A Data-Structure Metaphor for Visualisation

Within the philosophy of information the method of (levels of) abstraction dictates to a large extent what counts as good philosophical practice by requiring that acceptable questions and correct answers should always be formulated at a specific level of abstraction rather than independently of any level of abstraction. The epistemology that corresponds to this metaphilosophical position emphasises the role of models for our knowledge, but does not presuppose that some or all properties identified by a model should represent properties of the system that is being modelled. Instead, it is only assumed that the relevant properties are attributed to the system in question (Floridi 2011).

In this talk I want to leverage this view on modelling that remains neutral with respect to the representational role of models to relate the practical and theoretical understanding of visualisation in the fields of scientific visualisation, information visualisation, and visual analytics to how the epistemic and inferential role of models in science is conceptualised within the philosophy of science. The apparent lack of room for interaction between the latter two perspectives on visualisation cannot solely be retraced to their respective emphasis on the visualisation (and more generally modelling) of data and the visualisation and representation of systems or phenomena, and deserves a deeper inquiry. This is important because scientific visualisation, information visualisation, and visual analytics deal with scientific practices that are relevant to the philosophy of science, and indeed essential to gain a better understanding of data-intensive science.

As a preliminary, I want to describe a data-structure metaphor for visualisation (a suggestion already present in Larkin and Simon (1987), but also akin to certain theoretical frameworks that are used to study and develop data-visualisation methods (Silver 1995, Purchase et al. 2008)) as an addition or complement to the method of abstraction that extends our ability to reason about the flow of information between systems and models, or between different models, with the means to describe how the information encoded in our models is stored, and how it can be accessed, modified, and more generally by made available to algorithms. This can be used to account for the computational role of visualisation, and extends prior work on information-theoretic foundations of visualisation (Chen and Floridi 2013).

The main part of the talk is diagnostic, and is meant to gain a better understanding of what I think is the main difference in focus in vi-

sual analytics and related fields, as opposed to how the epistemology of visualisation is conceptualised within the philosophy of science, namely visualisation as a computational process (Chen and Golan 2015) versus visualisations as computational tools or tools for inference. This divide is particularly clear if we contrast the emphasis on visualisation pipelines, workflows and processes with the place accorded to visual artefacts like diagrams, drawings and other finished products in much of the philosophical literature (Stenning 2002, Kulvicki 2010, Bolinska 2015).

In a last part I sketch how a data-structure metaphor together with insights from the method of abstraction could help us to reconnect computational with epistemological and inferential concerns in the context of scientific visualisation.

References

Bolinska, A. (2015), 'Successful visual epistemic representation', *Studies in History and Philosophy of Science Part A* .

Chen, M. and Floridi, L. (2013), 'An analysis of information visualisation', *Synthese* **190**(16), 3421–3438.

Chen, M. and Golan, A. (2015), 'What may visualization processes optimize? eprint arxiv:1506.02245'.

Floridi, L. (2011), *The Philosophy of Information*, Oxford University Press, Oxford.

Kulvicki, J. (2010), 'Knowing with images: Medium and message*', *Philosophy of Science* **77**(2), 295–313.

Larkin, J. H. and Simon, H. A. (1987), 'Why a diagram is (sometimes) worth ten thousand words', *Cognitive Science* **11**(1), 65–100.

Purchase, H. C., Andrienko, N., Jankun-Kelly, T. J. and Ward, M. (2008), Theoretical foundations of information visualization, *in* 'Information Visualization', Springer, pp. 46–64.

Silver, D. (1995), 'Object-oriented visualization', *Computer Graphics and Applications, IEEE* **15**(3), 54–62.

Stenning, K. (2002), *Seeing reason: Image and language in learning to think.*, Oxford University Press.