CSE 250A. Intro to AI

Probabilistic Reasoning and Decision-Making

Welcome to CSE 250A!

“I've always considered the most boring 20 minutes of the semester the time I spend reading the syllabus on the first day of class.

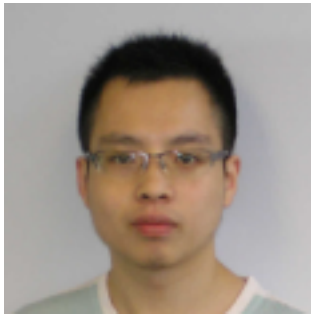
Students come in, potentially excited about getting started, only to end up listening to me read aloud.

I imagine them paraphrasing in their heads one of my favorite Woody Allen lines: Thanks, but I've been doing my own reading since about the first grade.”

http://chronicle.com/article/The-Promising-Syllabus/46748/

Teaching Assistants

- Shivani Agrawal
- Mainak Biswas
- Vamsi Cheekatimalla
- Zhanglong Ji
- Xinyue Li
- Apurva Pathak



(Bonus: you can get help in at least three different languages...)

Enrollment priority

- **CSE students**
  - MS & PhD students
  - Undergraduates
- **PhD students in other programs**
  - Bioinformatics
  - Cognitive science
  - ECE
  - Linguistics
- **MS and BS students in other programs**

http://cseweb.ucsd.edu/classes/fa16/cse250A-a/

CSE 250A. Principles of Artificial Intelligence: Probabilistic Reasoning and Decision-Making

Administrivia	Syllabus	Piazza	GradeSource

Subject

Probabilistic methods for reasoning and decision-making under uncertainty. Topics include: inference and learning in directed probabilistic graphical models; prediction and planning in Markov decision processes; applications to computer vision, robotics, speech recognition, natural language processing, and information retrieval.

Prerequisites

The course is aimed broadly at advanced undergraduates and beginning graduate students in mathematics, science, and engineering. Prerequisites are elementary probability, multivariable calculus, linear algebra, and basic programming ability in some high-level language such as C, Java, or Matlab. Programming assignments are completed in the language of the student's choice.

Relation to other courses

CSE 250a covers largely the same topics as CSE 150 (as I teach it), but at a faster pace and more advanced mathematical level. The homework assignments and exams in CSE 250A are also longer and more challenging. In general you should not take CSE 250a if you already have taken CSE 150 from me in a previous quarter.

Administrivia

1. **Instructor:** Lawrence Saul
2. **Teaching assistants (TAs):** TBA
3. **Lectures:**
   [A] Tue/Thu 11:00 am - 12:20 pm, PCYNH 106
   [B] Tue/Thu 12:30 pm - 13:50 pm, PCYNH 109
4. **TA sections:** TBA
5. **Instructor office hours:** Fri 9-10 am, Mon 9-10 am @ EBU-3B 3214
6. **Grading:** best 7 of 8 homework assignments (56%), in-class final (44%).

Textbooks

The course does not closely follow a particular text; the lectures are meant to be self-contained. Nevertheless, the following texts (though not required) may be useful as general references:

1. Artificial Intelligence: A Modern Approach (Russell & Norvig, 2010)
2. Machine Learning: A Probabilistic Perspective (Murphy, 2012)
3. Reinforcement Learning: An Introduction (Sutton & Barto, 1998)
4. Pattern Recognition and Machine Learning (Bishop, 2006)

Syllabus

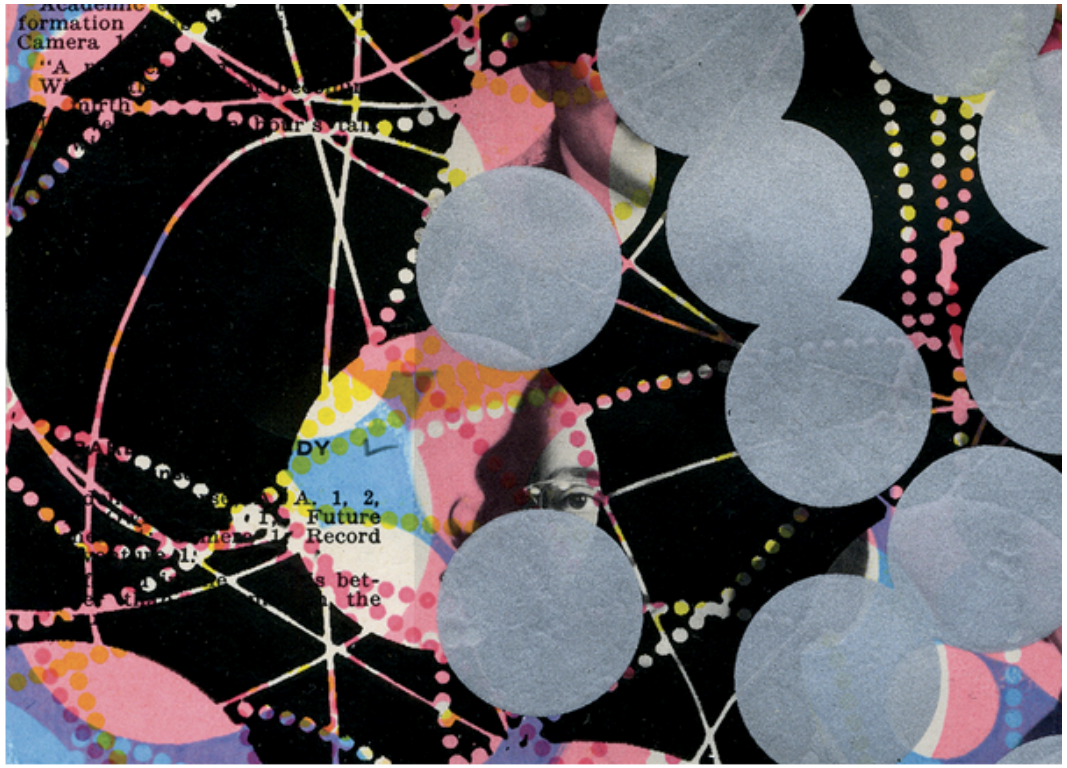
Thu Sep 22	Administrivia and course overview.	
Tue Sep 27	Modeling uncertainty, review of probability, explaining away.	HW 1 out.
Thu Sep 29	Belief networks: from probabilities to graphs.	
Tue Oct 04	Conditional independence, d-separation, polytrees.	HW 1 due. HW 2 out.
Thu Oct 06	Algorithms for exact and approximate inference.	
Tue Oct 11	Maximum likelihood estimation; Markov models of language; naive Bayes models of text.	HW 2 due. HW 3 out.
Thu Oct 13	Linear and logistic regression. Numerical optimization.	
Tue Oct 18	Latent variable modeling. Expectation-Maximization (EM) algorithm. Auxiliary functions.	HW 3 due. HW 4 out.
Thu Oct 20	EM algorithm: derivation, proof of convergence.	
Tue Oct 25	Examples of EM; applications to language modeling.	HW 4 due. HW 5 out.
Thu Oct 27	Hidden Markov models, automatic speech recognition, Viterbi algorithm.	
Tue Nov 01	Forward-backward algorithm, Gaussian mixture models, Kalman filters.	HW 5 due. HW 6 out.
Thu Nov 03	Reinforcement learning (RL), Markov decision processes.	
Tue Nov 08	Policy evaluation, policy improvement.	HW 6 due. HW 7 out.
Thu Nov 10	Policy iteration, value iteration.	
Tue Nov 15	Stochastic approximation theory, temporal difference prediction.	HW 7 due. HW 8 out.
Thu Nov 17	Q-learning, extensions of RL.	
Tue Nov 22	Bonus topic (if time).	HW 8 due.
Thu Nov 24	**Thanksgiving Holiday**	
Tue Nov 29	Final exam: part one (in-class)	
Thu Dec 01	Final exam: part two (in-class)	

Who uses probabilistic methods in AI and ML?

- **Search & Ads** – Google, Microsoft, Yahoo
- **Sales & Recommendations** – Amazon, Etsy
- **Social media** – Facebook, Twitter, LinkedIn
- **Gaming & HCI** – XBox, Wii
- **Forensics & signal analysis** – FBI, NSA
- **Data science & analytics**

"Every company is a data company."

Harvard
Business
Review



DATA

Data Scientist: The Sexiest Job of the 21st Century

Not in CSE 250A

- Things we won't cover
  - Mathematical logic
  - Traditional search (A*)
  - Theorem proving
  - Genetic algorithms
  - Philosophy of AI

Prerequisites

- **Programming**
  - **Homeworks will involve coding.**
  - **Also: basic data analysis and visualization.**
  - **Solutions accepted in any language!**
  - **Python, MATLAB, C/C++, Java, etc.**
  - **No hand-holding with compiling, debugging.**

Non-CS backgrounds are welcome.

Prerequisites

- **Elementary probability**
  - Random variables
  - Expected values
- **Multivariable calculus**
  - Chain rule
  - Gradients and partial derivatives
  - Computing maxima and minima
  - Constrained optimization
  - Lagrange multipliers

Prerequisites

- **Linear algebra**
  - **Vectors and matrices**
  - **Matrix multiplication, inverse, determinants**
  - **Systems of linear equations**
- **Mathematical maturity**
  - **Patience and persistence**
  - **Willingness to fill in gaps**
  - **Not for “hackers”**

Readings versus lectures

- **Readings**
  - No required texts.
  - Some handouts (on Piazza).
- **Lectures**
  - Designed to be self-contained.
  - Crucial for homework assignments.
  - Emphasis on mathematical development.
  - Blackboard, not powerpoint!

Grading

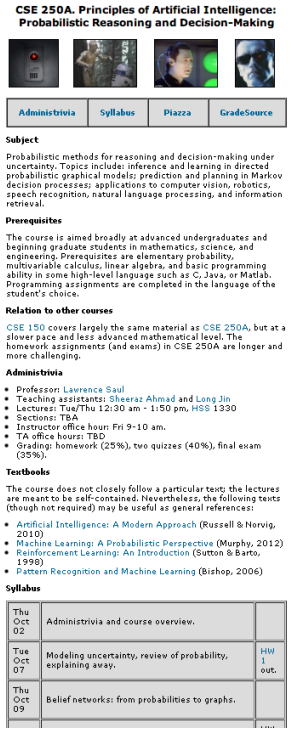
- **Breakdown**
  - 56% problem sets (best 7 of 8)
  - 44% in-class final (last week)
- **Academic dishonesty**
  - Neither ethical nor in your self-interest.
  - Always credit your sources.
  - Plagiarism is severely punished.
  - **Remember:** there are three students who want to take this class for every two that get in.

Homework

- **Weekly problem sets**
  - **Distributed on Tuesdays**
  - **Due on Tuesdays in class (not by email)**
- **Rules of the game**
  - **No extensions**
  - **Okay to work in groups**
  - **Write up your own solutions**
  - **Typesetting okay but not expected**

Online resources

- **Web page**
  - Syllabus, office hours, etc.
  - Not much else
- **Piazza**
  - Homework assignments
  - Q/A forums
  - Available soon
- **GradeSource**
  - You will receive a GradeSource ID after HW #1.
  - It is your responsibility to check grades.



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Relation to other courses

CSE 150 covers largely the same material as CSE 250A, but at a slower pace and less advanced mathematical level. The homework assignments (and exams) in CSE 250A are longer and more challenging.

Administrivia

- Professor: Lawrence Saul
- Teaching assistants: Sheeraz Ahmad and Long Jin
- Lectures: Tue/Thu 12:30 am - 1:50 pm, HSS 1330
- Sections: TBA
- Instructor office hour: Fri 9-10 am.
- TA office hours: TBD
- Grading: homework (25%), two quizzes (40%), final exam (35%).

Textbooks

The course does not closely follow a particular text; the lectures are meant to be self-contained. Nevertheless, the following texts (though not required) may be useful as general references:

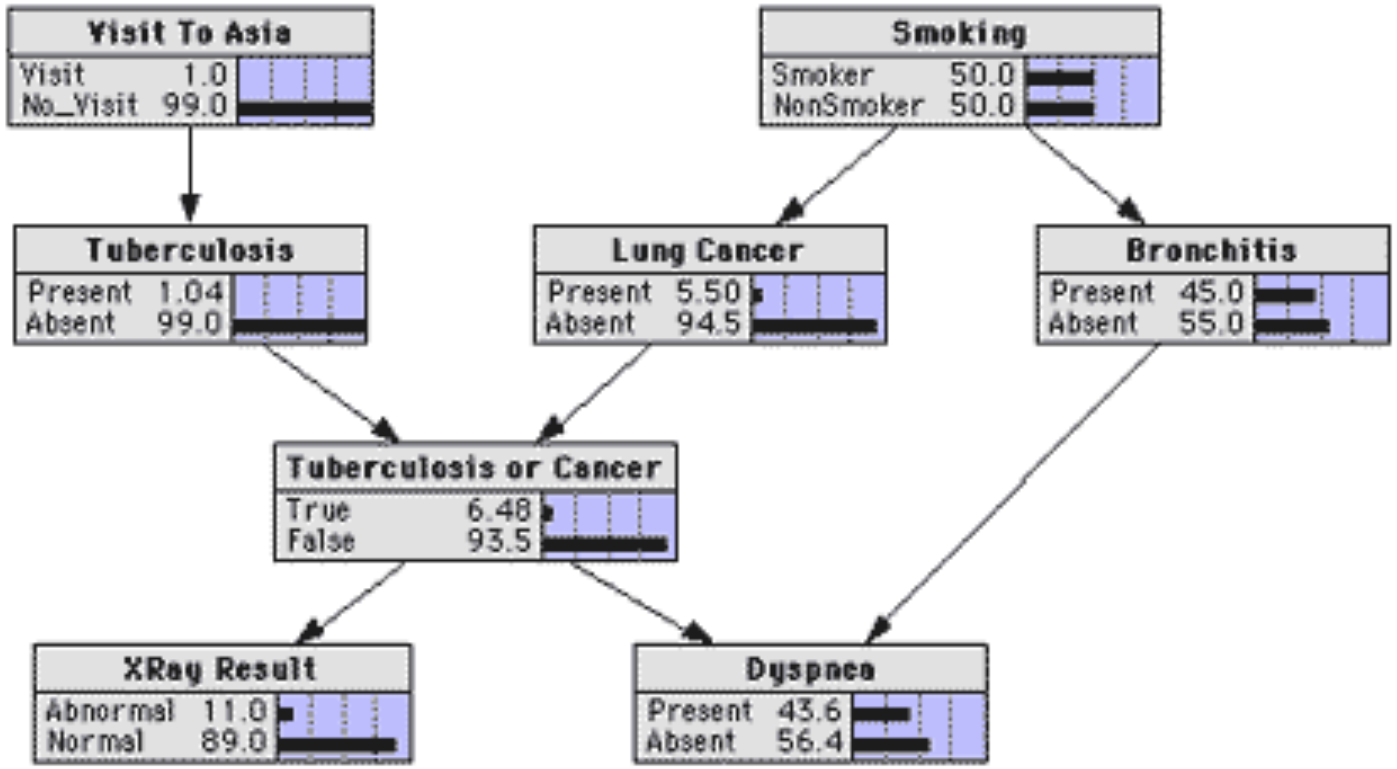
- Artificial Intelligence: A Modern Approach (Russell & Norvig, 2010)
- Machine Learning: A Probabilistic Perspective (Murphy, 2012)
- Reinforcement Learning: An Introduction (Sutton & Barto, 1998)
- Pattern Recognition and Machine Learning (Bishop, 2006)

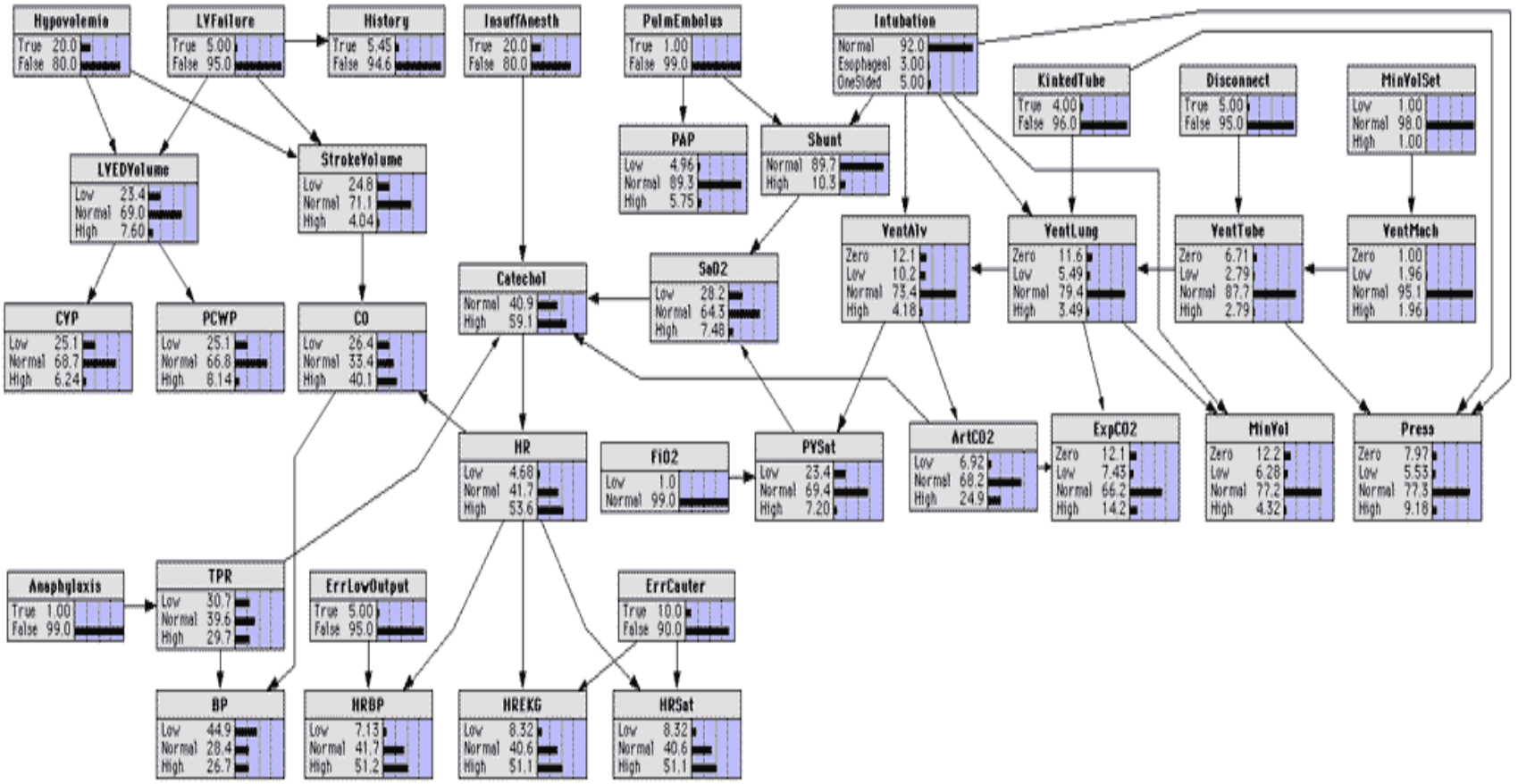
Syllabus

Thu Oct 02	Administrivia and course overview.	
Tue Oct 07	Modeling uncertainty, review of probability, explaining away.	HW 1 out.
Thu Oct 09	Belief networks: from probabilities to graphs.	

Medical diagnosis

(http://www.norsys.com/net_library.htm)



Medical diagnosis

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