Introduction to Computation for the Humanities and Social Sciences

CS 3
Chris Tanner
What is Computation?
Lecture 1

- People
- Motivation
- Course Topics
- Assignments

- Ex: Political Media Bias
- Computation vs Computer Science vs Programming vs Python
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People

Who am I?
Who am I?

• PhD student (graduating in May)

• Research Area: AI / Machine Learning,
  Natural Language Processing

• Call me Chris

• christanner@cs.brown.edu
HTAs and TAs
People

HTAs and TAs

• From 91 applicants, 54 were interviewed
From 91 applicants, 54 were interviewed

cs0030tas@lists.cs.brown.edu

HTAs:

- Anna Nakai — Political Science & Comp Sci
- Dylan Sam — Math & Comp Sci

TAs:

- Caroline Ribet — History
- Milla Shin — Comp Sci
- Dylan Tian — Visual Art & Comp Sci
People

Supervising Faculty

Tom Doeppner

twd@cs.brown.edu
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Motivation

Why is it important?

• Our world is now inundated with data
Motivation

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• Our world is now inundated with data

• With the ability to use this data, one may:
  • pose new questions
  • compute things with the data
  • draw new conclusions
  • provide quantitative results — allowing one to even complement qualitative problems
Motivation

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• With the ability to use this data, one may:
  • pose new questions
  • compute things with the data
  • draw new conclusions
  • provide quantitative results — allowing one to even complement qualitative problems

• Useful to everyone
Motivation

Marvel: “Infinity War is the most ambitious crossover event in history”

Me:

CSCI 0030 Introduction to Computation for the Humanities and Social Sciences

S01 TTh 9-10:20a

TBD
Motivation

Real-world Examples


*Paper Machines* is a free toolkit for historians who wish to perform a “distant reading” of large-scale textual corpora, particularly those associated with modern institutions like Parliament or the World Bank, by using algorithms to visualize how the official mind’s concerns change over time and space. I designed Paper Machines to help with my next monograph, *The Long Land War*, with funding from Harvard and Google in 2012 [...] The technology has been widely adopted and taught.
Motivation

Real-world Examples

2. Migration Research — Becca Wang (Sociology PhD student at Brown):

Given collected data:

- census data (who lives where)
- migration data (who migrated from rural South Africa to Johannesburg)
- quantitative assessment of how kids’ well-being

Compute:

- analysis which shows the effects migration has on kids, dependent on children's relationships to the given migrant(s) in their family (e.g., mother, father, older sister, uncle, etc).
Motivation

What this course teaches

• Problem-solving workflow to build defensible arguments backed by relevant data sources and appropriate methods
What this course teaches

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- How to find and process various types of data (e.g., pre-formatted text, unstructured web-based text like Twitter feeds, etc).
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• High-level understanding of core concepts (e.g., data structures, algorithms, computer science vs programming, machine learning, deep learning)
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• How to find and process various types of data (e.g., pre-formatted text, unstructured web-based text like Twitter feeds, etc).

• How to solve computational problems using Python (programming language)

• High-level understanding of core concepts (e.g., data structures, algorithms, computer science vs programming, machine learning, deep learning)

• How to implement a basic Machine Learning algorithm to classify text documents
Motivation

What this course does not teach

• Advanced math
  (math will be roughly limited to summing, averaging, and some fractions)

• Rigorous study of what truly qualifies as being logically sound/ statistically significant results
  (courses in Statistics, Logic, and Philosophy is best for such)

• Rigorous study of Computer Science programming
  (CS15/16/17/18/19 are great for that)
Who Should Take this Course

Course is designed for humanities and social science concentrators [who are interested in the aforementioned topics]. No programming background is expected.
Motivation

How to Enroll

1. Add your name to the pre-registration waitlist (link was available March 23)

2. Each lecture, sign the sign-in sheet, indicating that you’re still interested

3. Turn in each homework assignment

4. After 2 weeks, the first 30-35 students (per the waitlist) who have completed each homework and attended each lecture will receive an override code.

5. Goal is to admit students who are interested in the course and will likely not drop — contact Head TAs at anytime time to find your approximate chance
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Course Topics

1. Problem Solving and Python
   • Forming computational problems
   • Finding datasets
   • Getting started with Python
   • Designing and writing programs
   • How data is stored and changed
   • **Project 1**: Computation
1. **Problem Solving and Python**
   - Forming computational problems
   - Finding datasets
   - Getting started with Python
   - Designing and writing programs
   - How data is stored and changed
   - **Project 1:** Computation

2. **Textual Analysis**
   - Iterating through text data
   - Data Structures
   - Building a concordance of large texts
   - Sentiment Analysis
   - **Project 2:** Text Analysis
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   - **Project 2**: Text Analysis

3. **Data Visualization and using APIs**
   - Plotting Data in informative ways
   - Visualizing data on maps
   - Accessing Data from APIs
   - **Project 3**: Final Project
# Course Topics

## 1. Problem Solving and Python
- Forming computational problems
- Finding datasets
- Getting started with Python
- Designing and writing programs
- How data is stored and changed
- **Project 1:** Computation

## 2. Textual Analysis
- Iterating through text data
- Data Structures
- Building a concordance of large texts
- Sentiment Analysis
- **Project 2:** Text Analysis

## 3. Data Visualization and using APIs
- Plotting Data in informative ways
- Visualizing data on maps
- Accessing Data from APIs
- **Project 3:** Final Project

## 4. The Extended Landscape
1. What is Machine Learning?
2. Naive Bayes Classifier
3. The Academic Landscape
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Assignments

Class: Tuesdays and Thursdays @ 9am - 10:20am

Lab Time:
• last ~30 minutes of each class
• intended for starting on homework
• credit given for good effort
• all TAs available to help

Homework:
• issued Tuesday, due by Mon @ 11:59pm
• will give students hands-on experience
• start working on it during Lab Time
Assignments

**Projects:**
- 3 projects (programming-based)
- some freedom in designing each project
- intent is to apply skills towards real-world data/scenarios which interest you
- ~3 weeks to work on each project

**Pop Quizzes:**
- in lieu of exams, there will be a few (~5) pop quizzes
- issued at beginning of lecture
Assignments

Grading

• In-class lab time: 10% (for good effort)
• Homework assignments: 45%
• Projects:
  • Project 1: 7%
  • Project 2: 13%
  • Project 3: 20%
• Pop Quizzes: 5%

**NOTE:** Some extra credit will be possible on many assignments
Assignments

Late Policy

• Each student is **allowed a total of 3 late days**, which can be used toward any homework or project

• Each subsequent late day on a given assignment drops the max. possible grade by 10%

• Project #3 must be turned in by Dec 15, 11:59pm, regardless of how many late days you have

• If you are sick, provide notification from Health Services before the due date to receive an extension.
Assignments

Late Policy

• Don’t get behind! Material continuously builds.
Assignments

What to do if you’ll miss a class

• E-mail me for slides

• Try to complete the homework ASAP so you have sufficient time to go to TA hours
Laptop/Tablets Policy

- Research has shown that laptops usually have adverse affects in classroom

- Brown end-of-course evaluations have indicated that students are often distracted/bothered by others’ screens

- **Policy:** please refrain from using laptops in class (other than lab time), unless it’s important or you find it highly beneficial — in which case, be considerate to others around you.
Assignments

Resources

• **Website:** [http://cs.brown.edu/courses/csci0030/](http://cs.brown.edu/courses/csci0030/)

• **E-Mail:**
  - **HTAs and me** for issues related to course infrastructure: cs0030headtas@lists.cs.brown.edu
  - **TAs** for individual matters: cs0030tas@lists.cs.brown.edu
  - Grading issues? Email the TA who graded your work

• **Piazza:** for questions about assignments or general help:
  - [piazza.com](http://piazza.com), then search for **csci0030** and sign-up

• **TA hours** should be the preferred method for in-depth questions or help
Assignments

Resources

• **Meet with me:** by appointment
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An Example: Political Media Bias

Political Media Bias
An Example: Political Media Bias

Observations inform Research

“In 1981 … I was named a national correspondent, which allowed me to cover bigger, more important stories anywhere in the country … It was in New York that for the first time I started noticing things that made me feel uneasy.

“I noticed that we pointedly identified conservatives as conservatives, for example, but for some crazy reason we didn’t bother to identify liberals as liberals […] in the world of the Jenningses and Brokaws and Rathers, conservatives are out of the mainstream and need to be identified. Liberals, on the other hand, are the mainstream and don’t need to be identified.”
An Example: Political Media Bias

Let’s turn this into a research problem

Think, then discuss with your neighbor:

• What claim did he make?

• What was his justification for why that claim held true?

• How could we verify his claim?
What is our question?

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What is our question?

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An Example: Political Media Bias

“On The Bias”
Geoffrey Nunberg, Fresh Air

“Bernard Goldberg is hardly the first person to claim that the media have a liberal bias, and his Bias is far from the best-written or best-argued book to try to make that point. Even so, it has climbed to the top of the New York Times bestseller list, maybe because Goldberg is himself a CBS insider with lots of tell-all tidbits to offer about the likes of Dan Rather and Bob Schieffer.

“For the most part, Goldberg's book is a farrago of anecdotes, hearsay, and unsupported generalizations. But at one point he strays into territory that can actually be put to a test. That's when he claims that the media "pointedly identify conservative politicians as conservatives," but rarely use the word "liberal" to describe liberals.”

Problem Solving Workflow

- Define our question with precise, defined terms that can be proven true or false
- Select a relevant data source
- Design a feasible method that would answer your question
- Evaluate and analyze results
- Communicate your results to the intended audience

An Example: Political Media Bias
Clarifying our question

Think, then discuss with your neighbor:

- What is media bias?
- How might bias manifest in different ways in the media?
- To whom/what are they biased?
- What types of media are we interested in analyzing?
An Example: Political Media Bias

Types of Bias

- **Omission**: Using only arguments from one side

- **Source selection**: Include more sources or more authoritative sources for one side over the other

- **Story selection**: Regularly including stories that agree or reinforce the arguments of one side

- **Placement**: Using the benefit of the perceived importance of position to highlight certain stories
An Example: Political Media Bias

Types of Bias

- **Labeling**: (two types)
  - Using labels to categorize sources or individuals as extreme
  - Labeling people on one side of the argument with labels and not the other

- **Spin**: Story provides only one interpretation of the events
What is our question?

Instead of “Is the media biased toward liberals”,

“In major newspapers, are liberal politicians identified as liberals more or less often than conservatives are identified as conservatives?”
An Example: Political Media Bias

What data sources should we use?

Types we’ll use in this course

Harder              Easier

Video               Audio               Images

Formatted Text

Text

Unformatted Text

• TV video segments are very hard to analyze, but TV transcripts are significantly easier

• Text from newspaper articles is easy, but newspaper layout and organization is harder

• This course will teach you how to analyze text data, both formatted and unformatted (e.g., websites, Twitter, newspapers, etc)
An Example: Political Media Bias

What data sources should we use?

• What would be relevant, accessible data sources to solve this problem?

• How do we measure labeling bias in this dataset?

• How do we avoid introducing our own bias by the selection of data sources?
An Example: Political Media Bias

What data sources should we use?

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What data sources should we use?

Nunberg: 30 Major Newspapers

- The New York Times
- The LA Times
- The Washington Post
- The Boston Globe
- The Miami Herald
- The San Francisco Chronicle

Measuring Label Bias

“In major newspapers, are liberal politicians identified as liberals more or less often than conservatives are identified as conservatives?”

Nunberg’s Method

• Choose a representative set of politicians from each side
• Find mentions of politicians in the dataset
• Look at seven words before and after the politician’s name
• Compute fraction of times these words around their name contain the politician’s appropriate label

An Example: Political Media Bias

Nunberg’s chosen politicians to follow

Liberal Politicians

• Sen. Barbara Boxer
• Sen. Paul Wellstone
• Sen. Tom Harkin
• Sen. Ted Kennedy
• Rep. Barney Frank

Conservative Politicians

• Sen. Jesse Helms
• Sen. Tom DeLay
• Sen. John Ashcroft
• Sen. Dick Armey
• Rep. Trent Lott

An Example: Political Media Bias

Looking at words around a politician’s name

• There will inevitably be false positives
• e.g., the political label may not be referring to the politician
An Example: Political Media Bias

Looking at words around a politician’s name

• There will inevitably be false positives
• e.g., the political label may not be referring to the politician

Which of these examples will be correctly categorized by the method?

• “‘And now it’s gone too far,’ said John Ziegler, a conservative radio host”
• “When David [Brooks] complains that ‘conservative opinion-meisters began to value politics over everything else,’”
• The system rates Mr. Obama as being slightly more conservative than Jimmy Carter
An Example: Political Media Bias

<table>
<thead>
<tr>
<th>Liberal Legislators</th>
<th>Total instances in newspapers database</th>
<th>Pct within 7 words of relevant label</th>
<th>Total instances in &quot;liberal&quot; papers</th>
<th>Pct. within 7 words of label in &quot;liberal&quot; papers</th>
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</thead>
<tbody>
<tr>
<td>Paul Wellstone</td>
<td>2939</td>
<td>10.9%</td>
<td>578</td>
<td>8.48%</td>
</tr>
<tr>
<td>Barney Frank</td>
<td>8501</td>
<td>4.7%</td>
<td>1439</td>
<td>3.89%</td>
</tr>
<tr>
<td>Tom Harkin</td>
<td>10,147</td>
<td>3.7%</td>
<td>1784</td>
<td>2.02%</td>
</tr>
<tr>
<td>Ted Kennedy</td>
<td>17,197</td>
<td>3.0%</td>
<td>2444</td>
<td>2.74%</td>
</tr>
<tr>
<td>Barbara Boxer</td>
<td>8977</td>
<td>2.0%</td>
<td>3093</td>
<td>1.78%</td>
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<tr>
<td><strong>Avg. pct. for liberals, all papers</strong></td>
<td><strong>4.8%</strong></td>
<td></td>
<td></td>
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Conservative Legislators

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<td>4718</td>
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[1] [http://people.ischool.berkeley.edu/~nunberg/table.html](http://people.ischool.berkeley.edu/~nunberg/table.html)
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**Conclusion:**
Liberals are labelled more often than Conservatives.
An Example: Political Media Bias

What did we compute?
The word co-occurrence of political labels and specific members of congress.

Why?
As an approximation of how often members of congress are identified by their political affiliation

Assumption / Possible Weaknesses
As mentioned, there are probably errors:
• False Positives — a political label is present but does not represent the given, nearby politicians affiliation
• False Negatives (misses) — a politician is mentioned in the text but there is no political label nearby
How well did we do?

- 85% accuracy [1]
- Can calculate accuracy by manually inspecting many examples, then extrapolate.
  - e.g., look at 100 mentions of politicians, and if 85 of them were correct, it’s fair to say we have 85% accuracy
- Error calculation is **not mandatory, but it’s largely useful**, both to you and the audience which will receive your results.

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What is Computation?

• To compute, is to calculate something (e.g., to count, add, find mutual items, etc).

• It’s a specific operation, or set of operations, performed by a well-defined model or function.

• One can build a model/function to compute the following:
  • How many distinct Presidents has the United States had?
  • What’s the avg. age of US Presidents upon their taking office?
  • Is there a correlation between (a) the number of yearly daylight hours a country receives and (b) their citizens’ life expectancy?
  • Correlation between a country’s GDP and life expectancy?
What is Computation?

• The answer should not be subjective or non-deterministic
  
  • e.g., your computation should be repeatable/reproducible.

• For Example:

  • Who makes better pizza? Fellini’s or Antonio’s?
    
    (we could compute an approximate answer via polling, and we ought to explain how we calculated it)
Computation vs Comp Sci vs Programming vs Python

What is Computation?

• The answer should not be subjective or non-deterministic
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• For Example:
  • Who makes better pizza? Fellini’s or Antonio’s?  
    (we could compute an approximate answer via polling, and we ought to explain how we calculated it)
  • Do students rate Fellini’s or Antonio’s more favorably?  
    (more specific question, which leaves less room for incorrect computation, and less lengthy explanation of our calculation).
What is Computer Science?

- Computer Science is horribly named. Computational Science is a more appropriate a name

- “Computer Science is no more about computers than astronomy is about telescopes” — Edsger Dijkstra, 1970

- Computer Science is a broad field with many distinct sub-fields, but a commonality is computation, as it’s the main vehicle that drives all areas.

- aka “How do you compute stuff?”
What is Computer Science?

Graphics

• How do you calculate which a photo from an unprecedented point-of-view would look like? (graphics)
What is Computer Science?

- How do you calculate which a photo from an unprecedented point-of-view would look like? (graphics)
- How can you very quickly calculate the sub-sections of human DNA which are most likely to concern pancreatic cancer? (comp. bio)
What is Computer Science?

- How do you calculate which a photo from an unprecedented point-of-view would look like? \textit{(graphics)}
- How can you very quickly calculate the sub-sections of human DNA which are most likely to concern pancreatic cancer? \textit{(comp. bio)}
- How can you robustly handle internet traffic when 1,000 computers try to simultaneously connect to a website? \textit{(networking)}
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What is Computer Science?

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- How can you determine if two names within a document refer to the same underlying person or not? (natural language processing. my dissertation)
Main Takeaway: Computer Science has a bunch of areas, but computation is at the root of it all.

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Pursuing education in History

• In the field of History or Literature, the language of text is the medium of communication — it’s the currency to exchange ideas
• As long as one can understand the language, one has sufficient skills to start digesting (and maybe contributing) knowledge
• Then, one can learn the skills of the field, e.g.,:
  • how to draw inferences
  • how to make insightful comparisons
  • how to understand cultural references, metaphors, etc
  • deep knowledge of bodies of works
  • etc
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Then, one can learn the skills of the field, e.g.,:

- how to compute stuff, and to do so in smart ways (i.e. efficient)
- make the code compute more and more stuff, until it’s a complete product that does high-level things that you want (e.g., iPhone App, social network website, an autonomous car).
What is Programming?

- the act of typing words (instructions) in a specific computer language, in a way that a computer can understand and execute/compute
What is Programming? What is Python?

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- synonym: coding
- There are many different distinct computer languages that one can program in.
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• **synonym**: coding

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  • some are closer to interacting w/ hardware (think of needing to control sensors, motors, etc)
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  • **Python** is arguably the best language from the latter case
Computation vs Comp Sci vs Programming vs Python

• **Computation** — a calculation; a specific operation, or set of operations, performed by a well-defined model or function.

• **Computer Science** — a field of study which is deeply centered around computation, including the interest of both the computation itself, and applying computation towards various problems and tasks.

• **Programming** — the act of typing words (instructions) in a specific computer language, in a way that a computer can understand and execute (i.e., compute). This is the vehicle of communication within the field of computer science.

• **Python** — a specific, high-level yet powerful and easy-to-use programming language
Homework #1

1. Visit the course website for the assignment:
   a. Complete the Collaboration Policy
   b. For your own reading pleasure:
Please be vocal. My goal is to make this content as digestible, rewarding, and enriching as possible.