

Exercise 9

January 14

Task 37 Selection

Consider the two scenarios shown in Figure 1. You observe a set of 10 actions at different iterations. At iteration $t+1$, we select (using a selection mechanism) 10 actions from the action set at iteration t and these actions build the new action set for $t+1$. What is the selective pressure for the action denoted as a in (a) and in (b)?

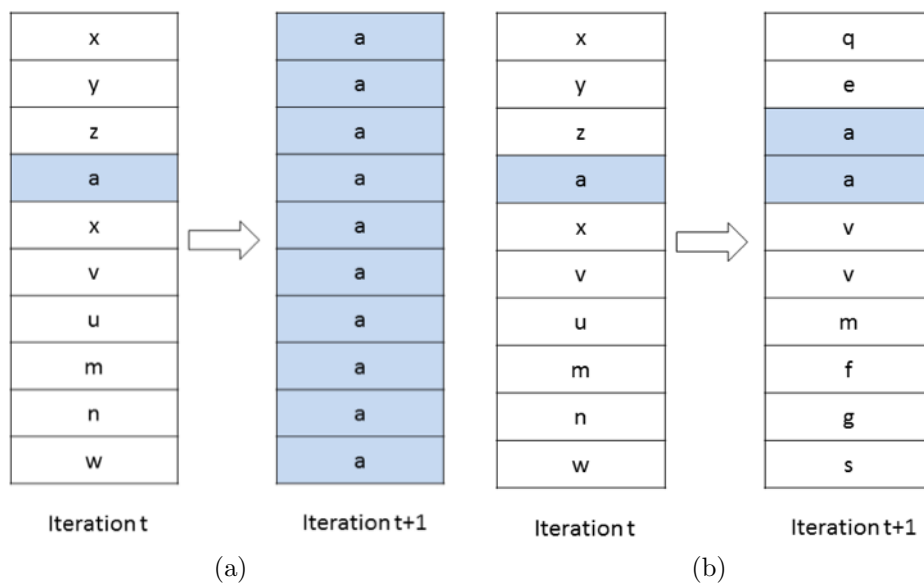


Figure 1

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Task 38 Voting Mechanisms

In the table below, you see five individuals, their current opinion and the quality value for each option.

i	$o_i(t)$	$q_i(o_1)$	$q_i(o_2)$	$q_i(o_3)$	$q_i(o_4)$
1	3	0.5	0.6	0.9	0.7
2	3	0.6	0.9	0.8	0.3
3	2	0.5	0.8	0.7	0.6
4	2	0.5	0.7	0.8	0.9
5	1	0.6	0.6	0.7	0.5

- a. What is the next opinion of each individual if we assume a fully connected neighbourhood and the following decision function:
 - Voter Model
 - Majority Rule
 - Direct Comparison
- b. Calculate the Borda-Count metric. What is the best option?
- c. If we use the single transferable vote method, which option is chosen?

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Task 39 Exploration and Dissemination

Assume we have a collective decision making process and we know the quality of the solutions. How can you modify the length of exploration and dissemination phase, in order to settle on the option with the best quality.

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Task 40 Movement and Environment

In this task we want to understand how the movement and environment affect the collective decision in a collective perception task.

We consider the following three different environments:

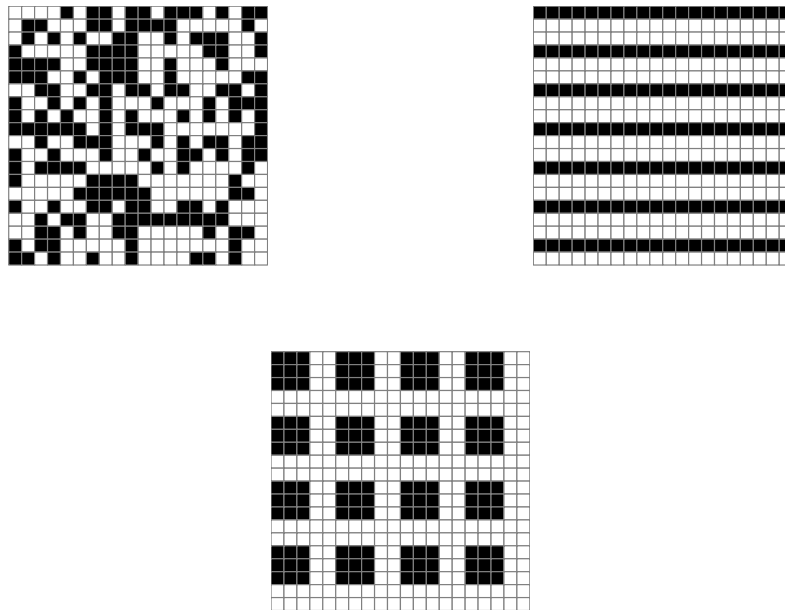


Figure 2: Environments

- a. How is the decision making affected by the environment if all individuals can only move horizontally or vertically (some individuals only move in x-direction and some only move in y-direction).
- b. Which decision function would you use to classify the environment as good as possible?

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Task 41 Collective Decision Making - Programming

Program a Collective Decision making. Store the opinion of all individuals in an array and update the opinion in the k -neighborhood based on the array index, i.e. use all individuals from index $i-k$ to $i+k$ to update the opinion.

- a. Implement two decision functions: Majority Rule and Voter Model - which of the two leads to faster convergence (use a neighborhood range of $k=2$)?
- b. Now shuffle the array between each update of the opinion to emulate movement - how does the convergence speed change?

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Task 42 Localisation

Assume we have used a distance-sensor to measure the distance of 4 known anchor-points a_i the environment to an individual \vec{x} . The distances to the individual and the position of the anchor points are indicated in Table 1.

- a. Compute the position of \vec{x} .
- b. How can we compute the position, in case the range measurements contain errors.
- c. What error is introduced in case you use the hop-count method? Can smoothed hop count mitigate the problem?

\vec{a}_i	$\ \vec{a}_i - \vec{x}\ $
(0, 0)	0.45
(1, 0)	0.89
(0, 1)	0.63
(1, 1)	1.00

Table 1