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Replicating the Sugarscape Model in FrABS

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Abstract

This report describes the work and results done to replicate the Sugarscape Model as presented in the book "Growing Artificial Societies - Social Sciences from the bottom up" by Joshua M. Epstein and Robert Axtell [2].

Contents

0.1	Introduction	3
0.2	Chapter II: Life And Death On The Sugarscape	4
0.3	Chapter III: Sex, Culture, And Conflict: The Emergence Of History	4

0.1 Introduction

The Sugarscape model was the most important use-case for driving the research on functional Agent-Based Simulation (ABS). To conduct the research we implemented a library called FrABS which allows to implement an ABS in the pure functional language Haskell. The library is a general-purpose library and thus supports implementing all kind of ABS where some of them may rely on specific time-semantics like the SIR model and others only focus on complex interactions of agents over discrete time-steps like Sugarscape. Especially for the last kind of models Sugarscape served as the primary use-case for developing the FrABS library and drove the development for implementing necessary features which were not present and required in other models:

- Sequential Update-Strategy (as required by the Model)
- Shuffling of Agents (as required by the Model)
- Conversations for synchronized exchange (Mating, Trading, Warfare)
- Complex Environment-Behaviour (regrowing of resources, seasons, pollution-diffusion)
- Monadic programming style (make code more clear and towards a imperative style)

In a first step we just "roughly" implemented Sugarscape without aligning our results with the ones reported in the book [2]. This work now tries to exactly replicate each ¹ of the dynamics, shows the generated dynamics and discusses the difficulties encountered.

The actual Sugarscape model is described in the book [2] in the Chapters III to V:

- Chapter II: Life And Death On The Sugarscape
- Chapter III: Sex, Culture, And Conflict: The Emergence Of History
- Chapter IV: Sugar and Spice - Trade Comes to the Sugarscape
- Chapter V: Disease Processes

We structure this report in the same way and ignore the conclusions of the book where further results are given.

¹With the exception of a few minor cases

0.1.1 Related Work

Due to the importance and influence of the Sugarscape model, others have already tried to replicate the results.

TODO: [1] Replication of Sugarscape Using MASON - Anthony Bigbee, Claudio Cioffi-Revilla, Sean Luke <https://cs.gmu.edu/~eclab/projects/mason/publications/replication2007.pdf>

TODO: [3] The Specification of Sugarscape - Joseph Kehoe <https://arxiv.org/abs/1505.06012v3>

TODO: implementation in netlogo: <https://www.openabm.org/model/4688/version/2/view>

0.2 Chapter II: Life And Death On The Sugarscape

0.3 Chapter III: Sex, Culture, And Conflict: The Emergence Of History

References

- [1] BIGBEE, A., CIOFFI-REVILLA, C., AND LUKE, S. Replication of Sugarscape Using MASON. In *Agent-Based Approaches in Economic and Social Complex Systems IV*, Springer Series on Agent Based Social Systems. Springer, Tokyo, 2007, pp. 183–190. DOI: 10.1007/978-4-431-71307-4_20.
- [2] EPSTEIN, J. M., AND AXTELL, R. *Growing Artificial Societies: Social Science from the Bottom Up*. The Brookings Institution, Washington, DC, USA, 1996.
- [3] KEHOE, J. The Specification of Sugarscape. *arXiv:1505.06012 [cs]* (May 2015). arXiv: 1505.06012.