15-780: Graduate AI

Lecture 1. Intro & Logic

Geoff Gordon (this lecture)
Tuomas Sandholm
TAs Erik Zawadzki, Abe Othman

Admin

Website

15-780 ⊗ Graduate AI ⊗ Spring 2011

Tuesdays and Thursdays from 10:30-Noon in GHC 4307.

School of Computer Science, Carnegie Mellon University.

People

This class is taught by Professors Geoff Gordon and Tuomas Sandholm. The TAs are Abe Othman and Erik Zawadzki.

Office hours are at noon after class on Tuesday (Tuomas - GHC 9205) and Thursday (Geoff - GHC 8105). Abe and Erik have their office hours Monday at 8pm and

http://www.cs.cmu.edu/~ggordon/780/
http://www.cs.cmu.edu/~sandholm/cs15-780S11/

Website highlights

- Book: Russell and Norvig. *Artificial Intelligence: A Modern Approach*, **3rd ed.**
- Grading: 4–5 HWs, “mid”term, project
- Project: proposal, 2 interim reports, final report, poster
- Office hours
- Recitation (*when?*)

Website highlights

- *Authoritative source for readings, HWs*
- *Please check the website regularly for readings (for Lec. 1–3, Russell & Norvig Chapters 7–9)*

Background

- *Suggest familiarity with at least some of the following:*
  - *Linear algebra*
  - *Calculus*
  - *Algorithms & data structures*
  - *Complexity theory*
  - *Logic*

Waitlist, Audits

- *Audits: register, fill out audit form*
  - *Must do final project, but no HWs, tests*
- *Waitlist: if you're on it, let us know*
- *If you need us to sign something, catch us after class or in office hours*

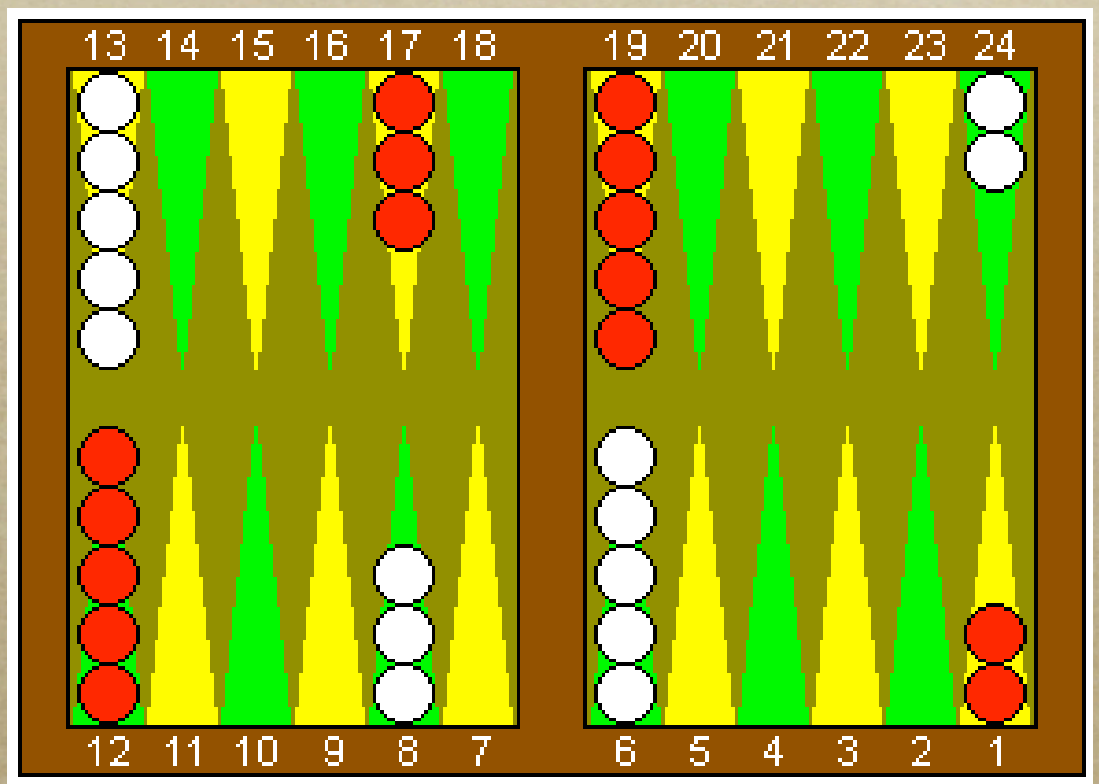
Course email list

- *15780students AT cs.cmu.edu*
- *To subscribe/unsubscribe:*
  - *email 15780students-request@…*
  - *word "help" in subject or body*
- *By the end of this week, everyone's official email should be in the list—we'll send a test message*

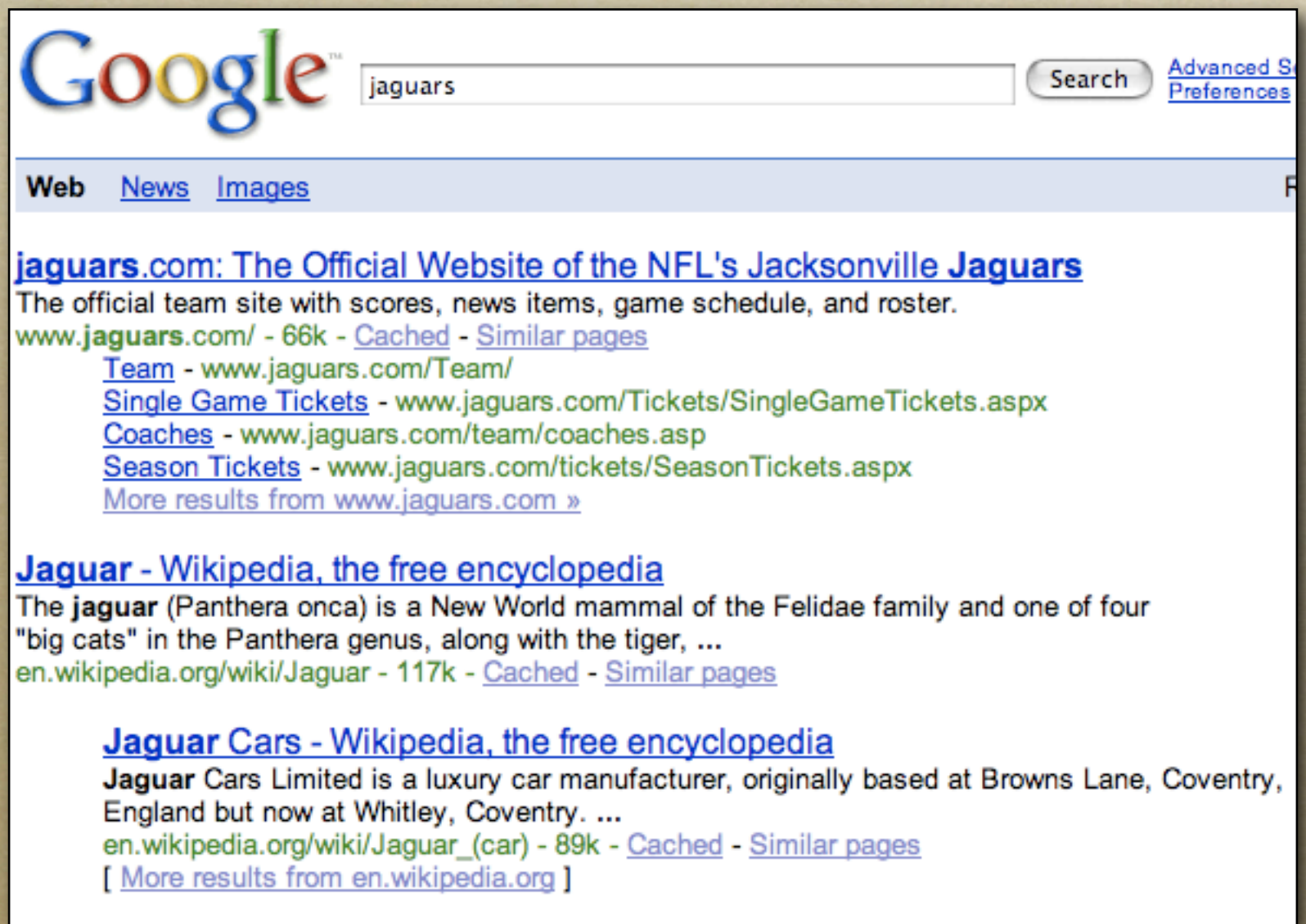
Intro

Definition by examples

- *Card games*
  - *Poker*
  - *Bridge*
- *Board games*
  - *Deep Blue*
  - *TD-Gammon*
  - *Samuels's checkers player*



Web search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jaguars.com: The Official Website of the NFL's Jacksonville Jaguars
The official team site with scores, news items, game schedule, and roster.
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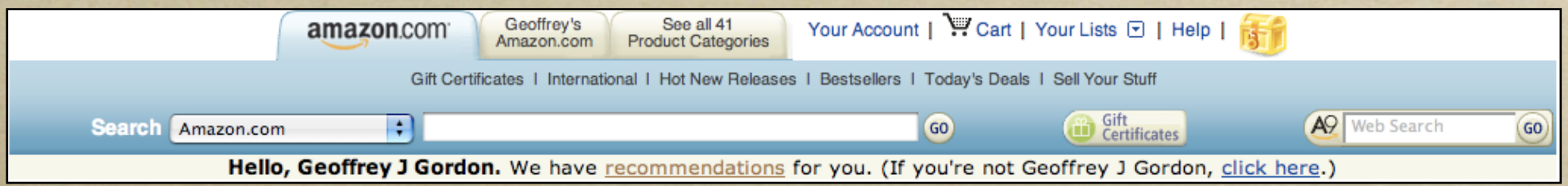
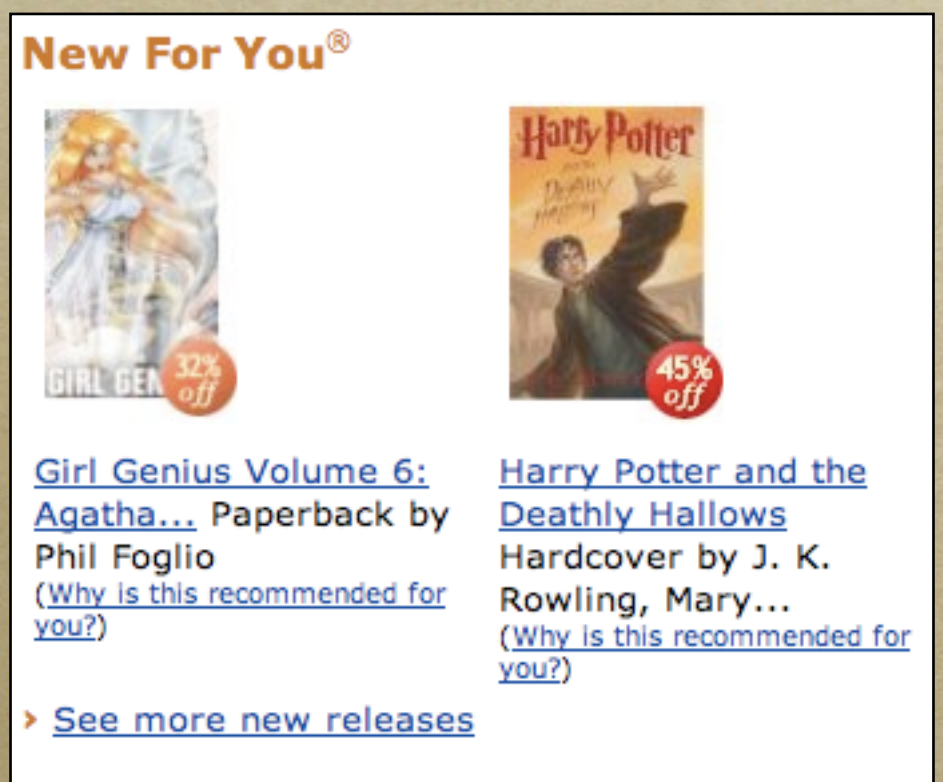
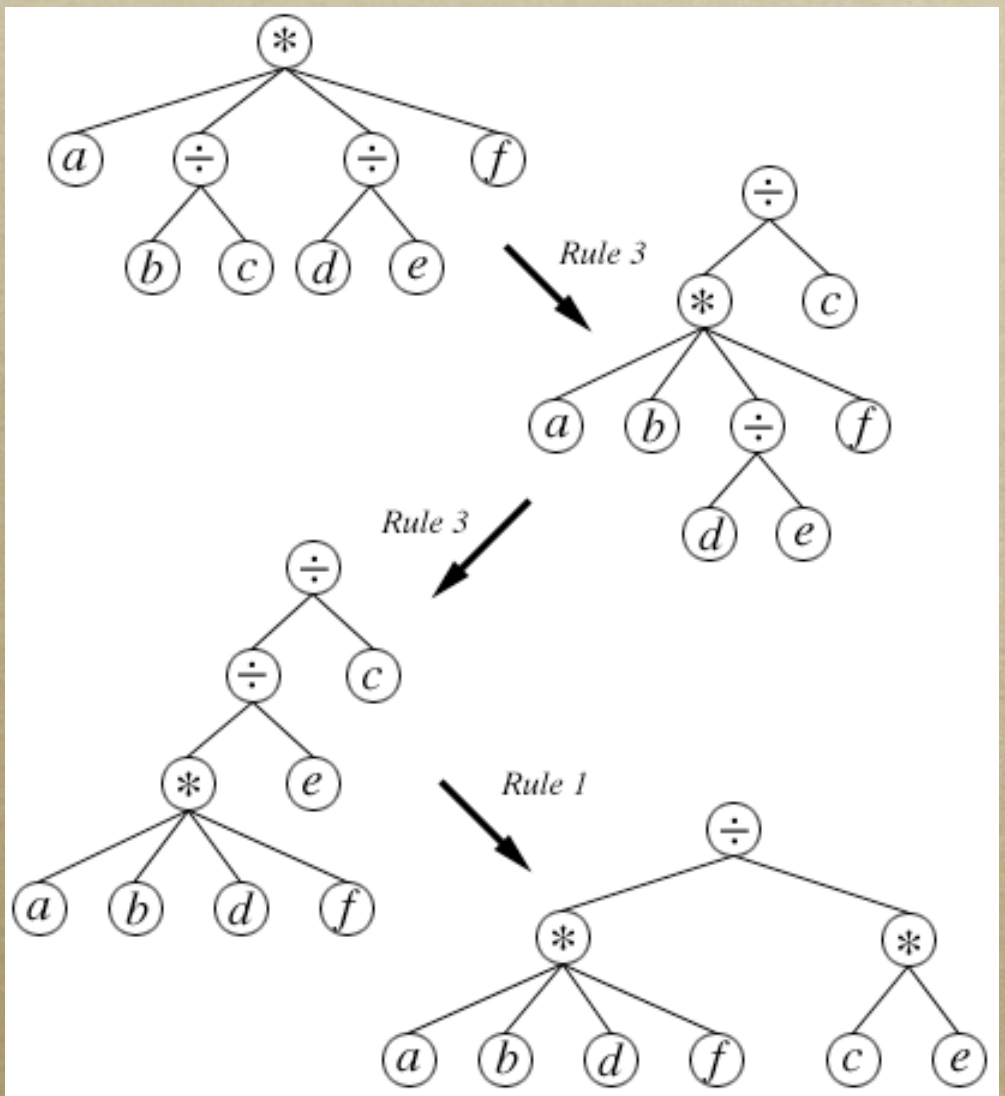
Team - www.jaguars.com/Team/
Single Game Tickets - www.jaguars.com/Tickets/SingleGameTickets.aspx
Coaches - www.jaguars.com/team/coaches.asp
Season Tickets - www.jaguars.com/tickets/SeasonTickets.aspx
More results from www.jaguars.com »
Jaguar - Wikipedia, the free encyclopedia
The jaguar (Panthera onca) is a New World mammal of the Felidae family and one of four "big cats" in the Panthera genus, along with the tiger, ...
en.wikipedia.org/wiki/Jaguar - 117k - Cached - Similar pages
Jaguar Cars - Wikipedia, the free encyclopedia
Jaguar Cars Limited is a luxury car manufacturer, originally based at Browns Lane, Coventry, England but now at Whitley, Coventry. ...
en.wikipedia.org/wiki/Jaguar_(car) - 89k - Cached - Similar pages
[More results from en.wikipedia.org]

Recommender systems





Computer algebra systems



from http://www.math.wpi.edu/IQP/BVCalcHist/calctoc.html

Grand Challenge road race

Red team: Whittaker et al
Junior: Thrun et al

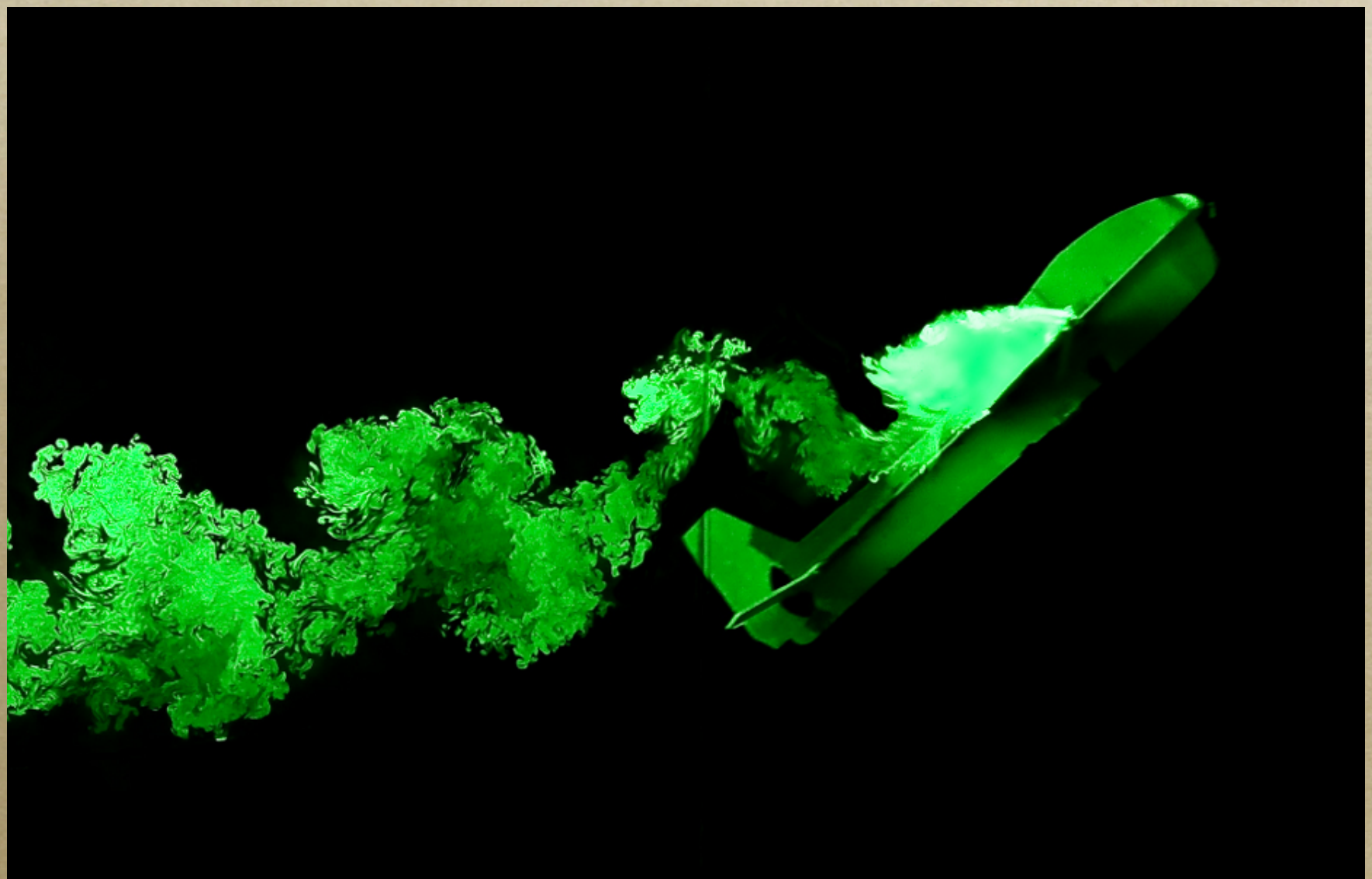
Robocup

Veloso et al

Landing a "bird"

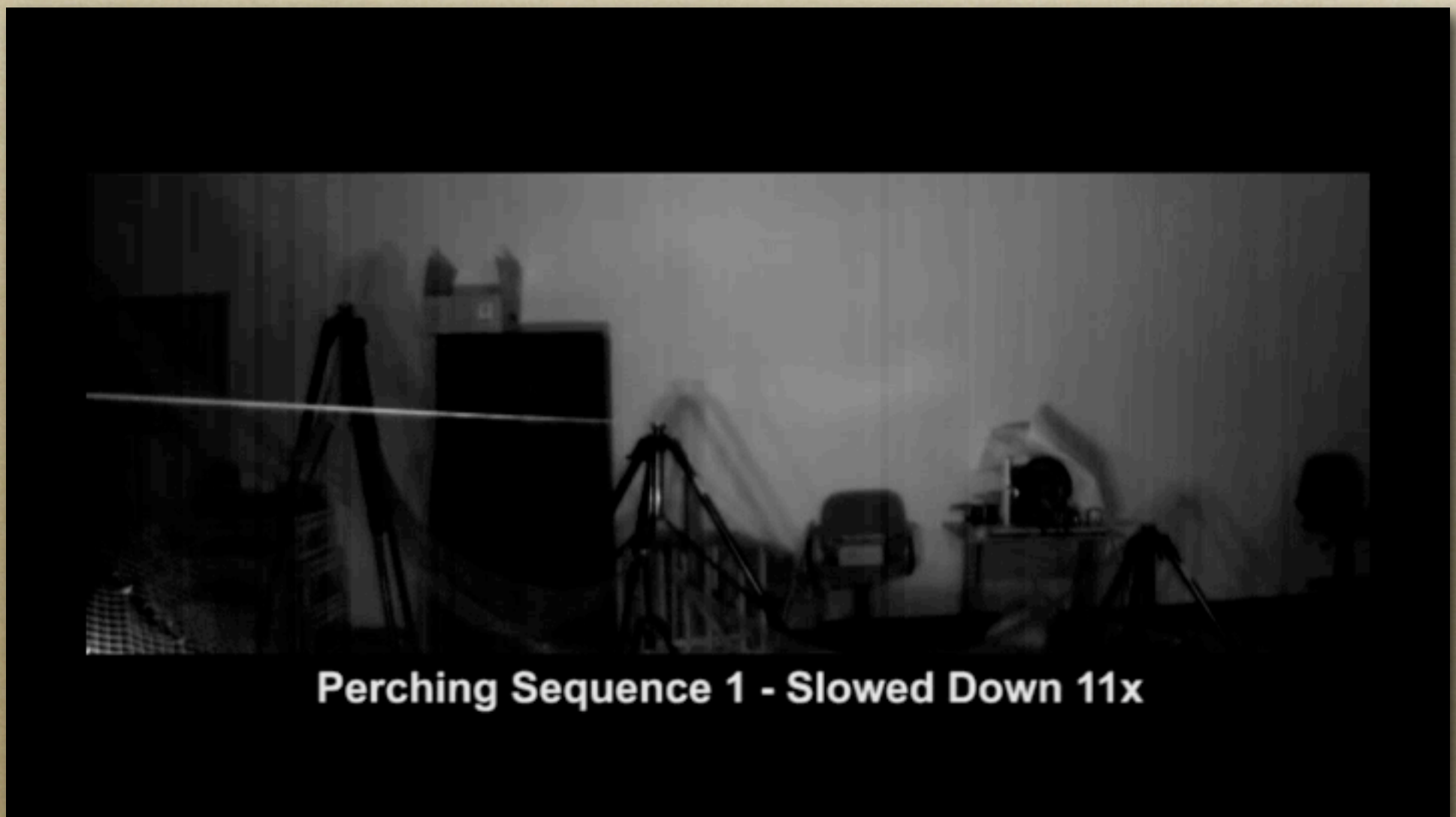
- *Standard airplane: laminar flow over wings*
  - *"easy" simulation and control problem*
- *Birds: **way** beyond performance envelope of planes* http://www.youtube.com/watch?v=LA6XSrM0V_0&feature=player_embedded
- *Secret: exploit turbulent flow (e.g., push off from vortex)*
- *But can't efficiently solve diff eqs for simulation, much less use them to plan optimal landing*

Landing a “bird”



Cory, Tedrake, et al.

Landing a “bird”

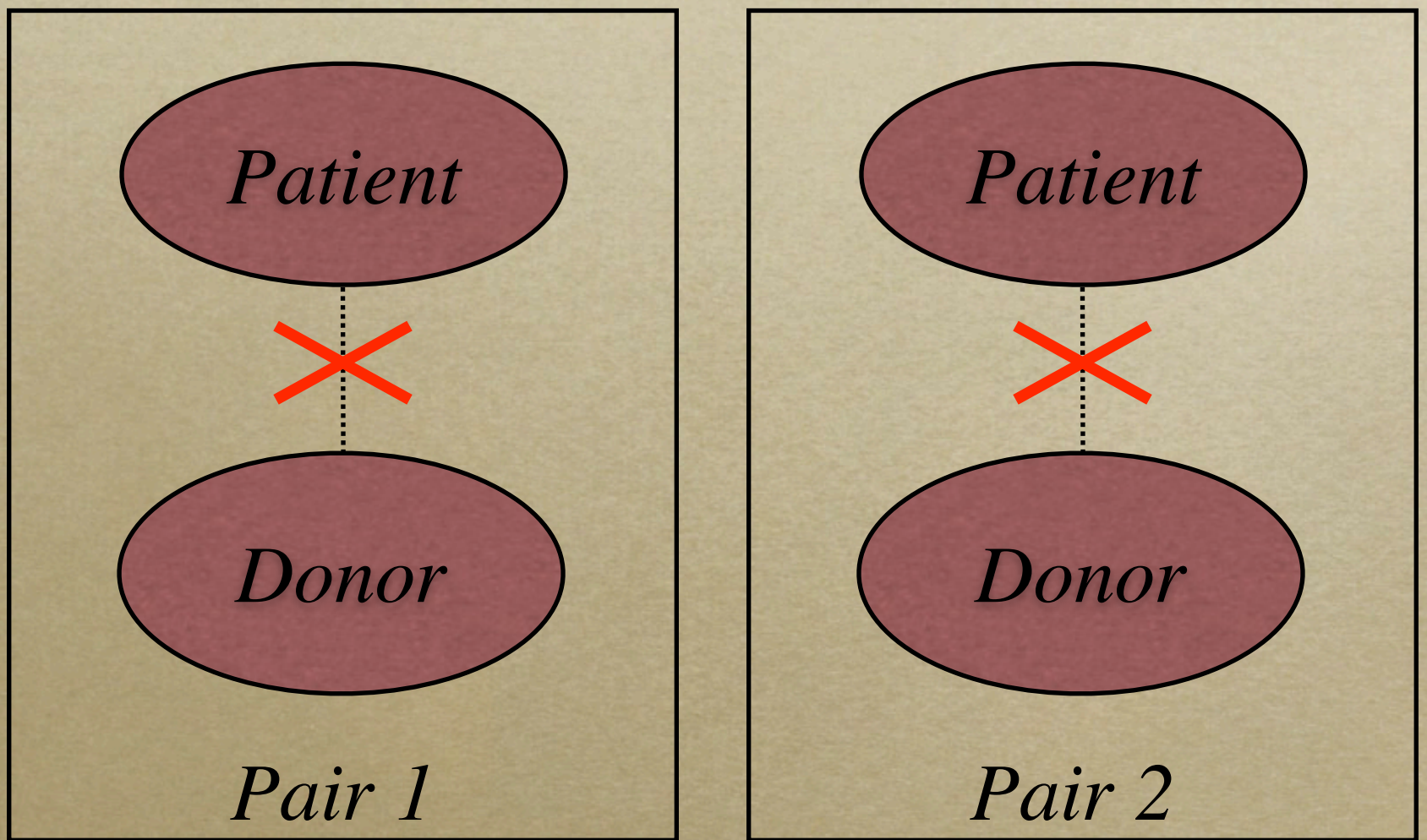


Cory, Tedrake, et al.

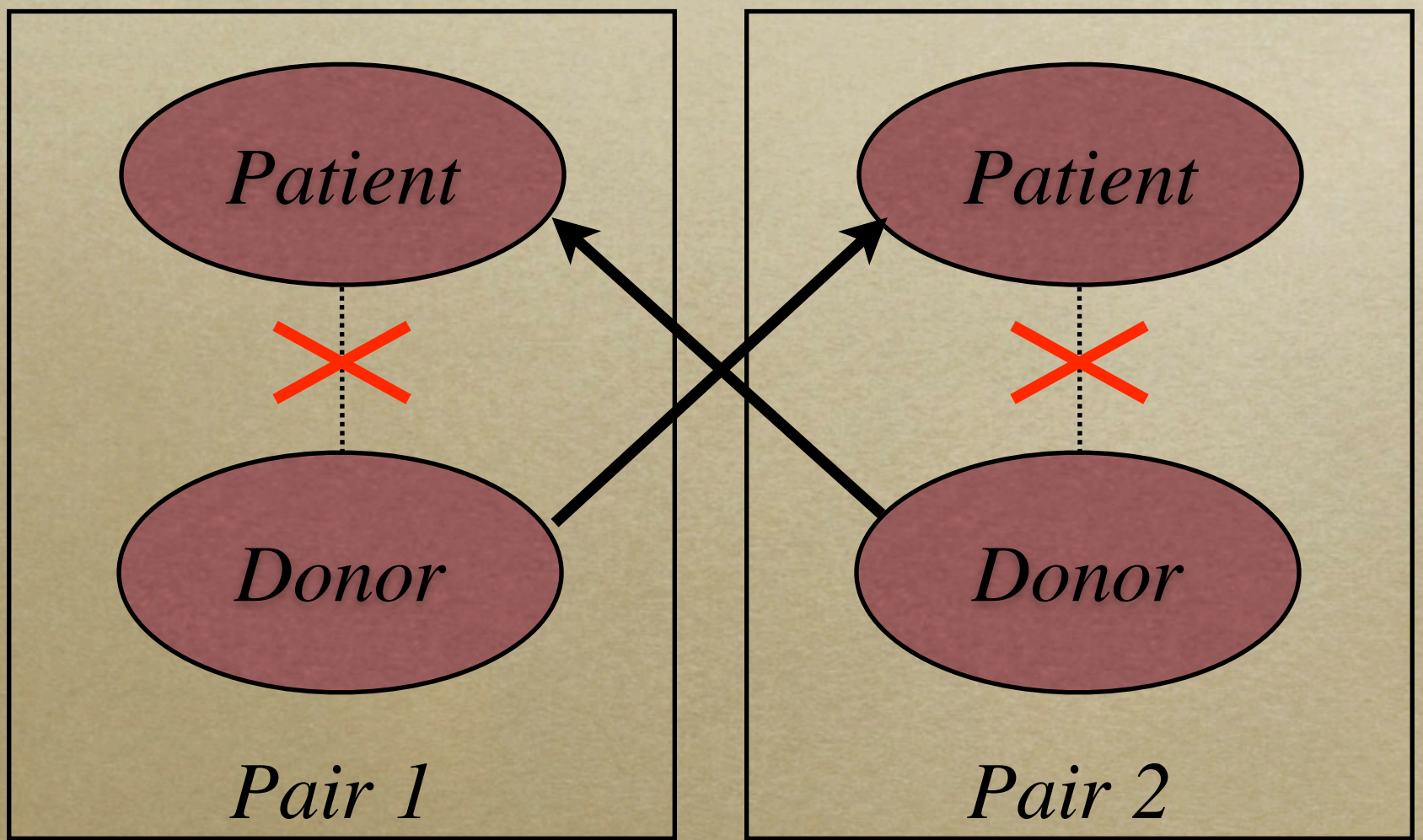
Kidney exchange

- *In US, ≥ 50,000/yr get lethal kidney disease*
- *Cure = transplant, but donor must be compatible (blood type, tissue type, etc.)*
- *Wait list for cadaver kidneys: 2–5 years*
- *Live donors: have 2 kidneys, can survive w/ 1*
- *Illegal to buy/sell, but altruists/friends/family donate*

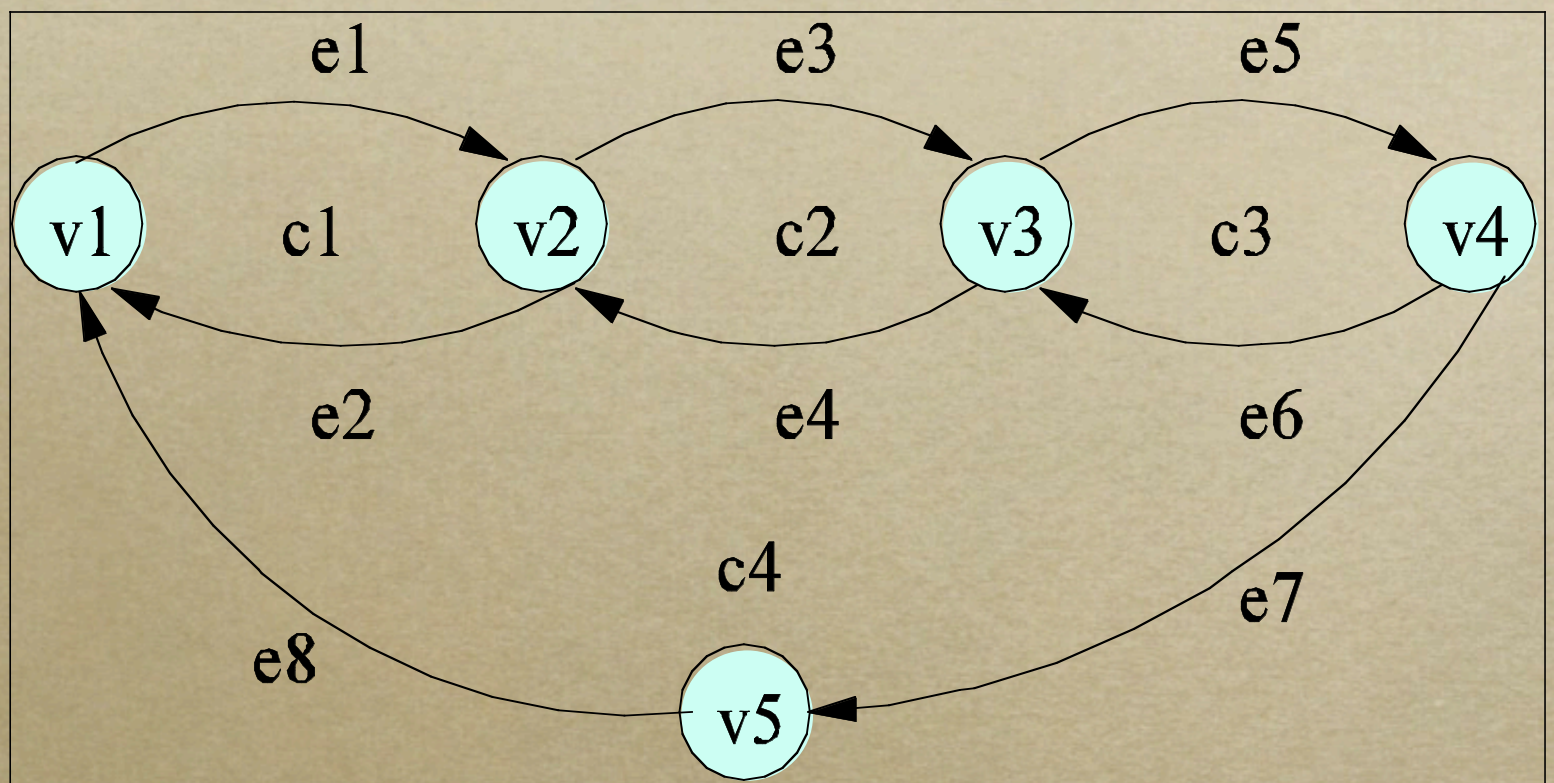
Kidney Exchange



Kidney Exchange



Optimization: cycle cover



Cycle length constraint ⇒ NP-complete combinatorial optimization

National market: ~10,000 patients at any one time

More examples

- *Motor skills: riding a bicycle, learning to walk, playing pool, …*
- *Vision*
- *Social skills: attending a party, giving directions, …*

More examples

- *Natural language understanding*
- *Speech recognition*

Common threads

- *Finding the needle in the haystack*
  - *Search*
  - *Optimization*
  - *Summation / integration*
- *Set the problem up well (so that we can apply a standard algorithm)*

Common threads

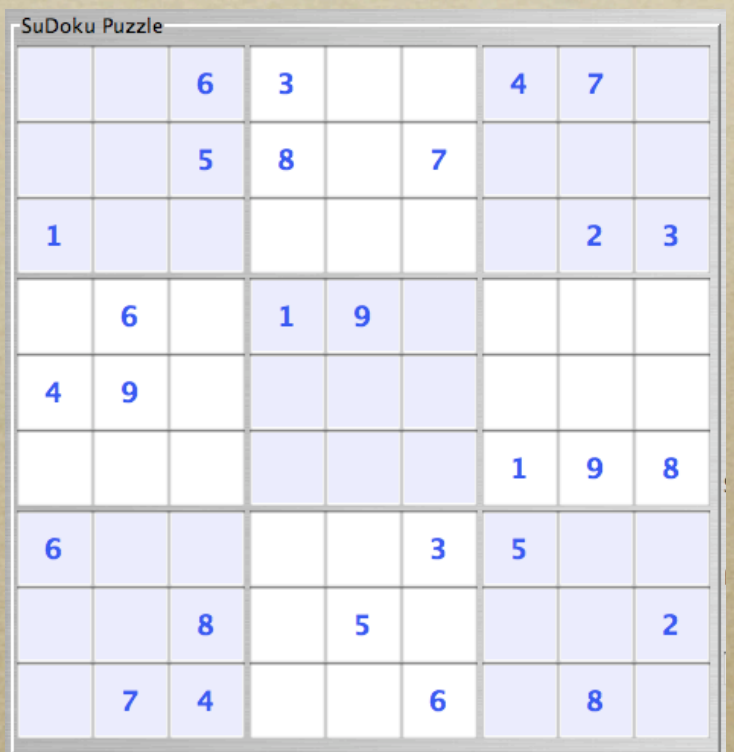
- *Sequential decisions, delayed feedback*
  - *Shoot or pass*
  - *Steering a car*
  - *Landing a "bird"*

Common threads

- *Managing uncertainty*
  - *chance outcomes (e.g., dice)*
  - *sensor uncertainty ("hidden state")*
  - *other agents*

Classic AI

- *No uncertainty, pure search*
  - *Mathematica*
  - *deterministic planning*
  - *Sudoku*
- *This is the topic of Part I of the course*



http://www.cs.qub.ac.uk/~I.Spence/SuDoku/SuDoku.html

Uncertainty

- *Adding outcome or sensor uncertainty to planning: unsolved problem, lots of current AI research*
  - *one-step decisions: graphical models*
  - *outcome only: MDPs*
  - *sensors: POMDPs, DBNs*
  - *other agents: game theory*
- *Topic of Part II of course*