

Psy 5018H: Math Models Human Behavior

Spring 2007

Prof. Paul Schrater

Homework #3, Due Mar. 20th, midnight.

Problem Set

Submit homework as an electronic file via email. You may submit any common file format.

1) Bayesian perception of motion (50%)

Read Weiss, Simoncelli, and Adelson “Motion Illusions as Optimal Percepts”. We will simulate their theory on a simple stimulus. I have written a series of utility files in Matlab for this purpose. Download the following files: MakePlaidMovie.m, ComputePrior.m, ComputeVelLikeli.m, ComputeImageDerivs.m, ShowPdistandMovieFrames.m, and BayesianMotPerExample.m. The function MakePlaidMovie will make an image sequence for a simple “plaid” stimulus. The other files will analyze and display the motion. Do the following steps for several different plaid stimuli

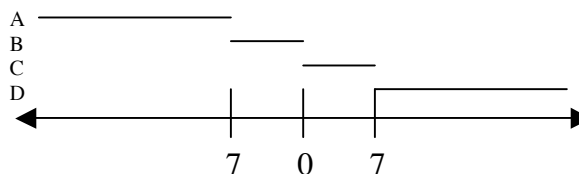
- 1) Make a movie sequence and view it
- 2) Compute the velocity likelihood for some image patch and view it
- 3) Combine the likelihood and the prior
- 4) Find the maximum a posteriori velocity

Examples of these steps are given in BayesianMotPerExample.m (except finding the maximum

The assignment:

- a) Write a function to return maximum a posteriori velocity estimates.
- b) Make a plot of “perceived” velocity (maximum a posteriori estimates) for some image patch location against 1) the contrast of the second component, and 2) size of the averaging window. Fix all other parameters at some reasonable values.
- c) For some parameter combinations, the plaid components are not combined but appear to move separately. Find a parameter set for which this is true for you and report it in your writeup. Can you explain this phenomena using the theory outlined in the paper? Briefly explain why, or if not what can be done to fix it.

2) Use Prospect Theory to analyze the following decision scenario (50%):





Minnesota wins

Iowa wins

You can make bets involving 4 different football outcomes based on a match-up between Minnesota and Iowa. A=Minnesota wins by more than 7. B=Minnesota wins by no more than 7 points. C=Iowa wins by no more than 7 points. D=Iowa wins by more than 7 points. Bookies have assigned the following payoffs for the different outcomes:

A) 10 to 1 B) 3 to 1 C) 1.5 to 1 D) 3 to 1. You have been given as an endowment 16 dollars and decide to hedge your bets by splitting the money two ways and betting on two outcomes. You must bet all the money or else you have to give it all back. Due to bookie rules, all bets come in \$4 increments with a minimum of \$4. The best expert opinion assigns the following probabilities for the four outcomes: $p(A) = 0.3$; $p(B) = 0.1$; $p(C) = 0.2$; $p(D) = 0.4$. Thus you form prospects of the form Prospect(j) = $(\$X, p(X); \$Y, p(Y))$. For example, bet \$4 on A and \$8 on C $\Rightarrow$ Prospect = $(\$40, 0.3; \$12, 0.2)$.

What is the best betting strategy someone for someone basing their decisions on cumulative prospect theory? Assume that the value of an amount of money x goes as $v^+(x) = x^\alpha$ if $x > 0$ and $v^-(x) = -\lambda(-x)^\alpha$ if $x < 0$, and assume that $\alpha = 0.88$ and $\lambda = 2.25$.

Also assume that decision weights obey:

$w(p) = a p^d / (a p^d + (1-p)^d)$, where $a = 0.76$, and $d = 0.72$ for gains and $d = 0.66$ for losses.

Think about the game, and try to decide what you would you. Try to find the best prospect. How do they compare?