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Modeling Artificial Neural Networks using a Visual Programming Paradigm

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Abstract: The understanding of soft computing methodology often requires grasping abstract concepts or imagining complex interactions of large models over long computing cycles. But this can be difficult for students with weak background in mathematics, especially in the early stages of soft computing education. This paper introduces applying a visual programming paradigm as a tool for educational introduction to soft computing methods. For the visual programming paradigm, IntelligentPad proposed by Y. Tanaka is used. IntelligentPad defines a visual appearance to objects or classes, and allows users to operate and link different objects together using the mouse. This paper reports on using IntelligentPad to teach the basic mechanism of artificial neural networks. The proposed method was applied to 3rd year college students to verify the validity of the proposed teaching method.

Keywords: Visual Programming, IntelligentPad, Artificial neural networks

I. INTRODUCTION

Understanding of soft computing methodology often requires grasping abstract concepts or imagining complex interactions of large models over long computing cycles. But this can be difficult for students with weak background in mathematics, especially in the early stages of soft computing education.

This paper introduces applying a visual programming paradigm as a tool for educational introduction to soft computing methods. For the visual programming paradigm, IntelligentPad proposed by Y. Tanaka[1] is used. IntelligentPad defines a visual appearance to objects or classes, and allows users to operate and link different objects together using the mouse.

Past research on using IntelligentPad for programming education[2] has reported promising results. This paper proposes using IntelligentPad to teach the basic mechanism of artificial neural networks. The proposed method was applied to 3rd year college students to verify the validity of the proposed teaching method.

II. INTELLIGENTPAD

IntelligentPad[1] is a visual programming and runtime paradigm proposed by Y.Tanaka. IntelligentPad is based on an object-oriented programming design, and supports a Model-View-Controller (MVC) model for classes to allow objects to have a visual representation on the screen. This visual object is called a "pad". Public methods or fields are defined as "slots" in a pad. Users can connect slots between different pads to realize message passing between objects. Creation of pads, laying of pads, and connecting slots of pads can all be done by the user using only the mouse.

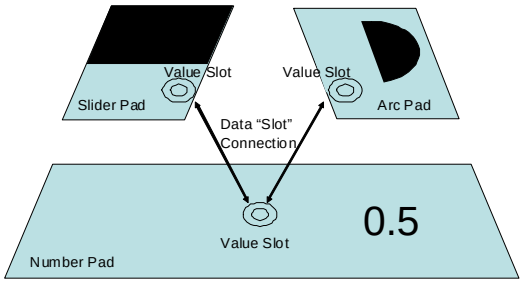

Fig.1. Slot connection of pads on IntelligentPad

III. ARTIFICIAL NEURAL NETWORKS ON INTELLIGENTPAD

In this research, IntelligentPad-Java provided by IntelligentPad Consortium[3] was used. IntelligentPad-Java is an IntelligentPad package implemented in Java,

and can be run as either a stand-alone application or Web browser applet.

The educational goal was for the students to understand the basic mechanism of a) a single neuron model and b) a feed-forward neural network model (Fig.2). For the neuron's synapse function, a simple step function with variable threshold value was selected for the purpose of simplicity.

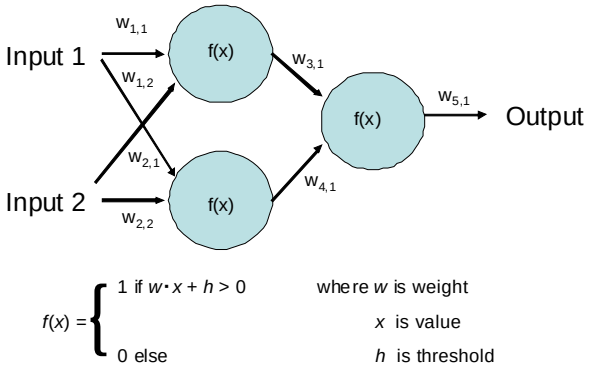

Fig.2. Feed-forward neural network model

The following different pads were provided to the students as basic building blocks of the neural network: number pad, arithmetic pad, comparison pad, switch pad, slider pad, range pad, and neuron pad.

A number pad is a class used to hold a single floating point numerical value. An arithmetic pad is a class that can add, subtract, multiply or divide 2 different numerical values and outputs the results. A comparison pad compares 2 different numerical values and outputs a whether the first input is equal, less than, or greater than the second input. A switch pad works as a toggle switch to display whether a value is either 0 or 1. A slider pad works as a bar or gauge to display a continuous range of values between 0 and 1. A range pad is used to normalize a specified range of values to a range of 0 and 1. The neuron pad takes 2 numerical input values and outputs 1 numerical value, providing the basic feed-forward calculation. The neuron pad also has a threshold slot for setting the synapse threshold.

By combining the provided pads and creating the correct connections between the pad slots, it is possible to create a visual representation of a single neuron model (Fig.3). Next by creating multiple copies of the single neuron and connecting the input and output slots of the neurons, a layered neural network can be created.

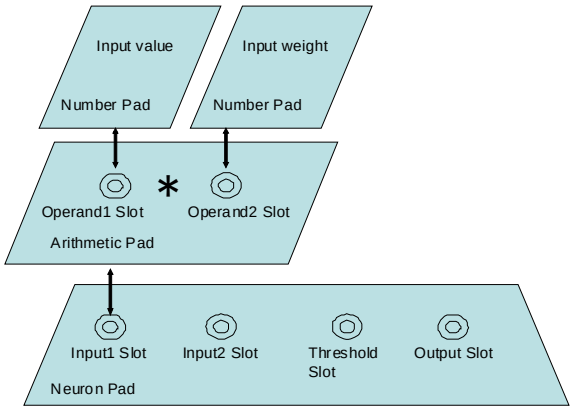

Fig.3. Neuron pad connection model

IV. APPLICATION RESULTS AND CONCLUSION

IntelligentPad-Java and the described pads were provided to 3rd year college students majoring in information systems, directly after a lecture on the mechanism of artificial neural networks. After a short explanation on how to use IntelligentPad, the students were given the task of 1) creating a visual representation of a single neuron and 2) creating a layered feed-forward neural network. With some help, all 13 participating students were able to create a running layered feed-forward neural network within 90 minutes (Fig.4).

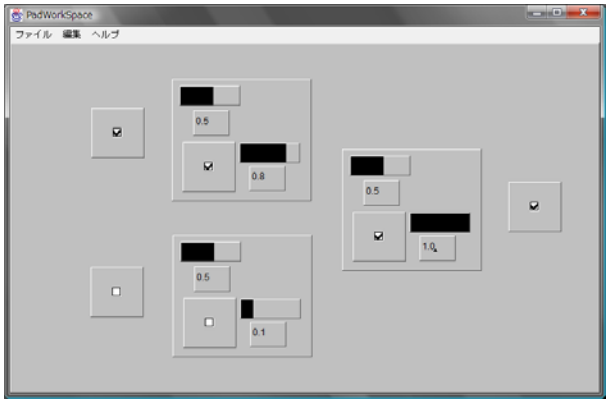

Fig.4. Example of layered network on IntelligentPad

This paper introduced applying a visual programming paradigm as a tool for educational introduction to soft computing methods. IntelligentPad

is a visual programming paradigm that defines a visual appearance to objects or classes, and allows users to operate and link different objects together using the mouse.

This paper proposed using IntelligentPad to teach the basic mechanism of artificial neural networks. The proposed method was applied to 3rd year college students. In the class, students were able to create a layered feed-forward neural network from basic classes, and greatly improved the students' understanding of the mechanism of artificial neural networks.

For future works, we will consider creating pads to implement the sigmoid function and realize back propagation using IntelligentPad. We also plan to use IntelligentPad for visually representing evolutionary computation methods, fuzzy logic, and other major soft computing algorithms.

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[3] IntelligentPad Consortium, http://pads.or.jp