

# Stat 271. Fall 2015. Homework 2

Prof. Alan Yuille

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**Due on Tuesday 17/Nov 2015. Email pdf file to [qiuwch@gmail.com](mailto:qiuwch@gmail.com)**

## **Question 1. Theory.**

Briefly describe how to make decisions with uncertain observations by using Bayes Decision Theory. What are priors, likelihood functions, and loss functions? How can this be applied to edge detection?

Briefly describe Markov Random Fields (MRF) and how they can be used to design vision models which include spatial context. Explain the relationship between Mean Field Theory (MFT), Gibbs Sampling, Deterministic Neural Network Models, and Stochastic Neural Network Models. Describe how to obtain an MFT algorithm for a Markov Random Field.

What is sparse coding? How do the basis functions learnt using sparse coding differ from those learnt using principal component analysis? Why does the sparsity penalty encourage many of the coefficients of basis functions to be zero? How does this depend on the parameter  $\lambda$  which penalizes the sum of the magnitude of the coefficients.

## **Question 2. Experimental Section: Edge Detection, Gibbs Sampling, and Sparse Coding**

This consists of three separate projects as described on the webpage:

`http://nbviewer.ipython.org/github/qiuwch/Stat271HWFall15/blob/master/HW2Intro.ipynb`

For details of the three projects – Statistical Edge Detection, Gibbs Sampling, Learn a Sparse Code for Natural Images – click on the three linked files. The homework tasks are described in the files (sometimes at the end of the files).

Note that the Sparse Coding project encourages people to team up in groups of up to three people. The code for this project is unstable on Windows, so it is best that each team can use Macs or Linux.

For more about the sparsity assignment, see: `http://nbviewer.ipython.org/github/qiuwch/Stat271HWFall15/blob/master/Sparse.ipynb`