Computational Cognitive Neuroscience
Exercise Set 3

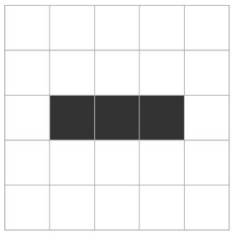
Due: 11.02.2016, before class

Guidelines for Submission

- Submissions can be made via email to hande.celikkanat@helsinki.fi before the deadline, or by delivering a hard copy at the beginning of the class.
- In case you are submitting both written exercises and programming exercises, please prepare two separate files respectively for submission.
- Please do submit programming exercises only via email, and as python scripts with .py extension. Also please kindly indicate with a comment which exercise you are attempting before related code.
- Maximum number of points you can get for exercises per week is 10. Maximum number of points you can get in total is 20. One exercise is worth 1 point – unless stated otherwise in the exercise.

1 Rojas Ch. 12-13

1. Let $n > 2$ be a natural number. Design a Hopfield network of n units where each unit is in a binary state (0 or 1) whose stable states are such that exactly 3 of the units are in the state 1 and all others are in the state 0.
2. Show that the Conway's Game of Life cannot be simulated by a Hopfield network. Hint:



3. Calculate the energy of the bidirectional associative memory when

$$W = \begin{matrix} -1 & 2 \\ 1 & 3 \end{matrix}, \ \mathbf{x} = [1 \ -1] \text{ and } \mathbf{y} = [11].$$

Is this a local minimum of the energy function? Find a local minimum.

4. Implement a bidirectional associative memory with sign-function as activation function (Rojas 13.1). With input x it should iterate the computation as long as it comes to a stable state.
5. Consider the asymmetric network on Figure 13.3. Draw an evolution diagram for it, similar to one in Figure 13.10.
6. Concentrate on your project work!