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Beyond Charts & Graphs: creating Data Visualizations to enhance knowledge

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Abstract. In an era characterized by a continual increase in the volume of information and data from diverse sources and presented in various formats, the challenge of effectively representing them and enabling users to derive meaningful insights becomes relevant. This underscores the growing significance of Data Visualization, defined as the systematic representation of data to convey information clearly and impactfully, leveraging human cognitive abilities. The objective is to create a valuable decision-making tool, spotlighting patterns or anomalies within the data. Moreover, Data Visualization enhances data processing in the human brain more efficiently than textual information, fostering comprehension of heterogeneous and large data sets, improving collaboration, and providing an adept ad-hoc data analysis tool.

This masterclass aims to empower participants with the skills and insights necessary for creating visualization. Focusing on the principles of data visualization, participants will explore diverse techniques to transform information into data representations, combining theoretical lessons with hands-on group activities.

The theoretical sessions cover the fundamentals, techniques, and best practices in data visualization, allowing participants to gain a solid understanding of the field. Complementing the theoretical aspect, practical group activities offer participants the chance to apply learned concepts in real-world scenarios and foster teamwork.

Contextualisation

In an era characterized by a continual increase in the volume of information and data emanating from diverse sources and presented in various formats, the challenge of effectively representing this vast data pool and enabling users to derive meaningful insights becomes relevant. Consequently, the relevance of Data Visualization has grown, defined as the systematic representation of data to convey extracted information in a clear and impactful manner, harnessing human cognitive abilities. The ultimate objective is to develop a valuable tool that aids the decision-making process, highlighting patterns or anomalies inherent in the data (Chen, 2017; Fernandez and Fetais, 2017; Wang et al., 2015).

Furthermore, Data Visualization facilitates the human brain in processing data faster and more effectively than simple textual information, increasing the ability to understand and process heterogeneous and large data sets (Chen, 2017), improving collaboration in an information-sharing scenario and providing a better ad-hoc data analysis tool (Wang et al., 2015).

Moreover, data visualization is often investigated in CSCW contexts to enhance collaboration by analyzing the effect of shared visualization Balakrishnan et al. (2010), make sense of data Beeferman and Gillani (2023), support target users Yoo et al. (2023), or facilitate the exploration of data Liao et al. (2023) in order also to enhance knowledge.

To derive maximum benefit from Data Visualization, different techniques are employed to represent and interact with the data, contingent upon the type of data under analysis. Understanding which techniques are the most efficient to enhance user comprehension of the represented information is crucial.

Data representation techniques and interaction methods are widely studied to understand the relationship between the type of data analyzed and their visual representation and to improve the user experience (Fernandez and Fetais, 2017; Schotter et al., 2018; Figueiras, 2015; Kosara, 2016).

However, it's not always enough to simply present the data - sometimes, users need to be able to interpret it for themselves in order to gain deeper insights and understanding. That's why this type of visualization is designed not only to convey the designer's message but also to allow the final users the freedom to explore and extract knowledge based on their own unique perspectives and experiences (Cairo, 2016). For this reason, it is crucial to recognize and admit the aspects of charts that may mislead users and take steps to prevent them. In literature, studies like Cairo (2016) and Pandey et al. (2015) aimed at pinpointing the misleading elements so that designers and users can become more conscious of them.

Often, data visualizations, especially if interactive, are designed by a multidisciplinary team with different skills (e.g., designers, computer scientists, and domain experts) that collaborate to enhance the knowledge of the target users. To do so, it is necessary to have the basis of data visualization and understand the best techniques and how to involve other users in the creation of these graphs.

Goals and Activities

The program is designed to empower the participants with the skills and insights needed to effectively communicate and collaborate through data. Participants will understand the principles of data visualization, exploring various techniques to translate complex information into visually compelling data visualizations. The course equips learners with the skills and knowledge to create impactful visualizations that foster awareness and decision-making processes. This masterclass is designed to be a comprehensive and engaging learning experience that will combine theoretical lessons with hands-on group activities.

During the theoretical lessons, participants will have the opportunity to learn the basics, techniques, and best practices in the data visualization field. The interactive sessions will allow attendees to ask questions, share their insights, and engage in discussions with their peers.

In addition to the theoretical part, the masterclass will also feature practical group activities, allowing participants to apply the concepts learned in real-world scenarios. These activities will be collaborative to encourage teamwork and problem-solving skills, providing attendees with a valuable opportunity to learn from each other.

Format and schedule

The masterclass will take place in person and span half a day, including theoretical lessons and practical group activities.

Outline:

- Welcome & introduction
- Fundamentals of Data Visualization
- Fundamentals of Collaborative Design Processes
- Practical activity on paper
- Introduction to some Interactive Visualization Tools
- Practical activity on laptop
- Some Ethical Considerations
- Wrap up

Target group

This Masterclass is designed for all students: master students, as well as PhD students, who would like to learn more about using visualization and visual tools in scientific or professional contexts.

To give all participants enough time during the interactive discussions and practical activities, a maximum of 15 participants will be admitted.

Required Resources

In terms of infrastructure, a room capable of accommodating the maximum number of participants, provided with a projector will be sufficient. If feasible, it would be beneficial to provide papers to the participants (approximately 2/3 for each) along with colored pencils for the practical activity session. Participants will be required to bring a laptop (no software installation is required).

Organiser's short bio

Chiara Ceccarini is a junior assistant professor at the Department of Computer Science and Engineering, University of Bologna (Italy), where she is currently teaching Web Systems Engineering and virtualized systems. Her research focuses on developing a methodology for designing interactive data visualization tools aimed at promoting and raising awareness among specific communities on issues of public relevance and interest, such as sustainability and the 17 Sustainable Development Goals (SDGs) identified by the United Nations. In particular, she investigated several case studies such as (1) Human-Building Interaction and the saving of energy resources and dematerialization, (2) sustainable tourism exploiting the concept of smart tourism for the creation of authentic connections between tourists and locals, and (3) Machine Learning for Data Visualization (ML4Viz) for the analysis of employee or former employee reviews related to the work environment which should reflect the values of the employee. However, she is also currently exploring alternative methods of data representation that extend beyond visual perception, delving into auditory or tactile modalities such as sonification and physicalization.

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