Welcome to the second week.

We must continue to acknowledge that this is an incredibly challenging, uncertain, and deeply troubling time. This impacts the course and all of us.

In addition to the continuing and intensifying global pandemic, last Wednesday we witnessed an insurrection, the breeching of the Capitol by a violent mob incited by Trump.

I am sure you were profoundly saddened by these events and like me could do little but remain glued to coverage and the subsequent analysis.

My continuing hope is the course can be a bit of a respite, an opportunity to think about research ideas, be creative, and develop visualization skills.
Last week I gave some advice for grad students, provided an overview of the course, and discussed the beginnings of statistical graphics with William Playfield in the late 18th century.

I ended with pointing you to a video about Vega-Lite. The week 1 video is on website.

There are assigned readings in the two Tufte books starting in week 3.
Today I want to accomplish three things

1. Make an argument for the importance of visualization
2. Discuss the required readings from last week
3. Try an experiment to help people get to know each other a bit better

I expect your week was interrupted by the events of last Wednesday too. We will postpone going over initial selection of general topic choices. Only 6 people had filled out the form as of yesterday evening.
Researchers of the week: Martin Wattenburg & Fernanda Viégas

Co-lead Google's PAIR (People+AI Research) initiative @GoogleBrain. Both joining Harvard this year.

Viégas and Wattenberg came to visualization by separate paths. Her initial training was in design, and his was in mathematics and computer science. They joined forces in 2003 and began exploring the possibilities of visualization as a medium. Before joining Google, he and Viégas founded Flowing Media, Inc., a visualization studio focused on media and consumer-oriented projects. Prior to Flowing Media, they led IBM’s Visual Communication Lab, where they created the ground-breaking public visualization platform Many Eyes.
Martin Wattenburg & Fernanda Viégas

Model interpretability
Can machines explain the “why” behind their decisions? We’re investigating ways for people to understand more about ML models, starting with visualizations that look under the hood of complex systems. See this video: Visualiz...

Tools for health
We are investigating how AI technology and design can help the practice of clinicians and medical researchers.

Design & Machine Learning
https://pair.withgoogle.com/guidebook

PAIR @ Medium
Exploring perspectives from a diverse range of contributors on exploring perspectives on...

Explaining fairness
Policy tradeoffs in machine learning can be complex, but visualizations can help explain them.

Forecasting earthquake aftershock locations with AI-assisted science
What is visualization?
What is a visualization?

Definition [www.oed.com]

1. The action or fact of visualizing; the power or process of forming a mental picture or vision of something not actually present to the sight; a picture thus formed.

2. The action or process of rendering visible.
What is a visualization?

“Transformation of the symbolic into the geometric” [McCormick et al. 1987]

“... finding the artificial memory that best supports our natural means of perception.” [Bertin 1967]

“The use of computer-generated, interactive, visual representations of data to amplify cognition.”

[Card, Mackinlay, & Shneiderman 1999]
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Summary Statistics Linear Regression

\[ u_X = 9.0 \quad \sigma_X = 3.317 \quad Y = 3 + 0.5 \times X \]

\[ u_Y = 7.5 \sigma_Y = 2.03 \quad R^2 = 0.67 \]

[Anscombe 73]
Functions of visualizations

“Making the invisible visible and the abstract concrete.”

Record information (photographs, graphs, maps, …)

Support reasoning about information (process, calculate, reason, feedback, interaction)

Convey information to others (present, share and persuade, collaborate and revise, emphasize important aspects of data)
**Challenger 1986**

### HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

<table>
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<th>SRM No.</th>
<th>Cross Sectional View</th>
<th>Top View</th>
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<tr>
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<td>Erosion Depth (in.)</td>
<td>Perimeter Affected (deg.)</td>
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<tr>
<td>1A LH Center Field***</td>
<td>27A</td>
<td>NONE</td>
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<tr>
<td>61A LH Forward Field***</td>
<td>15A</td>
<td>0.010</td>
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<tr>
<td>61C LH Forward Field***</td>
<td>15B</td>
<td>0.038</td>
</tr>
<tr>
<td>61C RH Forward Field (sec)***</td>
<td>15B</td>
<td>0.038</td>
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<tr>
<td>41A RH Forward Field</td>
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<td>41B LH Forward Field</td>
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<tr>
<td>STS-2 RH Aft Field</td>
<td>2B</td>
<td>0.053</td>
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**NOT** gas path detected in putty. Indication of heat on O-ring, but no damage.

**Soot** behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

Other SRM-15 field joints had no blowholes in putty and no soot near or beyond the primary O-ring.

SRM-22 forward field joint had putty path to primary O-ring, but no O-ring erosion and no soot blown off. Other SRM-22 field joints had no blowholes in putty.

### BLOW BY HISTORY

**SRM-15 WORST BLOW-BY**
- 2 case joints (30°), (110°) Arc
- Much worse visually than SRM-22

**SRM-22 BLOW-BY**
- 2 case joints (30-40°)

**SRM-13A, 15, 16A, 18, 23A, 24A**
- Nozzle blow-by

### HISTORY OF O-RING TEMPERATURES (DEGREES F)

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<tr>
<th>MOTOR</th>
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<td>68</td>
<td>36</td>
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<td>76</td>
<td>45</td>
<td>52</td>
<td>10 MPH</td>
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<td>72.5</td>
<td>40</td>
<td>48</td>
<td>10 MPH</td>
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<td>QM-4</td>
<td>76</td>
<td>48</td>
<td>51</td>
<td>10 MPH</td>
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<td>52</td>
<td>64</td>
<td>53</td>
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<tr>
<td>SRM-22</td>
<td>77</td>
<td>78</td>
<td>75</td>
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<td>SRM-25</td>
<td>55</td>
<td>26</td>
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<td>25 MPH</td>
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Make a decision: Challenger
Make a decision: Challenger

Visualizations drawn by Tufte show how low temperatures damage O-rings [Tufte 97].

O-ring damage index, each launch

26°–29° range of forecasted temperatures (as of January 27, 1986) for the launch of space shuttle Challenger on January 28.
Why do we create visualizations?

Find relationships and patterns
Detect outliers
Answer questions
Frame a narrative
Communicate or show information
Engage a viewer (interactivity)
Draw attention
Present argument
Persuade
Make information easier/faster to grasp
Condense or summarize information
Provide a point of view
Make decisions
Inspire

During World War II, researchers at the Center for Naval Analysis faced a critical problem. Many bombers were getting shot down on runs over Germany. The naval researchers knew they needed hard data to solve this problem and went to work. After each mission, the bullet holes and damage from each returning bomber was painstakingly reviewed and recorded.
Data in context: Cholera outbreak
Data in context: Cholera outbreak
Inspire

Double helix model [Watson and Crick 53]
Florence Nightingale

“to affect thro’ the eyes what we fail to convey to the public through their word-proof ears”

Diagram of the Causes of Mortality in the Army in the East.
Visual Proofs

Pythagorean Theorem
Chinese Proof By Dissection
Tufte/Blinn Videos

~9 minutes in Jim Blinn Matematica Series

Behold
Kantor’s Diagonal Proof Reals are Uncountably Infinite
Donald Schön studied professionals—especially professional designers—for many years. Although his academic home at MIT was in a department of urban design, his subjects of interest have ranged from psychiatrists and social workers to architects and jazz musicians.

After observing and interviewing practitioners in many domains, Schön was able to characterize the common elements in their practices and their ways of teaching new practitioners.

In *The Reflective Practitioner* Schön drew on examples from these studies to outline the basics of what it means to have and to apply expertise.
CHS: Medium: A Human-Centered Information Space: Designing Dynamic Personalized Visual Information

Amy Rae Fox, Arvind Satyanarayan, Philip Gao, Bajian Xu, and James D. Hollan

Design Lab and Department of Cognitive Sciences, UC San Diego
Visiualization Group, Massachusetts Institute of Technology

Overview: The historical moment when a person worked in front of a single computer has passed. Computers are now ubiquitous and embedded in virtually every new device and content, ranging from the environment all the way to the complex web of autonomous systems that exist in every sphere of personal and professional life. They connect our activities to ever-expanding information resources with previously unimaginable computational power. With all this increase in capacity, speed, and connectivity, information-based activities are becoming essential to every facet of daily life.

The advent of CHS is a new way of thinking about information space that focuses on the individual and the role that personalized interaction and visualization can have in supporting the needs of an individual's daily life. The goal is to enable a new way of interacting with information spaces.

Falling Down the Rabbit Hole: Exploratory Search and The Case for Personal Information Environments

AMY RAE FOX, ROBERT KALFMAN, AND JAMES D. HOLLAN, University of California, San Diego

Fig. 1. New Yorker coverartist Kathryn Schulz writes that, "It is most purely Canadian stuff. It all starts when a rabbit hole means to stand still en route to discovering alternate realities [1]." (Illustration by anonymous)

Some describe the web browser as a window onto the world in progress; it may also a rabbit hole through which we fall. Despite twenty years of research on exploratory search (finding innovative algorithms, visualizations, and design-specific tools, the personal information activity frequently remains frustrating and ineffective. To understand the troubling gap between research effort and user experience, we conducted a six-month participatory design engagement. Through surveys, interviews, activity recording, and browse-logging, we observed how a common exploratory activity—Bing search—is distributed through implicit exceptions of tools, data, physical and digital spaces. In turn, we offer a conceptual reformation of “the problem of exploratory search” based on how modern web browsers are used as nonpersonalized personal information environments. We contribute a descriptive dataset, uncharted problem space, and argument for how understanding the shared context of exploratory search can yield progress on this all-too-personal problem.

CCS Concepts: Human-centered computing → HCI-theory concepts and models; Empirical studies in HCI → Information systems → Search systems.


ACM Reference Format:

Communicating with Interactive Articles

Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.
Online Mingling: Supporting Ad Hoc, Private Conversations at Virtual Conferences

16 Pages • Posted: 4 Aug 2020

Jaeyoon Song
Massachusetts Institute of Technology (MIT) - Sloan School of Management

Christoph Riedl
Northeastern University - D'Amore-McKim School of Business; Northeastern University - College of Computer and Information Science; Harvard University - Institute for Quantitative Social Science

Thomas W. Malone
Massachusetts Institute of Technology (MIT) - Sloan School of Management

Date Written: July 31, 2020

Abstract
Even though many people have found today's commonly used videoconferencing systems very useful, these systems do not provide support for one of the most important aspects of in-person meetings: the ad hoc, private conversations that happen before, after, and during the breaks of scheduled events—the proverbial hallway conversations. Here we describe our design of a simple system, called Minglr, which supports this kind of interaction by facilitating the efficient matching of conversational partners. We also describe a study of this system's use at the ACM Collective Intelligence 2020 virtual conference. Analysis of our survey and system log data provides evidence for the usefulness of this capability, showing, for example, that 86% of people who used the system successfully at the conference thought that future virtual conferences should include a tool with similar functionality. We expect similar functionality to be incorporated in other videoconferencing systems and to be useful for many other kinds of business and social meetings, thus increasing the desirability and feasibility of many kinds of remote work and socializing.

MINGLR

• This is beta test software!
• Be sure to mute your Zoom microphone before going to Minglr.
• Minglr works best with the Chrome browser (except on iOS systems where you should use Safari).
• If you have Google or Facebook accounts, you can sign in with them.
• If not, you can click “sign up with email” and create a new account and password for yourself.
• If you need technical help, send email to minglr.cs@gmail.com.
Breakout Rooms