Visual program induction for sketch-based graphics design

Postdoctoral position

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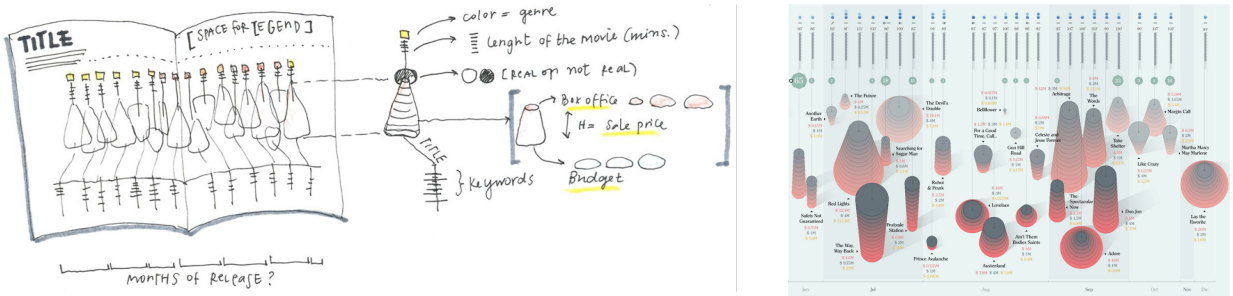

(a) Early sketch of a data visualization (b) Final visualization bound to data

Figure 1: Illustration of our goal. *Given a sketch of a data visualization (left), our goal is to synthesize a data visualization program that can be applied to real data (right). Illustrations from Giorgia Lupi [1].*

Context

Complex data often requires appropriate visualization to be understood. While visualization software offers powerful tools to generate visualizations from data, many expert designers prefer to start by exploring visualization solutions through hand-drawn sketches (Figure 1). Before having access to the actual data, sketches enable designers to "*visualize the architecture of the infographics and cultivate ideas for shaping the data visually,"* while later, sketching with data can *"help raise new questions about the data itself"* [1]. Unfortunately, existing visualization systems like *Excel* or *Tableau* impose a data-to-graphics workflow that hinders visual thinking, while existing graphics design systems like *Illustrator* are largely disconnected from data.

Goals and approach

Our goal is to support the transition from hand-drawn sketches to parametric visualizations that can be fed with real data. While this problem relates to our prior work on sketch-based modeling of parametric shapes [2,3], a key novelty is that we don't only need to recognize the shapes drawn by the designer, we also need to analyze their relationships, since it is often through variations of shape attributes (size, position, color) that designers convey quantitative information. Furthermore, we need to translate these relationships into visualization instructions that adapt automatically to new data.

Several domain-specific languages exist to express visualizations as programs [4]. Our problem can thus be seen as a form of *visual program induction* [5], where the goal is to find a sequence of programming instructions which, when executed with appropriate

parameters, recreate an input image. In our context, the instructions should generate shapes that are parameterized by the data to be visualized. While searching over the set of all possible programs expressible by a grammar is intractable, the emerging field of *neuro-symbolic programming* suggests efficient strategies that leverage machine learning to accelerate search algorithms [6]. We plan to build on such strategies as well as on domain-specific knowledge and additional user inputs to perform program inference within an interactive visualization design scenario [7].

Work environment and requirement

The postdoc will take place at Inria Sophia Antipolis. Candidates should have a Ph.D. in computer graphics, computer vision, data visualization, or machine learning.

The postdoc will be founded by the French national research agency (ANR) as part of a collaborative project with experts in information visualization and human-computer interaction.

References

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[2] Changjian Li, Hao Pan, Adrien Bousseau, Niloy J. Mitra. Sketch2CAD: Sequential CAD Modeling by Sketching in Context. ACM Transactions on Graphics (proc. SIGGRAPH Asia) 2020. http://geometry.cs.ucl.ac.uk/projects/2020/sketch2cad/

[3] Changjian Li, Hao Pan, Adrien Bousseau, Niloy J. Mitra. Free2CAD: Parsing Freehand Drawings into CAD Commands. ACM Transactions on Graphics (proc. SIGGRAPH) 2022. http://geometry.cs.ucl.ac.uk/projects/2022/free2cad/

[4] Vega – A Visualization Grammar. https://vega.github.io/vega/

[5] Kevin Ellis, Daniel Ritchie, Armando Solar-Lezama, Joshua B. Tenenbaum. Learning to Infer Graphics Programs from Hand-Drawn Images. NeurIPS 2018. https://arxiv.org/abs/1707.09627

[6] Daniel Ritchie, Paul Guerrero, R. Kenny Jones, Niloy Mitra, Adriana Schulz, Karl D. D. Willis, Jiajun Wu. Neurosymbolic Models for Computer Graphics. Eurographics State-of-The-Art-Reports 2023. https://drive.google.com/file/d/1g_VpZ80MzkcqZBqj81kBc2VXYKiyzhbO/view?usp=share_link

[7] Theophanis Tsandilas. StructGraphics: Flexible Visualization Design through Data-Agnostic and Reusable Graphical Structures. IEEE Transactions on Visualization and Computer Graphics (VIS'20), 2021. https://www.lri.fr/%7Efanis/StructGraphics/