Discovery

Using neural networks to create an adaptive character recognition system

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General Note

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ABSTRACT

The objective of this project is to create an easy to use environment in which the user can draw characters and then let the program try to interpret the characters. Such a program could be useful when demonstrating how character recognition using back propagation works or when demonstrating how many iterations of learning needs to be performed to get a satisfactory result.

Index Terms: Back Propagation Algorithm, ANN, OCR, Pattern Recognition

1. INTRODUCTION

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems.

ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. Other advantages include:

- Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
- Self Organization: An ANN can create its own organization or representation of the information it receives during learning time.
- Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
- Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

Background

Developing proprietary OCR system is a complicated task and requires a lot of effort. Such systems usually are really complicated and can hide a lot of logic behind the code. The use of artificial neural network in OCR applications can dramatically simplify the code and improve quality of recognition while achieving good performance. Another benefit of using neural network in OCR is extensibility of the system – ability to recognize more character sets than initially defined.

Back propagation Algorithm

Back Propagation ANN is the most commonly used, as it is very simple to implement and effective. Back Propagation ANNs contain one or more layers each of which are linked to the next layer. The first layer is called the input layer which meets the initial input (e.g. pixels from a letter) and so does the last one output layer which usually holds the input's identifier. The layers between input and output layers are called hidden layers which only propagate the previous layer's outputs to the next layer and propagate the following layer's error to the previous layer.

2. SYSTEM ANALYSIS

Systems analysis is the interdisciplinary branch of science, dealing with analysis of systems, often prior to their automation as computer systems, and the interactions within those systems. This field is closely related to operations research. The systematic application of engineering to solutions of a complete problem in its full environment by systematic assembly and matching of parts in the context of the lifetime use of the system. In other words, it is an explicit formal inquiry carried out to help someone identify a better course of action and make a better decision than he might otherwise have made. System analysis usually has some combination of the following:

- Identification and re-identification of objectives, constraints, and alternative courses of action.
- Examination of the probable consequences of the alternatives in terms of costs, benefits, and risks.
- Presentation of the results in a comparative framework so that the decision maker can make an informed choice from among the alternatives.

3. EXISTING SYSTEM

Classical approach requires the previous development of a mathematical or logical algorithm to solve the problem at hand, which must be subsequently translated into any computational language. This approach is limited, because it can only be used in cases where the processing to be made can be precisely described in a known rule set. Sometimes, however, the development of such a rule set is hard or impossible.

Also, as computers work in a totally logical form, the final software must be practically perfect to work correctly. Thus, the development of computer software is, indeed, a succession of project-test-interactive improvement cycles that can demand much time, effort, and money.The neural network solution of a problem should be selected from a large enough pool of potential solutions. Because of the nature of the neural networks, it is likely that if a single solution is build than that will not be the optimal one. If a pool of potential solutions is generated and trained, it is more likely that one which is close to the optimal one is found.

4. PROPOSED SYSTEM

Artificial Neural Network (ANN) concentrates mainly on the concept of recognizing the irregular patterns of an image or character. Pattern recognition implements the conventional OCR (Optical character recognition) methodology but with different set of algorithms for training the system and making use of it. Back propagation algorithm is being used for the purpose of training the system whereas feed forward method is implemented for the recognition purpose in an efficient manner. Various areas where when this technique implemented will improve the operational efficiency in various secured or restricted areas.

Advantages of proposed System

- Using neural network in character recognition (CR) is extensible of the system.
- Using many layer neural networks avoided, if possible. Complex learning algorithms should be avoided.

- Highest quality of recognition
- Good performance.

5. PROBLEM DEFINITION

Artificial Neural Networks are a recent development tool that is modeled from biological neural networks. The powerful side of this new tool is its ability to solve problems that are very hard to be solved by traditional computing methods (e.g. by algorithms). This Project briefly explains Artificial Neural Networks and their applications, describing how to implement a simple ANN for Character and image recognition.

- Apply input to the network.
- Calculate the output.
- Compare the resulting output with the desired output for the given input. This is called the error.
- Modify the weights for all neurons using the error.
- Repeat the process until the error reaches an acceptable value (e.g. error < 1%), which means that the Neural Network was trained successfully, or if reach a maximum count of iterations, which means that the Neural Network training was not successful.

Feed-Forward Networks

Feed-forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs. They are extensively used in pattern recognition. This type of organization is also referred to as bottom-up or top-down.

Characteristics of Feed-Forward Networks

- Perceptions are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.
- Each perception in one layer is connected to every perception on the next layer. Hence information is constantly "fed forward" from one layer to the next. And this explains why these networks are called feed-forward networks
- There is no connection among perceptions in the same layer.

Pattern Recognition

Pattern recognition can be implemented by using a feed-forward neural network that has been trained accordingly. During training, the network is trained to associate outputs with input patterns. When the network is used, it identifies the input pattern and tries to output the associated output pattern. The power of neural networks comes to life when a pattern that has no output associated with it, is given as an input. The addition of input weights and of the threshold makes this neuron a very flexible and powerful one. Neuron has the ability to adapt to a particular situation by changing its weights and/or threshold. Various algorithms exist that cause the neuron to 'adapt'; the most used ones are the Delta rule and the back error propagation. The former is used in feed-forward networks and the latter in feedback networks.

Creating the Neural Network

Construct the network first. In this example I use a Back propagation neural network. The Back propagation network is a multilayer perception model with an input layer, one or more hidden layers, and an output layer.

The nodes in the Back propagation neural network are interconnected via weighted links with each node usually connecting to the next layer up, till the output layer which provides output for the network. The input pattern values are presented and assigned to the input nodes of the input layer.

The input values are initialized to values between -1 and 1. The nodes in the next layer receive the input values through links and compute output values of their own, which are then passed to the next layer. These values propagate forward through the layers till the output layer is reached, or put another way, till each output layer node has produced an output value for the network.

The desired output for the input pattern is used to compute an error value for each node in the output layer, and then propagated backwards through the network as the delta rule is used to adjust the link values to produce better, the desired output. Once the error produced by the patterns in the training set is below a given tolerance, the training is complete and the network is presented new input patterns and produce an output based on the experience it gained from the learning process.

Training of the Network

To start training process of the network simple call the Train method and pass training patterns in it. Normally, an execution flow will leave this method when training is complete, but in some cases it could stay there. The Train method is currently implemented relying only on one fact: the network training will be completed sooner or later. Well, admit - this is wrong assumption and network training may never complete.

6. MODULES DESCRIPTION

Character Recognition

- User is drawing their own letters in drawing pad after typing they have to click to Recognition whether given or sketched letters.
- After Recognition it going to display corresponding letters in next to the textbox control.
- For example user recognition words is "rel" it will list "relation, relative rel*" or *rel* (* any number character)
- It also recognition any font style, shapes.

Add Dictionary

- Used for managing the dictionary words.
- In some case the words may not present in dictionary files so adding lasted word to dictionary by using this module.

Neural Topology Generation

Feed-forward neural networks

- The data flow from input to output units is strictly feed forward.
- The data processing can extend over multiple (layers of) units, but no feedback connections are present
- Connections extending from outputs of units to inputs of units in the same layer or previous layers.

Aiding neural technology by pattern matching Technique

- Pattern recognition can be implemented by using a feed-forward neural network that has been trained accordingly.
- During training, the network is trained to associate outputs with input patterns.
- When the network is used, it identifies the input pattern and tries to output the associated output pattern

Training of artificial neural networks

- To start training process of the network simple call the Train method and pass training patterns in it.
- Normally, an execution flow will leave this method when training is complete, but in some cases it could stay there forever.
- The Train method is currently implemented relying only on one fact: the network training will be completed sooner or later.

Field Name	Value
Status	Number
Name	Text
Sid	Binary value
Roles	Binary value
Createdate	Date
Update date	Date
Altuid	Number

7. INPUT AND OUTPUT DESIGN

The designs Decisions for handling input specify how data are accepted for computer processing. The design specifies the means by which the end user and the system operators direct the system in which action to take. Online system includes a Dialogue or conversation between the user and the system. The input design is the link that ties the information system in to the world of its users.

Objective Input Design

Input Design consists of developing specifications and procedures for data preparations and data entry. The following objectives are to be achieved.

Controlling the amount of Input

Data preparation and data entry depends on people. The costs get high if the input is high. The input phase of computing is slow which leaves the system idle consuming more time. The major reason for controlling the amount of input is the cost of preparing the data and entering the data is also high. Second, the input phase of computing can be a slow process that can take many times longer than the time needed by computers to carry out their tasks. By reducing input requirements, thes analyst can speed the entire process from data capture to processing to providing results to users.

Avoiding Delay

The delay in data entry and data preparation is called Bottleneck. Avoiding this bottleneck should be the objective of the analyst designing the input. In one sense, the rate at which errors occur depends on the quantity of data, since the smaller the amount of

data input, the fewer the opportunities for errors. The manner in which the data is entered also affects the occurrence of error .Another aspect of avoiding errors is the need to detect the error when they do occur. These are done using input validation techniques.

Avoiding Errors in Data

Reducing the volume of data can reduce the number of errors. Validation techniques can be used to avoid errors while Data entry itself.

Output design

Output refers to the results information that is generated by the system. Designing the computer output should proceed in a well organized, well thought out manner. The right output must be developed while ensuring that each output element is designed so that people will find system easy to use effectively. The basis of the output generated is to evaluate the usefulness of the application. The arrangement of information on a display is termed as a layout. The output design is specified on layout forms, sheets that describe the location characteristics and the format of the column headings and pagination. Output design phase of system is concerned with the convergences of information to the end user in user friendly manner. The output design should be efficient, intelligible so that relationship with the end user is improved considerably and thereby, enhancing the decision-making process. The contents of the output are then defined in a detailed manner during the physical design of outputs .Certain data are in a desirable manner.

Objectives of Effective Output Design

- Convey data about the past activities, current status, projections of the future.
- Confirm an action.
- Determine what information to present.
- Decide whether to display, print, or voice the information and select the medium of output.
- Arrange the presentation of information in an acceptable format.
- Decide how to distribute the output to intended recipient.

8. IMPLEMENTATION

Implementation is the state in the project where the theoretical design is turned into a working system. The most crucial stage in achieving a new successful system and giving confidence on the new system for the users that will work efficiently and effectively. The system is implemented only after thorough testing is done and if it is found to work according to the specification. It involves careful planning, investigation of the current system and is constraints on implementation, design of methods to achieve changeover, and evaluation of the changeover methods apart from planning. Two major tasks for preparing the implementation are educating, training the users and testing the system.

Program Code Preparation

One of the most important development activities is coding or programming. The system flowcharts and other charts are converted into modular programs. They have to be compiled, tested and debugged.

User Training and Documentation

Once the planning has been completed the major effort in the computer department is that the user department must consist of educated and trained staff as the system becomes more complex. The success of the system depends upon how they are operated and used the system. Thus the quality of training the personnel is connected to the success of the system. Implementation depends upon the right people being trained at the right time. Education involves creating the right atmosphere and motivating the user. Staff education should encourage the participation of all the staff.

Changeover

Changeover is the change of moving over from the old system to the new computerized system. In order that this is done all the files have to be converted to the new format. The accuracy of the conversion is of utmost importance both to user confidence in the system and to effective operation. When the files have been set up on the computer, the changeover can take place. There are several possible methods of doing this.

E.g. direct changeover, parallel running, pilot running, and staged changeover.

Direct Changeover

This method is the complete replacement of the old system by the new, in one move. When direct changeover is planned, system tests and training should be comprehensive and changeover itself is planned in detail.

Staged Changeover

A staged changeover involves a series of limited size direct changeovers. A complete start, a logical section is committed to the new system while the remaining parts or sections will be processed by the old system. In this project, direct changeover is applied where the entire system is implemented directly after it has been developed.

11. CONCLUSION

The computing world has a lot to gain from neural networks. Their ability to learn by example makes them very flexible and powerful. Furthermore there is no need to devise an algorithm in order to perform a specific task; i.e. there is no need to understand the internal mechanisms of that task. They are also very well suited for real time systems because of their fast response and computational times which are due to their parallel architecture.

Neural networks also contribute to other areas of research such as voice recognition and signal recognition. They are regularly used to model parts of living organisms and to investigate the internal mechanisms of the brain.   Perhaps the most exciting aspect of pattern recognition using neural networks is the possibility that some day 'conscious' networks might be produced. There is a number of scientists arguing that consciousness is a 'mechanical' property and that 'conscious' neural networks are a realistic possibility. Finally, would like to state that even though neural networks have a huge potential will only get the best of them when they are integrated with computing, the pattern recognition and related subjects.

FUTURE ENHANCEMENT

Integration
Integration of Optimal Character Recognition (OCR), Intelligent Character Recognition (ICR), Optical Markup Recognition (OMR), in one system would really enhance the technology.   Thus the technology can be used to recognize and listen to any form of document.

Character Enhancer
Enhancing the character before applying OCR would greatly improve the accuracy.

Color Detection
Color detection would be beneficial for the user as the job of formatting can be reduced up to some extent.

Spell Checking
Spell Checking during conversion would also increase the accuracy of recognition.

Creating perfect Zones
Increasing the accuracy of creating zones would also increase the efficiency of the software's.

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