Building an Explorable Explainer for Parallel Coordinates

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Abstract

This short report describes an ongoing project to build an explorable explainer for the parallel coordinates visualisation technique for multidimensional datasets. The Parallel Coordinates Explorable Explainer (PCEE) is an open-source web application, which guides a reader through the parallel coordinates technique, using narrative elements and embedded interactive illustrations.
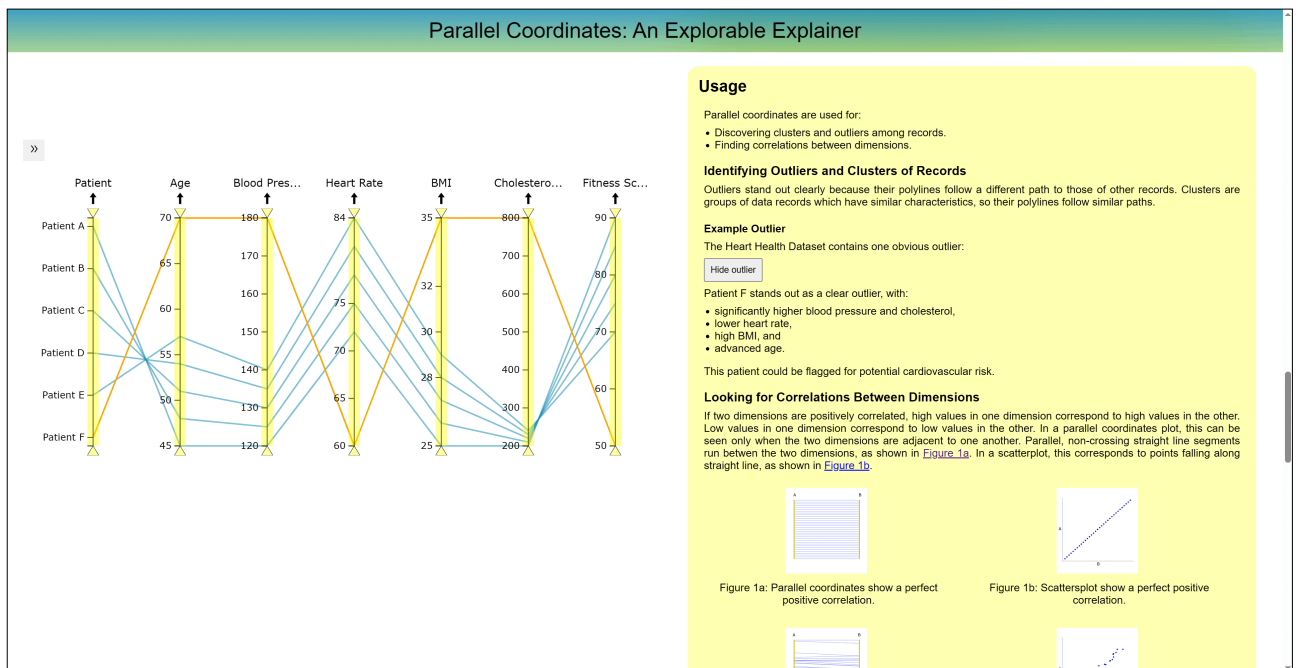
Figure 1: The PCEE explorable explainer for parallel coordinates.

1 Explorable Explainers

The term *explorable explainers* originated from Bret Victor's seminal blog posting in 2011 [Victor 2011] and Alan Kay's earlier ideas around *active essays* [Kay 1998, page 24]. In essence, an explorable explainer is a mixture of narrative text and interactive code, which takes a reader by the hand and guides them through a particular technique or concept. At various places in the text, interactive diagrams or charts are triggered to illustrate specific ideas. At other places, the reader may be free to explore a diagram or chart for themselves.

Today, explorable explainers are often built as Python notebooks or with JavaScript as interactive web applications. Many of them employ the narrative method of *scrollytelling*, whereby the user scrolling through the narrative text triggers corresponding animations and updates to embedded diagrams and charts [Oesch et al. 2022]. There are many great examples of explorable explainers, including many of the articles published by Distill [Carter and Olah 2021], such as the classic explainer about t-SNE [Wattenberg et al. 2016], and many of the papers at the VISxAI workshop [VISxAI 2025], including Yi Zhe Ang's explorable about k-means clustering [Ang 2022].

2   Parallel Coordinates

Parallel coordinates are a classic visualisation technique for multidimensional datasets. Dimensions are represented as parallel axes, and records are represented as polylines which touch each axis once. Interactivity such as moving and inverting dimensions, and selecting and filtering records allow an analyst to explore a multidimensional dataset. The technique was popularised by Al Inselberg in the 1980s [Inselberg 1985] and is documented thoroughly in his book [Inselberg 2009]. A survey of tools and techniques was provided by Heinrich and Weiskopf [2013].

Parallel coordinates are a powerful tool for performing exploration and analysis of multidimensional datasets, but they are often unfamiliar to end users and the general public. Stoiber et al. [2022] looked at whether providing onboarding in the form of a scrollytelling tutorial could help viewers read and interpret a parallel coordinates chart, but their study found no statistically significant improvement.

3   An Explorable Explainer for Parallel Coordinates

An explorable explainer seems a promising approach to introduce the idea behind a parallel coordinates visualisation, and to explain the powerful analysis methods provided by an interactive parallel coordinates tool. The original intention was to produce an explorable explainer, which a university lecturer could introduce in a data visualisation class, but then leave to students to work through in more detail. With some fine tuning and testing, it should also be possible for the explorable to be used as a self-study aid.

After some initial experimentation with different technologies [Drescher et al. 2023a], it was decided to build the explorable explainer as a web application in JavaScript. Although this approach requires more lower level software development, it allows maximum flexibility in terms of what can be implemented.

To build an explorable explainer for parallel coordinates, it was first necessary to build a parallel coordinates chart component, which can be steered (controlled) from outside over an API, so that the narrative text can issue commands to the chart at specific times. Some initial work was done by Drescher et al. [2023b], before Romana Gruber picked up and continued the project [Gruber 2024]. The component is called Steerable Parallel Coordinates in D3 (SPCD3) and is being developed as a separate standalone software library in TypeScript [Microsoft 2025] using D3v7 [Bostock 2025]. SPCD3 has both built-in interactivity which can be controlled manually by the end user, and the capability to be steered programmatically from outside via API calls.

The Parallel Coordinates Explorable Explainer (PCEE) provides an interactive narrative explaining the parallel coordinates technique and how it can be used to analyse a multidimensional dataset. It is built in TypeScript with Vue.js [You 2025], and is illustrated with interactive examples using SPCD3. An example can be seen in Figure 1. Native executable packages for Windows, Mac, and Linux can be built using Tauri [Tauri 2025]. Triggers within the narrative steer corresponding changes in the associated parallel coordinates visualisation: these potentially include scroll-driven triggers, button triggers, and stepper triggers (stepping through a sequence). For example, when explaining that two dimensions Age and Fitness Score need to be moved adjacent to one another, in order to look for a possible correlation between the dimensions, a button labelled Move Fitness Score next to Age will then trigger exactly this interaction.

4   Concluding Remarks

The code for both PCEE and SPCD3 is open-source and is available at Gruber [2025a] and Gruber [2025c], respectively. A live demo of the current development version of PCEE is available at Gruber [2025b]. PCEE is still under active development. One particular challenge is to make it as responsive as possible for users on smaller devices with touch screens. It is also envisaged to carry out some formative user testing, once the explorable has reached a sufficient level of stability and usability.

References

Ang, Yi Zhe [2022]. *K-Means Clustering*. Best Submission at VISxAI 2022. 17 Oct 2022. `https://k-means-ex plorable.vercel.app/`.

Bostock, Mike [2025]. *D3*. 06 Aug 2025. `https://d3js.org/`.

Carter, Shan and Chris Olah [2021]. *Distill*. 02 Sep 2021. `https://distill.pub/`.

Drescher, Philipp, Jeremias Kleinschuster, Sebastian Schreiner and Burim Vrella [2023a]. *Explorable Explainers: Survey Paper*. Survey Paper. Graz University of Technology, Information Visualisation, SS 2023, 19 May 2023. `https://courses.isds.tugraz.at/ivis/surveys/ss2023/ivis-ss2023-g1-survey-explorables.pdf`.

Drescher, Philipp, Jeremias Kleinschuster, Sebastian Schreiner and Burim Vrella [2023b]. *Steerable Parallel Coordinates in JavaScript*. Project Report. Graz University of Technology, Information Visualisation, SS 2023, 16 Jun 2023. `https://courses.isds.tugraz.at/ivis/surveys/ss2023/ivis-ss2023-g1-survey-explorab les.pdf`.

Gruber, Romana [2024]. *Steerable Parallel Coordinates in D3 (SPCD3)*. Project Report. Graz University of Technology, Seminar/Project Interactive and Visual Information Systems SS 2024, 30 Oct 2024. `https://ft p.isds.tugraz.at/pub/projects/gruber-2024-10-30-spcd3.pdf`.

Gruber, Romana [2025a]. *Parallel Coordinates Explorable Explainer (PCEE)*. 08 Jul 2025. `https://github.co m/tugraz-isds/pcee`.

Gruber, Romana [2025b]. *Parallel Coordinates: An Explorable Explainer (Demo)*. 08 Jul 2025. `https://tugra z-isds.github.io/pcee`.

Gruber, Romana [2025c]. *Steerable Parallel Coordinates in D3 (SPCD3)*. 07 Jul 2025. `https://github.com/tug raz-isds/spcd3`.

Heinrich, Julian and Daniel Weiskopf [2013]. *State of the Art of Parallel Coordinates*. Proc. Eurographics 2013 (Girona, Spain). Eurographics. 06 May 2013, pages 95–116. doi:10.2312/conf/EG2013/stars/095-116. `https://joules.de/files/heinrich_state_2013.pdf`.

Inselberg, Alfred [1985]. *The Plane with Parallel Coordinates*. The Visual Computer 1.2 (Dec 1985), pages 69–91. ISSN 1432-2315. doi:10.1007/BF01898350.

Inselberg, Alfred [2009]. *Parallel Coordinates: Visual Multidimensional Geometry and Its Applications*. Springer, 08 Oct 2009. 554 pages. ISBN 0387215077.

Kay, Alan [1998]. *Inventing the Future*. IEEE Software 15.2 (30 Apr 1998), pages 22–24. ISSN 0740-7459. doi:10.1109/MS.1998.663779.

Microsoft [2025]. *TypeScript*. 06 Aug 2025. `https://typescriptlang.org/`.

Oesch, Jonas, Adina Renner and Manuel Roth [2022]. *Scrolling into the Newsroom*. Information Design Journal 27.1 (09 Dec 2022), pages 102–114. ISSN 0142-5471. doi:10.1075/idj.22005.oes.

Stoiber, Christina, Conny Walchshofer, Margit Pohl, Benjamin Potzmann, Florian Grassinger, Holger Stitz, Marc Streit and Wolfgang Aigner [2022]. *Comparative Evaluations of Visualization Onboarding Methods*. Visual Informatics 6.4 (Jul 2022), pages 34–50. ISSN 2468-502X. doi:10.1016/j.visinf.2022.07.001.

Tauri [2025]. *Tauri 2.0*. 06 Aug 2025. `https://tauri.app/`.

Victor, Bret [2011]. *Explorable Explanations*. 10 Mar 2011. `https://worrydream.com/ExplorableExplanations/`.

VISxAI [2025]. *Workshop on Visualization for AI Explainability*. 07 Jul 2025. `https://visxai.io/`.

Wattenberg, Martin, Fernanda Viégas and Ian Johnson [2016]. *How to Use t-SNE Effectively*. 13 Oct 2016. doi:10.23915/distill.00002. `https://distill.pub/2016/misread-tsne`.

You, Evan [2025]. *Vue.js*. 06 Aug 2025. `https://vuejs.org/`.