**Evolution, Development and Learning in Predictor Neural Networks**

**Learning in multigoal environments without reward**

**Evolution, Development and Learning in multigoal environment with Predictor Neural Networks**

The problem of adaptation in multigoal environments is a great challenge for state of the art machine learning.

Artificial neural networks with unsupervised learning are suitable for automatic classification tasks but not sufficient for implementation of neurocontrollers for autonomous agents.

Supervised learning in neural networks can solve the problem of adaptation in theory but it requires data of all sensory inputs with corresponding desired actions for the task environment. For any practical situation obtaining full information of this kind is infeasible.

Reinforcement learning algorithms commonly apply to isolated problems.

Neuroevolution solves the problem for in constant but is limited in stochastic or changing environments.

What is required for the neural network learning algorithm to adapt successfully in multi-goal environment? The neural network should be able to produce initial or *primary* repertoire of basic behaviors. When during lifetime the agent starts to encounter problems in achieving goals with help of this primary repertoire it should be extended to allow mission completion for a spectrum of environmental variations. These particular solutions acquired by learning constitute the *secondary* repertoire of behaviors. Primary behaviors can be generated by evolutionary and developmental algorithms or pre-specified by hand. During life time adaptation learning algorithm should detect failures to execute existing behaviors and generate actions implementing alternative solution. We suggest that failure detection should be distributed over the whole neural network. Our hypothesis is that it is possible when neurons not only activate but also predict future activity of each other. If some neurons detect mismatch between predicted and actual activities then learning starts. To generate new action sequence without disruption of existing behavior we propose to integrate new neurons in the network during the learning process. The key feature of our model that makes adaptive learning possible is distributed prediction on the level of individual neurons, so we call this architecture *predictor neural network*. In this paper we present computational study of the model consisting of evolutionary and developmental phases for generation of primary repertoire as well as life-time phase with learning controlled by continuous distributed prediction by the network of its own activity.