Class Website
CX4242:

Data & Visual Analytics

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Founder of Filio, a visual asset management platform
Refer to:

Class Website

For anything (updates, lectures, logistics, and so on) related to this class

https://poloclub.github.io/cx4242-2020spring-campus/
How to succeed in this course?

I will always start the class with “Good Afternoon” or “How is everyone doing?”

I need a response **full of energy** from **all** students. It gives me a good feeling and shows me you are here to learn new exciting things. That way I stay motivated.

If I stay motivated → I do my best in teaching → you learn better

→ you will get an A

Let’s practice

**Good Afternoon**
Course TAs

Be very very nice to them!

Vatsal Srivastava

Sharmila Baskaran

Office hours and locations (TBD) on course homepage
The whole concept of this class is to deal with (really) large data.
Internet
50 Billion Web Pages
Facebook
2 Billion Users
Citation Network

250 Million Articles


Modified from well-formed.eigenfactor.org
Many More

**Twitter**
Who-follows-whom *(500 million users)*

**Amazon**
Who-buys-what *(120 million users)*

**AT&T Cellphone Network**
Who-calls-whom *(100 million users)*

**Protein-protein Interactions**
200 million possible interactions in human genome

The Booming Age of Data

- 30 trillion Web pages
- 500 million tweets per day
- 2.27 billion monthly active users
- 1.8 billion images uploaded to Internet per day
- 2.9 billion base pairs in human genome
"Big Data" Analyzed

<table>
<thead>
<tr>
<th>Graph</th>
<th>Nodes</th>
<th>Edges</th>
</tr>
</thead>
<tbody>
<tr>
<td>YahooWeb</td>
<td>1.4 Billion</td>
<td>6 Billion</td>
</tr>
<tr>
<td>Symantec Machine-File Graph</td>
<td>1 Billion</td>
<td>37 Billion</td>
</tr>
<tr>
<td>Twitter</td>
<td>104 Million</td>
<td>3.7 Billion</td>
</tr>
<tr>
<td>Phone call network</td>
<td>30 Million</td>
<td>260 Million</td>
</tr>
</tbody>
</table>

We also work with small data. Small data also needs love.
7 ± 2

Number of *items* an average human holds in *working memory*

*George Miller, 1956*
How to do that?

**COMPUTATION** + **HUMAN INTUITION**
Or, to ride the AI wave…

**Artificial Intelligence**

**+**

**Human Intelligence**
Both develop methods for making sense of network data. How to do that?

**COMPUTATION**  |  **INTERACTIVE VIS**

- Automatic
- User-driven; iterative
- Summarization, clustering, classification
- Interaction, visualization

> Millions of nodes
 Thousands of nodes
It is currently an active research area which combines the

Best of Both Worlds (Polo’s group specialty)
Our mission & vision:

**Scalable, interactive, usable tools for big data analytics**
“Computers are incredibly fast, accurate, and stupid. Human beings are incredibly slow, inaccurate, and brilliant. Together they are powerful beyond imagination.”

(Einstein might or might not have said this.)
Logistics

Course website
(policies, syllabus, schedule, etc.)
https://poloclub.github.io/cx4242-2020spring-campus/
(link available on Canvas)

Discussion, Q&A, find teammates

Piazza
(link/tab available on Canvas)

Assignment Submission

Canvas

Make sure you’re in the right Piazza!
(CX4242, CSE-6242-O01, CSE-6242-OAN have their Piazza forums too)
Course Homepage

For syllabus, schedule, projects, datasets, etc.

If you Google “cse6242Cx4242”, you will see many matches.
Make sure you click the correct site!
Announcements and Discussion

We use Piazza for all announcements and discussion. Everyone must join this class's Piazza (link available on Canvas). Double check that you are joining the correct Piazza! There are multiple concurrent course sections with the same name and course number taking place, e.g., online for OMSA and OMSCS, and campus for Atlanta-based students.

The fastest way to get help with homework assignments is to post your questions on Piazza. That way, only our TAs and instructor can help, your peers can too.

If you prefer that your question addresses to only our TAs and the instructor, you can use the private post feature (i.e., check the "Individual Students(s) / Instructors(s)" radio box).

While we welcome everyone to share their experiences in tackling issues and helping each other out, but please do not post your answers, as that may affect the learning experience of your fellow classmates.
Important to join Piazza because…

- I will announce events related to this class in collaboration with Polo’s graduate level of this class and data science in general
  - Distinguished lectures
  - Seminars
  - Hackathons (**free food**, prizes)
  - Company recruitment events (**free food**, swag)
Course Goals
What is **Data & Visual Analytics**?

No formal definition!

Oh wait, Polo has a definition for this:

the *interdisciplinary* science of combining *computation techniques* and *interactive visualization* to transform and model data to aid *discovery*, *decision making*, *etc.*
What are the "ingredients"?

Need to worry (a lot) about: storage, complex system design, scalability of algorithms, visualization techniques, interaction techniques, statistical tests, etc.

Wasn’t this complex before this big data era. Why?
The World of Data

- Number of emails sent every second: 2.9 million
- Data consumed by households each day: 375 megabytes
- Video uploaded to YouTube every minute: 20 hours
- Data processed by Google every day: 24 petabytes
- Tweets per day: 50 million
- Total minutes spent on Facebook each month: 700 billion
- Data sent and received by mobile internet users per second: 1.3 exabytes
- Products ordered on Amazon per second: 72.9 items

Sources: Clarify, comScore, McKinsey, Fast Company, Google, Twitter, YouTube

In the 21st century, we live a large part of our lives online. Almost everything we do is reduced to bits and sent through cables around the world at light speed. But just how much data are we generating? This is a look at just some of the massive amounts of information that human beings create every single day.
What is **big data**? Why care?

Many businesses are based on big data.

**Search engines:** rank webpages, predict what you’re going to type

**Advertisement:** infer what you like, based on what your friends like; show relevant ads

**E-commerce:** recommends movies/products (e.g., Netflix, Amazon)

Health IT: patient records (EMR)

Finance
Good news! Many jobs!

Most companies are looking for “data scientists”

The data scientist role is critical for organizations looking to extract insight from information assets for ‘big data’ initiatives and requires a **broad combination** of skills that may be fulfilled better as a team

- Gartner

(Breadth of knowledge is important. This course helps you learn some important skills.)
Course Schedule
(Analytics Building Blocks)

- Collection
- Cleaning
- Integration
- Analysis
- Visualization
- Presentation
- Dissemination
Building blocks. Not Rigid “Steps”.

- Collection
- Cleaning
- Integration
- Analysis
- Visualization
- Presentation
- Dissemination

Can skip some

Can go back (two-way street)

- **Data types** inform **visualization** design
- **Data size** informs choice of **algorithms**
- **Visualization** motivates more **data cleaning**
- **Visualization** challenges algorithm assumptions
e.g., user finds that results don’t make sense
Course Goals

- Learn **visual** and **computation** techniques and use them in **complementary** ways
- Gain a **breadth** of knowledge
- Learn **practical** know-how by working on **real data & problems**
Grading

- [50%] 4 homework assignments
- End-to-end analysis
- Techniques (computation and vis)
- “Big data” tools, e.g., Hadoop, Spark, etc.
- [50%] Group project -- 4 members per team
- [Tentative bonus points] In-class pop quizzes
  - Each quiz is worth 1% course grade
- No exams
Policies

On website; we go through them now

Grading, plagiarism, collaboration, late submission, and the “warnings” about the difficulty this course
From Previous Classes...

• Class projects turned into papers at top conferences (KDD, IUI, etc.)
• Projects as portfolio pieces on CV
• Increased job and internship opportunities
  • Former students sent me “thank you” notes
Aurigo: An Interactive Tour Planner for Personalized Itineraries

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ABSTRACT
Planning personalized tour itineraries is a complex and challenging task for both humans and computers. Doing it manually is time-consuming; approaching it as an optimization problem is computationally NP hard. We present Aurigo, a tour planning system combining a recommendation algorithm with interactive visualization to create personalized itineraries. This hybrid approach enables Aurigo to take into account both quantitative and qualitative preferences of the user. We conducted a within-subject study with 10 participants, which demonstrated that Aurigo helped them find points of interest quickly. Most participants chose Aurigo over Google Maps as their preferred tools to create personalized itineraries. Aurigo may be integrated into review websites or social networks, to leverage their databases of reviews and ratings and provide better itinerary recommendations.

Author Keywords
User Interfaces; Visualization; Recommendation; Tour itinerary planning

ACM Classification Keywords
(e.g. HCI): User interfaces
ISPARK: Interactive Visual Analytics for Fire Incidents and Station Placement

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ABSTRACT

In support of helping to reduce the response time of firefighters, and thus deaths, injuries, and property loss due to fires, we introduce ISPARK. The ISPARK system determines where fire stations should be located, analyzes the primary causes of fires, the existing infrastructure, and response times, by using visualizations which show the GIS mapping of fire stations on a dashboard. Incidents and response times are shown as additional layers, with clustering of fire incidents to determine predicted fire station locations, forecasting of fire incidents using regression, causal, infrastructure, and personnel analysis, creating an interactive, multi-faceted method for locating fire stations. A comparison of urban and rural fire incident response times is another dimension of this study. We demonstrate ISPARK’s usage and benefits using a publicly available dataset describing 300,000 fire incidents in the states of Massachusetts and Maine. ISPARK is generalizable to other geographic areas.

Figure 1: Screenshot of ISPARK showing actual (pink) and predicted (green) fire station locations in Maine determined by our approach, using coordinates with actual driving distances from fire stations to actual fire incidents. Fire incidents are shown as small yellow dots. ISPARK reduces the average
PASSAGE: A Travel Safety Assistant With Safe Path Recommendations For Pedestrians

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Abstract
Atlanta has consistently ranked as one of the most dangerous cities in America with over 2.5 million crime events recorded within the past six years. People who commute by walking are highly susceptible to crime here. To address this problem, this group has developed a mobile application, PASSAGE, that uses GPS data and crime data to find "safe" paths in Atlanta.

Author Information
Safe Path Application
Pulse
ACM
C3 H.5.ML
Usefulness of History

Figure 1: Paths recommended by PASSAGE...
“I feel like the concepts from your class are like a rite of passage for an aspiring data scientist. Assignments lead to a feelings of accomplishment and truly progressing in my area of passion.”

“I really get more intuition about how to deal with data with some powerful tools in HW3 [uses AWS]. That feeling is beyond description for me.”

“I would like to say thank you for your class! Thanks to the skills I got from the class and the project, I got the offer.”
What is the expectation from you

- Actively participate throughout the course!
- Ask questions during class and on Piazza
- Help out whenever you can, e.g., help answer questions on Piazza (It will involve bonus points)
- I will reserve last few minutes of every class for Q&A