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Japanese-American Kavli Frontiers of Science

11th Annual Japanese-American Kavli Frontiers of Science Symposium

Japan Society for the Promotion of Science
U.S. National Academy of Sciences

Arnold and Mabel Beckman Center
December 5-7, 2008
Irvine, California

[Bayesian Statistics & Massive Data Streams](#) [-Presentation](#) 

Jake Hoffman, Yahoo! Research

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The natural sciences aim to uncover models of the world that are complex enough to accurately describe observed phenomena, yet simple enough to generalize to future observations while providing a reasonably intuitive interpretation of the system under study. In traditional approaches, one posits a "first principles" model of the relevant system and calculates experimentally observable quantities from this model. One then performs the relevant experiments, measures the observable quantities, and compares the results with theoretical predictions. Unfortunately, for many of the complex systems that have recently received attention in the quantitative sciences – from biological to social to financial systems -- we typically cannot adhere to the program above: we may lack either the knowledge to posit reasonable models, the sophistication to compute quantities of interest from these models, or the technology to directly observe the relevant quantities. However, recent advances in experimental and information technology have made available vast amounts of data, inspiring the successful practice of data-driven modeling, in which one uses these data to infer properties of the systems under study. In this talk we show that Bayesian inference provides a principled and effective framework for data-driven modeling, allowing one to extract relevant information from large data sets in a robust and scalable manner. We review both the theory underlying Bayesian inference and the details of practical implementations. We discuss applications to several domains, emphasizing connections with traditional modeling techniques.

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[Indo-American Frontiers \(2007\):](#)

- ✧ [Algebra and Computation](#)

References

Further reading/references for Bayesian inference, ordered for least to most technical:

"What is Bayes's theorem...?", Wiggins, Chris, Scientific American, December 4, 2006.

"A primer on probabilistic inference", Thomas L. Griffiths and Alan Yuille
<http://cocosci.berkeley.edu/tom/papers/tutorial.pdf>

"Probability theory: The logic of science":
<http://www.amazon.com/Probability-Theory-E-T-Jaynes/dp/0521592712>
(several older editions are freely available online)

"A reading list on Bayesian methods":
<http://cocosci.berkeley.edu/tom/bayes.html>

"Information Theory, Inference, and Learning Algorithms":
<http://www.inference.phy.cam.ac.uk/mackay/itila/book.html>

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