Vision as Bayesian Inference

CSE 6XX, University at Buffalo SUNY

Syllabus for Spring 2008

Last updated: 19 Sept 2007

Instructor: Jason Corso (jcorso@cse)

Course Webpage: `http://www.cse.buffalo.edu/~jcorso/t/2008spring_vbi`.

Syllabus: `http://www.cse.buffalo.edu/~jcorso/t/2008spring_vbi/syllabus.pdf`.

Downloadable course material can be found on the UBLearns site.

Course Overview: The course will take an indepth look at various Bayesian methods in computer and medical vision. Through the language of Bayesian inference, the course will present a coherent view of the approaches to various key problems such as detecting objects in images, segmenting object boundaries, and recognizing objects. The course is roughly partitioned into two halves: modeling and inference. In the first half, we will cover both classical models such as weak membrance models and markov random fields as well as more recent models such as conditional random fields, latent dirichlet allocation, and topic models. In the second half, we will focus on inference algorithms. Methods will range from PDE boundary evolution algorithms such as region competition, and discrete optimization methods such as graph-cuts and graph-shifts, to stochastic optimization methods such as data-driven markov chain monte carlo. An emphasis will be placed on both the theoretical aspects of this field as well as the practical application of the models and inference algorithms.

Course Project: Each student will be required to implement a course project that is either a direct implementation of a method discussed during the semester or new research in Bayesian vision. A completed paper describing the project is required at the end of the semester (8 pages two column IEEE format) and we will have an open-house poster session to present the projects. Working project demos are suggested but not required for the poster session.

Prerequisites: It is assumed that the students have taken introductory courses in machine learning (CSE 574), pattern recognition (CSE 555), and computer vision (CSE 573). Permission of the instructor is required if these prerequisites have not been met.

Course Goals: After taking the course, the student should have a clear understanding of the state-of-the-art models and inference algorithm for solving vision problems within a Bayesian methodology. Through completing the course project, the student will also have a deep understanding of the low-level details of a particular modeol/algorithm.

Textbooks: There is unfortunately no complete textbook for this course. The required material will either be distrbuted by the instructor or found on reserve at the UB Library. Recommended textbooks are

1. Winkler, G. *Image Analysis, Random Fields and Markov Chain Monte Carlo Methods: A Mathematical Introduction*. Springer. 2006.
2. Bishop, C. M. *Pattern Recognition and Machine Learning*. Springer. 2007.

Meeting Times: TBA

Location: TBA

Office Hours: TBA

Grading: Letter grading distributed as follows:

- Discussion (20%)
- Homeworks (30%)
- Project (50%)

Programming Language: Depends on student chosen project (generally, Matlab or C/C++).

Similar Courses at Other Institutions: (incomplete and in no important order)

- Professor Alan Yuille at UCLA. *Vision as Bayesian Inference*. `http://www.stat.ucla.edu/~yuille/courses/Stat238/Stat_238.htm`
- Professor Song-Chun Zhu at UCLA. *Statistical Modeling and Learning in Vision and Image Science*. `http://www.stat.ucla.edu/%7Esczhu/Courses/UCLA/Stat_232A/Stat_232A.html`
- Professor Song-Chun Zhu at UCLA. *Statistical Computing and Inference in Vision and Image Science*. `http://www.stat.ucla.edu/%7Esczhu/Courses/UCLA/Stat_232B/Stat_232B.html`
- Professor Fei-Fei Li at Princeton. *High-Level Recognition in Computer Vision* `http://vision.cs.princeton.edu/cs598_spring07/`
- Professor Tal Arbel at McGill. *Statistical Computer Vision* `http://www.cim.mcgill.ca/~arbel/courses/626.html`
- Professor William T. Freeman at MIT. *Advances in Computer Vision: Learning and Interfaces* `http://courses.csail.mit.edu/6.869/`

Calendar

	Week	Topics and Readings	Presenter