Editors' Preface

The idea of the present volume emerged in 2002 from a series of talks by Frank Stephan in 2002, and John Case in 2003, on developments of algorithmic learning theory. These talks took place in the Mathematics Department at the George Washington University. Following the talks, Valentina Harizanov and Michele Friend raised the possibility of an exchange of ideas concerning algorithmic learning theory. In particular, this was to be a mutually beneficial exchange between philosophers, mathematicians and computer scientists.

Harizanov and Friend sent out invitations for contributions and invited Norma Goethe to join the editing team. The Dilthey Fellowship of the George Washington University provided resources over the summer of 2003 to enable the editors and some of the contributors to meet in Oviedo (Spain) at the 12th International Congress of Logic, Methodology and Philosophy of Science. The editing work proceeded from there.

The idea behind the volume is to rekindle inter-disciplinary discussion. Algorithmic learning theory has been around for nearly half a century. The immediate beginnings can be traced back to E. M. Gold's papers: "Limiting Recursion" (1965) and "Language identification in the limit" (1967).

However, from a logical point of view, the deeper roots of the learning-theoretic analysis go back to Carnap's work on inductive logic (1950, 1952). In the context of his goal to construct a system of inductive logic that may take its rightful place beside the formal systems of deductive logic, Carnap asked whether inductive procedures are less regulated by exact rules than deductive procedures. In the Schilpp volume devoted to Carnap's philosophy (1963), Reichenbach's student H. Putnam published his seminal article "'Degree of confirmation' and inductive logic". According to Carnap's reply to Putnam (included by Schilpp), the young critic had already advanced his objections in conversation in 1953; the paper was written around 1955–6.

Relying upon recursion theory, Putnam argued that Carnap's project of defining a *quantitative* concept of 'degree of confirmation' is completely misguided. Thus, a radically new, alternative perspective on induction saw the light for the first time. In the same year, Putnam published a second article "Probability and confirmation" (1963). Relying on his previous results, Putnam now called Carnap's goal into question, on the ground that his 'universal learning machine' is "a learning device of very low power". Nonetheless, Putnam concluded optimistically that even if present-day "inductive logics are learning devices of very low power", in the future, "the development of a powerful mathematical theory of inductive inference, of 'machines that learn', and of better mathematical models for human learning may all grow out of this enterprise".

Much of the subsequent work done in the area of algorithmic learning theory grows out of this spirit. Only two years later, Putnam published a third important paper closely related to the new perspective on induction, entitled "Trial and error predicates and a solution to a problem of Mostowski" (1965), which coincidentally appears in the same issue of the *Journal of Symbolic Logic* as Gold's first paper.

The reaction to the paper from philosophers partly consisted in tempering the imagination of popularisers of the technical work. The popularisers had started making claims about computers learning, and that it followed that computers have a brain, or something approaching free will. This led to speculation about moral obligations towards computers (as autonomous beings with rights). One can see, in retrospect at least, why these speculations needed reining in. The mathematicians and computer scientists have moved on. They have been mapping out the territory of limitations to learning, developing definitions, combining ideas and changing the parameters of the discussion to give an intricate and rigorous understanding of the phenomenon we call 'learning'.

There has been some serious philosophical work in the area since Putnam and Gold published their papers, for instance, by K. T. Kelly, C. Glymour, O. Schulte, and others. Otherwise, the thread of philosophical reactions to the developments in the mathematical sphere has been much thinner than the potential significance the work warrants. It is time to thicken the thread.

Harizanov, Goethe and Friend diagnosed that one of the contributing factors to the lack of communication between the mathematical and philosophical communities has been the plethora of technical terms which have accompanied the development of the mathematics. We address this problem here by giving some definitions explicitly in many of the papers. We hope that this will help bridge the gap between the mathematicians and the philosophers.

Acknowledgments

We should like to acknowledge the funding received from the Dilthey Faculty Fellowship Award of the George Washington University. This is an award whose primary purpose is to stimulate interdisciplinary work that requires crossing disciplines to achieve an integrated perspective and analysis. The funding was enough to spare Michele Friend and Valentina Harizanov their teaching duties in the summer of 2003. Norma Goethe should like to acknowledge the support of her research by a grant of FONCyT (Buenos Aires, Argentina).

We should also like to thank the contributors for their valuable and prompt contributions, and all the reviewers. We should especially like to thank John Case for his useful advice and support, especially at the beginning of the project. We should like to thank Sarah Pingrey for help with the final proofreading of several papers, and for her valuable assistance with TeX and assembling the volume. Sarah Pingrey was partially supported by Harizanov's George Washington University UFF grant. We should also like to thank Ed Canavan for his continuing support.

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May 2006