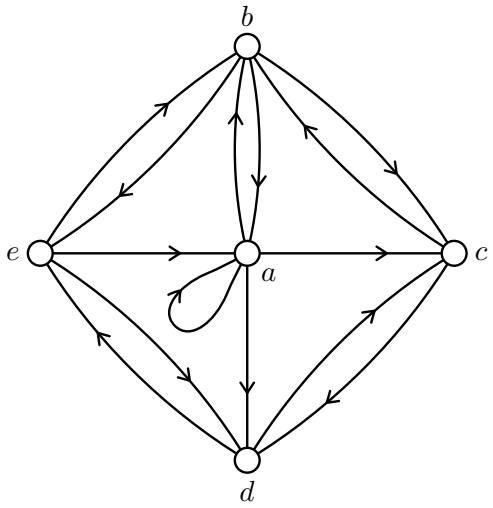
Cancer Biology 8347 - Cancer Systems Biology - Spring 2023

Problems on graph theory II

2. Consider the boolean network shown below, where every vertex has a threshold of 2. In other words, for a vertex to be 'on' at time $t+1$, it must have at least two incoming edges from vertices that are 'on' at time t.



For each of the following initial states (at time $t = 0$), construct the states at times $t = 0, 1, 2, 3, \ldots$. Show the state for each value of t by coloring in the vertices that are 'on' and leaving open the vertices that are 'off'. Label each state with '$t = 0$', '$t = 1$', and so on.

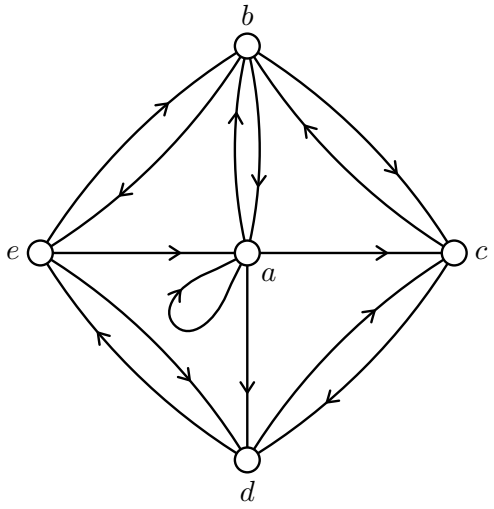
Continue until the states settle into an *attractor*. An attractor is a sequence of states (maybe just one state, or maybe several) that will repeat in a cyclic pattern. You can recognize that you have reached an attractor by the fact that you repeat a state S that you have seen before. Then the states following the first occurrence of S will be repeated over and over again.

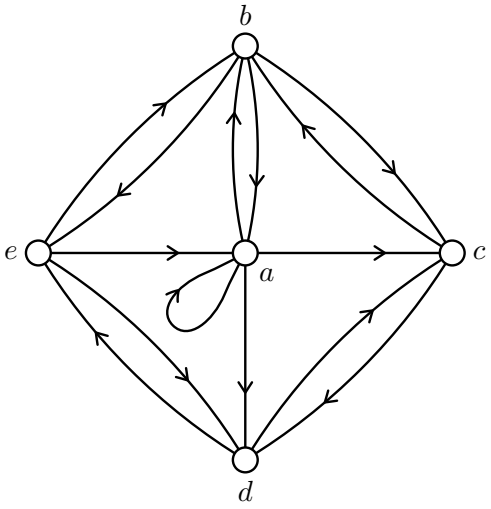
When you recognize that you have reached an attractor, describe the cycle of states in the attractor.

Note: Copies of the network are provided on the following pages. Please use these to show your work.

(a) Initial state at $t = 0$ has vertices a, c and d 'on', vertices b and e 'off'.

(b) Initial state at $t = 0$ has vertices a, b and c 'on', vertices d and e 'off'.


b
e
a
c
d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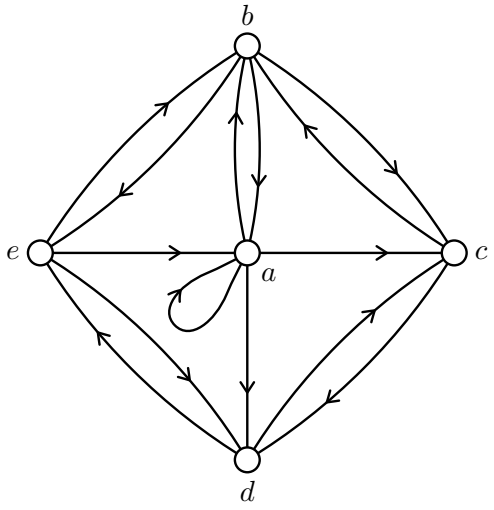
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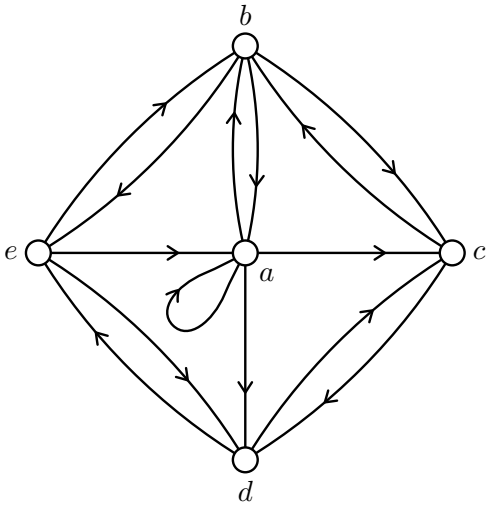
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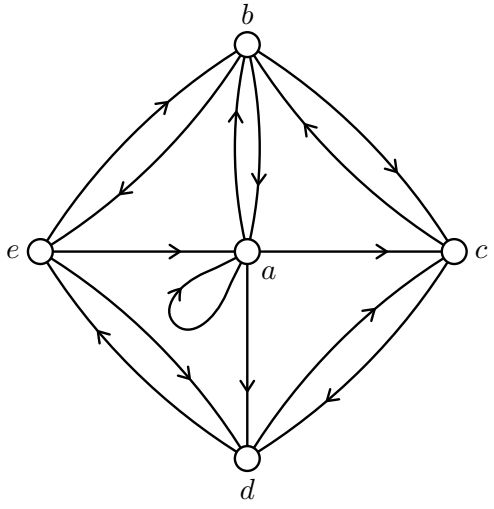
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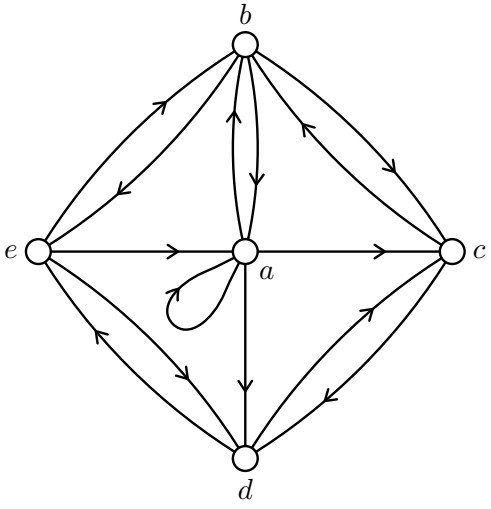
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