Visualizations to support trade-off comparisons

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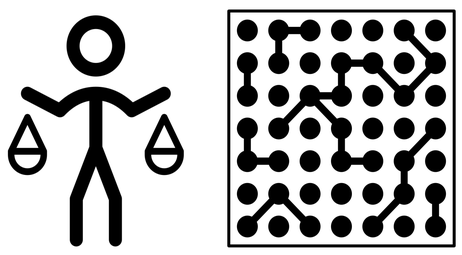
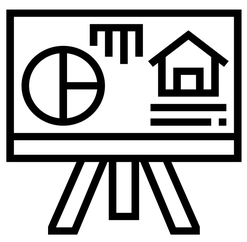
Context:

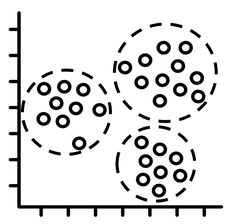
Agronomists make complex decisions from big quantities of simulation data that has already been optimised mathematically.



They use visualisations to explore their data and understand the trade-offs.*



During these trade-off analysis explorations, they compare different solution spaces: **groups of points** or **individual points** within the groups

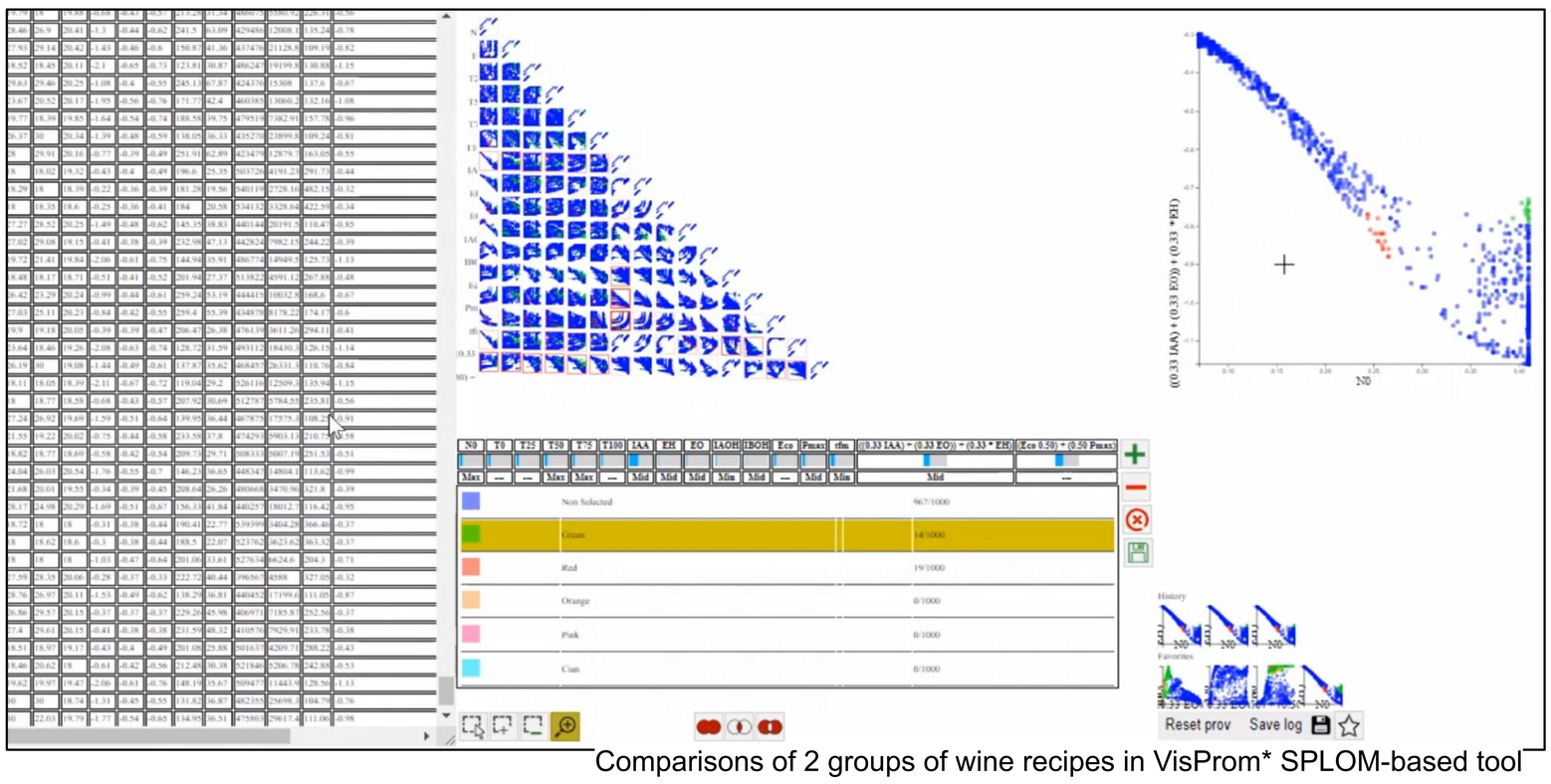


State of the art:

- Comparison methods and tasks + taxonomy inspired from real life: [Gleicher et al. 2011, 2018]*.
- Ranking tools for **single rows** in the data: Lineup[Gratzl et al. 2013]*, Weightlifter[Pajer et al. 2016]*, RankBooster[Puri 2020]* RankAxis [Liu 2022]*.

Comparison definition In the case of trade-off analysis:

Comparison is a **relative assessment of elements** that is **grounded in a context** comprised of the **elements compared, the whole body of data, and the user preferences.**



Comparisons of 2 groups of wine recipes in VisProm* SPLOM-based tool

Our goal:
Lay the foundation for generating design guide-lines for **visual group comparison in the context of trade-off analysis.**

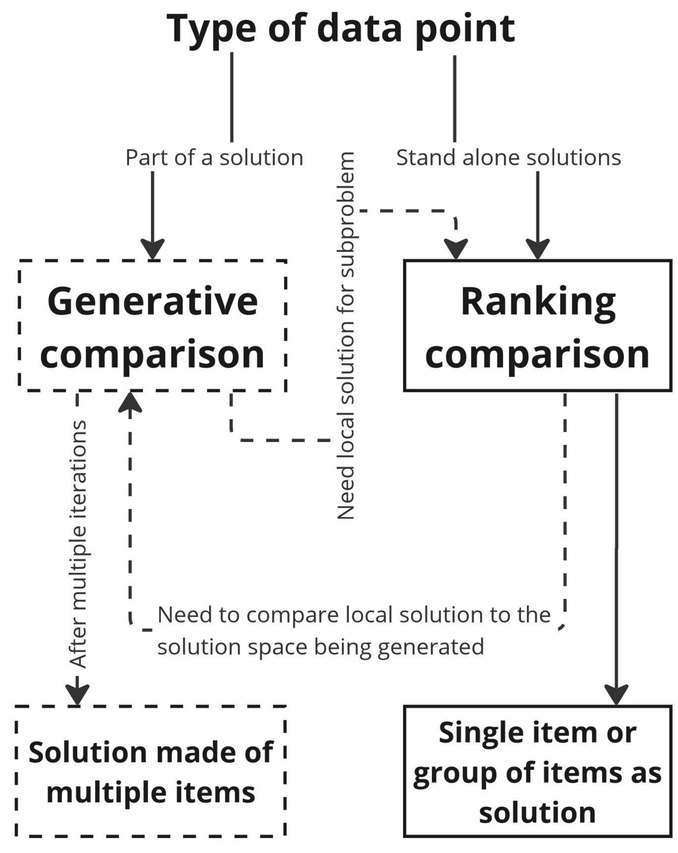
Results: Comparison needs identified

- Modular granularity:
  - manipulate and compare groups
  - but also compare point by point
- Aggregate the data and compare the groups using quantitative metrics (weighted mean, variance, the data ranges, etc.) Nevertheless individual items in the groups were important.
- We also identified 2 types of group comparison (generative comparison, ranking comparison).

Methodology & workshops:

Group code	Participants	Dataset	Tasks
ML	2 Machine learning experts	Openml-cc 18: a ML benchmark suit*	Interviewed them about a past exploration of trade-offs between the number of features (complexity) and accuracy of ML models. We discussed their needs in terms of comparisons and ranking, how they conduct them, and the comparisons' properties (what they compared, across which dimensions, etc...). They ranked their solutions **(ranking comparison)**
Food1	1 user with restrictive diet needs	USDA Foundation foods data	Creating 2 diets of about 40 items: One that maximizes energy (calories) while minimizing sugar and fat, another that Maximizes energy (calories) while minimizing sugar and carbohydrates. We discussed their needs in terms of comparing the 2 diets in terms of nutrients: more Iron, magnesium, vitamins… **(ranking comparison)**
Food2	1 user with restrictive diet needs	USDA Foundation foods data	Started out as the same task as Food1. They adapted the diet from the 1st task to their personal dietary needs while maintaining a similar nutritional balance (in this case the diet needed to become vegetarian and dairy free). Here the comparison was between the items they wanted to replace, the replacement candidates and the group as a whole.**(generative comparison)**

Types of comparisons:



*References: Boukhelifa, N., Bezerianos, A., Cristian Trelea, I., Perrot, N., & Lutton, E. (2019). An Exploratory Study on Visual Exploration of Model Simulations by Multiple Types of Experts. In Proceedings of the Annual ACM Conference on Human Factors in Computing Systems, CHI '19. | Chakhchoukh, M., Boukhelifa, N., & Bezerianos, A. (2022). Understanding How In-Visualization Provenance Can Support Trade-off Analysis. IEEE Transactions on Visualization and Computer Graphics.|Michael Gleicher, Danielle Albers, Rick Walker, Ilir Jusufi, Charles D. Hansen, & Jonathan C. Roberts (2011). Visual comparison for information visualization. Information Visualization, 10, 289 - 309.| Michael Gleicher (2018). Considerations for Visualizing Comparison. IEEE Transactions on Visualization and Computer Graphics, 24, 413-423.|Samuel Gratzl, Alexander Lex, Nils Gehlenborg, Hanspeter Pfister, & Marc Streit (2013). LineUp: Visual Analysis of Multi-Attribute Rankings. IEEE Transactions on Visualization and Computer Graphics (InfoVis '13), 19(12), 2277–2286.|Pajer, S., Streit, M., Torsney-Weir, T., Spechtenhauser, F., Möller, T., & Piringer, H. (2017). WeightLifter: Visual Weight Space Exploration for Multi-Criteria Decision Making. IEEE Transactions on Visualization and Computer Graphics, 23(1), 611-620.|Bernd Bischl, Giuseppe Casalicchio, Matthias Feurer, Pieter Gijsbers, Frank Hutter, Michel Lang, Rafael G. Mantovani, Jan N. van Rijn, & Joaquin Vanschoren. (2021). OpenML Benchmarking Suites.|Abishek Puri, Bon Kyung Ku, Yong Wang, & Huamin Qu. (2020). RankBooster: Visual Analysis of Ranking Predictions.|Qiangqiang Liu, Yukun Ren, Zhihua Zhu, Dai Li, Xiaojuan Ma, & Quan Li. (2022). RankAxis: Towards a Systematic Combination of Projection and Ranking in Multi-Attribute Data Exploration.