

# COMPARING NO FREE LUNCH AND SOLONOFF INDUCTION/AIXI

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## INTRODUCTION

No free Lunch (NFL) theorems generally relate to showing all algorithms perform identically when averaged over some class of functions. This is often used to claim that universal AI does not exist and that to perform well an agent must use prior knowledge to specialize.

An alternative view is to quantify Occams razor by Kolmogorov complexity and to make the assumption that environments are not uniformly distributed. Effectively this provides an alternative measure of performance where algorithms that perform well on simple functions (and by NFL correspondingly worse on complex ones) are considered better. This approach is the basis of Marcus's work on the AIXI algorithm which shows that an algorithm can perform optimally on all function classes under a few assumptions. [1]

## TASK DESCRIPTION

My goals:

- Understand the current body of research around NFL and relevant parts of Marcus's work on AIXI.
- Unify NFL and AIXI as closely as possible. Show where NFL breaks down for the AIXI case.
- Find good examples to explain the "paradox".

It would also be nice to find some new necessary/sufficient conditions for NFL depending on prior choice. There has been some work done here already but I haven't yet examined it so I don't know how practical this is.

Mathematical difficulty was a bit worrying at first but now I've started it's not turning out too bad.

## TIMELINE

Week 1-2	Reading Sutton and Barto RL book/Kolmogorov Complexity/Statistics
Week 3-4	Read "Gentle introduction to AIXI" and original Wolpert NFL paper [2]
Week 5-8	Reading NFL papers (a number already selected with supervisor) and Marcus's book on AIXI. Take summary of each paper as I go along as guide for report material. Proofs and ideas should also be happening here.
Week 9-10	More reading, proving and start writing report. Check results.
Week 11	Finish report. Consider ideas for speech.
Week 12	Everything to do with presentation
Week 13	Present!

## REFERENCES

- [1] Marcus Hutter. *Universal Artificial Intelligence: Sequential Decisions based on Algorithmic Probability*. Springer, Berlin, 2004.
- [2] D. H. Wolpert and W. G. Macready. No free lunch theorems for optimization. *Evolutionary Computation, IEEE Transactions on*, 1(1):67–82, 1997.