AGPhil 5: Symposium: Epistemology of Big Data in Physics III

Zeit: Donnerstag 17:15–19:00 Raum: GW2 B2900

Hauptvortrag AGPhil 5.1 Do 17:15 GW2 B2900

Combining theory with Big Data to predict trends in extreme weather and impacts — •David N Bresch, Reto Knutti, and Gertrude Hirsch Hadorn — ETH Zurich, Switzerland

We combine theory-based simulation with statistical analysis of large volumes of unstructured data (Big Data) to predict trends in extreme weather and impacts. In collaboration with MeteoSwiss, we develop a prototype application of such an impact model. The natural science part investigates how data of unknown quality can be used to validate and calibrate weather and climate impact models. We analyse whether such data reduce the uncertainties in impacts. We identify the hurdles for such an approach to be implemented in an operational model. The philosophy part further develops uncertainty typologies in decision support to include uncertainty in Big Data. We apply argument analysis to the predictive inferences in the scientific part. We develop prerequisites to classify impacts from extreme weather to be applied to datasets from mobile communication. The synthesis part analyses conditions for transferring results to other fields, and implications from how the role of theory changes with Big Data for scientific methodology and understanding.

AGPhil 5.2 Do 18:00 GW2 B2900

The automated discovery of physical laws — •Nico Formanek[1] and Ryan Reece[2] — [1]Höchstleistungsrechenzentrum Stuttgart (HLRS) — [2]University of California, Santa Cruz (UCSC)

In the recent past there have been several attempts to automatically infer known and new laws of physics from large empirical data sets. Machine learning methods are employed to some success in solid-state physics and materials science to predict electronic properties (Schütt et al.; Physical Review B 89, 205118 2014) but there is also the far reaching claim of Schmidt and Lipson concerning the inference of free-form natural laws from experimental data (Schmidt and Lipson; Science 324, 3 2009). Both points give rise to important philosophical questions: How do physical laws derived in such a way differ from humanly generated ones? How do they methodically differ from classical statistical correlations? What is the role of the physicist in studying those laws – is she becoming a mere interpreter of machine generated knowledge? The answer to these questions is by no means clear and depends on our preconceived notion of physical law. In this talk I point out how computer inferred physical laws pose a challenge to some traditional views of natural laws and how this affects the answer to the questions above.

N.B: This talk is complementary to the talk titled 'Machine learning and realism' which looks at automation in science from a physicist's perspective.

AGPhil 5.3 Do 18:30 GW2 B2900

Machine learning and realism — •Ryan Reece[1] and Nico Formanek[2] — [1]University of California, Santa Cruz (UCSC) — [2]Höchstleistungsrechenzentrum Stuttgart (HLRS)

Machine learning is bringing new methods for taming the torrents of big data facing today's scientific projects and businesses. Not only is machine learning bringing new ways of automating the processing of data, but also automating processes of making inferences on that data, including unsupervised classification, model selection, and model fitting (regression). We argue here that philosophers should be interested in these developments because they offer provocative ways of framing classic philosophical questions concerning the problem of induction, realism, and natural kinds, among others. Drawing on examples of uses of machine learning in particle physics analysis, we introduce and discuss the following questions: How does statistical hypothesis testing address the problem of induction? How can machine learning be used in statistical inference? Can the scientific method be automated? And if so, what does that imply about the objectivity of science? How is clustering related to natural kinds?

N.B.: This talk is complementary to the talk titled "The automated discovery of physical laws", which looks specifically at automated inference of physical laws.