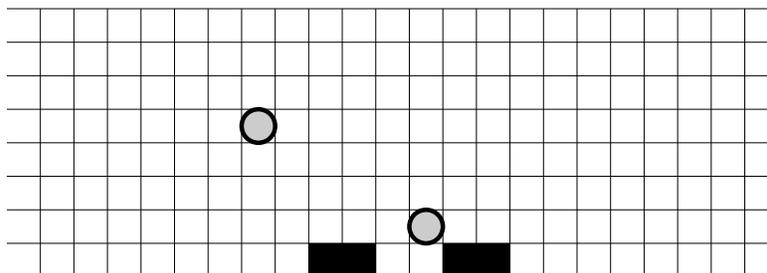


Introduction to Philosophy of Physics Homework 3

The nature of space and time, and time travel

Due: 9 April 2018

1. Describe Poincaré's space of a two-dimensional disc in your own words and explain how it is supposed to illustrate the conventionality of the 'true' geometry of space.
2. Mach offers an alternative explanation of Newton's bucket experiment.
 - (a) Reconstruct Mach's explanation and offer a brief evaluation of its tenability.
 - (b) Propose a thought experiment for which Newton's theory and Mach's theory give different predictions.
3. Distinguishing between space and time on the one hand and processes and events in space and time on the other, Huggett argues that not only do some processes in time seem to be irreversible, but that there is a similar 'reflection irreversibility' involving how things are in space. Explain.
4. What is the main thesis of the 'entropic approach'? Explain.
5. Consider the world described by Huggett (pp. 133f, Fig. 12.3). In this world, space is one-dimensional and discrete, built up from cells which are either occupied or empty. Time is also one-dimensional and discrete. Any spatial distribution of occupied and unoccupied cells is permissible. A *neighbourhood* of a cell consists in the cell itself and its immediately adjacent cells. The dynamical law in this world is as follows: a cell is occupied at some moment in time just in case exactly one or exactly two of the cells in its neighbourhood were occupied a moment earlier. Suppose the initial state of the world (bottom line in the figure) is as follows:



- (a) Given this initial state, fill in the entire grid (eight moments of time in total), representing occupied cells as black.
- (b) Suppose there is a time portal with its two 'mouths' connecting the cells indicated by a grey circle. Is there a consistent solution with the initial state as given in (a)? Explain.
- (c) *Extra credit.* Find non-trivial initial conditions, which lead to consistent evolutions with the time portal as described in (b).