CS-294 Markov Chain Monte Carlo: Foundations & Applications

Course Project: Fall 2009

1. General

The goal of the project is to give you an opportunity to investigate part of the course material (or a closely related topic) in greater depth, by reading, digesting and presenting (in both oral and written form) one or more original research papers. Exceptionally, and subject to approval, you may substitute for this some creative work on an existing open problem mentioned in class or a problem of your own choosing.

Projects should normally be done individually, but if you wish to work with somebody else and tackle a larger topic that is OK provided you agree it with me first. A list of suggested papers can be found on the class web page. In some cases a topic appears with two or three references; choosing a topic does not necessarily entail digesting all these references in detail, but usually one of them with the others as background.

The deliverables for all projects are:

- A presentation (of approximately 40 minutes duration, i.e., half of a normal lecture) accessible to the class. The presentation should use the whiteboard (though if you need to display a technical picture you may use a screen for that).
- A written report of 4–5 pages (11pt LaTeX, standard margins). [Note: The page limit is intentional. It is harder and arguably more useful to be able to write a report of four pages than one of ten pages.]

The presentation and the project are intended to complement one another, and should be prepared in parallel. The assessment will be based on both. The deadline for the reports will be Friday December 11th. The presentations will be scheduled during class times between Tuesday November 10th and Thursday December 10th. A schedule will be posted once topics have been chosen.

2. Choosing a project

You should choose a project and have it approved by me no later than **Friday November 6**. If you want to choose a project from the list, you should email your choice to me together with at least one, and preferably two alternatives in decreasing order of preference. First choices will be allocated on a first-come, first-served basis. Topics from the list will be marked as they are allocated.

If you want to propose a creative project, or any other project not on the list, you *must* come and discuss it with me before the above date.

3. More on reading projects

The idea here is that you should read, understand and fully digest one or two papers on a topic related to those discussed in class. You should understand the work well enough to give an intuitive explanation of it, answer questions about it, assess its strengths and limitations, and have something intelligent to say about its potential for further development. Your written report should consist of:

- Sufficient background to explain the results.
- Statement of the results.

- Assessment of how the results relate to other work in the field.
- Indication of the key ideas used in the proofs or technical development, distinguishing between novel and standard steps.

Your presentation should contain the same ingredients; however, you should use the different medium to complement your written report (e.g., by presenting examples, drawing pictures etc.)

4. More on other projects

These projects are inherently more open-ended and harder to describe in general terms. Possible examples are:

- Make some non-trivial progress on an existing open problem (e.g., determining the mixing rate of some new Markov chain, or improving the analysis of an old one).
- Perform an experimental evaluation of theoretical results proved in class.
- Apply some ideas or techniques from the class to a problem from your own research area.

Such a project may involve an experimental component, but should include at least some application of the analytical techniques we have discussed (e.g., analysis of a simple special case, or a precise heuristic discussion). *A mere implementation of some MCMC algorithm without reference to theoretical analysis is not sufficient.* Before embarking on such a project, it is essential that you specify your goals clearly and discuss them with me first.

The nature of the report and presentation for this type of project will depend on the material, but the essential ingredients should be similar to those listed above for reading projects. In addition, it may well be appropriate to attach an appendix giving technical proofs and/or experimental results.