

CS 5804: Introduction to Artificial Intelligence

Graduate level course in AI with coverage of search, knowledge representation and reasoning, machine learning (paradigms, models, and algorithms), use of knowledge in learning, and AI applications. The emphasis of the course is on recent developments in AI (i.e., beyond monkeys and bananas), especially contributions that forged novel connections among diverse areas, or addressed problems of significant impact. I have had to make some tough calls in deciding which material to include (exclude), so the course is not intended to be comprehensive. The goal is to emphasize certain thematic issues that recur in AI systems and applications.

Meeting Times	MWF 9:05-9:55am, McBryde 218
Instructor	Naren Ramakrishnan, 1-8451, McBryde 629 naren@cs.vt.edu, http://www.cs.vt.edu/~ramakris
Office Hours	Mondays 1-3pm, Tuesdays 10am-12pm, or walk in any time.
Teaching Assistant	Kibum Kim, 1-7985, McBryde 133 A1 kikim@vt.edu
Office Hours	Thursdays, Fridays 1:30-3:30pm.
Listserv	CS5804_15137@listserv.vt.edu (yes, the name is rather long winded.)
Course Web Page	http://courses.cs.vt.edu/~cs5804

If you are unable to make the above times and need to meet with us, you can setup an alternative time via email. If you need adaptations or accommodations because of a disability (learning disability, attention deficit disorder, psychological, or physical), if you have emergency medical information to share with the instructor, or if you need special arrangements in case the building must be evacuated, please meet with the instructor ASAP.

Pre-requisites: There are really no formal pre-requisites beyond graduate student standing. You are expected to have basic knowledge of probability, statistics, must have taken undergraduate courses in CS theory (algorithms, NP-completeness), and must not be averse to math. Knowledge of propositional and predicate logic or experience with PROLOG will be beneficial. I do not expect that you have taken an undergraduate course in AI.

Evaluation: There will be 8 homeworks, which will involve a mix of theoretical problems, programming assignments, and questions that will focus on your (surprise!) writing skills. The topical content of the programming assignments will usually be language-independent, so you will be free to use your favorite platform/language. No late submissions will be accepted. There will be a midterm exam and a final (both closed book and closed notes). Detailed breakdown: homeworks (50%), midterm exam (20%), final (30%).

All homeworks are designed by the instructor. In addition, the instructor grades both the exams individually. The homeworks are graded by the teaching assistant. If you have an exam or homework that you feel has been graded incorrectly, please contact us, and we can discuss a re-grading if appropriate.

Keeping in Touch: Please use the listserv actively for discussions and exchanging ideas. Since it is created automatically by a central university system, any student registered in CS 5804 will be

added to the mailing list. If you do not receive a test mail from the instructor by the end of the first week of classes, ensure that your email address is properly recorded in the university system.

Workload: The course moves at a very fast pace! I assume that this is your most intensive course this semester and that you relish 2-3 sleepless nights per week (I did, when I was a graduate student). Most assignments involve a fair amount of design, so plan your schedule accordingly.

Electronic Accounts and Programming: You are expected to have accounts on the graduate lab network in McBryde Hall or some other equivalent facility. Familiarity with high-level programming is expected, in an operating system of your choice. You are also expected to be a good coder, and to choose appropriate data structures and algorithm design strategies. Programs in AI can get unwieldy and sound choice of data structures can be useful in completing the homeworks.

Book: There is really no textbook that covers all relevant themes in the required detail. Being graduate students, you are expected to be able to cull ideas from research papers and form your own conceptual model of what modern AI is about. In short, no babysitting. Still, Russell and Norvig's *AIMA* is a classic book in coverage and will help you to keep track of the larger picture. We will follow a suggested sequence from the book and at periodic times, drill down into research literature to understand ideas in detail. We will also briefly use the book *Reinforcement Learning: An Introduction*, by Sutton and Barto. You do not have to buy this book as relevant material is web accessible and/or will be given as handouts. The formal list of readings (this is bound to change in the future) is:

AIMA S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, Upper Saddle River, NJ, 1995.

RL R.S. Sutton and A.G. Barto, *Reinforcement Learning*, MIT Press, 1998.

P1 V. Kumar, Algorithms for Constraint Satisfaction: A Survey, *AI Magazine*, Vol. 13, No. 1, pages 32-44, Spring 1992.

P2 B. Selman, H. Levesque, and D. Mitchell, A New Method for Solving Hard Satisfiability Problems, in *Proceedings of the Tenth National Conference on Artificial Intelligence (AAAI'92)*, pages 440-446, July 1992.

P3 G. Tesauro, Temporal Difference Learning and TD-Gammon, *Communications of the ACM*, Vol. 38, No. 3, pages 58-68, March 1995.

P4 W. Zhang and T.G. Dietterich, A Reinforcement Learning Approach to Job-Shop Scheduling, in *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence*, pages 1114-1120, 1995.

P5 D. Subramanian, P. Druschel, and J. Chen, Ants and Reinforcement Learning: A Case Study in Routing in Dynamic Networks, In *Proceedings of the Fifteenth International Joint Conference on Artificial Intelligence*, pages 832-839, 1997.

(These papers are linked in from the course web page. Please stay tuned to the course web page for the latest version!)

Outline of Lectures

<i>Date</i>	<i>Topic</i>	<i>Text</i>	<i>Assignments</i>
Jan 14	Introduction, Overview	AIMA (Chap 1)	
16	Intelligent Agents	AIMA (Chap 2)	
18	Problem Space Representations	AIMA (Chap 3)	
21	Uninformed Search Methods	AIMA (Chap 3)	
23	Informed Search Methods	AIMA (Chap 4)	
25	Heuristics	AIMA (Chap 4)	HW1 out
28	CSPs	P1	
30	CSPs (contd.)	P1	
Feb 1	GSAT, WalkSAT	P2 + AIMA (Chap 6)	HW1 due; HW2 out
4	Logic-based Reasoning	AIMA (Chap 7, 8)	
6	Inference Systems	AIMA (Chap 9, 10)	
8	Inference Systems (contd.)	AIMA (Chap 9,10)	HW2 due
11	Learning, Version Spaces	AIMA (Chap 18)	
13	Rectangle PAC-Learning		
15	Learning Descriptions	AIMA (Chap 18)	HW3 out
18			
20	Bayesian Classification		
22	Neural Networks	AIMA (Chap 19)	HW3 due; HW4 out
25	Neural Networks (contd.)	AIMA (Chap 19)	
27	Representational Choices		
Mar 1	Representational Choices		HW4 due
11	Midterm Exam		
13	The RL Problem	RL (Chap 1)	
15	Utility 101	AIMA (Chap 16)	
18	Learning to Act	RL (Chap 2)	
20	MDPs	RL (Chap 3)	
22	Dynamic Programming	RL (Chap 4)	HW5 out
25	Temporal Differencing	RL (Chap 6)	
27	Monte Carlo and TD		
29	Generalization with RL	AIMA (Chap 20)	HW5 due; HW6 out
Apr 1	TD-Gammon	P3	
3	Models and RL		
5	More RL Applications	P4, P5	HW6 due; HW7 out
8	EBG	AIMA (Chap 21)	
10	EBG (contd.)	AIMA (Chap 21)	
12	Relevancy	AIMA (Chap 21)	HW7 due
15	Inductive Logic Programming	AIMA (Chap 21)	
17	Inductive Logic Programming (contd.)	AIMA (Chap 21)	
19	Combo Learning		HW8 out
22	AI Applications		
24	AI Goofs		
26	AI Promises		HW8 due
29	Schedule for slippage		
May 1	Schedule for slippage		