Lecture 40

The End  What Next
Announcements

● **Final exam:**
  ○ Monday, May 14, 2:00 pm, Phillips 219
  ○ If you have a conflict, TODAY is the deadline to request a makeup

● **Course evaluation:**
  ○ Conducted by Engineering College
  ○ 1% of your final grade
  ○ Deadline May 14, 8:00 am
Data Science Lifecycle

- Ask Question
- Understand World
- Obtain Data
- Understand Data
<table>
<thead>
<tr>
<th>Applications (lectures and textbook)</th>
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<tbody>
<tr>
<td>● Text of books</td>
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<td>● Movies and actors</td>
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<tr>
<td>● Population (US Census)</td>
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<td>● Baby birth weight</td>
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<td>● Banknote forgery</td>
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<td>● Bikeshare trips</td>
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<td>● Chronic kidney disease</td>
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<tr>
<td>● Voter database</td>
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<td>● Athlete performance</td>
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<td>● Flight delays</td>
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<td>● Exam scores</td>
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<td>● Deflategate</td>
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<td>● Galton’s heights of parents and children</td>
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<td>● House prices</td>
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<tr>
<td>● Hybrid car efficiency</td>
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<tr>
<td>● Salaries (sports, city employees)</td>
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<tr>
<td>● SAT scores</td>
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<tr>
<td>● ...</td>
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</tbody>
</table>
Applications (assignments)

- Global poverty
- Death penalty and murder rates
- Movie scripts
- World population
- Farmers markets
- Size and age of universe
- Price of diamonds
- Old Faithful eruptions
- Unemployment
- Restaurant inspections
- Sports betting
- ...
What is Data Science? [lec01]

Answering questions from data using computation

- **Exploration**
  - Identifying patterns in information
  - Uses visualizations

- **Inference**
  - Quantifying whether those patterns are reliable
  - Uses randomization

- **Prediction**
  - Making informed guesses
  - Uses machine learning
Data Exploration and Visualization

- **Basics of Python programming**: 3, 4.1-3
- **Arrays**: 4.4-6
- **Tables**: 5, 7
  
  Concepts: columns, rows, labels
  Operations: sort, where, group, pivot, join, apply

- **Plots, charts, graphs**: 6
  
  Concepts: categorical, quantitative
  Kinds: bar, scatter, line, histogram (density)

With this alone, you are now wizards
Data Exploration and Visualization

What next?

● **Programming in IS:** INFO 1300+2300+3300: learn to build web sites, databases, and advanced data visualization techniques

● **Programming in CS:** CS 1110+2110: learn to engineer software in Python and Java

● **On your own:** learn Pandas and Matplotlib
Inference

- **Experiments:** 2
  Treatment, control, confounding factors, association, causation

- **Probability:** 6.1-2, 8.4-5, 9.1, 9.3, 12
  Laws of probability, distributions, sampling, variability, mean, standard deviation, normal distribution, Central Limit Theorem, bounds

- **Hypothesis testing:** 10
  Null vs. alternative, test statistics, simulation, p-value

- **Estimation:** 11
  Bootstrap, percentiles, confidence interval
Inference

MODEL  Probability  Inference

DATA
Inference

What next?

- **Statistics** (and math prereqs):
  AEM 2100, BTRY 3010, CEE 3040, ECON 3130, ENGRD 2700, HADM 2010, ILRST 2100, MATH 1710 or 4710, PAM 2100, PSYCH 3500, SOC 3010, STSCI 2100

- **Learn R**: popular for statistics
Prediction

- **Regression:** 13, 14, 15.6
  - Correlation, regression line, RMSE, minimization, residuals, non-linear regression, multiple regression, dummy coding

- **Classification:** 15
  - Nearest neighbors, scaling, distance, decision boundary, train vs. test, accuracy
## Prediction

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Categorical</th>
<th>Quantitative</th>
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<tbody>
<tr>
<td>1</td>
<td>1. Linear regression</td>
<td></td>
</tr>
<tr>
<td>Many</td>
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# Prediction

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<tr>
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<td>2. Nearest neighbor classification</td>
<td>1. Linear regression</td>
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## Prediction

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<td></td>
<td>3. Multiple regression (least squares, NN)</td>
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Prediction

What next?

● **Linear algebra:** MATH 2210, 2310, or 2940 (some calculus required)

● **Machine learning:** CS 4780, 4786, ORIE 4740, 4741, STSCI 4740, 4780 (and probably many others)

● **On your own:** try a self-paced tutorial or competition on Kaggle
Data Science Venn Diagram v2.0

- Computer Science
- Machine Learning
- Math and Statistics
- Traditional Software
- Unicorn
- Traditional Research
- Subject Matter Expertise
More Data Science

- Next steps: ORIE 2380, INFO 2950
- Learn R or Julia: other popular data science platforms
- Cornell Data Science (CDS) project team, INFO 1998
Thank you to TAs!

Skyler Seto, Tony Sirianni
Yang Guo, Charlene Luo, Lauren Sedita, Anil Vadali
Thank you!

To all of you!

You were part of a grand adventure!

- New course
- New staff
- New assignments
- New technology
Finally

Stay in touch! On behalf of Prof. Udell and myself...

- Tell us when 1380 helps you out in the future
- Ask us cool questions
- Drop by our offices to tell us about the rest of your time at Cornell (and beyond)... We really do like to know
Finally

GO DO AMAZING THINGS WITH YOUR LIFE