

EPISTEMOLOGY OF MACHINE LEARNING
ASSIGNMENT #2

Deadline: **Thursday June 7**, before class. Strive to answer concisely yet informatively. Aim for about half a page per question; not more than one page.

- (1) On the website <http://no-free-lunch.org/>, devoted to Wolpert's No-Free-Lunch theorem(s), we read that "Wolpert's result, in essence, formalizes Hume, extends him and calls the whole of science into question." Criticize this assertion by comparing the No-Free-Lunch theorem to Hume's original problem of induction.
- (2) Harman & Kulkarni, following Vapnik (2000, 45ff), relate the role of VC dimension in statistical learning theory to Popper's philosophy of falsificationism. Steel (2011) indeed suggests an analogy between Popper's conviction that the process of conjecturing and testing highly falsifiable theories is necessary for science to converge on ever closer approximations to the truth, and the fundamental theorem of PAC learning that states that a finite VC dimension is necessary for PAC learnability. Identify and describe a significant *disanalogy* between the two approaches.
- (3) The bias-complexity trade-off between making inductive assumptions and risking overfitting can be made precise in the decomposition of an hypothesis' true error into its approximation error and its estimation error. Reformulate the worry that Harman & Kulkarni (sec. 3.2) express about PAC learnability explicitly in terms of approximation and estimation error, and explain how this worry leads them to consider the property of universal consistency. Do you agree with Harman & Kulkarni (sec. 3.3) that universal consistency "is clearly a desirable characteristic of a method"?