# Topics in Inductive Logic, UC Irvine, March 19-20, 2015

Social and Behavioral Sciences Bldg 214,
Room 1517, 8:00 am - 6:00 pm

Inductive logic was a research program started
by Rudolf Carnap in the 1940s and involves
the philosophical and mathematical analysis
of inductive inference. It has a close connection
to the Bayes-Laplace tradition in
probability theory and statistics. While
inductive logic has largely disappeared from
the radar of mainstream philosophy of science,
progress has been made in various fields that
are related to inductive logic. The aim of this
workshop is to discuss some of these new
developments.
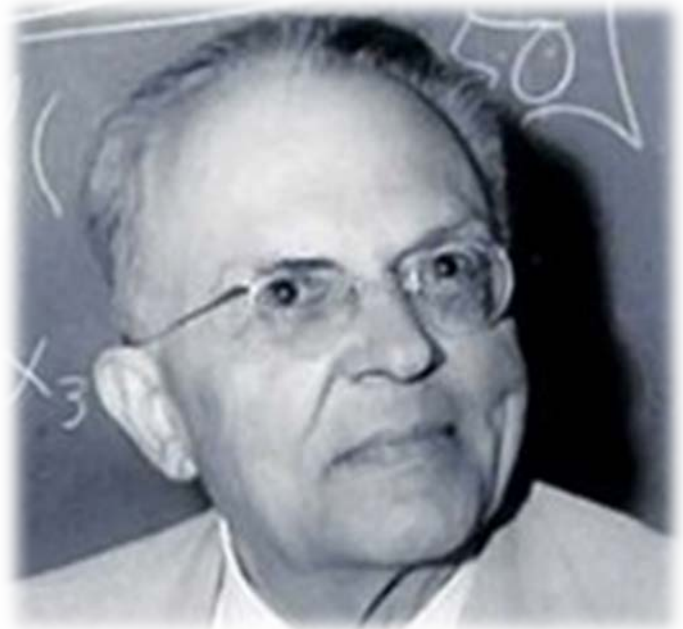
Organizers
Simon Huttegger, Associate Professor of Logic and Philosophy of Science, and Chancellor's Fellow,
University of California, Irvine, The Department of Logic and Philosophy of Science

Speakers
Frederick Eberhardt (Cal Tech), Simon Huttegger (UCI), Jeffrey Paris (Manchester), Jan-Willem Romeijn
(Groningen), Gerhard Schurz (Düsseldorf), Tom Sterkenburg (Groningen), Marta Sznajder (LMU),
Jon Williamson (Kent), Sandy Zabell (Northwestern)

*To register, contact Patty Jones at patty.jones@uci.edu before March 13th

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T**hursday, March 19.**

9:00am
Sandy Zabell, Professor of Statistics and Mathematics, Northwestern University
http://www.statistics.northwestern.edu/people/sandy-zabell.html

"The Problem of Zero Probability"
The de Finetti representation theorem affords a nice resolution of Hume's classic problem of inductive
inference. There are several important pieces to the puzzle: providing an operational definition for
probability, justifying its static and dynamic properties as codified by the standard axioms, invoking
some form of exchangeability. But, at least in the form of the problem put forward by Hume, there is also
what some have characterized as "fine print": the assumption that one's prior not be dogmatic, in the
sense that appropriate subsets of the parameter space are not assigned an initial probability of zero.

In his talk, Dr. Zabell will discuss the question of if or when a Bayesian should ever assign a probability
of zero to events that are initially thought to be possible. The first part of the talk will survey the general
question; the second half will draw lessons for the resolution of the problem of induction.

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<u>10:45am</u>
Marta Sznajder, Doctoral Fellow, LMU (Munich)
http://www.mcmp.philosophie.uni-muenchen.de/people/doct_fellows/sznajder/index.html

"Inductive Logic, Conceptual Spaces, and Theory Change"
The idea that we could and possibly should represent concepts in a geometrical manner can be found in two seemingly separate traditions. First, it was introduced by Rudolf Carnap under the guise of attribute spaces, a concept developed in his late work on inductive logic (Carnap 1971, 1980). Second, currently flourishing in cognitive science is the theory of conceptual spaces, advanced i.a. by Peter Gärdenfors. It is aimed at an empirically informed and accurate geometrical representations of concepts. In her talk, Ms. Sznajder will show how the two proposals relate to each other, not only insofar as Carnap's attribute spaces can be seen as predecessors of the modern conceptual spaces, but also through the possibilities of extending the Basic System (and, more broadly, inductive logic) with the insights brought in by the conceptual spaces program. Further, Ms. Sznajder will discuss a recent proposal of Zenker and Gärdenfors (2014) on describing theory change in terms of changes in the relevant conceptual spaces. Finally, Ms. Sznajder will argue that the authors' conclusion that the use of conceptual spaces can replace the three-level view of scientific theories, postulated by Michael Friedman, cannot be arrived at quite yet.

<u>1:15pm</u>
Jon Williamson, Professor of Philosophy, University of Kent
http://www.kent.ac.uk/secl/philosophy/staff/williamson.html

"Classical Inductive Logic, Carnap's Programme and the Objective Bayesian Approach"
In his talk, Dr. Williamson will introduce what he calls classical inductive logic, due to Wittgenstein, and its limitations. He will explain how Carnap's approach, originally due to W.E. Johnson, tried to overcome these problems and why it failed. Finally, he will introduce the objective Bayesian approach to inductive logic and argue that it can overcome the limitations of the classical and Carnapian approaches.

<u>3:00pm</u>
Gerhard Schurz, Professor of Philosophy, Heinrich-Heine-Universität Düsseldorf Director, Düsseldorf Center for Logic and Philosophy of Science
http://www.phil-fak.uni-duesseldorf.de/philo/personal/thphil/schurz/

"Inductive Logic, Wolpert's No-Free-Lunch Theorem, and the Optimality of Meta-Induction"
Wolpert's No-Free-Lunch Theorem is a mathematical proof of Hume's inductive scepticism.
Wolpert proves that under mild assumptions every prediction method - induction, anti-induction, guessing or what else - has the same expected predictive success, according to a uniform prior probability distribution over possible worlds.

In the first part of his talk, Dr. Gerhard Schurz will discuss how strong the limitations are that follow from this result for the program of Inductive Logic. In the second part, he will present a different account to Hume's problem of induction that is based on the optimality of meta-induction. According to this result, there exist meta-inductive prediction-selection methods whose predictive success is optimal in regard to all prediction method whose output is accessible to them. Dr. Schurz will discuss this result in the light of inductive logic and Wolpert 's no-free-lunch theorem.

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<u>4:30pm</u>
Frederick Eberhardt, Professor of Philosophy, Cal Tech
http://www.hss.caltech.edu/content/frederick-eberhardt

"Causal Variables in a Pixel World"
How can one construct causal macro-variables from the ground up? Dr. Eberhardt will present some of the problems, some formal limitations and finally a successful account of trying to provide a theory of how to define and automatically identify a cause of some target behavior in a domain where we have no prior knowledge that delineates the candidate causes. This work is motivated by an aim to weaken the standard assumption in causal discovery of a given set of well-defined variables, since in many domains we have very little knowledge of what the candidate causes are. Eberhardt will use vision as an example, since visual causes are sometimes very clearly delineated, such as when a traffic light turns to green, and sometimes very subtle, such as with the increased judgment of attractiveness for more symmetric human faces. The resulting account illustrates in what sense Goodman's new riddle can be reconstructed for causal variables.

Friday, March 20.

<u>9:00am</u>
Jeffrey Paris, Professor of Mathematics, University of Manchester
http://www.maths.manchester.ac.uk/~jeff/

"Analogy in Pure Inductive Logic"
Dealing as it does with the assignment of probabilities on solely rational or logical grounds in the absence of any intended interpretation Pure Inductive Logic would seem to provide a natural context to investigate the idea of `reasoning by analogy'. In particular: In what sense does this concept exist in its own right? Can it be formalized? Is it `rational' and if so what consequence does it have for the rational assignment of probabilities?

In his talk, Jeffrey Paris will briefly describe the context and default assumptions of Pure Inductive Logic and then go on to explain four general principles of analogical support which have been proposed in this framework.

<u>10:45am</u>
Tom Sterkenburg, PhD Student, Centrum Wiskunde & Informatica (CWI, National Research Institute for Mathematics and Computer Science, Netherlands) and Rijksuniversiteit Groningen, Department of Philosophy. http://www.cwi.nl~tom/

"Ocam's Razor in Algorithmic Information Theory"
The notion of Kolmogorov-complexity provides a quantification of how much we can possibly compress (i.e., describe in a shorter way) a given sequence of data. As the name suggests, this compressibility is to reflect the data sequence's complexity: the lower the Kolmogorov-complexity, the simpler the sequence. A parallel definition can be employed in the context of sequential prediction. That is, we can specify an idealized prediction method that assigns future data elements a higher probability as the combination of past and future elements exhibit a sequence that is more compressible. Furthermore, under the

assumption that the data is generated in a computable way, we can formally prove that this prediction method will almost always converge to the best possible predictions.

On the previous identification of compressibility and simplicity, this prediction method shows a bias towards simple sequences; and so it is customarily presented as a formalization of the principle of Occam's razor. Indeed, it is often suggested that the proof of the performance of this prediction method constitutes a demonstration that a preference for simplicity will lead us to the truth, and can therefore provide us with a genuine justification of Occam's razor.

In his talk, Tom Sterkenburg will explicate the relevant argument that is to justify Occam's razor. He will then recast the argument in Bayesian terms, thereby revealing the hidden assumptions and showing why, unfortunately, the argument has no such justificatory force. On the way, he will also discuss the close affinity of algorithmic information theory to Carnap's early programme of inductive logic.

1:15pm
Simon Huttegger, Professor of Logic and Philosophy of Science, UCI
http://faculty.sites.uci.edu/shuttegg/

"Analogical Predictive Probabilities"
How should analogical considerations enter inductive reasoning? This question was raised after the introduction of Carnap's early systems of inductive logic, and various inductive rules have been developed since. Most of these proposals do not have an axiomatic foundation along the lines of W. E. Johnson's and Carnap's work. Thus, it is at least to some extent unclear to which inductive problems they are supposed to apply. By taking clues from de Finetti's ideas about analogy, I present a new analogical inductive logic that is based on a rigorous foundation. The axioms of the new theory extend the axioms of Johnson and Carnap in fairly minimal ways, and they allow us to discuss in a precise way the merits and limitations of the resulting system of inductive logic.

3:00pm
Jan-Willem Romeijn, Professor of Philosophy of Science, University of Groningen
http://www.philos.rug.nl/~romeyn/

"Analogy by Proximity in Conceptual Space"
This paper exploits tools from Bayesian statistics to develop an account of analogical inductive predictions. In the first part of the talk Dr. Romeijn will consider the well-known link between prediction rules and Bayesian statistics due to De Finetti. In the second part of the talk work in progress with Marta Sznajder - the Bayesian framework will be employed to facilitate a refinement of the observation algebra on which predictions are defined. This leads to a new understanding of the role of similarity in inductive predictions.

The first part starts with the observation that Carnapian prediction rules for multiple predicate families have analogical effects built in. This can be illuminated by representing the prediction rules in terms of Dirichlet priors over Bernoulli hypotheses. Carnap's analogical prediction rules can be illuminated in much the same way, by simply choosing a different class of priors. Romeijn argues that the representation of analogical predictions in terms of such priors offers conceptual advantages. It brings out

the reasoning that underlies analogical predictions.

 The longer second part develops a particular driver of analogical predictions: similarities among predicates. Romeijn shows that the notion of similarity-as-distance can be developed further by representing predicates as regions in a conceptual space. This representation invites the definition of a refined predictive system, in which a probability density over a conceptual space is adapted in the light of observation. It turns out that the Bayesian methods of part one can be used again in this context, offering a new approach to analogical predictions based on
similarity.