The Nuts & Bolts of Learning

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Machine intelligence provides general tools for solving hard problems. The fields of artificial intelligence, machine learning, and pattern recognition supply techniques for optimizing the control of complex systems and for extracting useful knowledge from massive amounts of data. These techniques help us predict what will happen next, giving us improved control over our health, our environment, and our economy. Example applications include financial forecasting, disease detection, healthcare optimization, energy conservation, knowledge discovery, chemical and resource process control, and the piloting of autonomous vehicles.

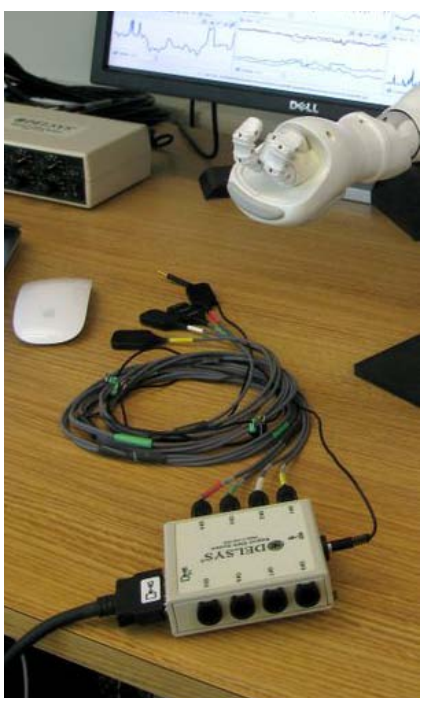
For many applications, machine intelligence provides the only viable connection between interesting data and useful outcomes. This connection is often formed through learning. Key ideas to consider when approaching problems from a machine learning perspective include what to learn, how to learn, and when to learn.

What to Learn: learning can be usefully broken down into two objectives: anticipating the future (prediction) and changing the future (control). What's more, making accurate predictions is often an important requirement for optimizing the control of a system.

How to Learn: machine learning is conventionally classified into three settings: learning from example data that are paired with labels (example learning), learning directly from the structure of the data (unsupervised learning), and learning through trial and error to achieve a goal (reinforcement learning).

When to Learn: machine intelligence includes learning systems and learned systems. Learning systems are trained during the online, ongoing operation of a system. Learned systems are trained prior to being put into regular use; this type of training is also called offline learning.

What follows is an example of how some of these ideas have been applied to help personalize prosthetic arms.



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