U. Minn. Psy 5036
Daniel Kersten
Final project ideas

Format

Should be written like a scientific paper.

Might require most of the code to be put in appendices.

Can use modules you find elsewhere, but preserve copyrights, and reference

Will post final notebooks on the class web site.

Your "audience" will be your class peers.

Types of projects

Three broad types of projects are listed below.

Support of the scientific field, course development:

- **Develop *Mathematica* package for:**

  e.g. Pyramid image decomposition: Laplacian pyramid or wavelets

- **Develop *Mathematica* tutorial:**

  e.g. Singular value decomposition & principal components

Perceptual demonstrations

- **Motion illusions**

  e.g. stereograms, autostereograms, lightness illusions

  with interactive parameter variation

  http://viperlib.york.ac.uk/

- **Natural visual "mistakes"**

Look for everyday visual mistakes or illusions. For example, sometimes a shadow is mistaken for a pigment change, the slant of a surface is under or over-estimated, the size of an object is incorrect, or varies depending on context, ...

Use a digital camera to document these naturally occuring illusions. Find a dozen or so, classify them, and interpret them from the point of view of vision solving a computational problem.

Visual psychophysics (quantitative measurements)

- **What does the eye see best?**

E.g. Right-side up vs. upside-down faces. (*Mathematica* basic template notebook available)

- **Data analysis/report of data collected elsewhere (by you)**

OK to complement other projects, but need to clarify how the work load is divided up.

Classification images

The idea is the development of a computer program that can reveal an observer's internal perceptual template for a task.

See: http://www.journalofvision.org/2/1/introduction.html

See: Gold et al. (2000) Ringach (1998), , Olman and Kersten (2004)

Importance of the phase spectrum in visual recognition

See, Glass patterns, Barlow and Olshausen

Models of human/biological vision

Computational models

- **Machine vision: but should have discussion/comparison of relevance to human vision.**
- **Orthogonal wavelet decomposition in Mathematica**

See: http://www.cns.nyu.edu/~eero/software.html for Matlab versions, and the Imagepyramid notebook on the class webpage.

- **Bayesian edge detection**
- **Statistical analyses of images**

  e.g. Bayesian edge detector, correlational analyses, ...
- **Analyze image statistics for natural image contours**
- **Histogram matching for textures**

(e.g. Heeger, 1995)

- **Dynamic model of hand reach**

Neural network simulations

- **Biologically constrained neural network for stereo vision**
- **Neural network models**

  e.g. adaptive receptive field development, visual attention,...

Neuroimaging simulation

- **Cortical magnification**

Use function interpolation to illustrate how the retintopic map maps the visual field onto primary visual cortex.

See: http://gandalf.psych.umn.edu/~kersten/kersten-lab/demos/RetCorLogPolInt.mov

- **Linear systems analysis of cortical activity in fMRI**

E.g. Boynton et al. (1996), Engel et al. (1997)

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