Emergence of Complexity in Cellular Automata

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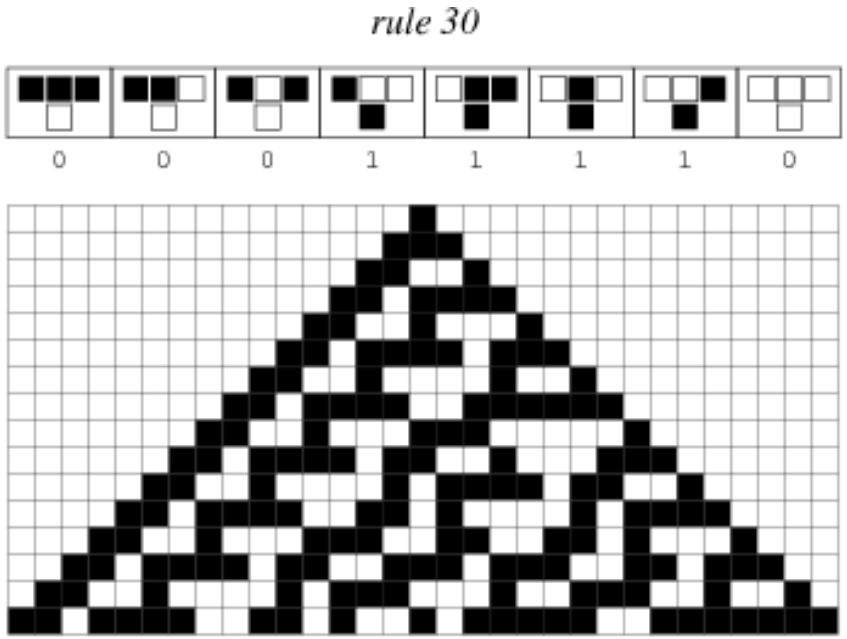
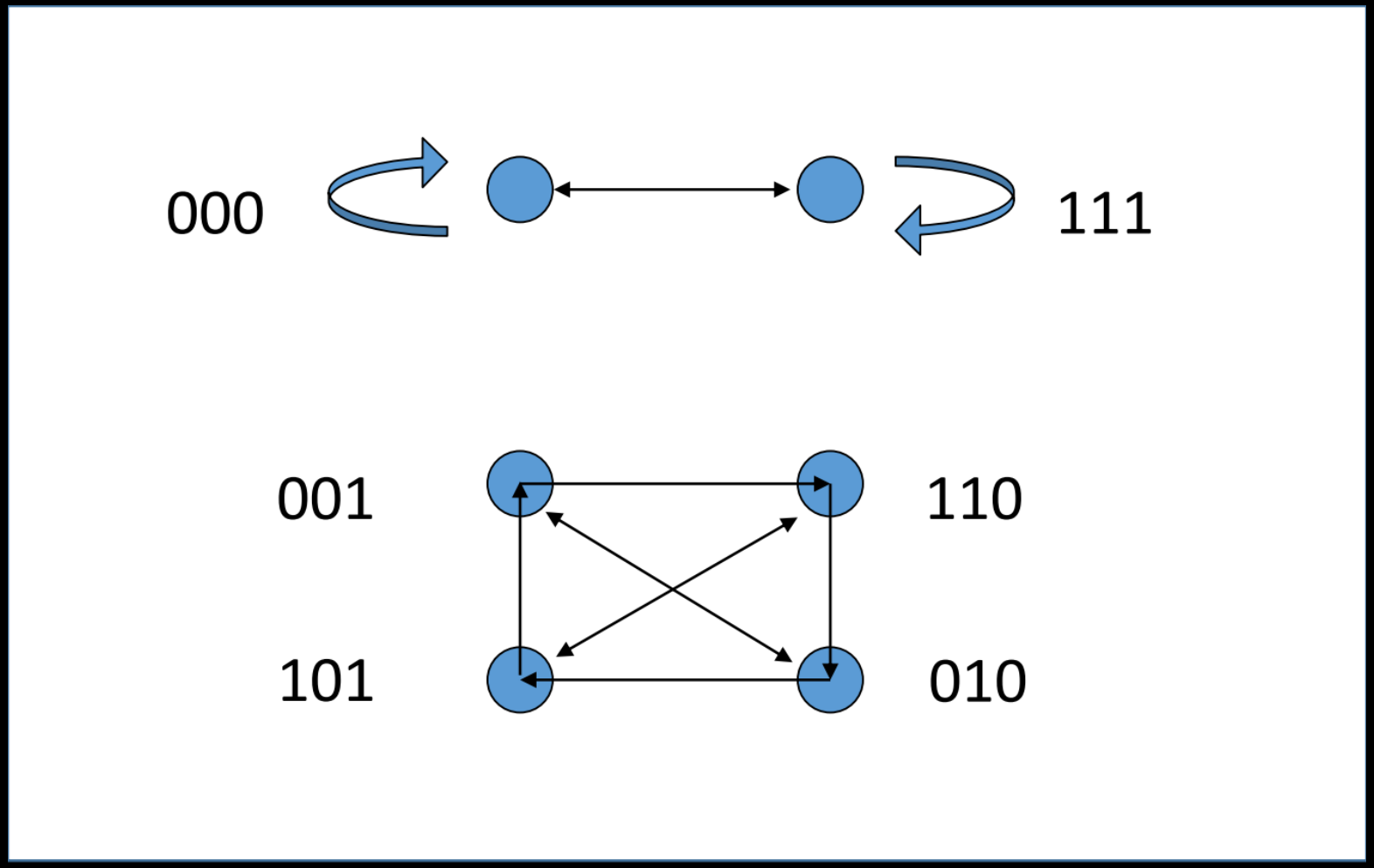
What are Cellular Automata?

- Computational model that evolves over time
- Cellular Automata can be reversible
- They have the ability to demonstrate OEE, which can be used to measure complexity

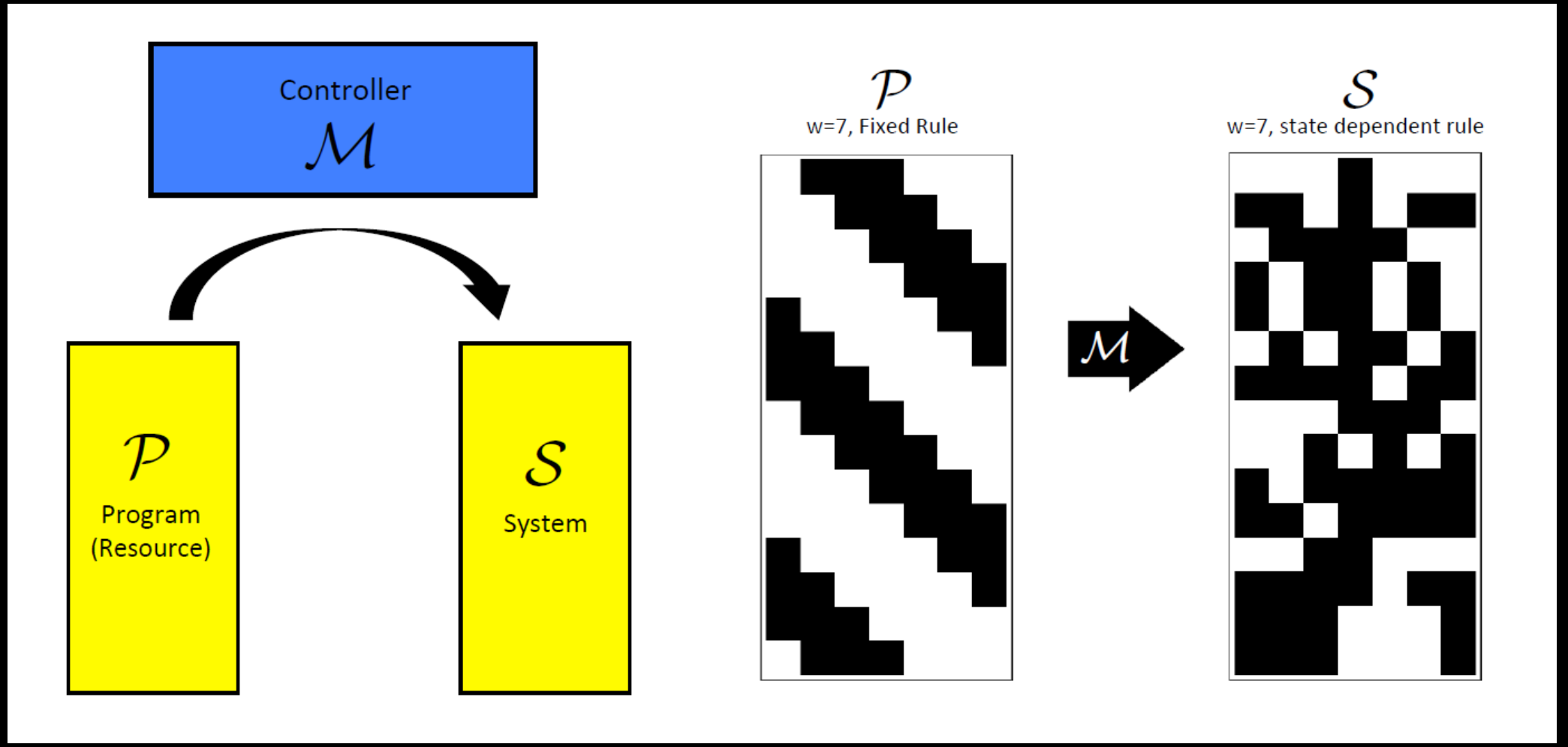


http://mathworld.wolfram.com/CellularAutomaton.html

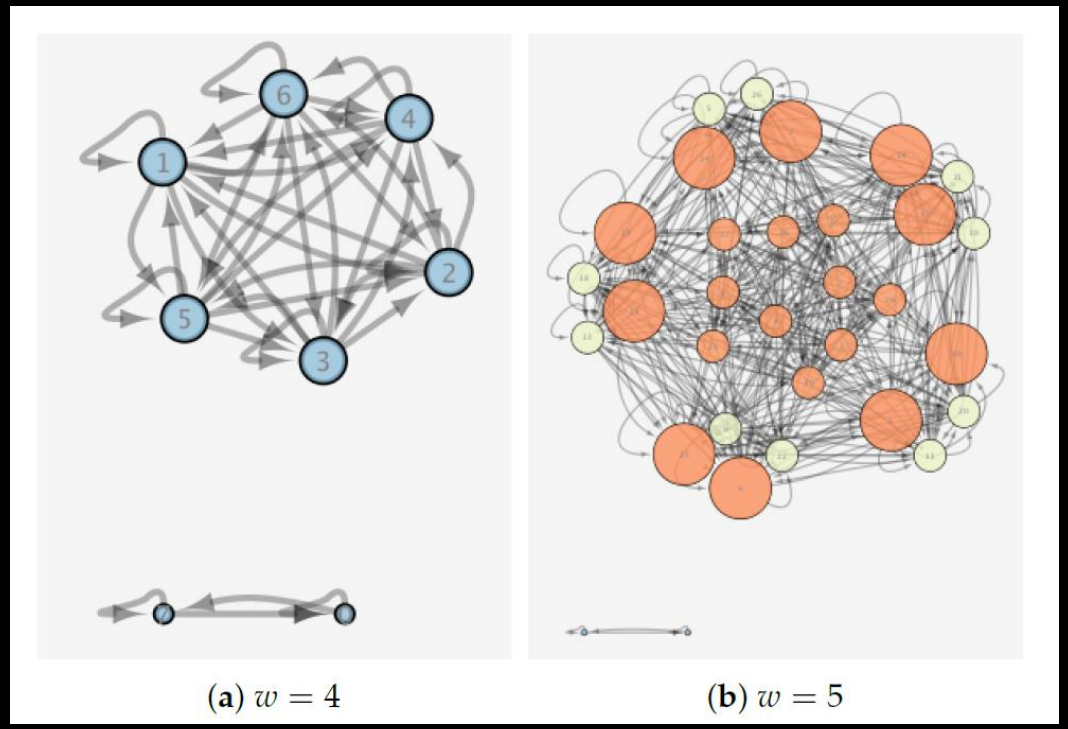
Reversibility



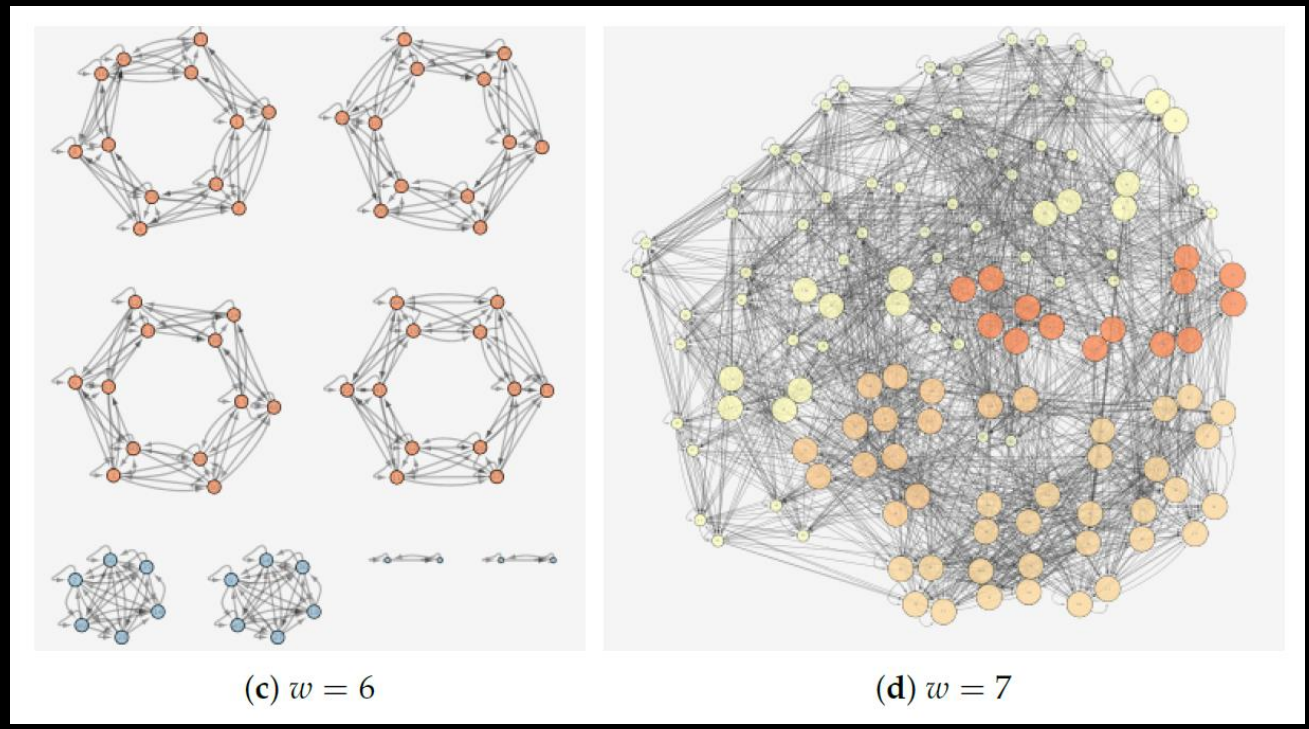
Open Ended Evolution (method)



State Transitions (varying w, constant R_p)



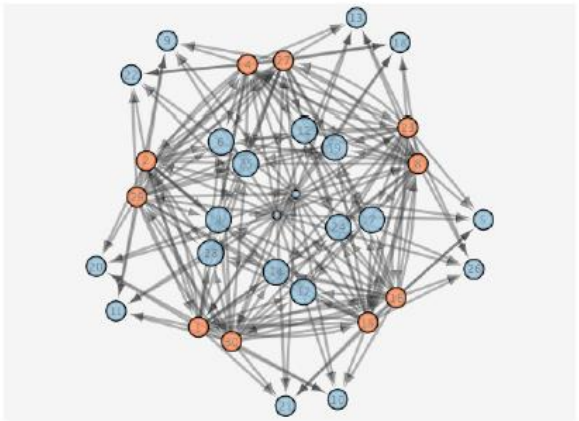
(a) $w = 4$ (b) $w = 5$



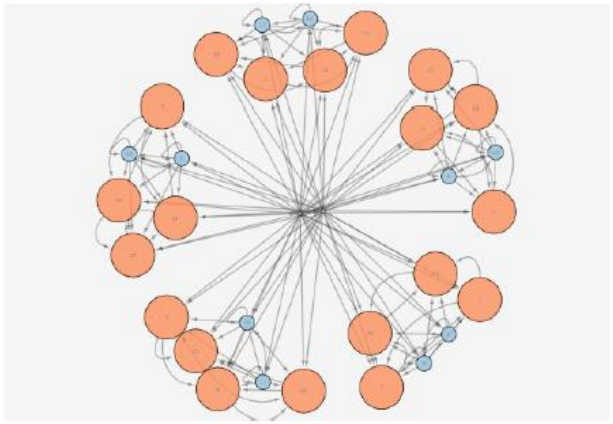
(c) $w = 6$ (d) $w = 7$

State Transitions (varying R_p, constant w)

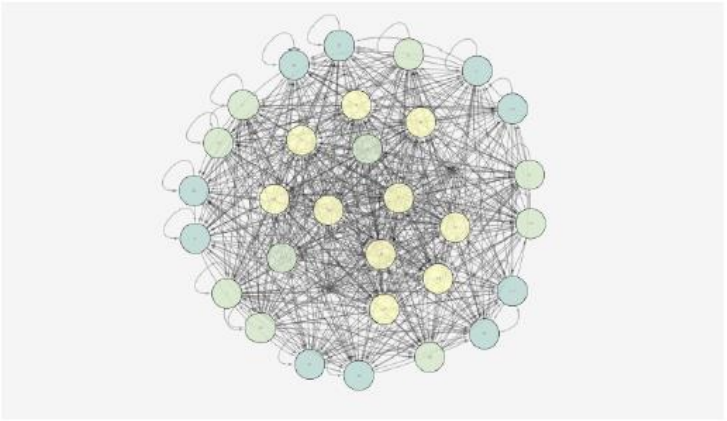
(a) $R_p = 0$



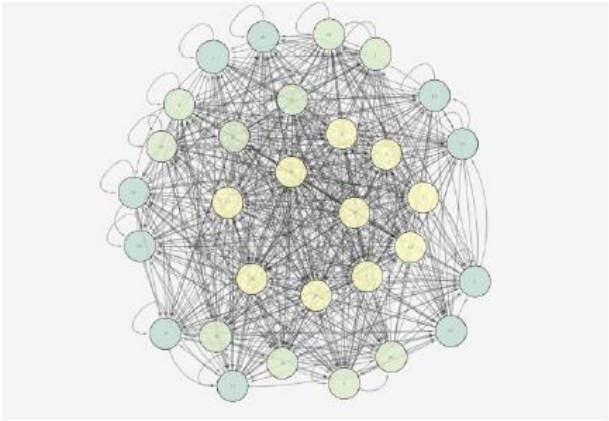
(b) $R_p = 0.2$



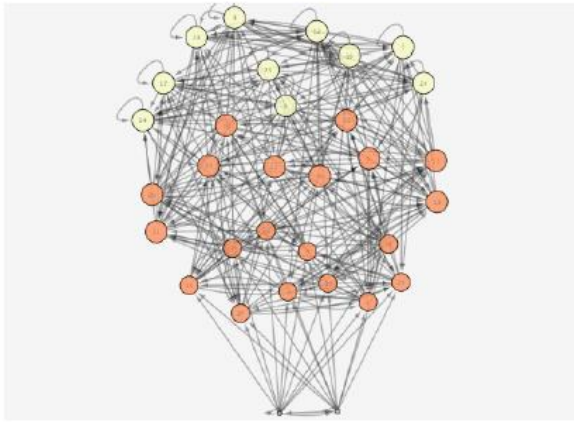
(c) $R_p = 0.4$



(d) $R_p = 0.5$

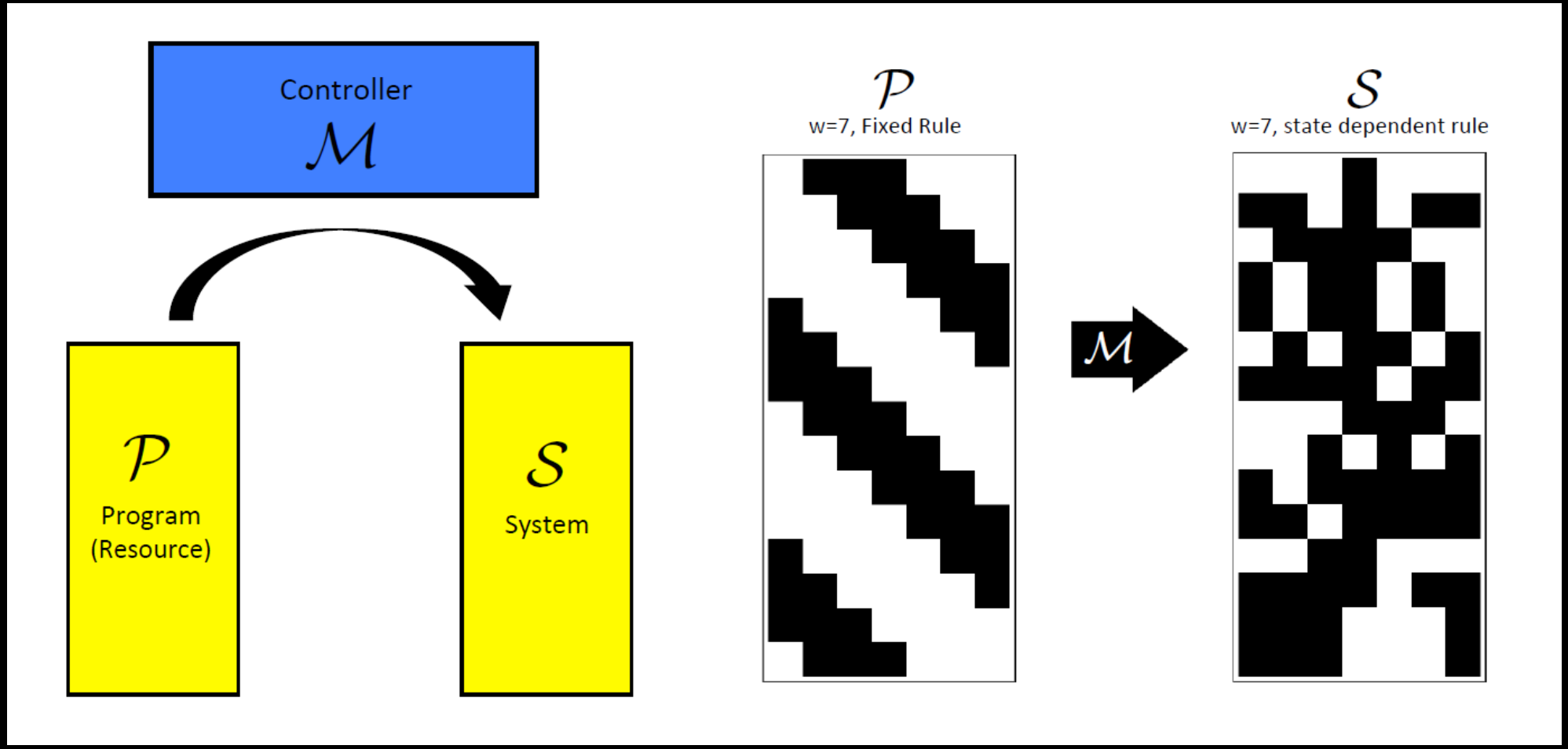


(e) $R_p = 0.7$



(f) $R_p = 0.8$

Revisiting the Model



What We're Currently Exploring

- Is there any relationship between complexity and effective information?
  - Effective Information:
    - "Assess the causal influence of one subset of a system on another." – Hoel, 2016
    - "When effective information is asses over the entire system, it captures how effective and informative a system's causal structure is. Used this way, effective information represents a quantification of "deep understanding"." – Hoel, 2016, Pearl, 200.

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