvers. Finding scientific topics. Proceedings of the National Academy of Sciences, 101 (Suppl 1) 5228, 2004.
- A. Asuncion, M. Welling, P. Smyth, and Y.W. Teh. On Smoothing and Inference for Topic Models. ICML2009.
- source code – http//github.com/ivanistheone/arXivLDA/