Student Name: _____ Student ID # _____

OU Academic Integrity Pledge

On my honor I affirm that I have neither given nor received inappropriate aid in the completion of this exercise.

Signature: _____ Date: _____

Notes Regarding this Examination

Open Book(s) You may consult any printed textbooks in your immediate possession during the course of this examination.

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No Electronic Devices Permitted You may not use any electronic devices during the course of this examination, including but not limited to calculators, computers, and cellular phones. All electronic devices in the student's possession must be turned off and placed out of sight (for example, in the student's own pocket or backpack) for the duration of the examination.

Violations Copying another's work, or possession of electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies.

Question 1: Fundamentals of Artificial Neural Networks (10 points)

A sigmoidal neural activation function is standard for feedforward artificial neural networks trained using backpropagation of error. *Explain* the key advantage of this activation function for such a network in comparison to the alternative activation functions listed below.

A. Linear

B. Step

Question 2: Fundamentals of Evolutionary Computation (10 points)

How does a population-based heuristic search method (such as a genetic algorithm or other evolutionary computation method) differ from a heuristic search method that lacks a population (such as hill-climbing or simulated annealing)? In other words, what role does a population play in evolutionary computation?

Question 3: Problem Solving with Artificial Neural Networks (30 points)

Meredith wants to estimate computer lab usage rates for the company lab. She has data from the past several months that she can use. She suspects that usage varies by day of the week and hour of the day but also increases as deadlines approach. She decides to use an artificial neural network (ANN) to calculate her estimates for her.

Provide your input on the following design aspects for this ANN. That is, give choices for these design aspects and **justify** your choices.

A. How many input units should the ANN have?

B. How many output units should the ANN have?

C. Should the ANN use hidden units or not?

D. Should the ANN use feedforward connections, recurrent connections, both, or neither?

E. What activation function(s) should the neurons use?

F. What learning mechanism(s) should the ANN use?

Question 4: Problem Solving with Evolutionary Computation (30 points)

Jeff wants to use a genetic algorithm (GA) to do classroom scheduling. He has access to a database of all of the courses to be offered, their expected enrollments, and their instructors. He also has access to a database of all the classrooms available and their capacities. All of the time slots available are fixed in advance and are the same for all rooms. (For example, MWF 9:00-9:45 is one time slot that a course might be offered in any given room.) Naturally, an instructor cannot teach more than one course during the same time slot and a room cannot have more than one course taught in it during the same time slot. In addition, we should try to turn away as few students from each course as possible. (Note that, for the sake of simplicity, we are not considering the fact that a student may want to take more than one course at the same time and that courses that are likely to be taken by the same student should not be offered at the same time.)

Provide your input on the following design aspects of a GA system for this problem. That is, give choices for these design aspects and **justify** your choices.

A. How should the chromosome be encoded?

B. What should the fitness function be?

C. Should crossover be used? If so, how should it be implemented?

D. Should mutation be used? If so, how should it be implemented?

Question 5: Evolutionary Artificial Neural Networks (20 points)

A. **Explain** one advantage to evolving the weights of an ANN rather than learning them.

B. **Explain** one advantage to learning the weights of an ANN rather than evolving them.

C. **Explain** one advantage to evolving the topology of an ANN rather than hand coding it.

D. **Explain** one advantage to hand coding the topology of an ANN rather than evolving it.