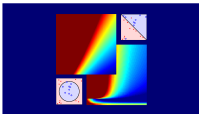# Machine Learning Foundations
(機器學習基石)

Lecture 4: Feasibility of Learning, Extended

Hsuan-Tien Lin (林軒田)
htlin@csie.ntu.edu.tw

Department of Computer Science
& Information Engineering

National Taiwan University
(國立台灣大學資訊工程系)

What is the Next Number?

1,4,1,5

What is the Next Number?

1,4,1,5

1,4,1,5,**0**,-1,1,6
by $y_t = y_{t-4} - y_{t-2}$

1,4,1,5,**1**,6,1,7
by $y_t = y_{t-2} + [\![t \text{ is even}]\!]$

1,4,1,5,**2**,9,3,14
by $y_t = y_{t-4} + y_{t-2}$

any number can be the next!
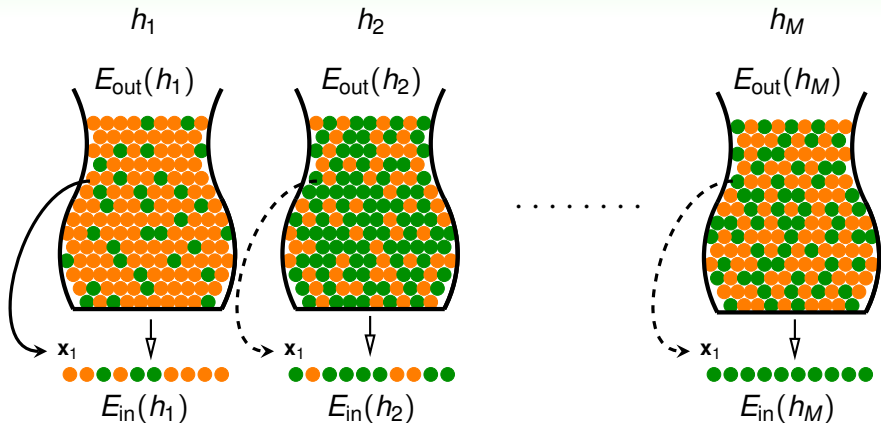
No Free Lunch Theorem for Machine Learning

(Roughly) Without any assumptions on the learning problem on hand,
all learning algorithms perform the same.
(Wolpert, The Lack of A Priori Distinctions Between Learning Algorithms, 1996)

(CC-BY-SA 2.0 by Gaspar Torriero on Flickr)

no algorithm is best
for all learning problems

Dependent Sampling from Multiple *h*

h_1 $\qquad$ h_2 $\qquad$ h_M

$E_{\text{out}}(h_1)$ $\qquad$ $E_{\text{out}}(h_2)$ $\qquad$ $E_{\text{out}}(h_M)$

. . . .

$\mathbf{x}_1$ $\qquad$ $\mathbf{x}_1$ $\qquad$ $\mathbf{x}_1$

$E_{\text{in}}(h_1)$ $\qquad$ $E_{\text{in}}(h_2)$ $\qquad$ $E_{\text{in}}(h_M)$

dependent sampling: not easy to analyze with
independent BAD probabilities like coin game