CS 440 / ECE 448
Introduction to Artificial Intelligence
Fall 2010

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See web site for office hours

- Text:

    Artificial Intelligence: A Modern Approach
    (3rd Edition) Russell & Norvig, Prentice Hall

- Web Site:

    www.cs.illinois.edu/class/fa10/cs440/

- Newsgroup:

    class.fa10.cs440 on news.cs.illinois.edu

- All official announcements will be either in class or on the web site (or both)

Grading

- Graduate and Undergraduate graded separately

- Homework (written & MPs): ~ 25%

- In-class exercises: ~ 5%

- Midterm: ~35%
  - In class
  - October 7

- Final: ~35%
  - December 15
  - 1.25 hrs.
  - Focus primarily on material after midterm

- 4th Unit/Hour credit:
  - Significant programming project
  - Accompanying paper
  - Due last class
  - 25% of your grade

Check for conflicts now!
Let me know no later than two weeks from today of problems

Cheating

Unless specifically announced, you are expected to do each homework on your own. You may discuss concepts with your classmates, but there must be no interactions about *solutions*. You may consult the web but the work handed in must be done on your own.

The penalty for cheating on any assignment is straightforward. On the first occurrence, you will receive a zero for the assignment and your course grade will be reduced by one full letter grade. A second occurrence will result in course failure.

Homework

Unless announced in advance, solutions will be posted no sooner than two days after the due date. Homework will be accepted until that point with a penalty of 10% for any fraction of a day that it is late. No assignments will be accepted after the solutions have been posted. Late homework will only be accepted in class, during office hours, or electronically by email to the TA.

Homework regrades requests must be made within one week after the graded homework is returned (exam regrade requests must be made immediately).

About our Text

- Best available text, good but not perfect
- Assigned reading / HWs
- Also an excellent reference work
  - Overly complete; Very accurate; Usually std treatment
  - Feel free to consult other sources
  - You are responsible for integration
    Exams & homework assume accuracy of
    1) lectures 2) text 3) other sources

- Not as readable as some…
    SO ASK QUESTIONS in class!
    Expose & clear up confusions early
    Your classmates will appreciate it!!

We will assume that you

1) Attend & understand all lectures
2) Understand all assigned readings
3) Finish & understand all assignments satisfactorily

"Understand" means "can *use* knowledge productively"

Importance of concepts can be inferred from the above...

Tentative Syllabus

TOPIC	TEXT CHAPTERS	APPROX. BEGIN DATE
Introduction	1, 2, Appx.A	8/24
Models & Search	3, 4	8/26
Logic & Knowledge Rep.	7, 8, 9	9/7
Planning & Action	10	9/14
Reinforcement Learning	17, 21	9/21
Uncertainty & Statistics	13, 14	10/12
Machine Learning	18, 20	10/28
Applications	22, 24	11/18
Social/Phil. Implications	26	12/7

What you can expect from us

- What is AI?

- Why is it difficult?

- What can it do now?

- Where is it going?

Assignment:

Read Ch 3 & 4 on Search

Read Ch 1 & 2 at your leisure

Review & understand Appendix A

What is AI?

- An attempt to program computers to do things that would be said to require intelligence if done by people.

- A way to study the human mind.

- A formalization of "common sense."

- A collection of methods and approaches.

- The next step in computer user friendliness and adaptivity.

What is Intelligence?

Fast thinking?

Knowing a lot?

Pass as a smart human?

Effective reasoning?

Being able to learn?

Perceiving and acting on one's environment?

Writing poetry?

Passing an AI class?

Operational Definitions of AI

Thinking Humanly

"The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning..."

[Bellman, 1978]

Thinking Rationally

"The study of mental faculties through the use of computational models."

[Charniak & McDermott, 1985]

Acting Humanly

"The study of how to make computers do things at which, at the moment, people are better."

[Rich & Knight, 1991]

Acting Rationally

"The branch of computer science that is concerned with the automation of intelligent behavior."

[Luger & Stubblefield, 1993]

AI History

1943   McCulloch & Pitts: Boolean circuit model of brain

1950   Turing's ``Computing Machinery and Intelligence''
            the imitation game

1950s   Early AI programs, including Samuel's checkers program,

          Newell & Simon's Logic Theorist, Gelernter's Geometry Engine

1956   McCarthy organizes Dartmouth meeting and includes Minsky,

            Shannon, Newell, Samuel, Simon

         Name "Artificial Intelligence'' adopted

1957   General Problem Solver [Newell, Simon, Shaw @ CMU]

1958   Creation of the MIT AI Lab by Minsky and McCarthy

1958   LISP, [McCarthy], second high level language (MIT AI Memo 1)

1963   Creation of the Stanford AI Lab by McCarthy

1965   Robinson's complete algorithm for logical reasoning

1966-74 AI discovers computational complexity …

1966-72 Shakey, SRI's Mobile Robot [Fikes, Nilson]

AI History (Cont.)

1969   Publication of "Perceptrons" [Minsky & Papert], Neural network research almost disappears

1969-79   Early development of knowledge-based systems

1970   SHRDLU, Winograd's natural language system

1971   MACSYMA, an symbolic algebraic manipulation system

1980-88   Expert systems industry booms

1981   Japan: Fifth generation project
US: Microelectronics and Computer Technology Corp.
UK: Alvey

1988-93   Expert systems industry counters the feared "AI Winter"

1985-95   Rise of probabilistic / statistical approaches

1997   Deep Blue defeats reigning chess champion Gary Kasparov 3.5-2.5

2005   Stanley the car wins $2,000,000 DARPA Grand Challenge, autonomously driving 132 miles of dessert roads

2009   BellKor's Pragmatic Chaos wins Netflix collaborative flitering prize using ensemble ML methods.

Game Playing
Which are still interesting?

Tic Tac Toe	Never was interesting
Connect Four	Solved
Go-Moku	Solved
Qubic	Solved
Checkers	Probably solved
Othello	Much better than any human
Backgammon	Better than all but a few humans
Chess	Better than any / all but a few humans
Scrabble	Close to the best humans
Bridge	Worse than best players at local clubs
Go	Worse than the best 9 year old humans

Is Game-Playing Interesting?

Initially - "Yes"

Now - "No" *

Easy/Difficult for humans ≠ Easy/Difficult for computers
(often inverted!)

* Computational Game Theory is an important advanced topic in AI

What is Hard?

Making a bed

Walking / Running / Playing basketball

Feeding one's self

Explaining / answering questions about a picture or natural language utterance

Mixed initiative / cooperative behavior

Reasoning under uncertainty / inferring missing structure

We're so good it's often hard to see why computers are bad

Embellishment is Essential

Unbiased Interpretation is Impossible
Understanding = Bias

These people were wrong (what / why?)

John Locke:

Empiricism (esp. *Tabula Rasa*)

Gene Roddenberry:

Star Trek's Mr. Spock (too logical)

Robert Heinlein:

Fair Witness in *Stranger in a Strange Land*
 (too literal)

These Sentences are Difficult
(for computers, why?)

Newspaper headline during H1N1 flu scare:
Sick Teachers Pose a Problem

Twelve South Korean government officials were killed Friday when a bomb exploded at a wreath-laying ceremony in Rangoon, Burma.

John wanted to be chairman of his department.
He bought some arsenic.

Hard for people:
Did you hear about the taxi driver who ran over himself?

Metaphor / Hyperbole

"The shocking truth is that while record deficits are unanimously condemned, the politicians in power have not lifted one finger to balance the books."

Literal Impossibilities

Is the kettle boiling yet?

Are the cans of tuna we bought last year still palatable?

Please turn on the fish!

Similar or Different?

John drove his car to buy groceries.

John drove his sister to buy groceries.

John drove his car to commit suicide.

John drove his sister to commit suicide.

Common sense can resolve the relationship among the nouns

More common sense...

Frank hit the girl with long hair.

Did you see that woman with a glass eye?

Is it legal in Arkansas to hang a man with a moustache?

Is it good to write on an empty stomach?

Center Embedding

The mouse died.

The mouse the cat chased died.

The mouse the cat the dog bit chased died.

Garden Path Sentences

The grocery store always orders a hundred pound bags of sugar.

The horse raced past the barn fell.

Memory

Question:

Did you ever shake hands with Abraham Lincoln?

Did you ever shake hands with Barack Obama?

More Memory

Whose face is on the penny?

Vision

Vision

The lines are parallel
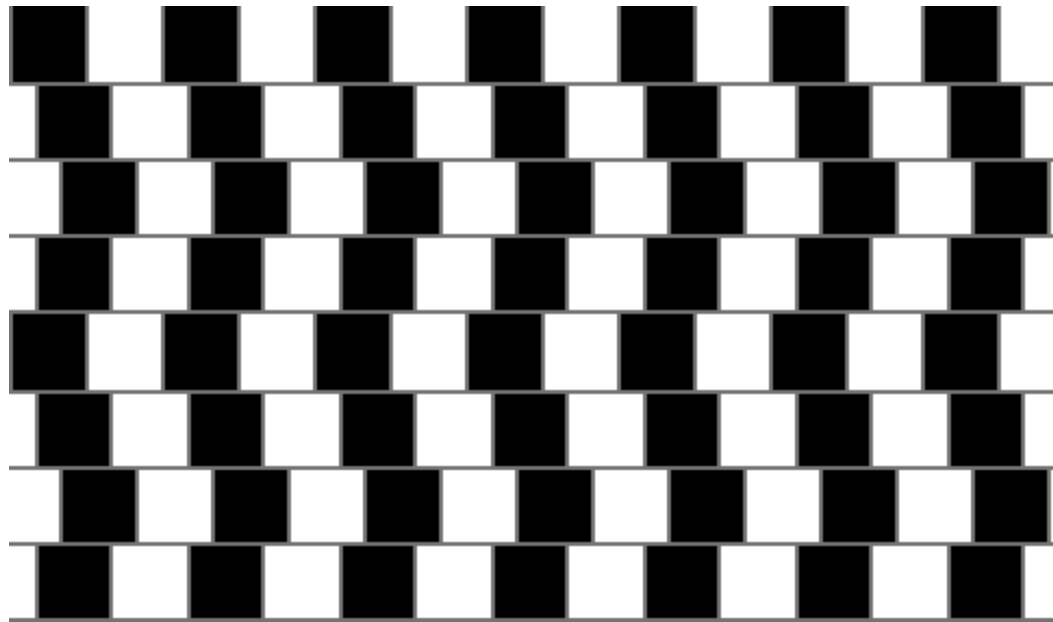
These are circles not spirals
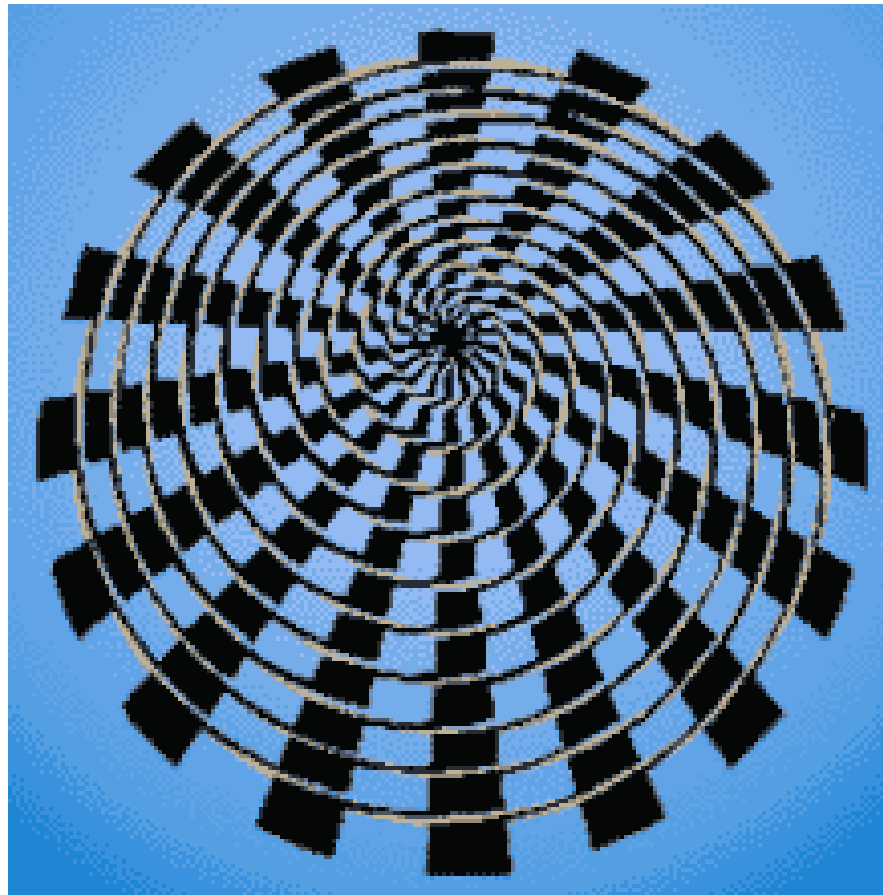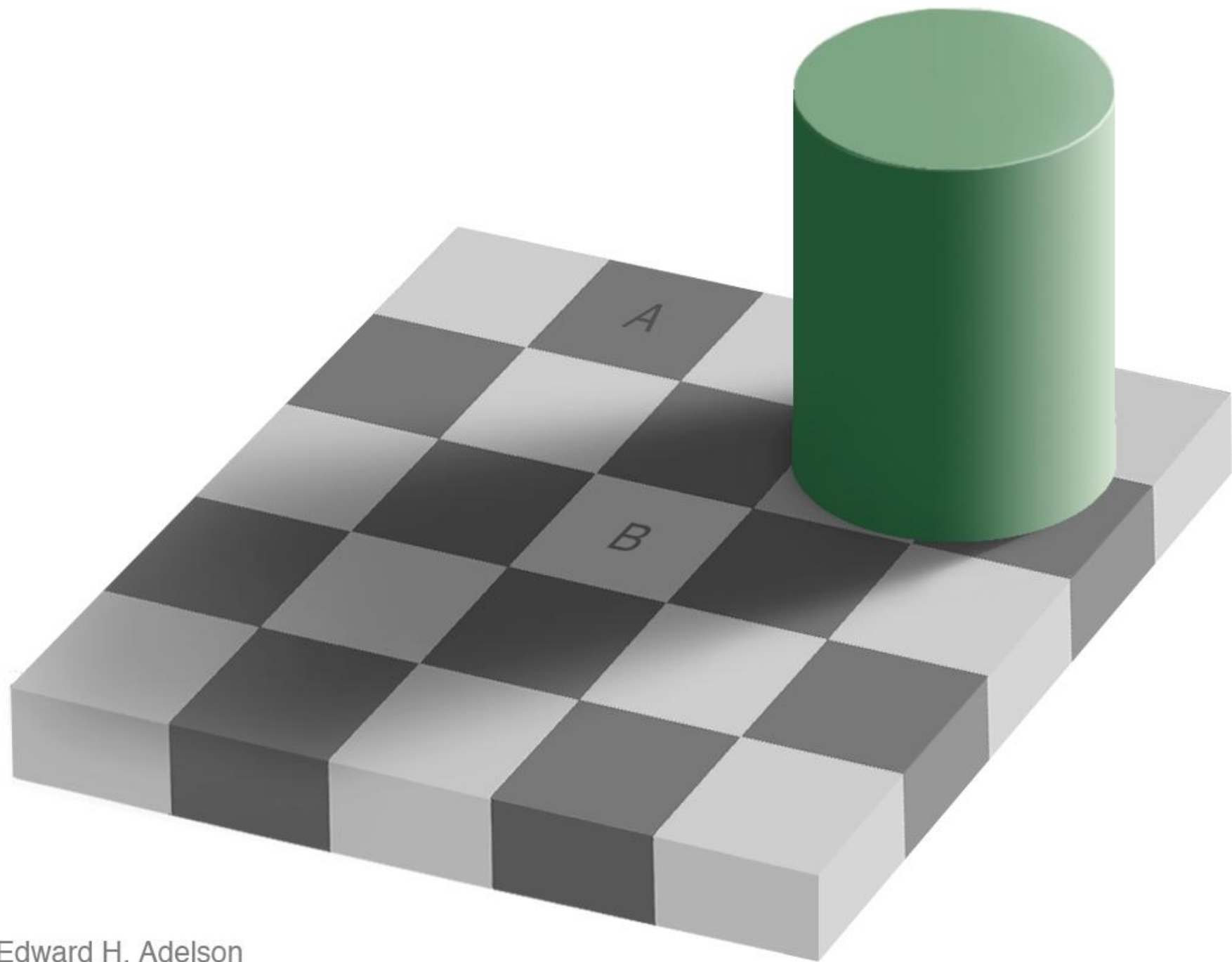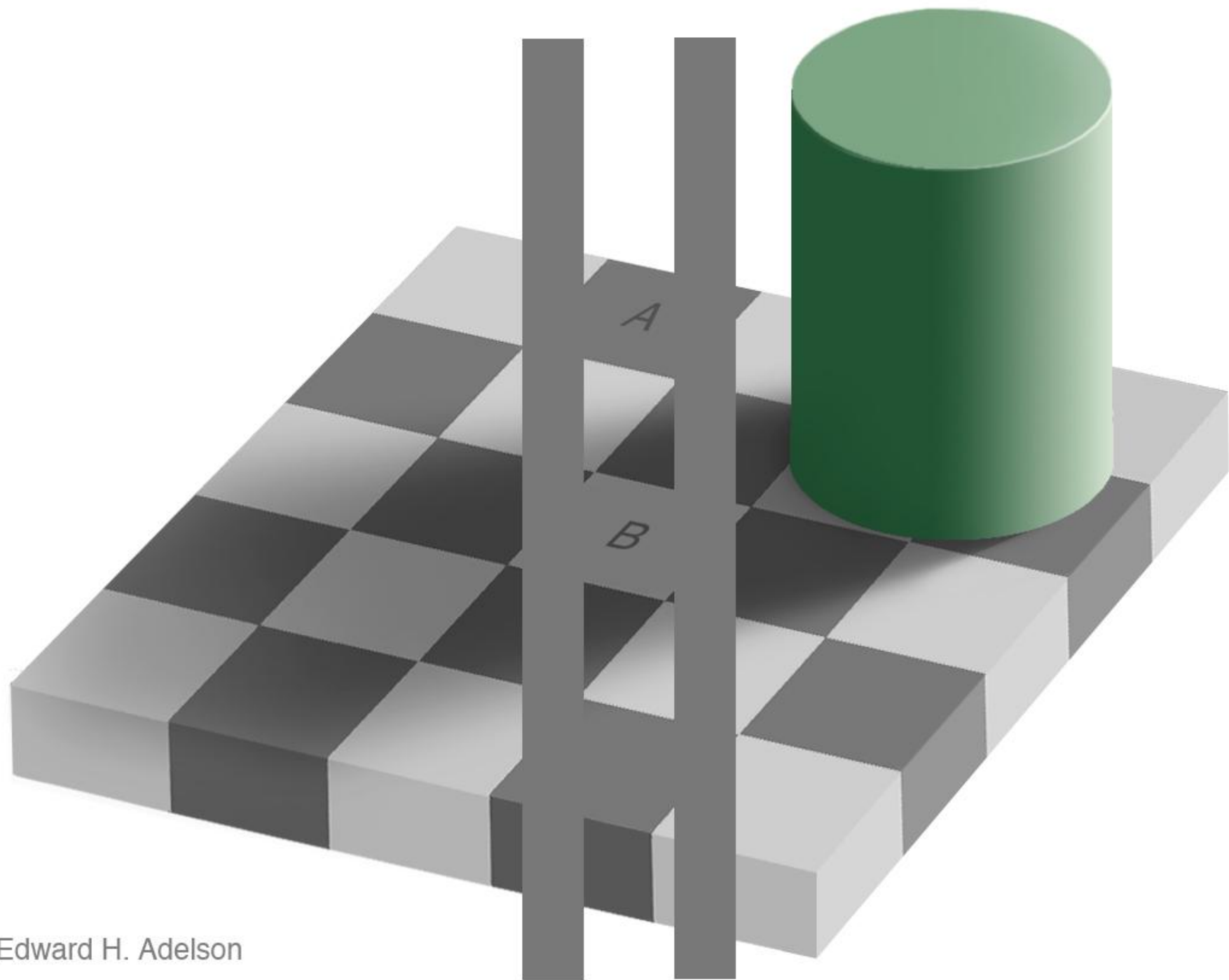
See black dots? Count them.
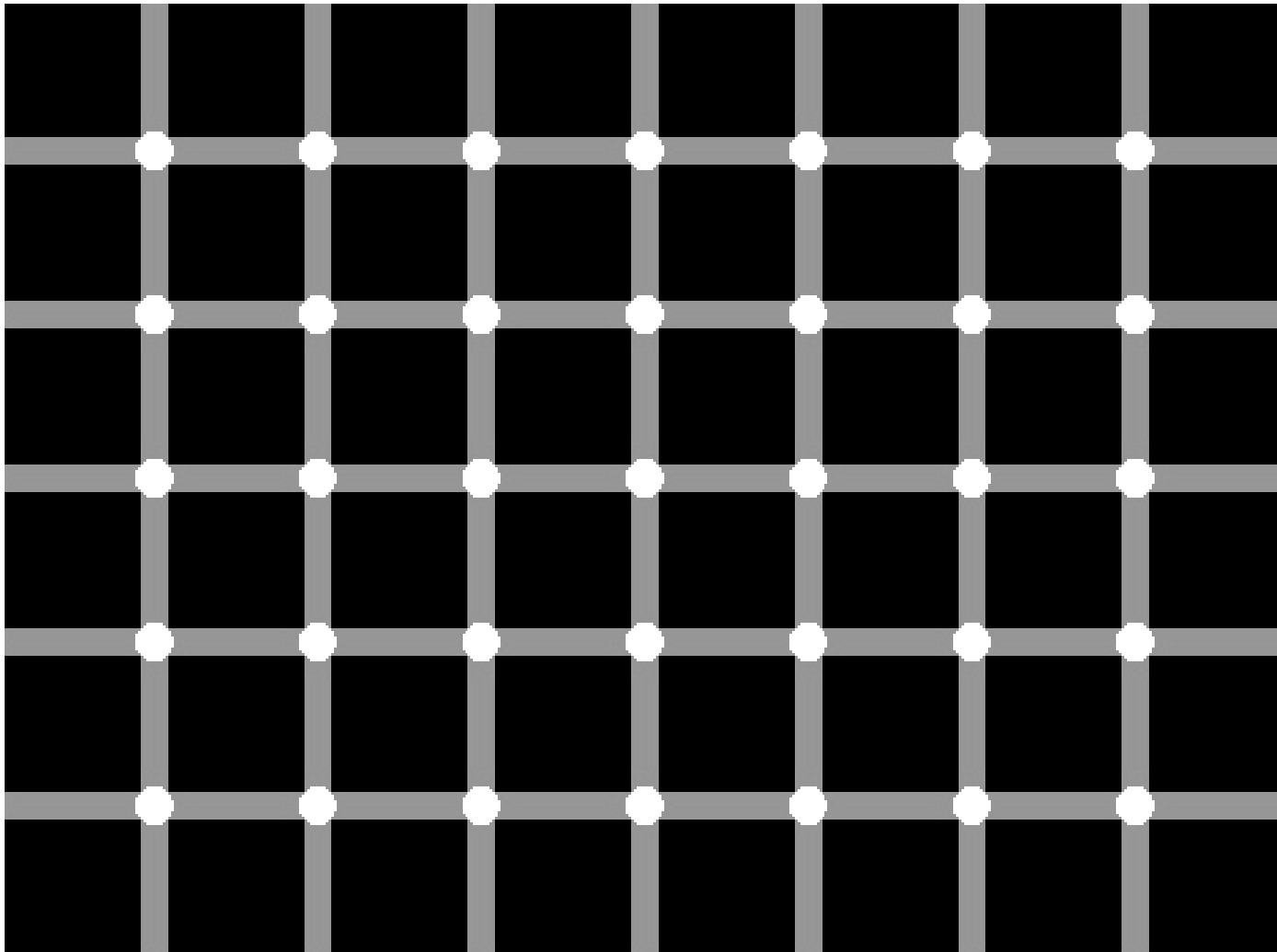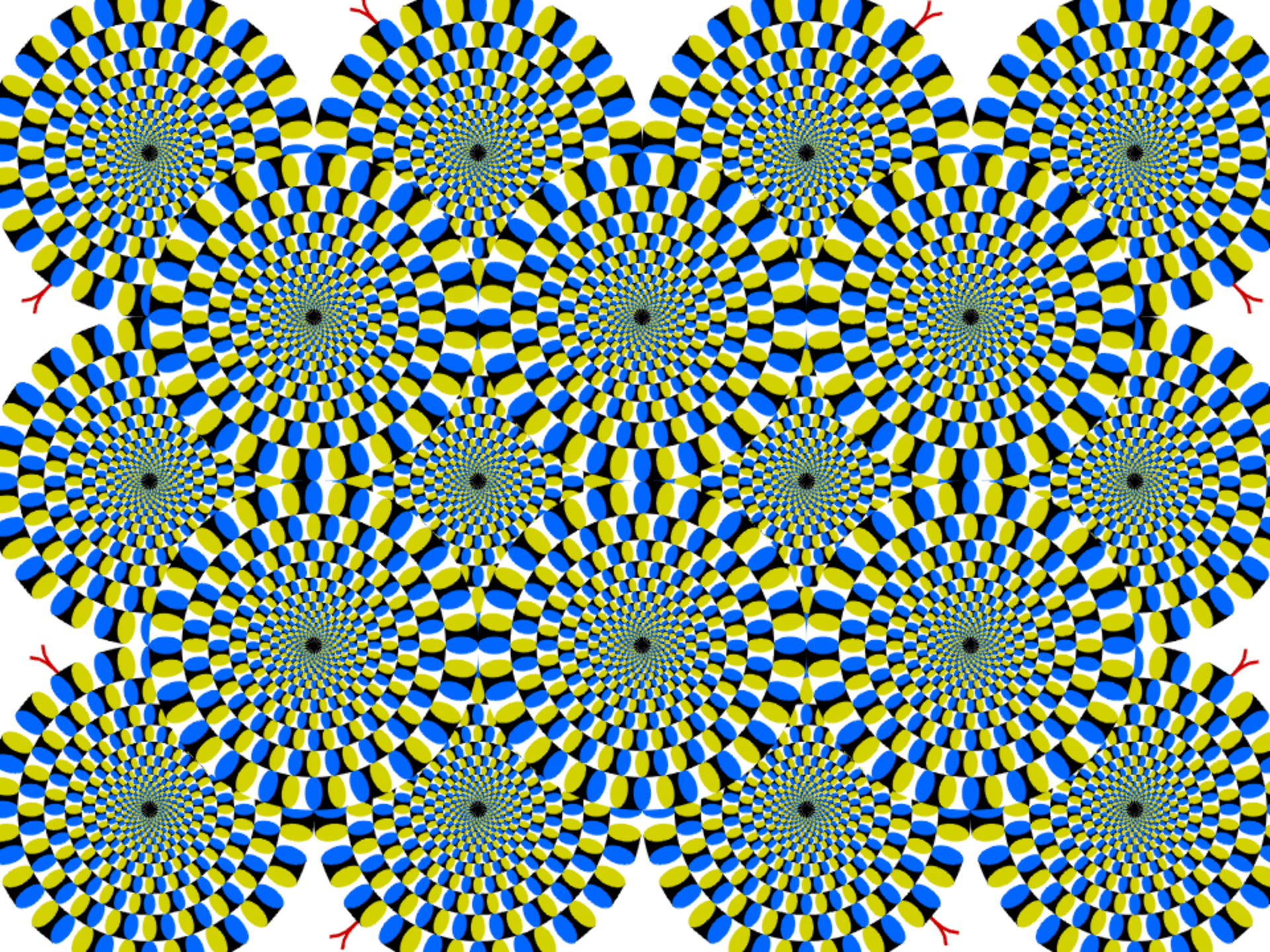
What is this?
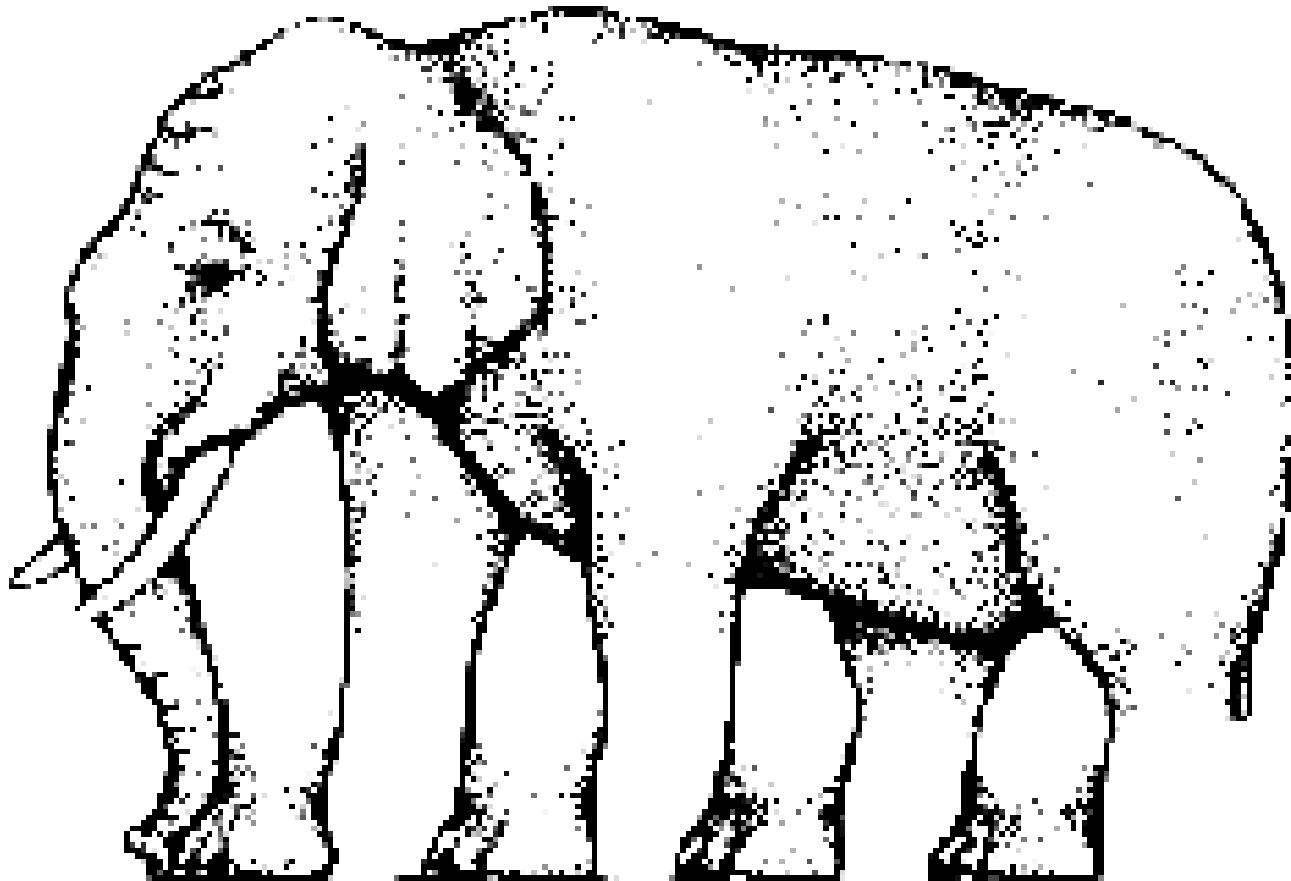
Stroop effect (1935)

Edward H. Adelson

A

B

Edward H. Adelson

AI Areas

- Machine Learning
- Knowledge Representation & Reasoning
- Planning
- Natural language processing
- Collaborative Filtering
- Bioinformatics
- Data Mining
- Diagnosis
- Vision
- Robotics
- Semantic Web

- [many more]