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SMALL NETWORKS FOR PATTERN RECOGNITION, CLUSTERING, AND TIME SERIES

Tokhirov Rustam Solijonovich

Teacher, Kokand University

ANNOTATION

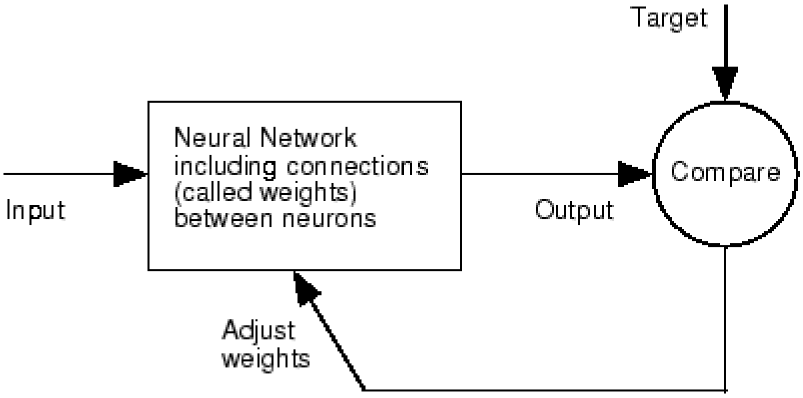
In this article highlights of small networks for pattern recognition, clustering, and time series.

KEY WORDS: *network, clustering, time series, neural network.*

DISCUSSION

Neural networks consist of simple elements that operate in parallel. These elements are inspired by biological nervous systems. As by nature, the relationships between elements basically define the network function. You can train a neural network to perform a specific function by adjusting the values of relationships (weights) between elements.

Typically, neural networks are configured or trained so that a specific input leads to a specific target output. The following figure illustrates this situation. Here, the network is configured based on comparing the output and the target, until the network output matches the target. Typically, many such input/goal pairs are needed to train the network.


Target
Neural Network including connections (called weights) between neurons
Input
Output
Compare
Adjust weights

Neural networks have been trained to perform complex functions in various fields, including pattern recognition, identification, classification, speech, vision, and control systems.

Neural networks can also be trained to solve problems that are difficult for ordinary computers or people. Toolbox emphasizes the use of neural network paradigms that build before - or independently used in-development, financial, and other practical applications.

The following topics explain how to use graphical tools for training neural networks to solve problems in functional curve matching, pattern recognition, clustering, and time series. Using these tools can give you an excellent introduction to using the Deep Learning Toolbox software:

- Suitable data with a small neural network
- Classify patterns with a small neural network
- Cluster data with a self-organizing map
- Small timeseries neural network forecast and simulation

Small network applications and functions in the Deep Learning Toolbox

There are four ways you can use the Deep Learning Toolbox software.

• The first path through its tools. You can open any of these tools from the main tool launched by the nnstart command. These tools provide a convenient way to access the Toolbox features for the following tasks:

o Function corresponding to (nftool)
o pattern Recognition (nprtool)
o clustering Data (nctool)
o Analysis of the timeseries (ntstool)

• The second way to use the Toolbox is through basic command-line operations. Command-line operations offer more flexibility than tools, but with some added complexity. If this is your first experience with the Toolbox, the tools provide a better introduction. In addition, the tools can generate scripts of registered MATLAB ® code to provide you with templates for creating your own custom command-line functions. The process of using tools first, and then generating and modifying MATLAB scripts, is a great way to learn about the functionality of the Toolbox.

• The third way to use the Toolbox is by customizing it. This advanced feature allows you to create your own neural networks while still having access to the full functionality of the Toolbox. You can create networks with arbitrary connections and still be able to train them using existing Toolbox learning functions (how long when network components are differentiable).

• The fourth way to use the Toolbox is through the ability to change any of the functions contained in the Toolbox. Each computing component is written in MATLAB code and is fully accessible.

These four levels of Toolbox usage cover the novice to expert: simple tools guide the new user through specific applications, and network customization allows researchers to try out a new architecture with minimal effort. Regardless of your neural network level and MATLAB knowledge, there are Toolbox functions to suit your needs.

Automatic script generation.

The tools themselves are an important part of the learning process for the Deep Learning Toolbox software. They guide you through the neural network development process to solve problems in four areas of an important application, without requiring any knowledge of neural networks or sophistication in using MATLAB. In addition, the tools can automatically generate both simple and advanced MATLAB scripts that can reproduce the steps performed by the tool, but with the option to replace the default settings. These scripts can provide you with templates for creating custom code, and they can help you get familiar with the functionality of the Toolbox command line. It is highly recommended that you use the automatic script generation tool of these tools.

Deep Learning Toolbox Applications.

It would be impossible to cover the General scope of applications for which neural networks have provided outstanding solutions. The remaining sections of this topic describe only a few applications in functional curve matching, pattern recognition, clustering, and time series analysis. The following table provides an idea of the variety of applications for which neural networks provide modern solutions

Industry.	Business applications
Space high	Performance aircraft autopilot, flight course simulation, aircraft control systems, autopilot improvements, aircraft structural element simulation and aircraft structural element failure detection
Automotive	Automobile automatic guidance system, and warranty analysis of action
Banking	Check and other document reading and credit application evaluation Protection regulation of weapons, target tracking, opposes discrimination, face recognition, new types of sensors, sonar, radar, and image signal processing including data compression, feature detection and noise suppression, and signal/pattern recognition
Electronics code sequence	Prediction, integrated circuit chip placement, process control, chip failure analysis, machine vision, speech synthesis, and nonlinear modeling
Entertainment	Animation, special effects and market forecasting
Financial real estate	Valuation, loan notification, mortgage screening, corporate bond valuation, credit line usage analysis, credit card tracking, portfolio trading program, corporate financial analysis and currency price forecast
Industrial	Forecast of production processes such as furnace exhaust gases, replacing complex and expensive equipment used for this purpose in the past
Insurance	Assessment for the application of policy and optimization of product

Production process	Management, product design and analysis, machine process and diagnosis, real-time particle identification, visual quality control systems, beer testing, welding quality analysis, paper quality forecast, computer chip quality analysis, staking operations analysis, chemical product design analysis, machine maintenance analysis, project price proposal, planning and management and dynamic modeling of chemical process system
Medicine	Medical analysis of breast cancer cell, EEG and ECG analysis, prosthetic design, optimization of transplant times, reducing hospital expenditure, improving the quality of the hospital and emergency department test discussion
Oil and gas	Research
Robotics trajectory	Control, forklift robot, manipulator controllers and vision systems
Securities market	Analysis, automatic bond rating and reference systems of sale of shares Speech Recognition, speech compression, vowel classification, and text-to-speech synthesis
Telecommunications image	Compression and data compression, automated information services, real-time translation of spoken language and consumer payment processing systems
Transportation of the truck brake diagnosis	System, planning of the mechanism and routing system

Small steps in neural network design

In the remaining sections of this topic, you will follow the standard steps for developing neural networks to solve problems in four areas of application: functional curve matching, pattern recognition, clustering, and time series analysis. The workflow for any of these issues has seven primary steps. (Data collection in step 1, while important, usually occurs outside of the MATLAB environment.)

1. Collect data
2. Create a network
3. Configure the network
4. Initialize weights and offsets
5. Train the network
6. Confirm the network
7. Use the network

If the network performance is not satisfactory, you could try any of these approaches:

• Reset the initial network weights and offsets to new values with in it and learn again (see " Initialization Weights" (in it).

• Increase the number of hidden neurons or the number of delays.

• Increase the number of training vectors.

• Increase the number of input values if more relevant information is available.

• Try a different training algorithm (see "Training Algorithms").

To get more experience with command-line operations, try some of these tasks:

• During training, open a graph window (such as an erroneous correlation graph), and watch it animate.

• Build from the command line with functions such as plot response, ploterrcorr, and plot perform. (For more information about using these features, see their description pages.)

Also, see the improved script for more options when learning from the command line. Each time the neural network is trained, it can lead to a different solution due to different initial weights and shift values and different data divisions into training, validation, and test suites. As a result, different neural networks trained on the same problem can give different output parameters for the same input. To ensure that a neural network of good accuracy has been found, retrain several times.

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