V. SUBJECTS FOR JOURNAL CLUB PRESENTATIONS & REPORTS: (INCOMPLETE) POOL OF OPTIONS

A. General Information

Each student will be required to choose a subject for **journal club presentation and report**. List of suggested subjects is listed below. In terms of picking a subject – the policy is 'first come first served'. Please e-mail the lecturer as soon as possible.

The list is not meant to be complete or exclusive. In particular, the students are encouraged to suggest additional subjects linked to the course material and possibly related to their own research focus/interest. All additional subjects should be discussed with and approved by the lecturer.

Subjects should be presented during the presentation session which will be scheduled for May 24, Tue. Each presentation is 20 mins. All reports should be submitted by May 28, 11:59pm.

Reports are individual, should be at least 10 pages but not longer that 20 pages. Presentations and reports will be graded together. See `http://www.people.fas.harvard.edu/~rpoddar/Papers/ldpc.pdf` for an exemplary student report.

Projects resulting in julia/ijulia programs/illustrations on the subjects linked to the lectures, which can be used as a basis for illustrations in the course in the future, are especially encouraged.

B. Incomplete List of Suggested Subjects

Large Deviation for Multiplicative Processes

Stretching and Rotations of clouds and particles, ordered exponentials, long time statistics of Lyapunov exponents. Cramer/entropy function. `http://arxiv.org/abs/cond-mat/0105199`

The Noisy Channel Coding (Shannon) Theorem

Sec. 9.3 and 10 of [2]

Compressed Sensing and its many uses (How l_1 norm promotes sparcity?)

Pick a review from the extended list available at `https://en.wikipedia.org/wiki/Compressed_sensing` An original option is `http://statweb.stanford.edu/~candes/papers/DecodingLP.pdf`

Slice Sampling MCMC

See `https://en.wikipedia.org/wiki/Slice_sampling`. Recommended review is Neal, Radford M. (2003). "Slice Sampling". Annals of Statistics 31 (3): 705767.

Simulated Annealing Sampling

Important idea and algorithm allowing to explore seriously non-convex problems – rugged landscape with multiple valleys, saddle points, minima and peaks. The original paper is Kirkpatrick, S.; Gelatt Jr, C. D.; Vecchi, M. P. (1983). "Optimization by Simulated Annealing". Science 220 (4598): 671680. See also `https://en.wikipedia.org/wiki/Simulated_annealing` and references there in.

Hamiltonian MCMC

MCMC which is capable to accelerate sampling by adding additional degrees of freedom - related to controlled inertia/momenta expressed through a Hamiltonian description (from physics) — thus the name. Recommended review `http://www.cs.utoronto.ca/~radford/ftp/ham-mcmc.pdf`

Irreversible Monte Carlo algorithms for efficient sampling

The original paper is `http://arxiv.org/abs/0809.0916`.

Warm Algorithm in Classical and Quantum Statistical Physics

The original paper is `http://scholarworks.umass.edu/cgi/viewcontent.cgi?article=2194&context=physics_faculty_pubs`. See also `http://wiki.phys.ethz.ch/quantumsimulations/_media/lecture_101007.pdf`.

Gillespie algorithm

Sampling from stochastic equations (Langevin type) which proceeds by jumps. See the original paper Gillespie, Daniel T. (1977). "Exact Stochastic Simulation of Coupled Chemical Reactions". The Journal of Physical Chemistry 81 (25): 23402361 and also check `https://en.wikipedia.org/wiki/Gillespie_algorithm`.

Sequential Monte Carlo for Importance Sampling & Inference

Recommended paper `https://www.irisa.fr/aspi/legland/ensta/ref/doucet00b.pdf`.

Ising models and Other Graphical Models in Image Analysis

Recommended tutorial `https://www.math.ntnu.no/~joeid/TMA4250/image_ana.pdf`.

Efficient Exact Inference in Planar Ising Model

Recommended paper `http://arxiv.org/pdf/0810.4401.pdf`.

Stochastic Resonances

Curious physics phenomena important in optics & communications which explains how noise/randomness allows to amplify

signal and observe what otherwise would be difficult to detect. Recommended paper is Benzi, R.; Sutera, A.; and Vulpiani, A. "The Mechanism of Stochastic Resonance." J. Phys. A 14, L453-L457, 1981.

Decoding of Low Density Parity Check Codes

Section 47 of [2]. Implementation of a message passing decoding in julia/ijulia is especially encouraged.

Analytic and Algorithmic Solution of Satisfiability Problem

The original paper is `http://cacs.usc.edu/education/cs653/Mezard-RSAT-Science02.pdf` Also check the book of Mezard and Montanari + papers/reviews of Parisi, Mezard and Zechina.

Neural Network Learning

Part V of [2].

Jackson Networks of Queues

Recommended paper is Kelly, F. P. (Jun 1976). "Networks of Queues". Advances in Applied Probability 8 (2): 416432. See alos `https://en.wikipedia.org/wiki/Jackson_network` and references there in. It may also be useful to consult with the recent book: "Stochastic Networks" by E. Yudovina and F. Kelly, Cambridge University Press, 2014. Implementation of a julia/ijulia illustration/program for this subject is especially encouraged.

Path Integral Control & Reinforcement Learning

Recommended review `http://www.snn.ru.nl/~bertk/kappen_granada2006.pdf` Implementation of a julia/ilulia illustration/program for this subject is especially encouraged.