Bayesian inference:

Details on the reading material:

We will study the following chapters: (some of these may be distributed over two sessions)

- *Principles and elementary applications (ch 1).*
  This is an introduction to the inference problem. It is pointed out that we seldom have the possibility, neither in daily life nor in science, to use classical (deductive) logic to draw strict conclusions from our observations. Instead we most often deal with problems having incomplete information so that we only can make judgements about a certain hypothesis being more likely than another.
  In the chapter Jaynes sets up a set of very simple desired properties for a theory for such inference.
- *The quantitative rules (ch 2).*
  In this chapter Jaynes shows that we from the set of desired properties presented in chapter 1 can derive the fundamental product- and sum rules that we recognize from probability theory. In this way it is shown that the validity for probability theory can be extended to cover a much larger set of applications that is usually acknowledged in classical probability theory.
- *Elementary sampling theory (ch 3).*
  This chapter takes a Bayesian viewpoint on the classical urn-with-balls-of-different-colors-problem. In this chapter we get a first glance of the differences between the classical and the Bayesian theory.
- *Elementary hypothesis testing (ch 4).*
  Here we apply the theory on the hypothesis testing problem. In classical theory we would now need to switch to the field of statistical inference and start using concepts, such as, significance tests etc. Jaynes shows that there is no need to do this, we instead keep on calculating the probabilities of the different hypotheses being true.
- *Elementary parameter estimation (ch 6).*
  Among other things, we here will consider continuous variables and combining probabilities with value judgements for different types of errors in order to form optimal estimates.
- *Discrete prior probabilities: the entropy principle. (ch 11)*
  The assignment of prior probabilities based on background information is a very important topic in Bayesian inference. In this chapter, the Maximum entropy principle for doing this is presented. Together with this chapter, we also read parts of the related chapter 7, dealing with the normal distribution.
- *Decision theory: historical background (ch 13)*
  Introduction to decision theory.
- *Simple applications of decision theory. (ch 14)*
  Self-explanatory title.

  In addition to the above chapters we will treat the following practical topics:

marginalization (that is, "integrating out" nuissance parameters), Markov Chain Monte Carlo (MCMC) techniques for solving integrals over large dimensional spaces.