Lecture Calendar

* For each lecture we link to [suggested readings](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#readings) below the calendar table.
* During the regular lecture times (Tuesdays and Thursdays at 2:00pm), Prof. Sudderth will present the posted slides via Zoom.  
  *To join lectures, use a*[*UCI zoom account*](https://uci.zoom.us/)*(and login with your UCInetID) to connect to the CS274B Zoom meeting:*[*https://uci.zoom.us/j/475883671 (Links to an external site.)*](https://uci.zoom.us/j/475883671)
* To join the live Zoom meeting, you will need to use the password e-mailed to registered students.
* After each lecture, a recording will be posted to the [CS274B Yuja channel (Links to an external site.)](https://uci.yuja.com/V/PlayList?node=3573522&a=1215245837&autoplay=1)

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| **Number** | **Date** | **Topics** | **Readings** | **Materials** |
| 1A | 3/31/2020 | Survey of Applications and Algorithms | [Tutorials](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#overview) | [Overview slidesPreview the document](https://canvas.eee.uci.edu/courses/24331/files/9057980/download?wrap=1) |
| 1B | 4/02/2020 | Directed and Undirected Graphical Models | [Markov properties](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#markov) |  |
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| 2A | 4/07/2020 | Inference Problems, Variable Elimination Algorithms | [Variable elimination](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#elimination) |  |
| 2B | 4/09/2020 | Message Passing Algorithms, Belief Propagation | [Belief propagation](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#beliefProp) |  |
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| 3A | 4/14/2020 | Junction Trees, Loopy Belief Propagation | [Junction trees](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#junctionTree) |  |
| 3B | 4/16/2020 | Learning Directed Graphical Models, L2 Regularization | [Parameter learning](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#learnParams) |  |
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| 4A | 4/21/2020 | Learning Graphs via L1 Regularization, Exponential Families | [Exponential families](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#expFamily) |  |
| 4B | 4/23/2020 | Learning Undirected Graphical Models, Expectation Maximization (EM) Algorithms | [EM algorithms](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#learnEM) |  |
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| 5A | 4/28/2020 | EM for Graphical Models | [EM algorithms](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#learnEM) |  |
| 5B | 4/30/2020 | Monte Carlo Methods | [Monte Carlo](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#monteCarlo) |  |
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| 6A | 5/05/2020 | MCMC Methods, Gibbs Samplers | [MCMC](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#mcmc) |  |
| 6B | 5/07/2020 | Kalman Filters, Particle Filters | [Gaussian models](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#gauss), [Particles](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#particle) |  |
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| 7A | 5/12/2020 | Particle Belief Propagation | [Particles](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#particle) |  |
| 7B | 5/14/2020 | Mean Field Variational Methods | [Variational methods](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#variational) |  |
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| 8A | 5/19/2020 | Bethe Variational Methods, Loopy BP | [Loopy BP](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#loopy) |  |
| 8B | 5/21/2020 | **Final Project Help Session** |  |  |
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| 9A | 5/26/2020 | Bayesian Nonparametrics | [BNP](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#bnp) |  |
| 9B | 5/28/2020 | Stochastic and Memoized Variational Inference | [BNP](https://canvas.eee.uci.edu/courses/24331/pages/lecture-calendar#bnp) |  |
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| 10A | 6/02/2020 | Structured Variational Autoencoders |  |  |
| 10B | 6/04/2020 | **Final Project Presentations** |  |  |
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| - | 6/11/2020 | **Final Project Reports Due** |  |  |

Suggested Readings

We provide suggested readings from several sources. You do *not* need to read all of them. Instead, we suggest you compare various options, and choose the reference whose style you like best. Barber's [Bayesian Reasoning and Machine Learning (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/) is freely available online, and is a good place to start.

Acronyms for Primary Resources

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): *Bayesian Reasoning and Machine Learning*, David Barber, Cambridge University Press 2012. Free online.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): *Machine Learning: A Probabilistic Perspective*, Kevin Murphy, MIT Press 2012. Excerpt online.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): *Pattern Recognition and Machine Learning*, Christopher Bishop, Springer 2007. Excerpt online.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): *Graphical Models, Exponential Families, and Variational Inference*, Martin Wainwright & Michael Jordan, Foundations & Trends in Machine Learning, 2008.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): *Graphical Models for Visual Object Recognition and Tracking*, Erik B. Sudderth, PhD Thesis (Chapter 2), MIT 2006.

Graphical Model Tutorials

* [A Brief Introduction to Graphical Models & Bayesian Networks (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/Bayes/bnintro.html), K. Murphy, 1998.
* [Graphical Models (Links to an external site.)](http://projecteuclid.org/euclid.ss/1089808279), M. Jordan, Statistical Science 2004.

Directed & Undirected Graphs: Factorization & Markov Properties

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Chapters 2-4, excluding Sec. 3.4.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 10.1-10.2, 10.5, 19.1-19.4.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 8.1-8.3.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 2.1-2.4.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.2.1-2.2.3.

Inference via Variable Elimination

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 5.1, 5.3.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 20.3.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 8.4.

Inference via Belief Propagation: Sum-Product & Max-Product

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 5.1-5.2.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 20.2.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 8.4.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 2.5.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.2.5, 2.3.2.
* [Factor Graphs and the Sum-Product Algorithm (Links to an external site.)](http://www.psi.toronto.edu/pubs/2001/frey2001factor.pdf), F. Kschischang, B. Frey, & H. A. Loeliger, IEEE Trans. Info Theory 2001.

Inference via Junction Tree Propagation

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Chapter 6.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 20.4-20.5.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 2.5.
* [A Short Course on Graphical Models (Links to an external site.)](http://ai.stanford.edu/~paskin/gm-short-course/), M. Paskin, 2003.

Exponential Family Distributions: Learning & Inference

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Chapter 8 excluding Sec. 8.4, 8.8.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 9.2.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 2.4.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Chapter 3.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.1.

Learning (Directed & Undirected) Graphical Model Parameters

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Chapter 9 excluding Sec. 9.5.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 10.4, 19.5.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 6.1.

Learning via the Expectation Maximization (EM) Algorithm

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 11.1-11.3.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 11.4.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Chapter 9.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 6.2.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.3.3.
* [A View of the EM Algorithm that Justifies Incremental, Sparse, and Other Variants (Links to an external site.)](http://www.cs.toronto.edu/~radford/ftp/emk.pdf), R. Neal & G. Hinton, 1998.

Learning (Directed & Undirected) Graphical Model Structure

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 9.5-9.6, 12.1-12.3, 12.5.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Chapter 26 excluding Sec. 26.5-26.7.

Inference & Learning for Gaussian Graphical Models

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 8.4, Chapter 24.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 10.2.5, 18.1-18.4, 19.4.4, 20.2.3, 26.7.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 13.3.
* [A Unifying Review of Linear Gaussian Models (Links to an external site.)](http://authors.library.caltech.edu/13697/1/ROWnc99.pdf), S. Roweis & Z. Ghahramani, Neural Computation 1999.
* [Bayesian Modeling of Uncertainty in Low-Level Vision (Links to an external site.)](http://research.microsoft.com/pubs/66645/Szeliski-IJCV90.pdf), R. Szeliski, IJCV 1990.

Monte Carlo Methods: Rejection & Importance Sampling

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 27.1-27.2.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 23.1-23.4.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 11.1.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.4.
* [Introduction to Monte Carlo Methods (Links to an external site.)](http://www.inference.phy.cam.ac.uk/mackay/erice.pdf), Sec. 1-3, D. MacKay, 1999.

Particles & Sequential Monte Carlo

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 27.6.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 23.5.
* [An Overview of Existing Methods and Recent Advances in Sequential Monte Carlo (Links to an external site.)](http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4266870), Cappe, Godsill, & Moulines, IEEE 2007.
* [Nonparametric Belief PropagationLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/cacm10nbp.pdf), Sudderth, Ihler, Isard, Freeman, & Willsky, CACM 2010.

Markov Chain Monte Carlo (MCMC): Gibbs & Metropolis-Hastings

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 27.3-27.5.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Chapter 24.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 11.2-11.4.
* [Introduction to Monte Carlo Methods (Links to an external site.)](http://www.inference.phy.cam.ac.uk/mackay/erice.pdf), Sec. 4-8, D. MacKay, 1999.
* [An Introduction to MCMC for Machine Learning (Links to an external site.)](http://link.springer.com/article/10.1023%2FA%3A1020281327116), Andrieu, de Freitas, Doucet, & Jordan, Machine Learning 2003.

Variational Methods: Naive & Structured Mean Field

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 28.3-28.4.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Chapter 21.
* [PRML (Links to an external site.)](http://research.microsoft.com/en-us/um/people/cmbishop/PRML/): Sec. 10.1-10.6.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Chapter 5.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.3.1.
* [Variational Message Passing (Links to an external site.)](http://www.jmlr.org/papers/volume6/winn05a/winn05a.pdf), J. Winn & C. Bishop, JMLR 2005.

Variational Methods: Bethe Approximations, Loopy & Reweighted BP

* [BRML (Links to an external site.)](http://www.cs.ucl.ac.uk/staff/d.barber/brml/): Sec. 28.7.
* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 22.1-22.4.
* [GEV (Links to an external site.)](https://www.nowpublishers.com/article/Details/MAL-001): Sec. 4.1, Chapter 7.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.3.2.
* [Understanding Belief Propagation and its Generalizations (Links to an external site.)](http://www.merl.com/publications/docs/TR2001-22.pdf), J. Yedidia, W. Freeman, & Y. Weiss, IJCAI 2001.

Discriminative Learning: Conditional Random Fields & Structural SVMs

* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 19.6-19.7.
* [An Introduction to Conditional Random Fields (Links to an external site.)](http://homepages.inf.ed.ac.uk/csutton/publications/crftut-fnt.pdf), C. Sutton & A. McCallum, Foundations & Trends in ML 2011.
* [Structured Prediction and Learning in Computer Vision (Links to an external site.)](http://www.nowozin.net/sebastian/cvpr2012tutorial/), S. Nowozin & C. Lampert, CVPR 2012.

Bayesian Nonparametrics: Dirichlet Processes

* [MLaPP (Links to an external site.)](http://www.cs.ubc.ca/~murphyk/MLbook/): Sec. 25.2.
* [EBSLinks to an external site.](http://www.ics.uci.edu/~sudderth/papers/sudderthPhD.pdf): Sec. 2.5.
* [Modern Bayesian Nonparametrics (Links to an external site.)](http://www.stats.ox.ac.uk/~teh/teaching/npbayes/nips2011.pdf), P. Orbanz & Y. W. Teh, NIPS 2011.