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/cx4242-2019fall-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!

Manasa Gogineni Vatsal Srivastava

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
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*
Data Insights
How to do that?

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

**Artificial Intelligence**

+ **Human Intelligence**
How to do that?

**COMPUTATION**

Automatic
User-driven; iterative
Summarization, clustering, classification

**INTERACTIVE VIS**

Both develop making sense of millions of nodes thousands of nodes
### Our Approach for Big Data Analytics

<table>
<thead>
<tr>
<th>Data Mining</th>
<th>HCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic</td>
<td>User-driven; iterative</td>
</tr>
<tr>
<td>Summarization, clustering, classification</td>
<td>Interaction, visualization</td>
</tr>
<tr>
<td>&gt;Millions of items</td>
<td>Thousands of items</td>
</tr>
</tbody>
</table>

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/cx4242-2019fall-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!

There are multiple CX4242 sections. This is the course homepage for campus CX4242A.
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 per day processed by Google: 24 petabytes
Tweets per day: 50 million
Total minutes spent on Facebook each month: 700 billion
Data sent and received by mobile internet users: 1.3 exabytes
Products ordered on Amazon per second: 72.9 items

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.

Sources: CNN.com/Science, Malini Bernard, Reddit, Survey, Twitter, YouTube

In partnership with IBM

http://spanning.com/blog/choosing-between-storage-based-and-unlimited-storage-for-cloud-data-backup/
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”.

- 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 to 6 people
• [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. HCl): 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.
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, our group has developed a mobile application, PASSAGE, that uses real-time crime data to find "safe paths" for users in Atlanta.

Authors
Safe Path Assistant
Pulse

ACM SIGGRAPH
H.5.2
Using, storing, and managing graphics

Information
Georgia Institute of Technology

Figure 1: Paths recommended by PASSAGE

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“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