# A Multitask Learning Model for Autonomous Acquisition of Recognition Concepts

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In machine learning and neural networks, we are obviously interested in understanding and replicating the knowledge acquisition processes of humans. A particular area of interest is learning of related tasks. We generally observe that humans can learn a new task quite quickly when the task is similar to the one they have learned before. For example, a person who plays tennis can quickly and easily learn a similar sport such as squash or table tennis. So the theoretical question is: In what ways is the human brain using knowledge of one task to enhance its learning of another similar task? The conjecture is that the human brain is using some form of knowledge transfer when it knows that a new task is similar to the one it had learned before.

We consider a dynamic multitask learning environment where training examples for different tasks are given sequentially to the learning system, but we permit frequent switching of tasks. In addition, no particular order is required for the sequence of training examples for a given task or for the random switching of tasks. This continuous online task learning is very similar to human learning. In real life, humans are often provided with different descriptions of the same object and they learn to describe those objects with lots of descriptors. For example, a child initially learns to recognize people and faces. Then, over time, a child learns other descriptions of people - their sex (male or female), their approximate age (young or old), their approximate size (big or small, fat or skinny), their approximate height (short or tall) and so on. Learning each type of description is a separate task for the child. A child is generally taught these tasks in a trial and error process over time using a variety of examples.

Let’s take another example to describe a multitask recognition problem. An artificial robot is presented with various objects and with various descriptions of those objects at different times and the task is to learn to describe those objects with an appropriate set of descriptors. In this case, the robot has to do the followings: (1) automatically group the various descriptors into appropriate tasks without external supervision, (2) build and train models appropriate to each task, and (3) then apply those task models to describe new objects of similar type. It is anticipated that future robots would need these kinds of algorithms to recognize and learn new tasks on their own without outside intervention. In fact, similar learning assumptions have been considered in Automated Mental Development (AMD).

To build such an autonomous system, we recently proposed a multitask learning model which has the following properties: (1) the ability to transfer knowledge from one task to another to

speed-up learning, (2) automated recognition of tasks, (3) incremental, one-pass online learning, and (4) reorganizing classifiers to consolidate misallocated tasks. I will demonstrate how the proposed model builds new recognition concepts autonomously using a simple object recognition problem.

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