Computational Science 2

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Seminar
Exercises

Exercise 3 (12.5.2020):

Game of Life
from *An Introduction to Computer Simulation Methods*,
Chapter 14, Problem 14.6

a) Start `LifeApp` and choose several initial configurations with a small number of live cells and determine the different types of patterns that emerge. Use the initial configurations suggested in Fig. 1 below. Does it matter whether you use fixed or periodic boundary conditions? Use a 16×16 lattice.

b) Modify `LifeApp` so that each cell is initially alive with a 50% probability. Use a 32×32 lattice. What types of patterns typically result after a long time? What happens for 20% live cells? What happens for 70% live cells?

c) Assume that each cell is initially alive with probability p. Given that the density of live cells at time t is $\rho(t)$, what is $\rho(t+1)$, the expected density at time $t+1$? Do the simulation and plot $\rho(t+1)$ versus $\rho(t)$. If $p = 0.5$, what is the steady-state density of live cells?

d) `LifeApp` has not been optimized for the Game of Life and is written so that other rules can be implemented easily. Rewrite the program so that it uses bit manipulation.

Figure 1: Examples of initial configurations