

# CSE841 Artificial Intelligence

Dept. of Computer Science and Eng., Michigan State University

Fall, 2010

**Course web:** <http://www.cse.msu.edu/~cse841/>

**Description:** Graduate survey course in Artificial Intelligence. Types of intelligence, knowledge representation, cognitive models. Goal-based systems, heuristic search, games, deductive systems and expert systems. Computer vision, speech recognition, language understanding, robotics, learning, mental development.

**Class:** Mondays and Wednesdays, 10.20am - 11:40am, 1225 Engineering Building

**Instructor:** Juyang (John) Weng, phone: 353-4388, e-mail: [weng@cse.msu.edu](mailto:weng@cse.msu.edu),  
home page: <http://www.cse.msu.edu/~weng/>

Office: 3144 Engineering Building

Office hours: Mondays and Wednesdays 4:30pm - 5:30pm or by appointment. Emails and telephone calls are not good for asking technical questions. See me for them.

## 1 Objectives

This is a graduate course in Artificial Intelligence. Types of intelligence; learning; development; brain-mind architecture; symboloc representation; emergenet representation; knowledge representation; cognitive models; goal-based systems; heuristic search; games as environments; deductive systems and expert systems; vision; audition, touch; language understanding; robotics.

Rather than present AI as a loose collection of ideas and techniques, this course will strive to emphasize important unifying themes that occur throughout many areas of AI research. Further, to take advantages of recent exciting multidisciplinary advances in understanding and modeling the brain, we will link this unifying theme with the brain. These include:

- Many methods can be viewed as context-based searching through a space of learned experience.
- Search should be made more effective through brain's representation of learned knowledge.
- The viewpoint of an intelligent "agent" as an effective one for describing and understanding AI approaches.
- The subject of the brain and its development potentially will not only unify all the subareas of AI but also lead to wide-front breakthroughs. The realization of this potential needs multidisciplinary research by many researchers who dare to face various challenges of "muddy" tasks.

## 2 Course Materials

Text: Manuscript by J. Weng, material available online after each lecture. The class voted for this option.

## 3 Course Prerequisites

This course assumes the following perquisites:

- Programming skills in a high-level language (e.g. C or C++).
- Exposure to concepts in discrete structures, probability/statistics, and algorithmic analysis.

## 4 Weekly Course Outline

Week	Week Dates	Topics	Text Reference	Reading
1	9/1	Administrivia, introduction to AI	Ch. 1	
2	9/8	Agents and Tasks	Ch. 1	Turing*
3	9/13, 9/15	Representations	Ch. 2	Boden
4	9/20, 9/22	Autonomous Development	Ch. 3	ChineseRoom*
5	9/27, 9/29	Neurons	Sec. 4.1-4.4	McCarthy
6	10/4, 10/6	Principal Component Analysis	Sec. 4.5	Weng*
7	10/11, 10/13	Lobe Component Analysis	Sec. 4.6-4.7	Mitchell
8	10/18, 10/20	<b>Mid-Term</b> (Wednesday 10/20)	-	
9	10/25, 10/27	Properties of Representation	Ch. 5	Brooks*
10	11/01, 11/3	Dealing with space: attention	Ch. 6	Zweig
11	11/8, 11/10	Dealing with time: events	Ch. 7	Kaelbling*
12	11/15, 11/17	Perception, cognition and actions	Ch. 8	Echo
13	11/22, 11/24	Languages, communication and planning	Ch. 9	Urmson*
14	11/29, 12/01	Reinforcement learning and modulation	Ch. 10	Hofstadter
15	12/06, 12/8	Autonomous thinking and creativity	Ch. 11	

No final exam.

Chapters refer to Weng's manuscript. Readings refer to papers that you are expected to read, and write a short critique for the ones marked with \*. Note the types on the web page. Some are pdf files (readable with acroreader on any system), some are html pages. This is my best guess at the schedule, it is obviously subject to change.

## 5 Reading

### 5.1 Doing the work

Every week, you will be required to read a paper all of which is on the class web page. For the ones marked with \* in the table above, you are required to turn in a one-page (450 - 500 words) critique of the paper, due Wednesday before the class. Points will be deducted for more and fewer words. Wrong papers will be graded as zero. One page is not a lot of room. Be concise about your analysis. It should include (1) *summary* about the contribution, (2) limitations, (3) your analysis of the subject especially new perspectives. Grading is done by anonymous classmates. Never tell anybody about your ID number. Never try to know other's ID number. Violation of the above double-blind review rule will result in a zero grade. On Wednesdays when a critique is due, we will discuss the paper de jour near the end of the class. Please read these instructions on the syllabus before reading each paper and work on your critique.

Print your critique as a single page. Always start with:

Line 1: Critique < number > for <Title of the paper >

Line 2: by <Authors of the paper >

Line 3: Critique by <Your CSE841 ID number > (Do not use your name)

### 5.2 List of Papers

The ones marked with \* require critique.

1. Week 2: **Turing\***: "Computing Machinery and Intelligence"
2. Week 3: **Boden**: "Creativity and Unpredictability"
3. Week 4: **Hauser\***: "The Chinese Room Argument"

4. Week 5: **McCarthy**: “Little Thoughts of Thinking Machines”
5. Week 6: **Weng et al.\*** “Autonomous Mental Development by Robots and Animals”
6. Week 7: **Craven et al.**: “Learning to Extract Symbolic Knowledge from the World Wide Web”
7. Week 9: **Brooks\***: “Elephants don’t Play Chess”
8. Week 10: **Zweig and Russell**: “Speech Recognition with Dynamic Bayesian Nets”.
9. Week 11: **Kaelbling, Littman, Moore\***: “Reinforcement learning: A Survey”
10. Week 12: **Hraber, Jones, Forrest**: “The Ecology of Echo”
11. Week 13: **Urmson et al.\***: “Autonomous Driving in Traffic: Boss and the Urban Challenge”
12. Week 14: **Chalmers, French, Hofstadter**: “High-level Perception, Representation and Analogy, A Critique of Artificial Intelligence Methodology”

## 6 Assignments

- Assigned reading. One paper every week. One critique for each paper marked with \*.
- Homework. We will give 5 homeworks. Some require programming. You need to start at least a week early. Each of the homeworks 1 through 4 has a unit weight, Homework 5 (longer) has a weight of two units.

Week	Day	Date	Subject
2	Wed.	09/08	Critique (Turing) due.
3	Wed.	09/15	Homework 1 handed out at weekend
4	Wed.	09/22	Critique (Chinese room) due
5	Wed.	09/29	Homework 1 due at weekend, Homework 2 handed out
6	Wed.	10/06	Critique (Weng) due
7	Wed.	10/13	Homework 2 due at weekend
8	Wed.	10/20	Mid-term week; Homework 3 handed out
9	Wed.	10/27	Critique (Brooks) due
10	Wed.	11/03	Homework 3 due at weekend, Homework 4 handed out
11	Wed.	11/10	Critique (Kaelbling) due
12	Wed.	11/17	Homework 4 due at weekend, Homework 5 handed out
13	Wed.	11/24	Critique (Urmson) due
14	Wed.	12/01	Continue discussion with Weng for Homework 5, none due
15	Wed.	12/08	Homework 5 due at weekend

A hard copy of each due, including program source program, must be handed in at the beginning (not at the end) of the class on the due date. No late work is accepted. In case of documented schedule crisis (e.g., university team competition) provide formal signed documents.

## 7 Grading Policy

You will receive grades for this course based on your performance measured as follows.

- Assigned reading – 10 %.  
Totally 6 critiques.

- Assigned homework/programming – 60%.

We will have about 6 homeworks/programming assignments.

- MidTerm – 25%.

There will be an in-class mid-term exam based on the material covered in the first half of the course. The exam will consist of questions similar to the homework.

- Class Participation – 5%.

This will be based on attendance, and participation in the class discussions.

## 8 Auxiliary Resources

Here is a source list of reading material pertinent to AI. At various points during the course, you may want more detail on some particular topic. Don't forget to check for AI resources on the web (e.g. the AAAI web page etc.).

### 8.1 Some AI Books, Supplemental Readings and Journals

The following books are on reserve for this course.

- *Artificial Intelligence* by Russell and Norvig, Prentice-Hall, 2010 (3rd edition).
- *Handbook of AI*, Paul Cohen and Ed Feigenbaum (editors), published by Kaufmann. (in reserve collection).
- *Artificial Intelligence*, 3rd edition, by Pat Winston, Addison Wesley.
- *Pattern Classification*, 2nd edition, by Duda, Hart, and Stork, Wiley.
- *Essentials of AI*, Matt Ginsberg, Morgan Kaufmann.
- *An Introduction to Genetic Algorithms*, M. Mitchell, MIT Press. (Supplemental reading for genetic algorithms.)
- *Rethinking Innateness: A Connectionist Perspective on Development*, J.L. Elman and E. A. Bates and M. H. Johnson and A. Karmiloff-Smith and D. Parisi and K. Plunkett, MIT Press. (Supplemental reading for mental development.)
- *Artificial Intelligence journal*, Elsevier press. (A leading AI journal).
- *AMD Newsletters*, the publication of the IEEE CIS AMD Technical Committee. <http://www.cse.msu.edu/amdtc/amdnl/>
- *IEEE Transactions on Autonomous Mental Development*.
- Conference proceedings: AAAI, IJCAI, WCCI, IJCNN, ICDL.
- *Mental Development Repository* <http://www.mentaldev.org/>