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Supervised Neural Network Learning with an Environment Adapted Supervision Based on Motivation Learning Factors

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Abstract

This research introduces an innovative approach for **supervised learning systems in cases when we do not have initially defined training data sets**, but we need to develop them gradually during training process on the basis of the motivation factors that come from the given environment. We suppose to **gradually develop and update knowledge** about the environment and use it for supervision of training MLP.

Introduction

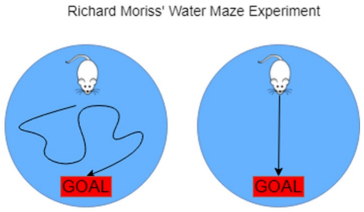
In the beginning, the gradually gained knowledge does not have to be correct, but it allows to **adapt** a neural network still better and more efficiently in time. It is illustrated on the problem of acquiring the ability to return to the starting position optimally by a virtual robot from anywhere in an initially unknown and gradually explored maze. The proposed approach focuses on the attempt to **reflect human cognitive abilities** and **motivation factors** in an introduced model using artificial neural networks. This research presents a new approach in which the decision-making method arises from the **supervised learning process** controlled by the knowledge gained during maze exploration. This research presents a model of maze exploration and knowledge-based adaptation of the neural network.

Cognitive Concepts

- Curiosity,
- Implicit and episodic memory,
- The need to preserve.

Problem

This is an extension of the Richard Morris' water maze experiment analyzing the rats' ability of spatial learning, by motivating animals to reach the labyrinth end platform. There are three basic strategies to accomplish the task: (1) **remembering the movements necessary to achieve the platform**, (2) using the sense of sight to navigate and (3) using reference points to locate oneself.

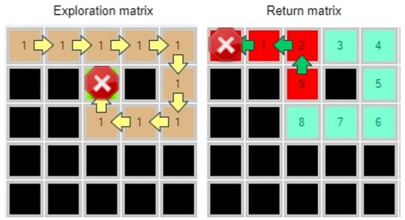


In this research, strategy (1) has been applied which is based on the building of implicit memory on the basis of episodic memory.

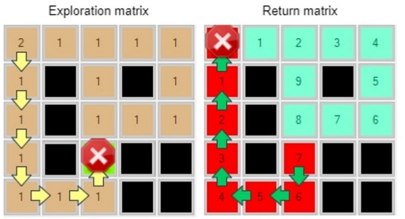
Model

An environment model was created in order to implement the algorithms of environment recognition and return from a given position to the initial position. The environment is defined as a grid of fields, on which the robot can move, and the fields which are unobtainable. The tutor forms knowledge about each field in the explored environment. The knowledge is represented by the number of visits of each field and a value specifying the current lowest known number of necessary steps to return to the starting position. An **exploration matrix** was created containing information on the number of field visits in the previous expeditions and determining the direction of environment recognition. In turn, the **return matrix** represents the tutor's knowledge about the environment and contains information about the number of steps needed to return to the starting position and determines the return direction for training the neural network of the robot. During exploration, robot chooses the least visited field from its neighbourhood based on the exploration matrix values and analogically during the return from return matrix.

Visualization of Algorithms



Building the knowledge



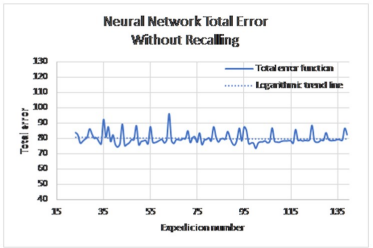
Adding not optimal choices to memory

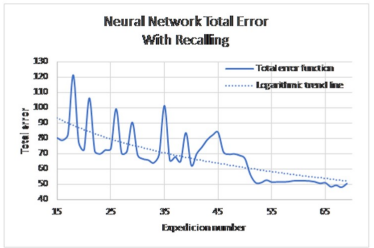
Adaptive Knowledge-based Learning

The first phase of learning consists of the **gradual collection of training data sets**. As described, the response to some of these data will be changed in the following steps. At this stage, the neural network learns "easy" examples, and for some "difficult" ones is not sure of the answer. We use the analogy: new but easy vocabulary is remembered quickly, but with difficult ones, problems still arise.

The **teacher's virtual memory** is created when the initial learning phase is over. The teacher writes in it, with which **examples the student has a problem**, that is, for which input data is made a mistake bigger than assumed one. In the next learning iterations, these examples are reminded. We use the analogy with focusing on learning difficult vocabulary.

Results





Conclusions

In this research, a new knowledge-based learning to determine the optimal return route to the initial position in a new environment was introduced. The described cognitive approach enables to automatically collect information about the maze using motivated learning, form the necessary knowledge and use it to control a classic supervised training algorithm to learn the neural network the optimal solutions.

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