

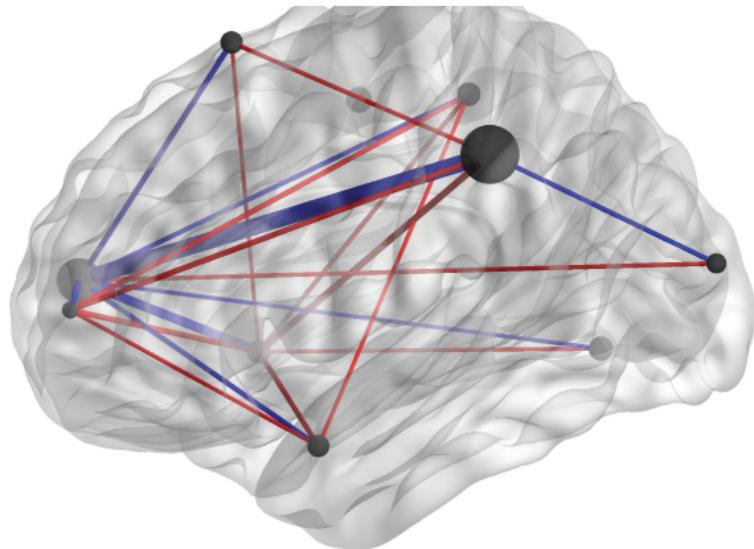
Machine Learning Introduction

Rajesh Ranganath

Machine Learning

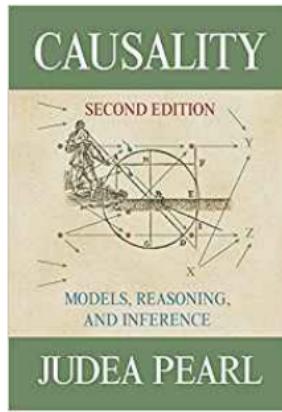


Neuroscience



[Manning+ 2014]

Causality



[Pearl+]

Machine Translation

English-German translations

src	Orlando Bloom and Miranda Kerr still love each other
ref	Orlando Bloom und <i>Miranda Kerr</i> lieben sich noch immer
best	Orlando Bloom und <i>Miranda Kerr</i> lieben einander noch immer .
base	Orlando Bloom und Lucas Miranda lieben einander noch immer .
src	" We 're pleased the FAA recognizes that an enjoyable passenger experience is not incompatible with safety and security , " said Roger Dow , CEO of the U.S. Travel Association .
ref	" Wir freuen uns , dass die FAA erkennt , dass ein angenehmes Passagiererlebnis nicht im Widerspruch zur Sicherheit steht " , sagte <i>Roger Dow</i> , CEO der U.S. Travel Association .
best	" Wir freuen uns , dass die FAA anerkennt , dass ein angenehmes ist nicht mit Sicherheit und Sicherheit <i>unvereinbar</i> ist " , sagte <i>Roger Dow</i> , CEO der US - die .
base	" Wir freuen uns über die <unk> , dass ein <unk> <unk> mit Sicherheit nicht vereinbar ist mit Sicherheit und Sicherheit " , sagte <i>Roger Cameron</i> , CEO der US - <unk> .

[Luong+ 2015]

Image Classification

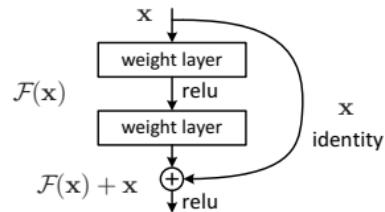


Figure 2. Residual learning: a building block.

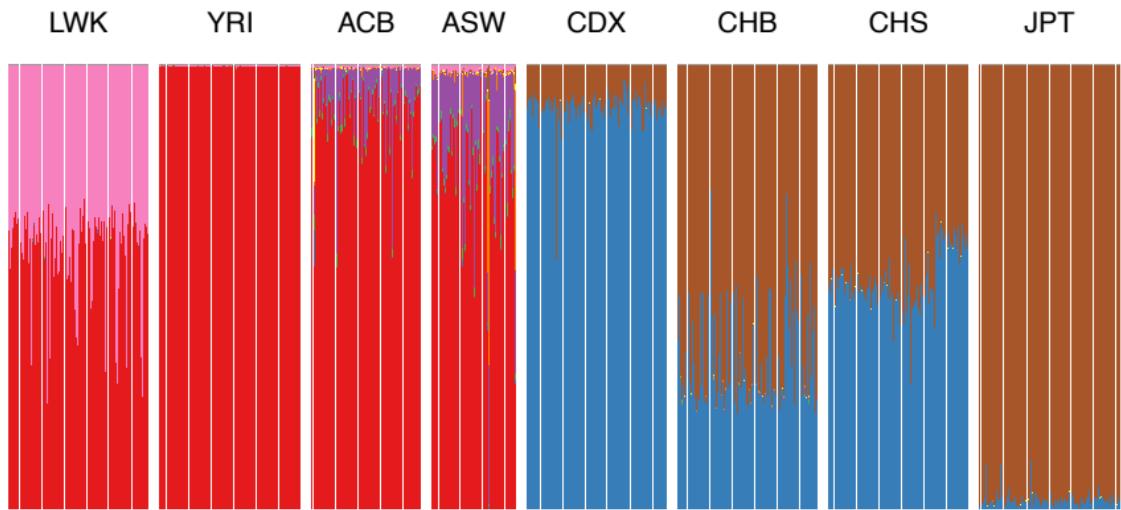
[He+ 2015]

Astrophysics



[Regier+ 2015]

Genetics



[Gopalan+ 2016]

What's this class about?

Broken into four high level themes

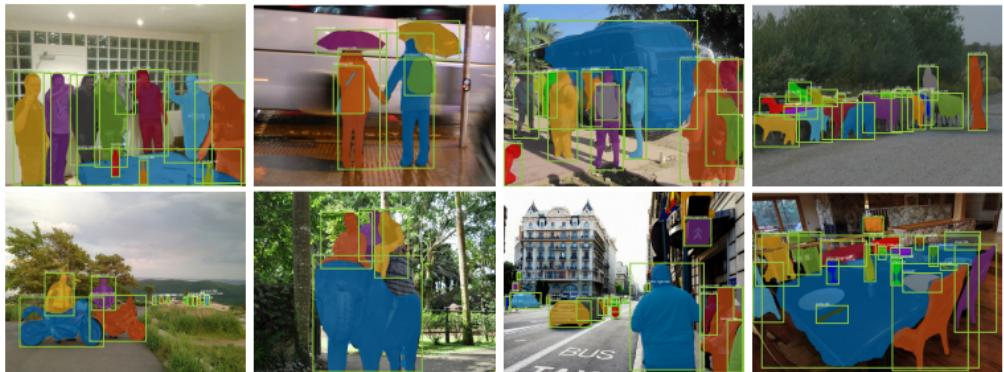
- Supervised Learning
- Graphical Models and Approximate Inference
- Causal Inference
- Reinforcement Learning

Supervised Learning

Take some input x and predict y

Supervised Learning

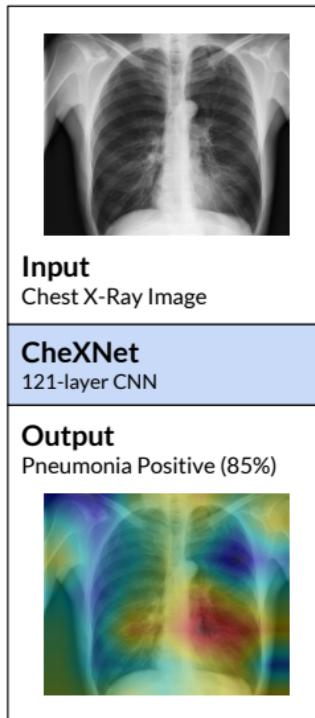
Take some input x and predict y



[He+ 2015]

Supervised Learning

Take some input x and predict y



Supervised Learning

Take some input x and predict y

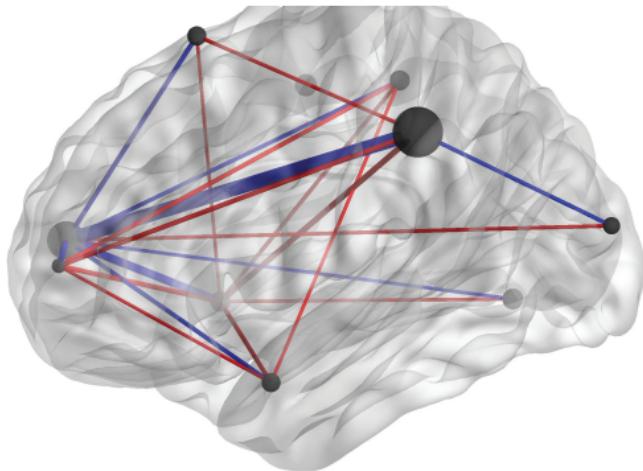
We will cover deep variants!

Graphical Models and Approximate Inference

Take some input x understand relationships

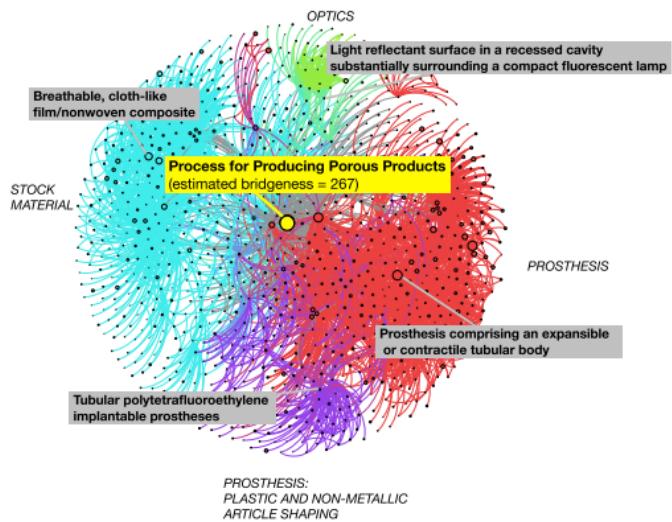
Graphical Models and Approximate Inference

Take some input x understand relationships



Graphical Models and Approximate Inference

Take some input x understand relationships



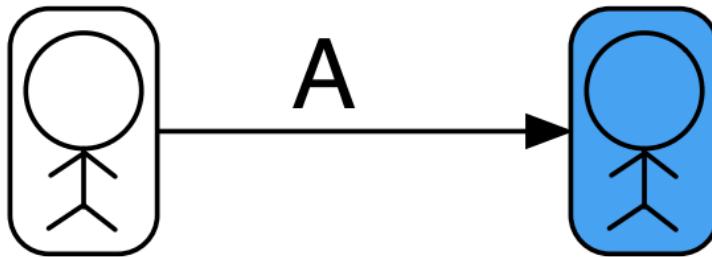
[Gopalan+ 2014]

Causal Inference

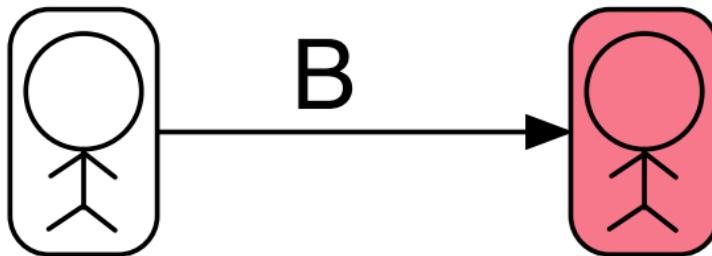
Understand the effect of altering x on y

Causal Inference

Understand the effect of altering x on y



person i

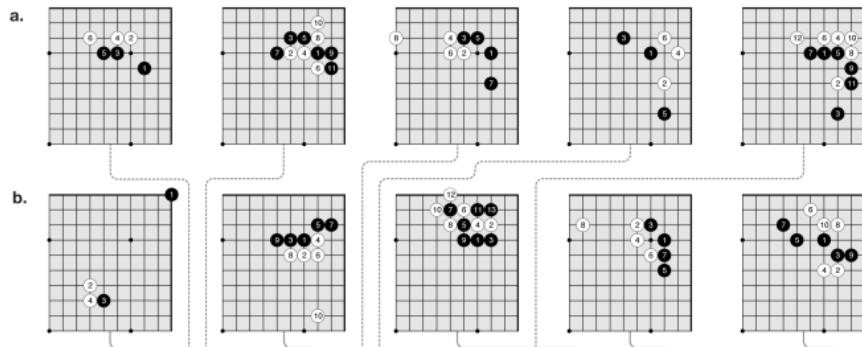


Reinforcement Learning

Understand how to take a sequence of actions to meet a goal

Reinforcement Learning

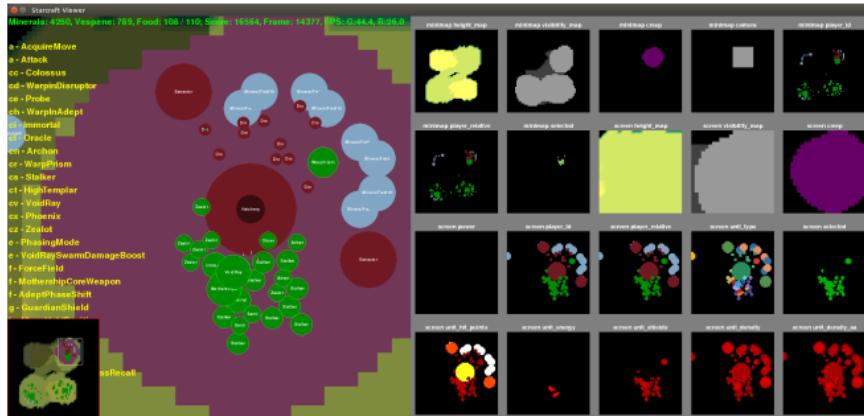
Understand how to take a sequence of actions to meet a goal



[Silver+ 2016]

Reinforcement Learning

Understand how to take a sequence of actions to meet a goal



[Vinayals+]

Reinforcement Learning

Understand how to take a sequence of actions to meet a goal

We will talk about deep reinforcement learning

- Learn how different methods work
- Learn why different methods need to exist
- **How to think about the data generating distribution**
- Class is mathematical and conceptual

Food for thought: How can something learn?

Food for thought: How can something learn?

To learn you need information.

Logistics

Course website: <https://rajeshhr.github.io/fall-ml-2022/>

Office Hours: Tuesdays, 3:30-4:30pm. Online.

Ed: You will be added

Gradescope: You will be added

Logistics

Deliverables

- Class will have 5 homeworks (40%)
- Homeworks are challenging
- Every class has reading response due at the start of the next class(10%)
- You will be asked to scribe one lecture (5%)
- Participation (5%)
- Final project (paper and presentation) due at the end of the term (40 %)

Questions?

Quiz: Homework -1

Quiz

- Probabilities are between 0 and 1. Consider the Gaussian distribution with variance 0.01.

$$p(x) = \frac{1}{\sqrt{2\pi 0.01}} \exp\left(-\frac{1}{2 * 0.01}x^2\right)$$

$p(0) \approx 3.98$. How is this possible?

- Let $x \in \mathbb{R}^n$. Let $y = \sin(Ax) \in \mathbb{R}^m$. What is $\frac{\partial y}{\partial x}$? What is its dimension?
- Define the covariance. Give an example of two random variables that have zero covariance but are not independent
- Define conditional independence. Can variables be independent, but also conditionally dependent?

Introductions

Particular Subjects of Interest