主题讲座：适合**DVA Lab**同学体质的论文阅读教程

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论文是什么

- What：论文究竟是个啥？

  A research paper is a type of academic writing that provides an in-depth analysis, evaluation, or interpretation of a single topic, based on empirical evidence.
  研究论文是一种学术写作类型，它根据经验证据对单一主题进行深入分析、评价或解释。

- Why：为啥要写论文？

  Research papers are an excellent platform to disseminate a novel finding to a general or focused audience, which may be interested in replicating the experiments; identifying novel applications for the finding, etc., as well as to popularize your research to the world and prevent duplication of the study..
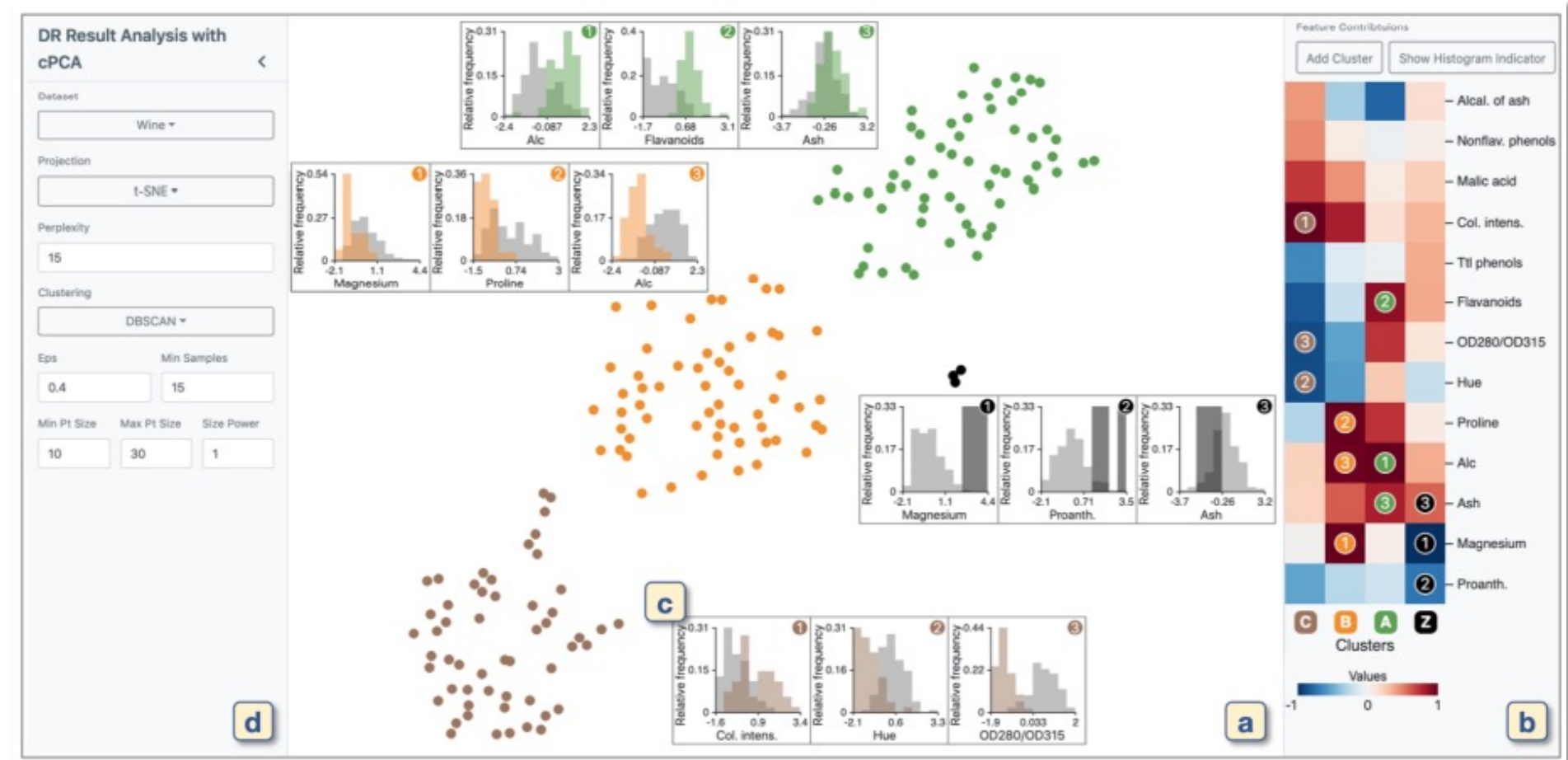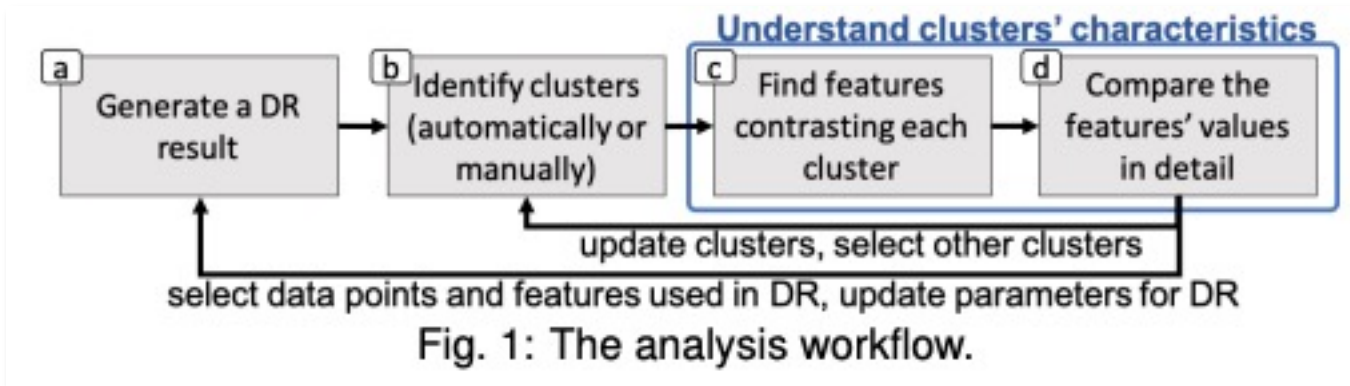 研究论文是一个很好的平台，可以向一般或重点受众传播一个新的发现，他们可能对复制实验感兴趣；确定该发现的新应用等，也可以向全世界普及你的研究，防止研究的重复。

可视化会议中的论文类型

- Algorithm & Technique
- Design Study
- Evaluation
- System

- 但是很多时候，论文分类不一定非常典型
  - 以下是一些IEEE VIS "官方" 展示的典型示例

Algorithm & Technique

- Focus on novel algorithms and an implementation
  - E.g., a new algorithm that refines or improves a technique proposed in previous work
  - Keywords:
    - Accuracy
    - Speed
    - Memory
    - etc.

Fig. 1: The analysis workflow.

Fujiwara, T., Kwon, O.-H., & Ma, K.-L. (2019). Supporting Analysis of Dimensionality Reduction Results with Contrastive Learning. IEEE Transactions on Visualization and Computer Graphics, PP(c), 1. https://doi.org/10.1109/TVCG.2019.2934251
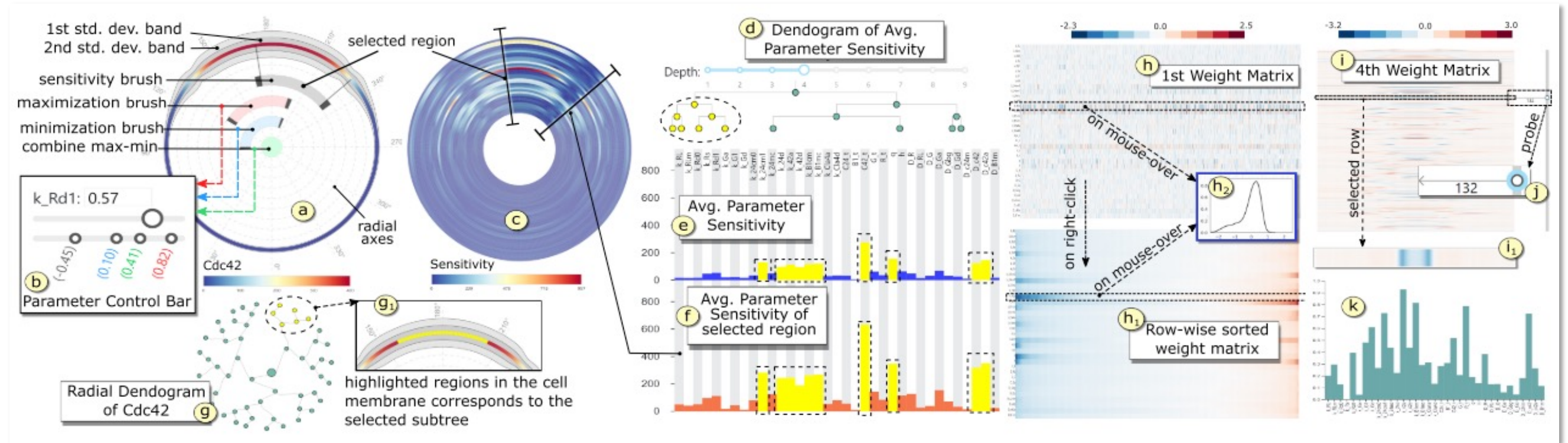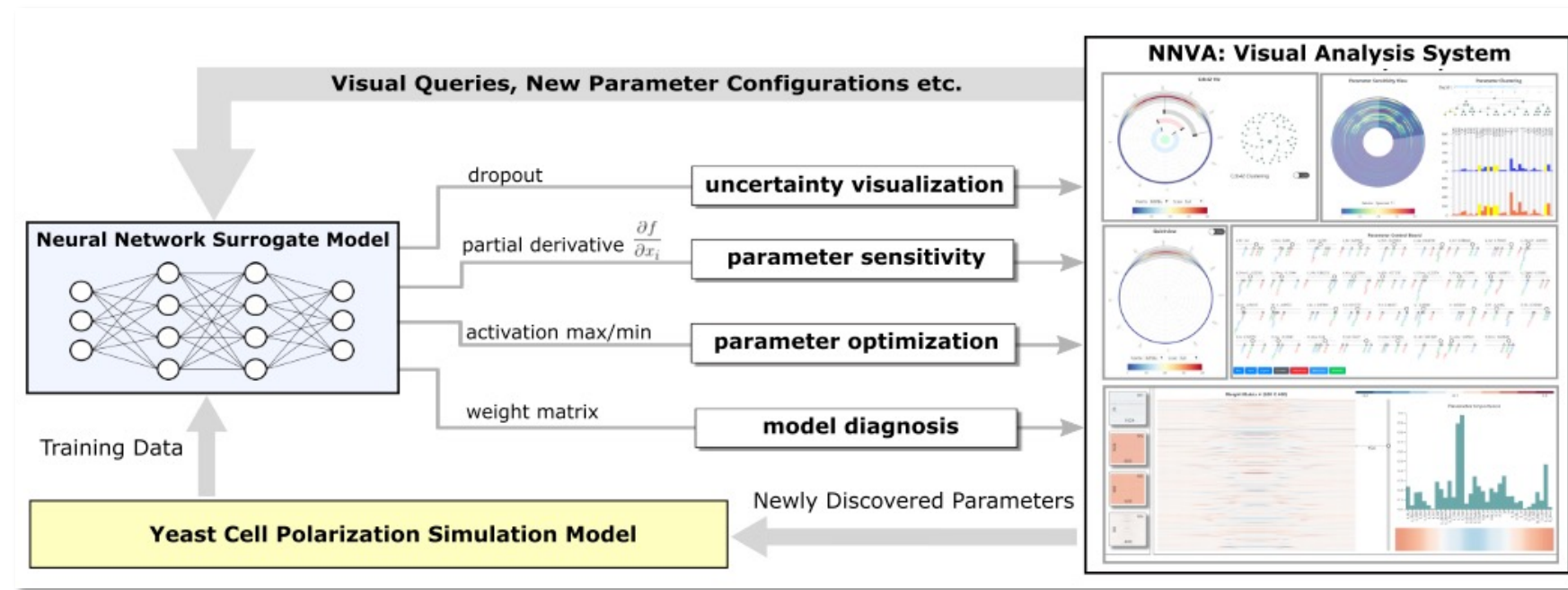
Design Study

- A new visual representation that is a suitable solution for a particular domain problem
  - E.g. visual analytics frameworks
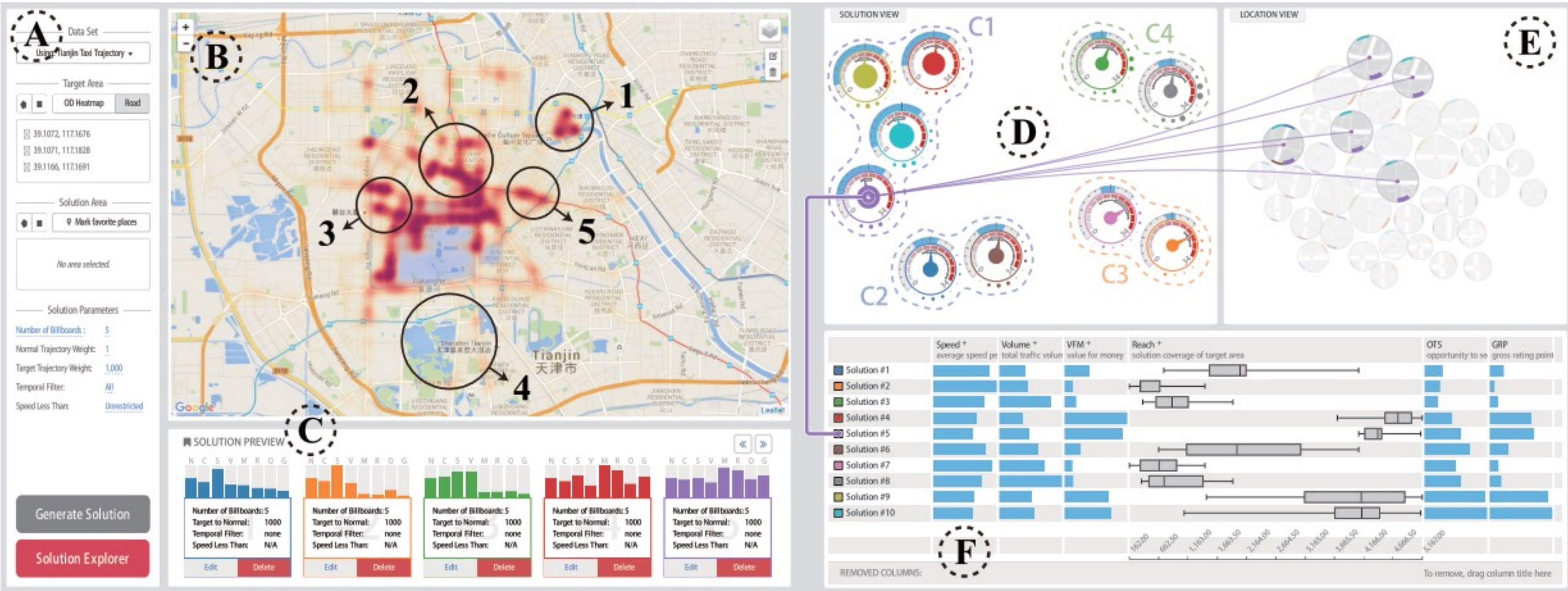
Liu, D., Weng, D., Li, Y., Bao, J., Zheng, Y., Qu, H., & Wu, Y. (2017). SmartAdP: Visual Analytics of Large-scale Taxi Trajectories for Selecting Billboard Locations. IEEE Transactions on Visualization and Computer Graphics, 23(1), 1–10. https://doi.org/10.1109/TVCG.2016.2598432

Hazarika, S., Li, H., Wang, K.-C., Shen, H.-W., & Chou, C.-S. (2020). NNVA: Neural Network Assisted Visual Analysis of Yeast Cell Polarization Simulation. IEEE Transactions on Visualization and Computer Graphics, 26(1), 34–44. https://doi.org/10.1109/TVCG.2019.2934591

Evaluation

- Assessing how an infovis system or technique is used by some target population
  - (Typically) do not introduce new techniques or algorithms
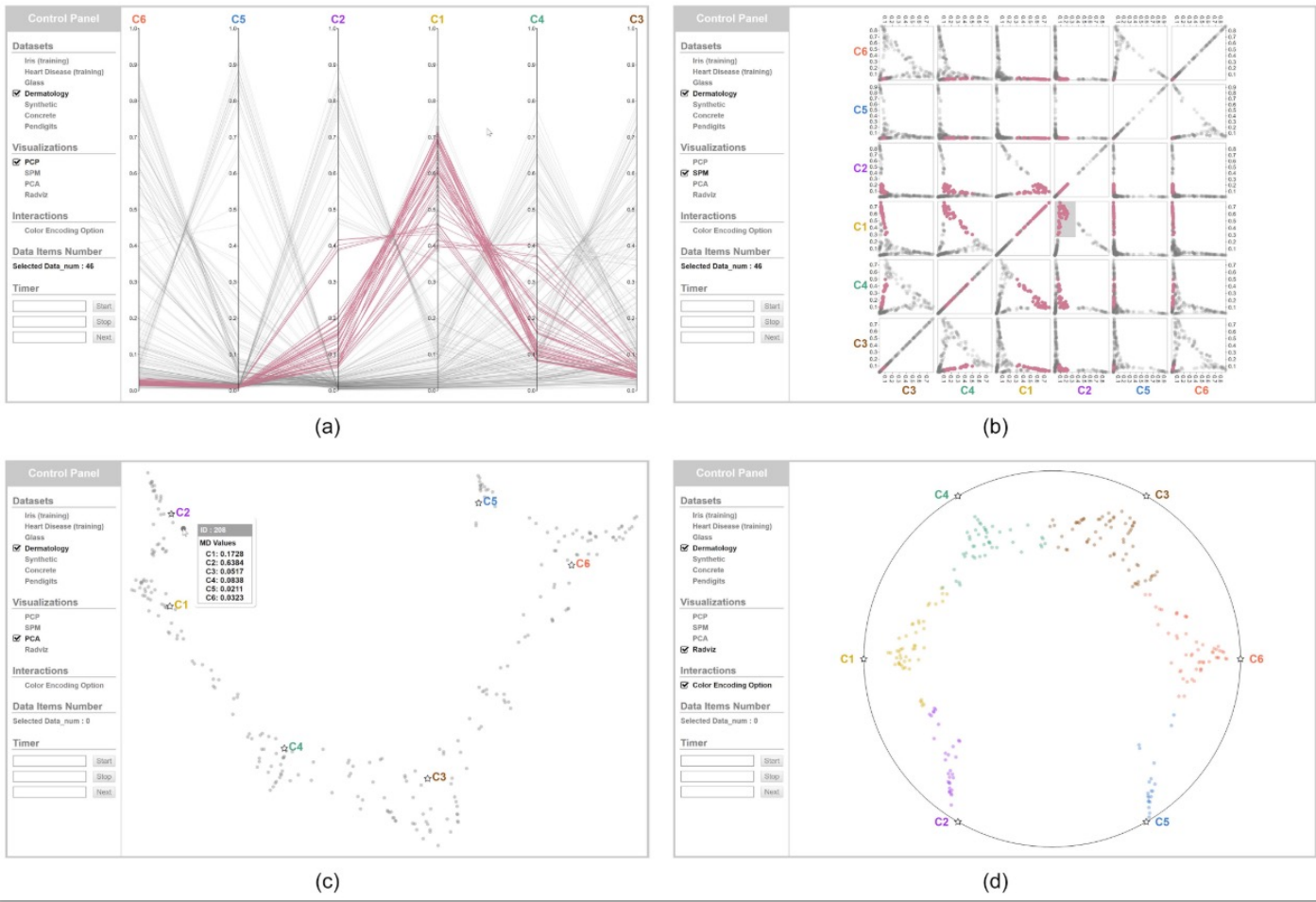 - (Often) use implementations described in previous work

(a)   (b)   (c)   (d)

Table 1. Analytical tasks and representative questions.

Tasks		Questions
Data-oriented Tasks	T1. Information recognition of a data item	Q1. Membership information of a data item: What are the maximum and minimum MDs of a given data item?
		Q2. Stability of a data item: Is a given data item stable? (PS: If a data item belongs to one cluster with a dominant high MD, then it is stable; otherwise, it is unstable.)
	T2. Information recognition of a data group	Q3. Stability of a data group: Are more stable data items than unstable data items presented in a given data group?
Cluster-oriented Tasks	T3. Information recognition of a single cluster	Q4. Membership information of a single cluster: What are the maximum and minimum MDs of a given cluster?
		Q5. Dominant cluster: Does a dominant cluster exist in a fuzzy clustering result? (PS: According to the maximum MD principle, if the number of data items partitioned into a cluster is significantly greater than that of other clusters, then the cluster is a dominant cluster.)
	T4. Information recognition of a cluster group	Q6. Similarities betw... membership distribu...
		Q7. Correlations betw... correlations? (PS: If the membersh... or decrease simultan...

Figure 3. Results of mean accuracy (a), mean time (b), and mean satisfaction score (c) in solving each question with the four visualization techniques. Colors indicate groups of no significant pairwise differences, with the winners shown in dark blue, losers in gray, and the ones in between in light blue. Taking Q7 in (a) as an example, the four fields have various colors that reflect the significant differences; the dark blue SPM is the winner, and the gray PCP is the loser, whereas the fields of PCA and Radviz are light blue, which indicates that they are in between and that no significant difference exists between them.
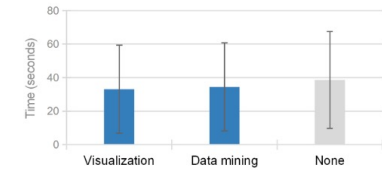

Figure 4. Results of the mean time of the volunteers with different academic backgrounds. Different colors indicate that there are significant differences among corresponding groups. The volunteers with a visualization background or a data mining background have a significant advantage over the volunteers with no background, while no significant difference exists between the former two groups of volunteers.
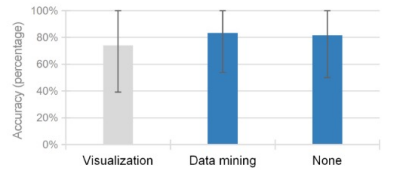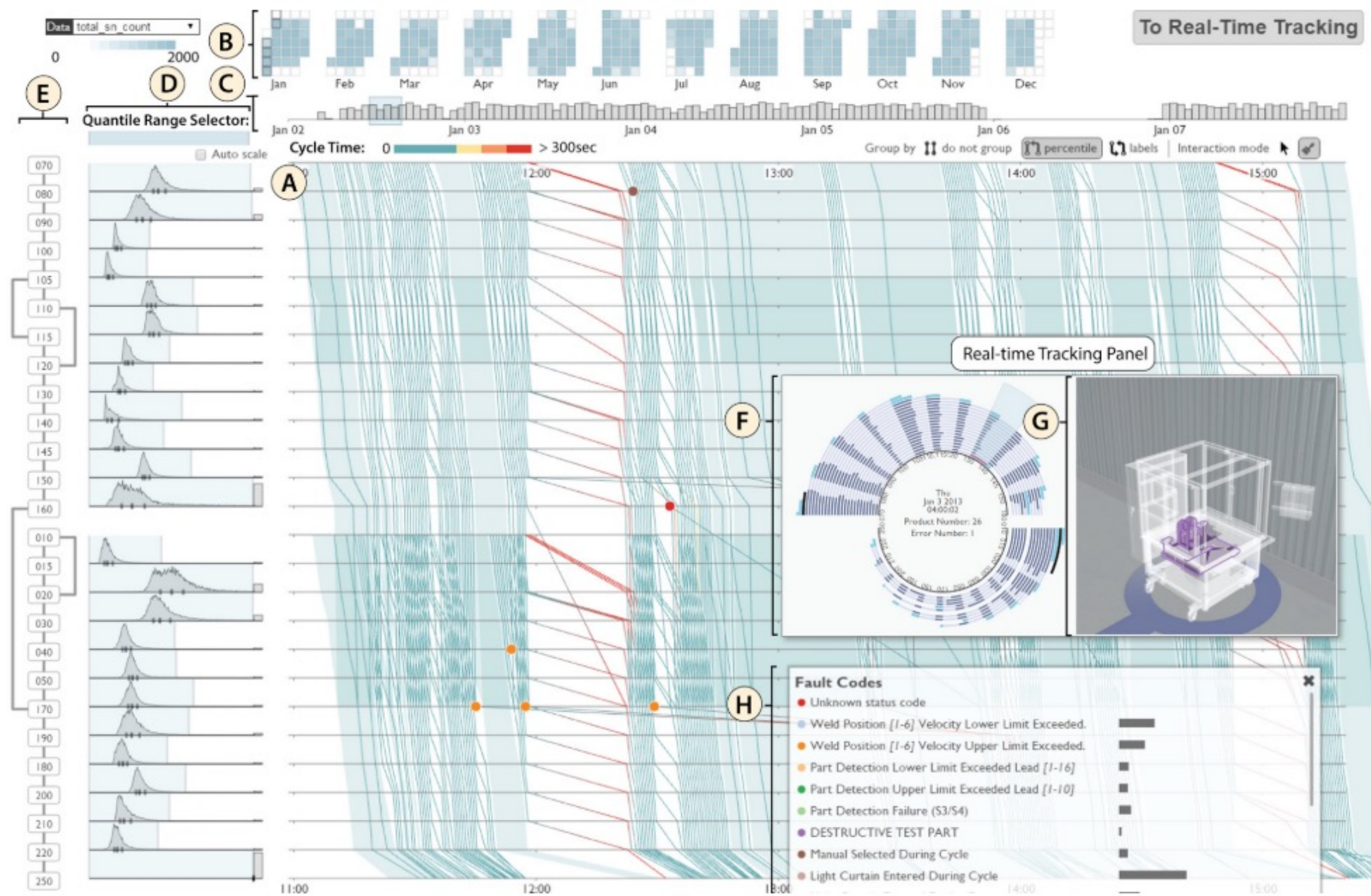
Figure 5. Results of the mean accuracy of the volunteers with different academic backgrounds. Different colors indicate that there are significant differences among corresponding groups. The volunteers with a data mining background or no background have a significant advantage over the volunteers with a visualization background, while no significant difference exists between the former two groups of volunteers.

Zhao, Y., Luo, F., Chen, M., Wang, Y. Y., Xia, J., Zhou, F., Wang, Y. Y., Chen, Y., & Chen, W. (2018). Evaluating Multi-Dimensional Visualizations for Understanding Fuzzy Clusters. IEEE Transactions on Visualization and Computer Graphics, PP(c), 1. https://doi.org/10.1109/TVCG.2018.2865020

System

- Architectural choices made in the design of an infrastructure, framework, or toolkit
  - A systems paper (typically) does not introduce new techniques or algorithms
    - … and also does not introduce a new design for an application that solves a specific problem
  - Contribution: The *discussion* of *architectural design choices and abstractions* in a framework or library, not just a single application

- Sometimes it is difficult to tell the difference between design study and system papers

Xu, P., Mei, H., Ren, L., & Chen, W. (2017). ViDX: Visual Diagnostics of Assembly Line Performance in Smart Factories. IEEE Transactions on Visualization and Computer Graphics, 23(1), 291–300. https://doi.org/10.1109/TVCG.2016.2598664

Xie, C., Xu, W., & Mueller, K. (2018). A Visual Analytics Framework for the Detection of Anomalous Call Stack Trees in High Performance Computing Applications. IEEE Transactions on Visualization and Computer Graphics, PP(c), 1–1. https://doi.org/10.1109/TVCG.2018.2865026

不敢读论文？

- Just read it
  - 不要害怕开始
  - 有阅读才会有积累

论文阅读中常遇到的问题

- 1. 翻译成中文再读
  - 中文写完翻译成英文

- 2. 一字不落挨着读

- 3. 读完马冬梅，回头想：马什么梅？

- 4. 这概念是啥？那个概念又是啥？

论文阅读中常遇到的问题

- 1. 翻译成中文再读——**语言功底**
  - 另一角度的相关问题：中文写完翻译成英文

- 2. 一字不落挨着读——**分清主次**

- 3. 读完马冬梅，回头想：马什么梅？——**理清逻辑**

- 4. 这概念是啥？那个概念又是啥？——**基础概念和背景知识**

- **每个问题都可以展开成一个主题报告**

更加根源的一个问题：从哪里找论文？

- 自己找
  - 论文来源？
    - 大致了解每个领域的会议期刊等级（等级与工作质量一般呈正相关）
    - 可视化领域（按CCF论文等级排序）：
      - IEEE VIS、IEEE TVCG、ACM CHI、ACM CSCW、ACM UIST；
      - CGF、EuroVis
      - PacificVis
  - 论文主题？
    - 是否相关
    - 是否热门

  - 其他评估指标
    - 被引数
    - 是否有媒体曝光
  - 工具
    - Google Scholar（泛搜）
    - ACM Portal、IEEE Xplore（泛搜+精搜）

更加根源的一个问题：从哪里找论文？

- 从引文中找
  - （与后续话题相关）

- 问别人
  - 发挥主观能动性

语言功底

- Practice makes perfect
  - 在不同场合使用英语
    - 包括但不限于：手机界面/电脑界面/游戏界面改为英文；阅读英语读物；刷英文视频
  - 在英语环境下生活一段时间
  - 有意识不要直接翻译

分清主次

- 阅读目的（由浅到深）
  - 快速阅读（以判断是否需要精读）
  - 略读（理解idea、concept）
  - 精读（详细阅读方法）

分清主次

- 阅读目的（由浅到深）
  - 快速阅读（以判断是否需要精读）
  - 略读（理解idea、concept）
  - 精读（详细阅读方法）← 只有这里才（大致）需要一句一句读

- 注意：concept和implementation的区别
  - concept是论文的high-level idea，是一个解决问题的思路
  - implementation则是具体的方法
  - 大部分情况下了解concept就可以，只有需要深入理解一篇论文或者要复现它时，才需要关注到具体的实现。

理清逻辑

- 文章"八股"
  - 例：Introduction
    - 背景；
    - 动机；
    - 当前方法的不足；
    - 作者做了什么？；
    - 新方法的优点；
    - 贡献总结

理清逻辑

- 带着问题去阅读——高中阅读，托福/雅思阅读
  - 阅读过程中填答案
  - <u>无必要</u>，不纠结细节
    - 注意前提"无必要"，比如略读/快速搜索相关文献时
    - 有必要时，可以层次、渐进地深入细节

- 描述性问题（基础要求）
  - 论文的核心问题是什么？
  - 论文的核心贡献是什么？
  - 论文的方法大致是什么？
  - 论文的方法有什么优点？

理清逻辑

- 带着问题去阅读——想想高考阅读、托福/雅思阅读
  - 阅读过程中填答案
  - 无必要，不纠结细节
    - 注意前提"无必要"，比如略读/快速搜索相关文献时
    - 有必要时，可以层次、渐进地深入细节

- 发散性问题（进阶要求）
  - 论文的核心问题是什么？这是一个新问题还是老问题？是否是个好的科研问题？
  - 论文的核心贡献是什么？是否足够有意义？
  - 论文的方法大致是什么？新方法还是老方法？能否有效解决问题？作者是如何验证的？
  - 论文的方法有什么优点（作者自己说的）和缺点（作者可能没说的）？
  - 论文的问题/方法是否能泛化或者有启发意义？

基础概念和背景知识

- 加强基础知识学习
  - 教科书&基础论文：集大成者，基础概念
  - 综述性论文：前沿汇总
  - 总结：还是要多读

- "论文引用树"
  - 读一篇文章——扩展到引用（甚至引用的引用）

- 量变引起质变
  - 初期先把"量"堆上去

当我们有了大模型——

- 常用LLM服务：如ChatGPT、Claude、New Bing等等
  - 学会使用它们

- 可以协助的事情：
  - 快速论文总结（用于排除不需要看的论文）

- 很多好用的Prompt

- 从Stackoverflow-oriented programing到ChatGPT-oriented programming

当我们有了大模型——

- 然而，它**无法**代替你完成以下任务：
  - 代替你提高英文阅读水平
  - 代替你积累知识量、梳理知识体系
  - 代替你想新的idea

- 同时，大模型还有以下问题，使用时需要特别注意：
  - 不一定忠实于原文原意（模型可能出错）
    - 编造事实（相关地，容易道歉而不坚持事实）
  - 生成的内容是原文（**写作论文时需格外注意，否则会涉嫌抄袭**）

  大模型是很好的工具，要学会使用它。但它无法代替你的思考。

论文整理工具

- 有很多，大家可以多探索
  - Zotero
  - ReadPapers
  - 本地文件夹

  - Mendeley（本人在用）
    - Too old to be abandoned