Computational Science 2017

Hertentamen 4 januari 2015

1.
    a. A distinguishable piece of the universe, or A system is a potential source of data
    b. Anything to which an mathematical experiment can be applied to answer questions about a system
    c. To predict the future (like weather forecasts) or to avoid having to do the experiment in real life (like testing the fire-safety of the UvA).
    d. A simulation is executed when an experiment is applied to a model.
2. A model is a simplified version of the real world, it isn't perfect.
3. The best model to simulate (according to occam's razor) would be to choose the simplest model with only the variables that really make a difference. Let's say you model traffic flow. The only useful variable would be the car density, extra variables like gender or car size can be ignored because of the negligible importance.
4. 10100101
5.
    a. $k^{k\text{^}N}$
    b. $k^{N(k-1)+1}$
6.
    a. False (class 3)
    b. False
    c. True (sommige class 4 kunnen CA simuleren)
    d. False
7. A: false
   B:
   C:
   D: false
8. A: (x1 AND NOT x2) OR (NOT x1 AND x2)
   B: NOT (NOT x1 AND NOT x2)
   C: Any boolean function can be constructed with AND, OR and NOT. Since OR can be constructed from AND and NOT, this means AND and NOT can also construct any boolean function.
   D: Storage (still cells), AND, OR and NOT gates (NAND can create all of those), clock
   E: Game of Life uses NAND gates, AND can be constructed from NAND
   (x1 NAND x2) NAND (x1 NAND x2)

Tentamen 22 September 2015

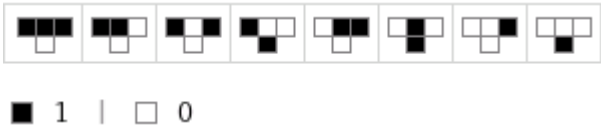
1.
    a. A system is a distinguishable piece of the universe which is a potential source of data. An experiment is the process of extracting data from a system by exerting it through its input. Lastly, a model for a system and an experiment is anything to which experiments can be applied in order to answer questions about the system.
    A simulation is an experiment applied on a model.
    b. - Computer models are cheaper to setup than alternative methods that could be used to predict what will happen in a system, eg building a prototype.
    - Computer models can model dangerous situations safely
    - Computer models can repeat tests several times over
    - Computer models can easily be altered to quickly see the outcomes.
    c. Not every situation might have been considered, this could cause the model to give incorrect answers. A model is not valid for every situation.
    d. The best model to simulate (according to occam's razor) would be to choose the simplest model with only the variables that really make a difference. Let's say you model traffic flow. The only useful variable would be the car density, extra variables like gender or car size can be ignored because of the negligible importance.
2. 1010011

3.
    a. k^{k^N}
    b. $k^{N(k-1)+1}$
4.
    a. True
    b. True (not proven but highly probable)
    c. False
    d. True
5.
    a. Elke mogelijke combinatie x1, x2,.....xn met uitkomst y kan nagemaakt worden met behulp van And, Or en Not gates. Geef een willekeurig voorbeeld van xi variabelen en een willekeurige uitkomst en toon aan hoe dat met and / or / not gates gedaan kan worden? (dan nog in engels)
    b. Stable blocks can be used to make a memory of binary numbers. You can write in the memory using glider guns to create zeros and ones and to destroy ones. And, or, not gates can mimic every boolean formula and those gates can be made in the game of life. The UTM finite state control consists of boolean operations so this can be made in game of life. An UTM can run every Turing machine, all algorithms are Turing machines so game of life can run every

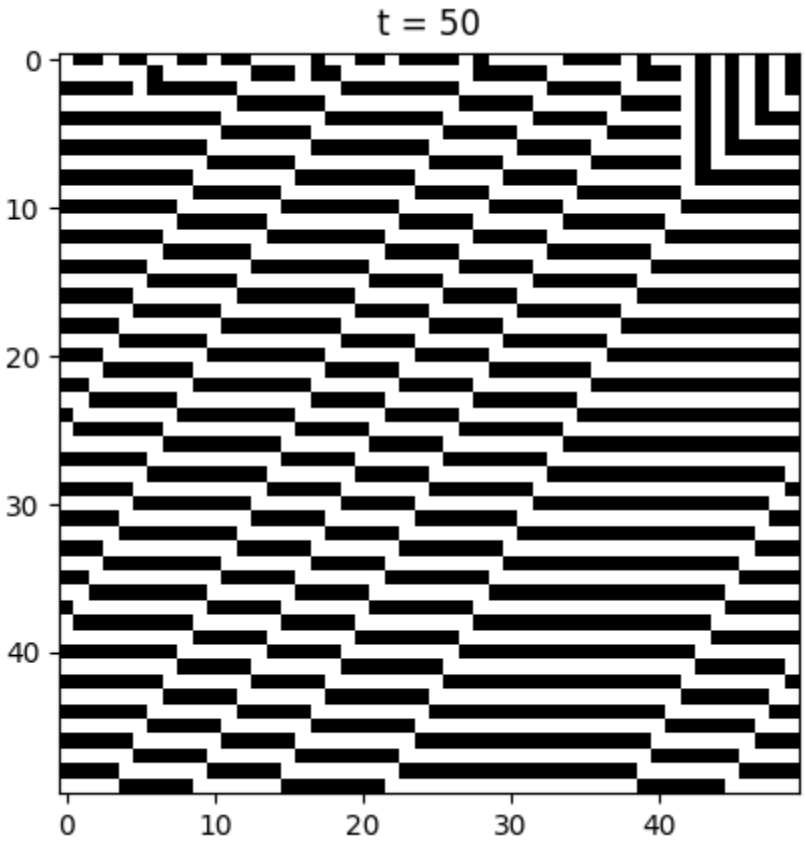
algorithm: It is a universal computer

6.

a. This rule is neither totalistic nor outer-totalistic because 100 leads to a 1 and 001 leads to a 0, but both have the sum of 1.



b. No, looking at the figure below, you can see the CA enters a loop. However the amount of ones (and thus the probability of each cell) differs with different begin situations.



c. No, 110 and 011 both lead to a state of 0. So if you reverse it you won't know if the previous step was 110 or 011.

7.

a. A CA of a certain rule is not reversible if it has a transient path. This CA can still be ergodic or not because having a transient path does not rule out one of the two. (?)

A reversible rule only has one cycle, a ergodic has also one cycle but can have transient states that lead towards the cycle. We don't know if there is only one cycle or not thus we cannot rule out that it is a ergodic rule or not.

b. Add an extra row before the rule tetris shape, copy these new rule parts and flip the upper and bottom middle cells: (wie dit geschreven heeft is dom)

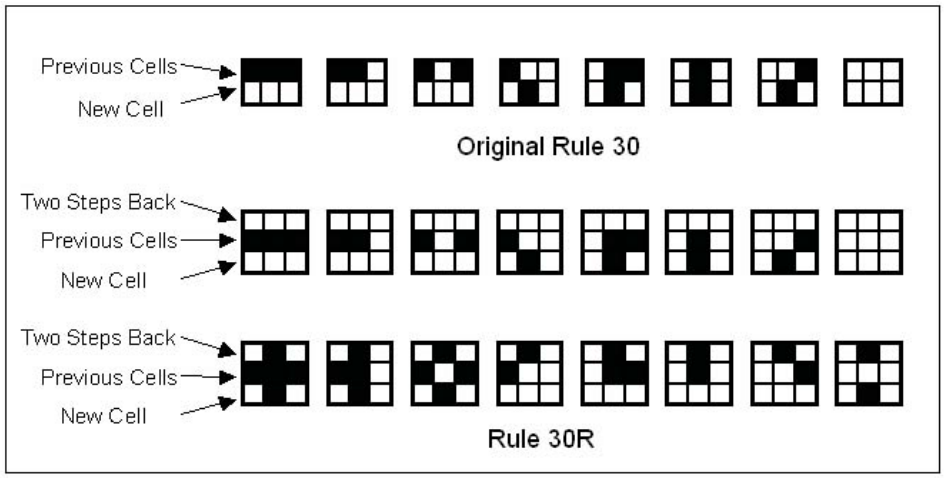


Figure 3 Rule 30 vs. Rule 30R

(Zie pdf Part V slide 58)
Second order means that the state of a cell not only depends on the state of the previous cell but also from the state of the cell before that (t-2)

8.

a. f(x + y) = f(x) + f(y) // (vector addition mod k)
b. Stel je een driehoek voor, rij t=100 van links naar rechts, alles modulo K
100 boven 0, 100 boven 1, 100 boven 2…….10 0 boven 99, 100 boven 100.

9.

a. If accuracy isn't extremely important, this can be a lot faster to simulate.
b. To calculate a precise approximation, the step size used for the mean field approximation has to be infinitely small. So this solution isn't always optimal to use for approximation. *(dat slaat nergens op)*
c. dx/dt = 2x
dx = 2x * dt
1/x * dx = 2*dt
ln(x) = 2 * t + C
C = ln(x0) - 2 * 0
ln(x) = 2 * t +ln(x0)
ln(x / xo) = 2 * t
x / x0 = e ^ (2 * t)
x = x0 * e ^ (2 * t)