

Design Topic: Data and Visualization

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SOCS McGill University

Agenda

- Design for ML End-User
- Design for Visual Analytics

End-User Visualization

- Setup Expectations
- Gain control of the ML performance
- Communicating uncertainty

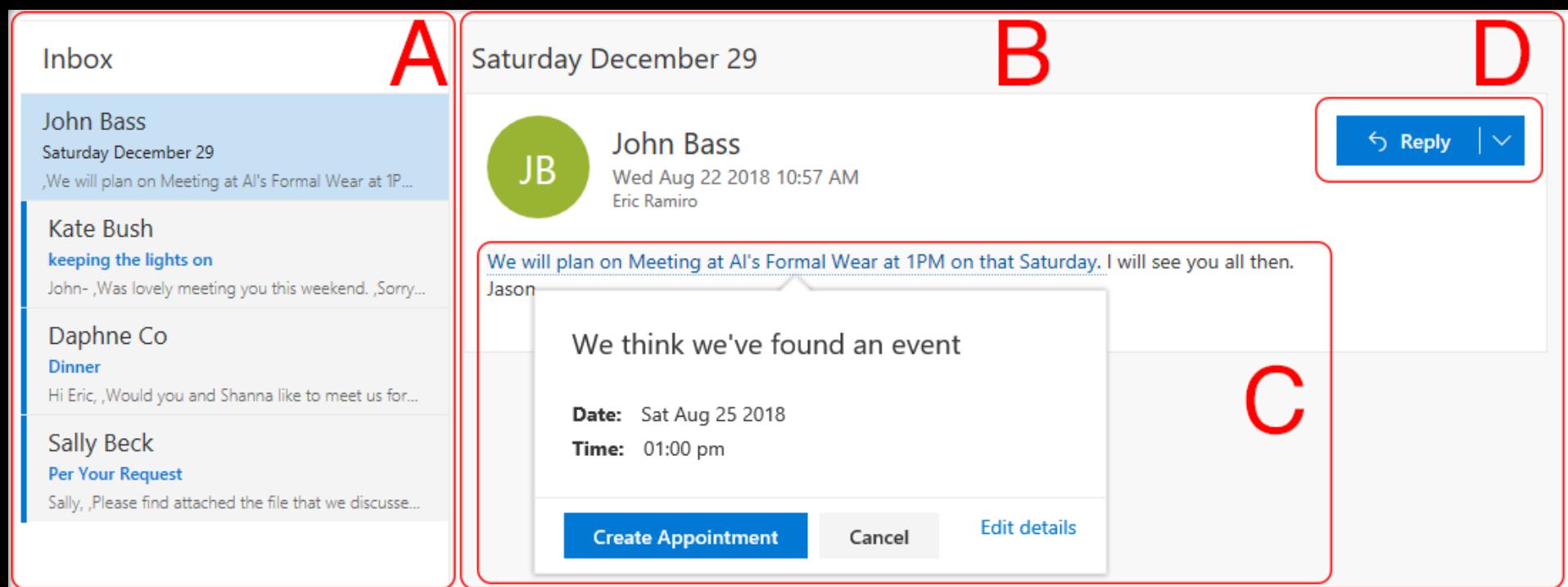


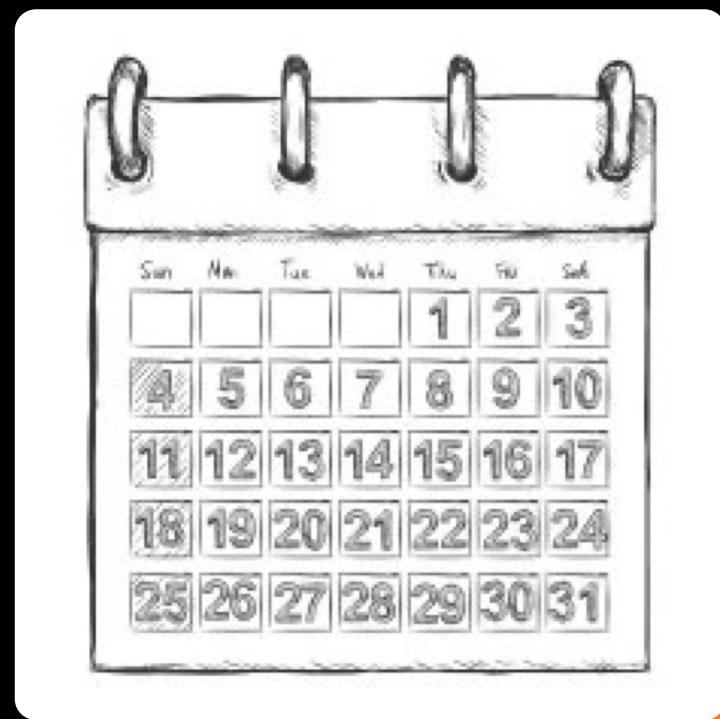
Figure 2: Screenshot of the Scheduling Assistant interface mimicking the inbox part of a web interface of a popular email client - Microsoft (MS) Outlook. A) list of emails in the inbox, B) content of the selected emails, C) the AI functionality - detection and highlighting of email requests from free-text, D) reply button allowing user to either reply with text or schedule a meeting manually

Kocielnik, Rafal, Saleema Amershi, and Paul N. Bennett. "Will you accept an imperfect ai? exploring designs for adjusting end-user expectations of ai systems." In CHI'2019, pp. 1-14. 2019.

Activity

- Design a strategy and corresponding interface to communicate the ML performance to the user

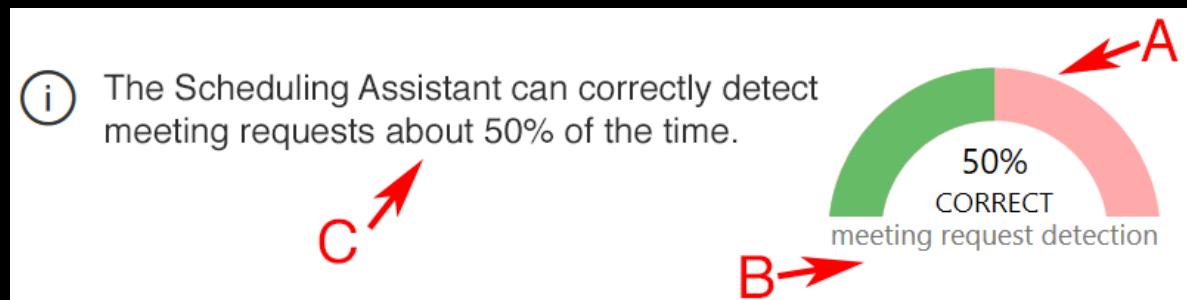
*An accuracy of 50%, a recall of 38.5%
and a precision of 71.4%.*



Self Assessment

- Is your communication simple enough for everyday user to interpret?
- Have you combined the use of text and visualization for communicating statistic aspects of the algorithm?
- Have you used examples to explain the capacity and limitation of the ML component.

Accuracy Indicator



What about recall and precision? What is important to the user? Do you think the gauge chart is still effective?

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Example-Based Explanation

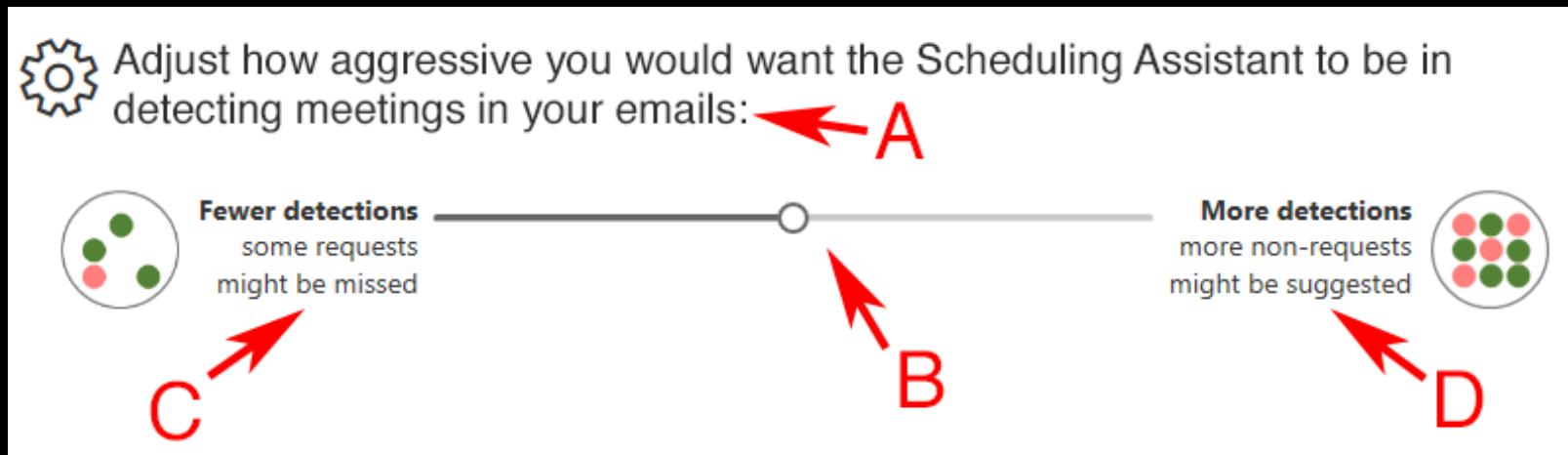
 The Scheduling Assistant examines each sentence separately and looks for meeting related phrases to make a decision.  C

<u>Example sentences</u>	<u>Scheduling Assistant's detection</u>
Let's meet this Friday at 12:30 for 30 mins in the main conference room	 Very likely a meeting request
Can we discuss this tomorrow at 5pm?	 Likely a meeting request 
Can we discuss in the morning? 	 Unlikely a meeting request
Have a great trip!	 Very unlikely a meeting request

Any improvement ideas?

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User Control

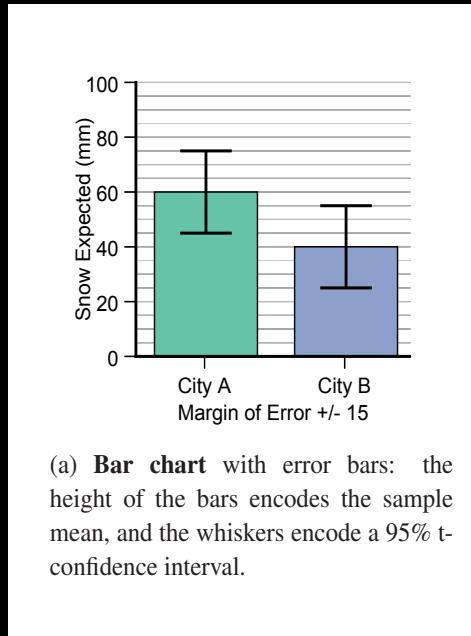


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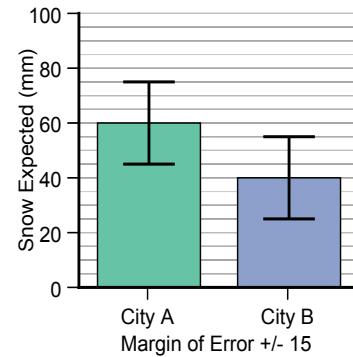
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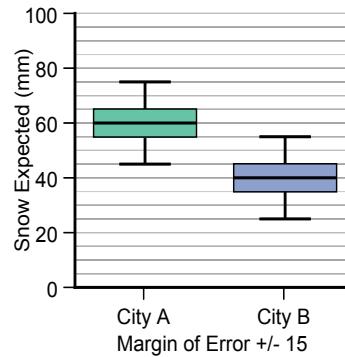
Communicate Uncertainty



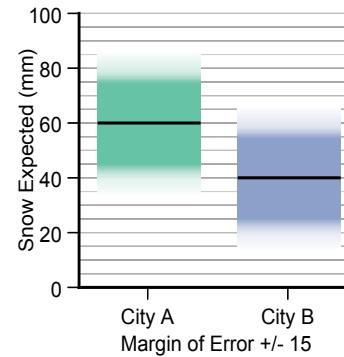
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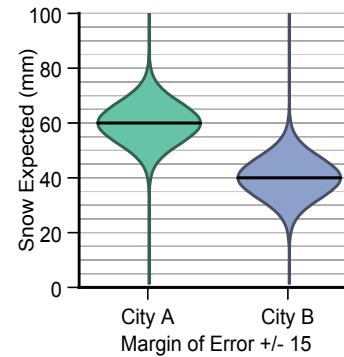
(a) **Bar chart** with error bars: the height of the bars encodes the sample mean, and the whiskers encode a 95% t-confidence interval.



(b) **Modified box plot:** The whiskers are the 95% t-confidence interval, the box is a 50% t-confidence interval.



(c) **Gradient plot:** the transparency of the colored region corresponds to the cumulative density function of a t-distribution.



(d) **Violin plot:** the width of the colored region corresponds to the probability density function of a t-distribution.

Transit Prediction

What questions user hope to ask?

- When to leave
- Wait time
- Time to next bus
- Schedule risk
- Schedule opportunity



Activity

What information need to be presented to the user?
In what way?



Design Requirements

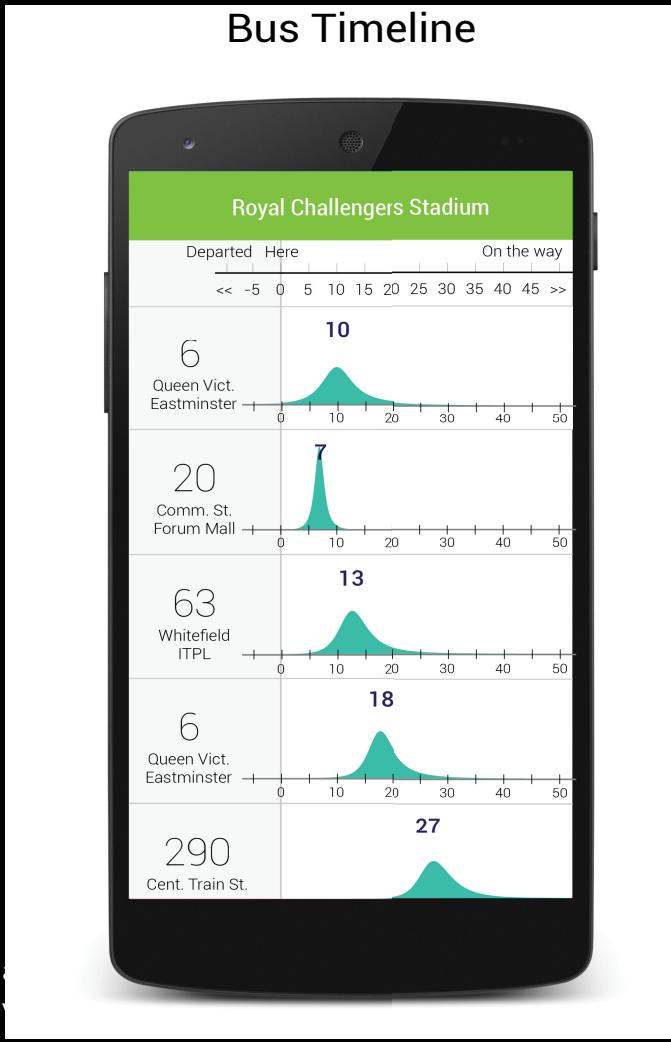
- Point estimate of time to arrival
- Probabilistic estimate of time to arrival

Kay, Matthew, Tara Kola, Jessica R. Hullman, and Sean A. Munson. "When (ish) is my bus? user-centered visualizations of uncertainty in everyday, mobile predictive systems." In *CHI'2016*, pp. 5092-5103. 2016

Design Requirements

- Point estimate of time to arrival
- Probabilistic estimate of time to arrival
- Probabilistic estimate of arrival status
- Data freshness

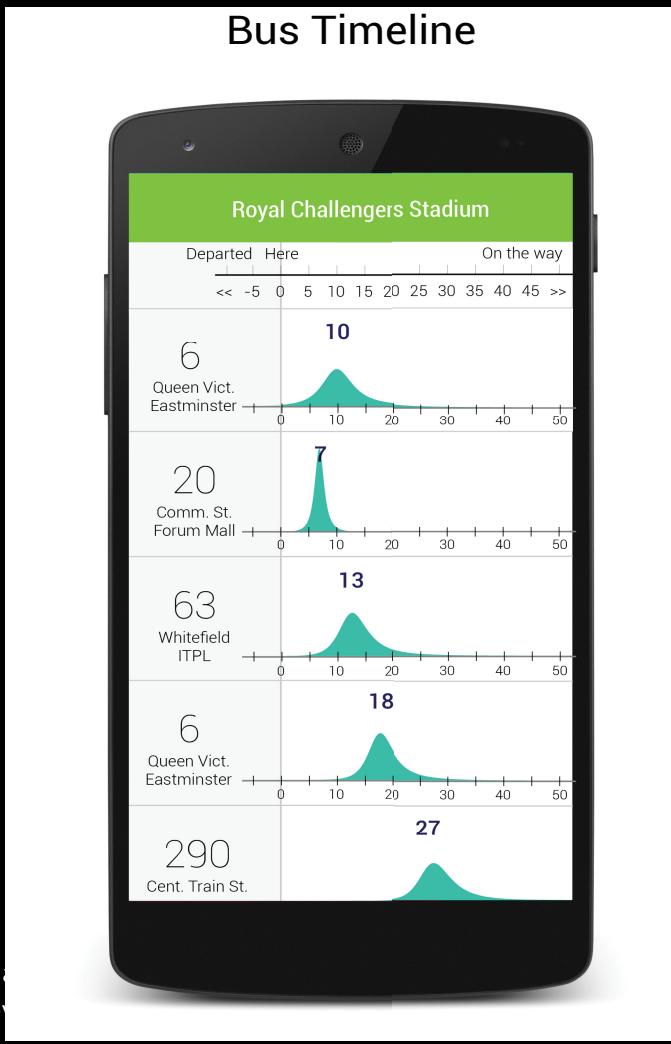
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centered visualizations of uncertainty in event
5092-5103. 2016



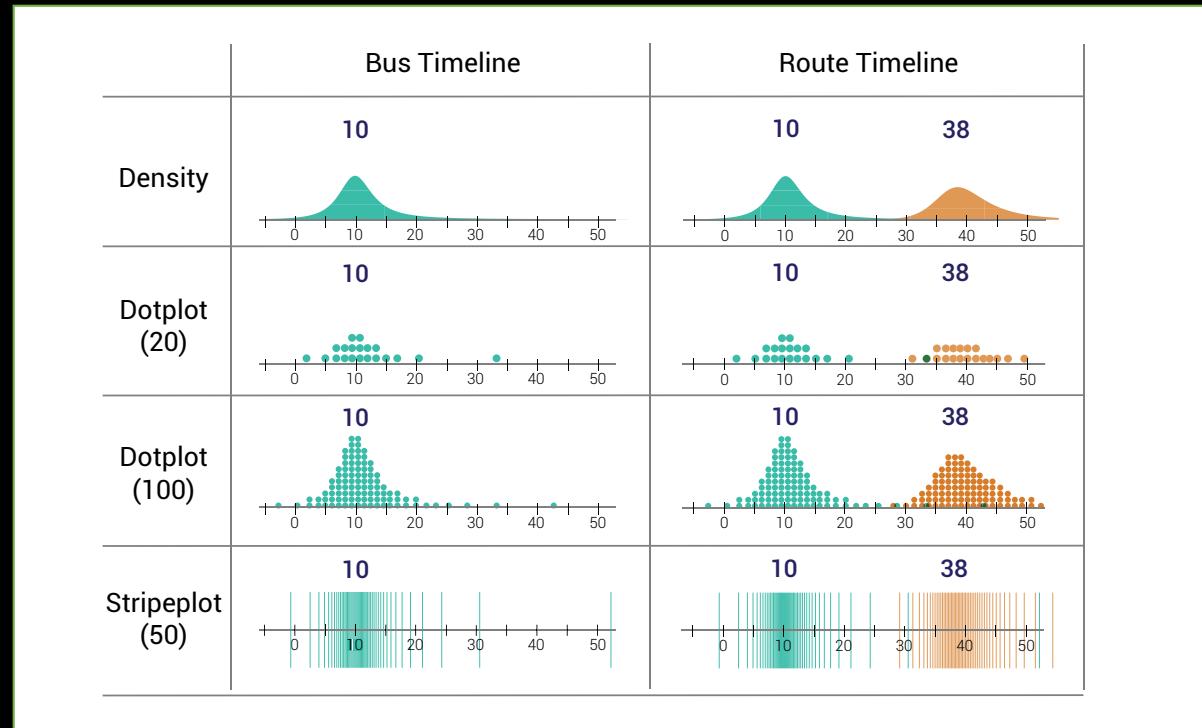
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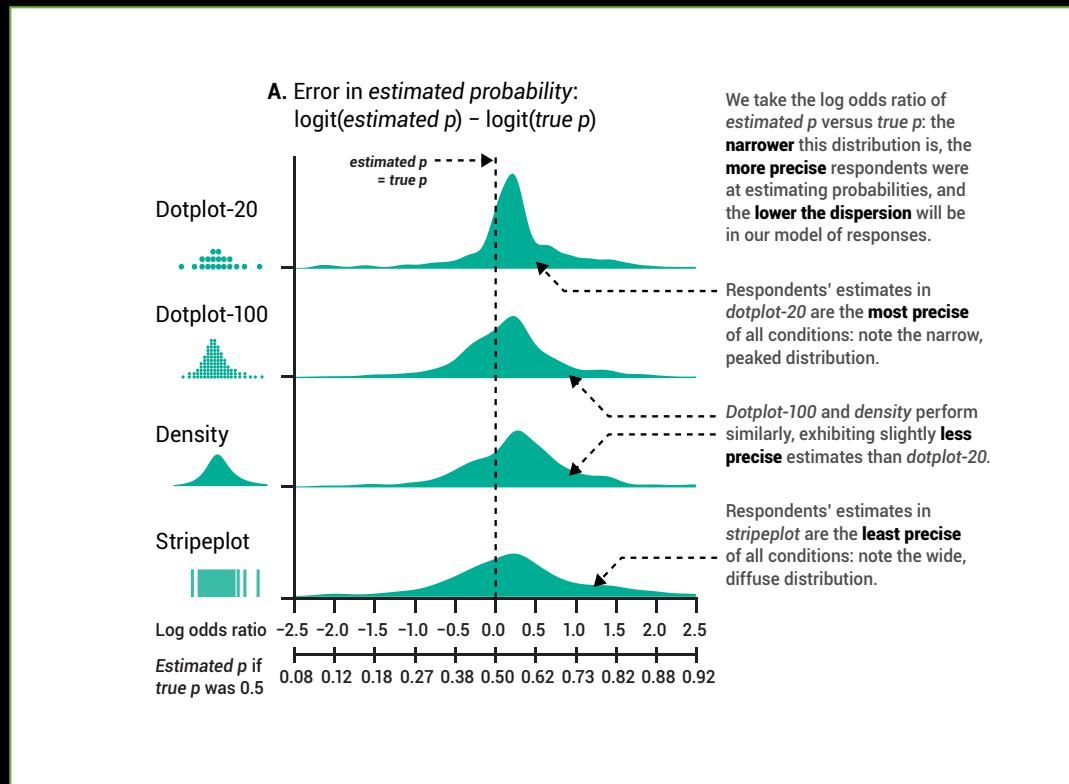


Encoding probability in space-constrained environments



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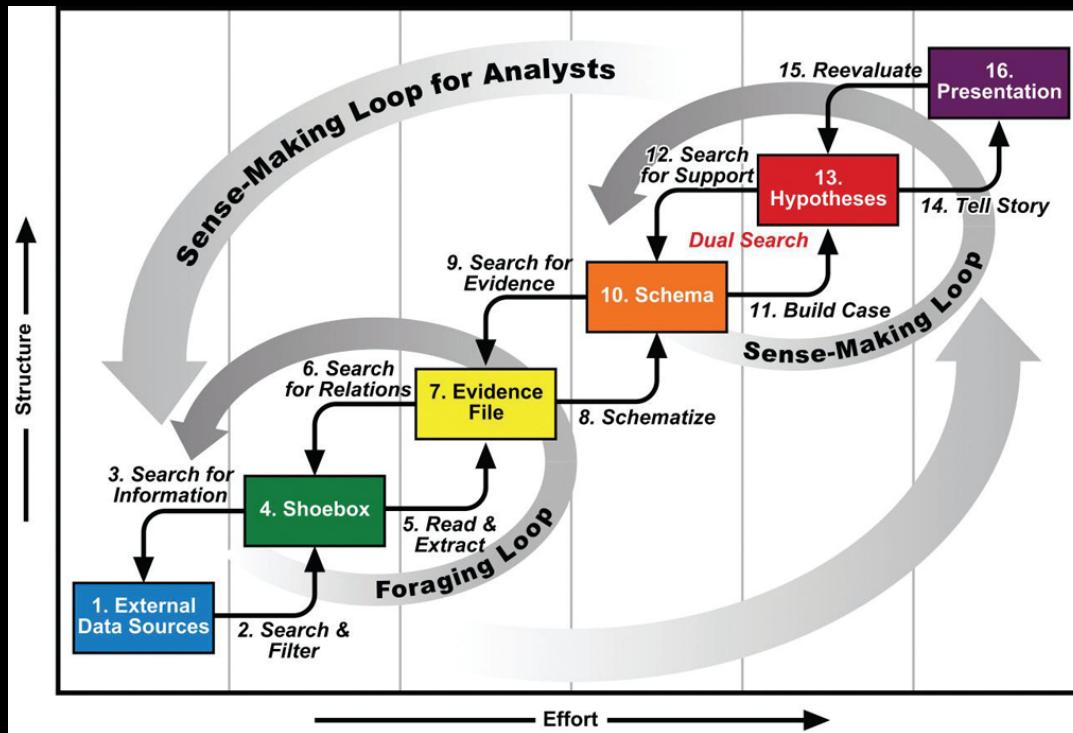
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Visual Analytics

- Sensemaking
- Analytical reasoning

*For Interactive Data
Visualization*

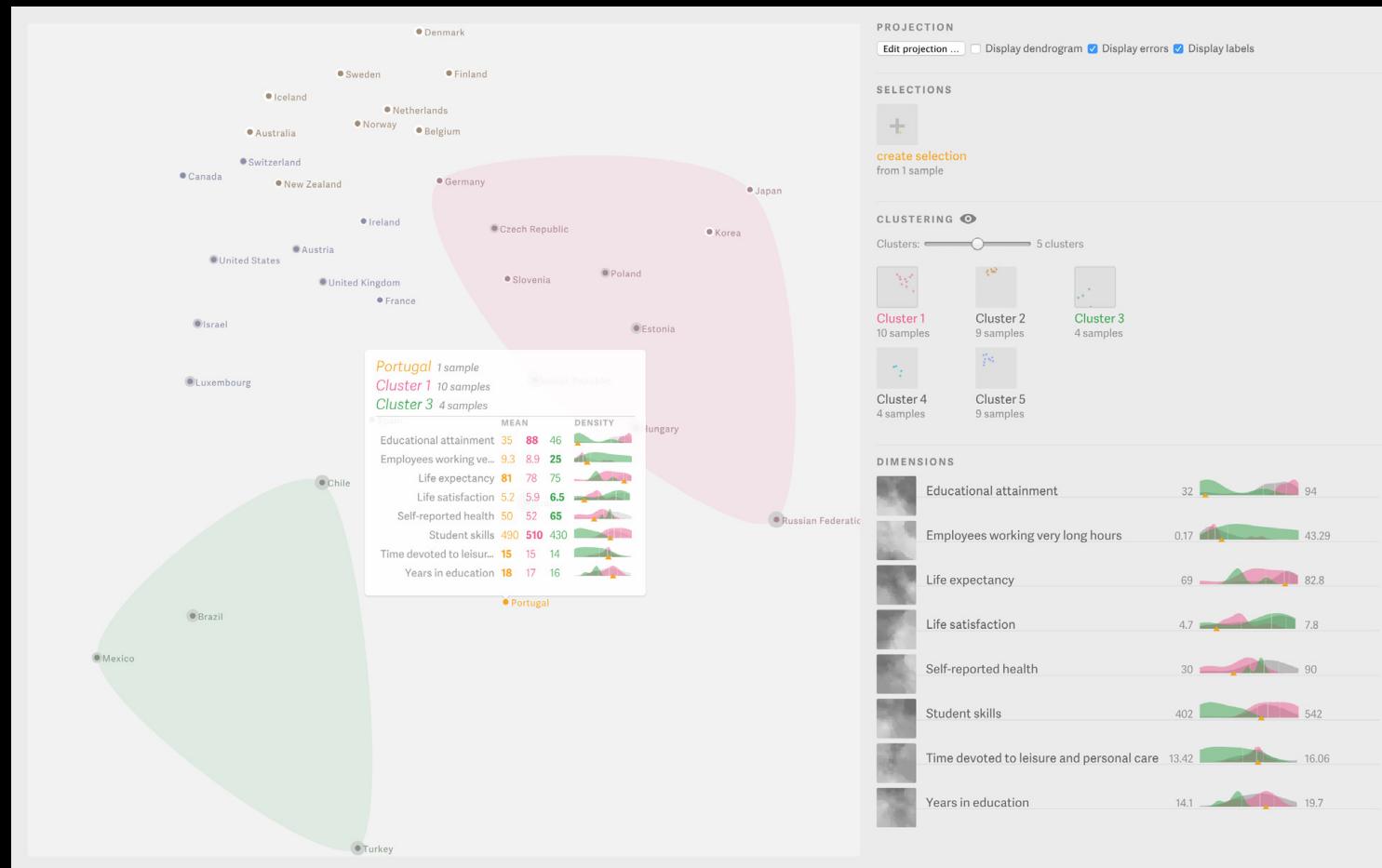




PIROLI P., CARD S.: The sensemaking process and leverage points for analyst technology as identified through cognitive task analysis. In *Proceedings of International Conference on Intelligence Analysis* (2005), vol. 5, pp. 2–4.

ML Methods used in Visual Analytics

- Dimension reduction
- Clustering
- Classification
- Regression



Stahnke, Julian, Marian Dörk, Boris Müller, and Andreas Thom. "Probing projections: Interaction techniques for interpreting arrangements and errors of dimensionality reductions." *IEEE transactions on visualization and computer graphics* 22, no. 1 (2015): 629-638.

Application Domains

- Text analytics and topic modeling
- Multimedia visual analytics
- Streaming data
- Biological data
- ...

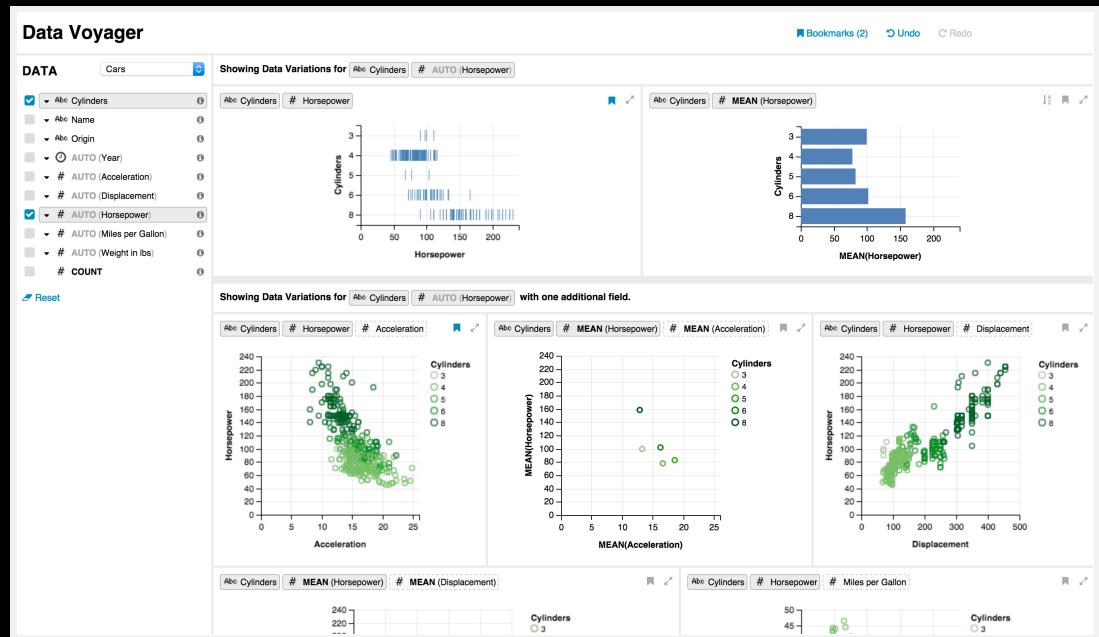
Endert, Alex, William Ribarsky, Cagatay Turkay, BL William Wong, Ian Nabney, I. Díaz Blanco, and Fabrice Rossi. "The state of the art in integrating machine learning into visual analytics." In *Computer Graphics Forum*, vol. 36, no. 8, pp. 458-486. 2017.

Activity

- Choose one of the two cases.
 - Examine what kind of tasks can be supported by this tool?
 - What are the interface design?
 - What role does the interaction with the user take during visual analytics, if any? How effective do you think it is?
 - How is ML used, if any, in this tool?
 - How can the design be improved?

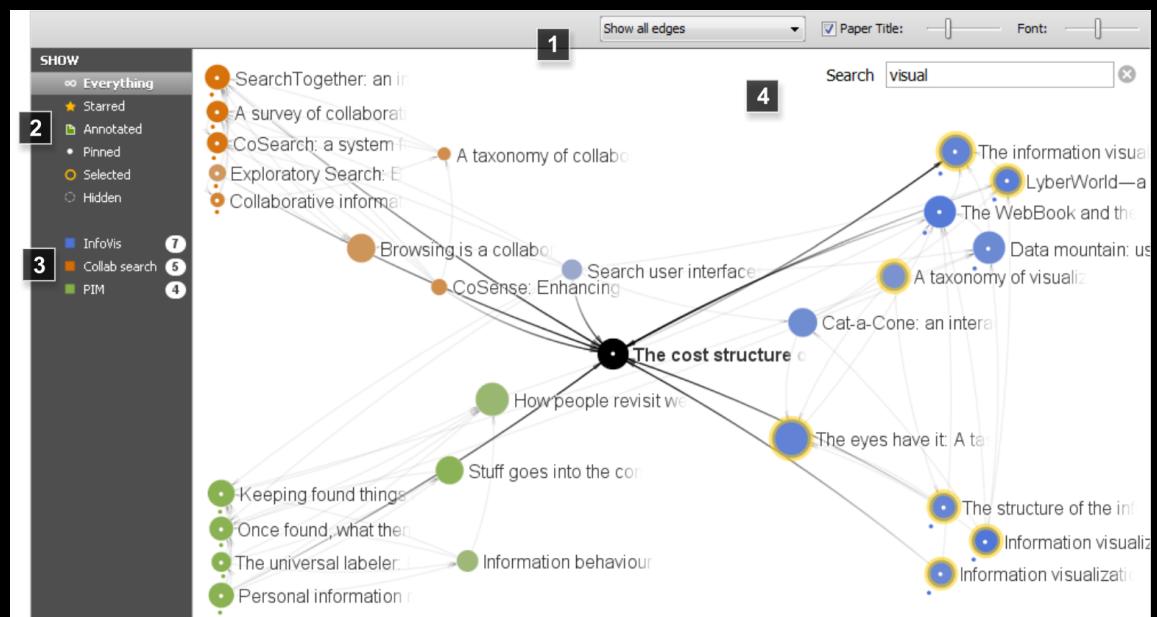
Case1

- Wongsuphasawat, Kanit, Dominik Moritz, Anushka Anand, Jock Mackinlay, Bill Howe, and Jeffrey Heer.
"Voyager: Exploratory analysis via faceted browsing of visualization recommendations." *IEEE transactions on visualization and computer graphics* 22, no. 1 (2015): 649-658.



Case2

- Chau, Duen Horng, Aniket Kittur, Jason I. Hong, and Christos Faloutsos. "Apolo: making sense of large network data by combining rich user interaction and machine learning." In *Proceedings of the SIGCHI conference on human factors in computing systems*, pp. 167-176. 2011.



Next on Thursday

Design for Decision Making