

Introduction Computational Science

UvA course 5062INCS6Y 2016/2017

Partial exam. 28 February 2017

Each question gives 1 point. For a partially correct answer, one earns a fraction of a point.

Enjoy! ;)

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MODELLING AND SIMULATION

1. Draw a scheme showing different ways to study a system. Don't forget about the block from this quote: "Only an idiot uses simulation in place of <??>" (Francois Cellier)
2. Give at least 3 reasons for modelling and simulation.
3. List 3 limitations and "dangers" of modelling.
4. To check the correctness of our modelling & simulation results, we apply two distinct techniques in the workflow: $Real\ system \xleftarrow{(A)} Model \xleftarrow{(B)} Simulation$. Write down the names of these two techniques: $A=<??>$, $B=<??>$
5. Draw the time-state plots for 3 types of models: continuous, discrete-time, discrete-event. In the legend, write the model types and real-life examples.

FUNDAMENTALS OF CELLULAR AUTOMATA

6. Consider a two-dimensional cellular automaton with three possible states ($k=3$) in Moore's neighbourhood. In your answers, please do NOT use calculator, just write the exponents.
 - (A) What is the size of input alphabet α ?
 - (B) How many transition functions (rules) are possible?
 - (C) How many rules are totalistic?
7. Consider a Wolfram Rule 253:
 - (A) Write down the Rule in a binary form.
 - (B) Starting from a single seed 0001000 at time $t=0$, write the next two states at $t=1$ and $t=2$.
 - (C) Calculate its transient length L_{trans} and cycle length L_{cycle} .
8. Characterize this Rule 253:
 - (A) What Wolfram Class does it belong to? (give a Class number and a very short description)
 - (B) Calculate the rule's Langton parameter, assuming the quiescent state $s=0$.
 - (C) Is this Rule reversible? totalistic? probabilistic? additive? symmetric? ergodic? (yes/no and briefly explain why).
9. Give examples of CA applications for each Wolfram Class and other types of classification (as above).

QUANTIFY COMPLEXITY

10. How many discrete values of the Langton parameter λ are possible in a generic CA with k states and neighbourhood size N ? Remember that in our Quiz, many participants made a little mistake.

