In this assignment, you are to evolve your own 2-neuron CTRNN oscillator.

If you wish, you may use my C++ code for evolutionary search and CTRNNs. Alternately, you may use your own or any public domain EVA code along with your own implementation of CTRNNs in any language that you choose.

You will need to write your own evaluation function that takes a search vector, decodes it into a 2-neuron CTRNN, runs the network for a given period of time, and then returns a measure of oscillation performance. I suggest the following structure for your evaluation function:

1. Create a 2-neuron CTRNN
2. Set its parameters from the search vector passed into your evaluation function
3. Initialize the state of each neuron (e.g., to 0)
4. Run the network for some amount of time (\texttt{TransientDuration}) to skip transient dynamics
5. Now run the network for an additional amount of time (\texttt{EvaluationDuration}) and collect performance information
6. Return the oscillation performance

In order to achieve the best results, you may need to experiment with different \texttt{TransientDuration} and \texttt{EvaluationDuration} values.

Here are two suggestions for evaluating oscillation performance. First, you could add up the absolute value of the time rate of change of one of the neurons (e.g., \( \dot{o}_1 = do_1/dt \)) and divide by \texttt{EvaluationDuration}. This gives the average total change in output. The idea here is that the neuron outputs in an oscillation network will keep changing, whereas those in a nonoscillating network will not. Second, you could divide \((o_1, o_2)\) output space into some number of cells (e.g., 10×10). Then you could count the number of distinct cells that the output trajectory visits during the evaluation phase. The idea here is that the state of an oscillating network will visit more output cells than will a nonoscillating network after transients have passed.

Once you are successfully evolving oscillators, you should run 5 searches with different random seeds and turn in a written report containing the following:

1. A superimposed best performance vs. generation plot for all five trials
2. Plots of the neuron outputs over time for several cycles of the best circuit you evolved
3. A discussion of the approach you took and the results you obtained
4. A commented source code listing of your main program