Artificial Intelligence & Machine Learning

ICS 90 Guest Lecture
Prof. Alex Ihler
What is AI?
Rapid Progress in AI

- Autonomous Vehicles

- CMU “Sandstorm”
  - 2004
  - (DARPA Grand Challenge)

- Stanford “Stanley”
  - 2005
  - 2007

- Nevada license
  - 2011

- Google self-driving car
  - 2014
  - 2016
Rapid Progress in AI

• Games


Checkers “Chinook”

Jeopardy “Watson”

Go “AlphaGo”

UCI alum Yutian Chen with DeepMind’s team playing Ke Jie
Rapid Progress in AI

• ...and more games...

AI Competitions:

- **DOTA2 PvP (OpenAI)**
  - 2010 – present
  - [Website](https://cilab.sejong.ac.kr/sc_competition/)

- **Super Smash Bros (MIT)**
  - 2016 – present
  - [Website](http://www.pacmanvghosts.co.uk/)

- **Angry Birds**
  - 2012 – present
  - [Website](http://www.aibirds.org/)

- **StarCraft**
  - 2010 – present
  - [Website](https://cilab.sejong.ac.kr/sc_competition/)
Still a Long Way to Go
AIs

- AI as an assistant
  - Simplify interface, "do what you want"
AIs

• AI as an assistant
  – Simplify interface, “do what you want”

• AI as an opponent
  – Responsive & “realistic” behavior
  – Train; evaluate play quality; ...
What is ML?

• How can a computer “learn” from experience (observed data)?

• Less than the whole of AI?
  – Just one part of intelligence...

• More than just AI?
  – Applicable to many “practical” problems
  – Making sense of data automatically
  – Found in
    • Data mining & information retrieval
    • Computational biology
    • Signal processing
    • Image processing & computer vision
    • Data compression and coding
Supervised learning

- Observe examples; try to predict for new data

\[ y \approx f(x) \]
Supervised learning

- Observe examples; try to predict for new data

\[ y \approx f(x) \]
Supervised learning

- Observe examples; try to predict for new data

\[ y \approx f(x)? \]
**Prediction**

- Based on past history, predict future outcomes

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**Wall Street**

Sun Microsystems, Inc. (SUNW) Nasdaq Nat. Whl.

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Sun Microsystems: 43.69 (Daily)

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**Netflix**

**Movies You'll Love**

Based on your ratings

1. Rate your genres.
2. Rate the movies you've seen.

**New Suggestions for You**

Based on your recent ratings

- *Crawford 2-Disc Set*
- *Moses*
- *The Bible Collection: Moses*
- *Lewis and Clark: Great Journey West*

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*You have 1279 Suggestions from 398 ratings.*
Classification

• Discriminating between two (or more) types of data

• Example: Spam filtering

Cures fast and effective! - Canadian *** Pharmacy
#1 Internet Inline Drugstore Viagra Our price $1.15
Cialis Our price $1.99 …

Interested in your research on graphical models -
Dear Prof. Ihler, I have read some of your papers
on probabilistic graphical models. Because I …
Classification

- Example: face detection
Structured prediction problems

- Given an observation $x$, predict structured set of targets $y$
Structured prediction problems

- Given an observation $x$, predict structured set of targets $y$
- May layer multiple models capturing different aspects

Pose estimation:

Speech to text; translation:

Where is the train station?

Donde esta la estacion de trenes?
Tools for Machine Learning

• Probability and Statistics
  – Allows computing with / about uncertainty
  – Combine multiple sources of (uncertain) information
  – Search for “simple” explanations

• Also: optimization, information theory, ...

• Classes
  – CS171, Intro to AI
  – CS178, Machine Learning
  – CS177, Probability in Computer Science
  – CS175, Projects in AI
  – CS179, Graphical models
  – CS172, Neural networks & deep learning
Collaborative Filtering (Netflix)

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(slide from BellKor)
Latent variable models

$R_{ij}$
Crowdsourcing

- Use “workers” to evaluate data or make predictions
  - Workers are unreliable: ask multiple workers
  - Combine results using a probabilistic model
Conclusions

• Artificial Intelligence
  – Search, planning, making decisions

• Machine learning
  – Organizing and understanding observed data
  – Finding simple representations
  – Making predictions in complex systems
  – Approximate computations for difficult problems

• Related disciplines
  – Computer vision
  – Computational biology

• Lots of great classes: 171, 177, 178, 179, 175, ...
• Lots of great faculty here at UCI