MSDS 458 Simple MLP no backprop output – run 8

```
Calling the main() procedure from the program
Starting main() function

Calling welcome() function

starting the welcome() function
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Welcome to the Multilayer Perceptron Neural Network
  trained using the backpropagation method.
Version 1.0, 03/25/2017, A.J. Maren
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********************************************************************************
*

ending the welcome() function and returning to main

setting alpha, summedInput, maxNumIterations, and eta
Setting the debug_xxx_off statements to be false, so will print extra

calling the obtainNeuralNetworkSizeSpecs() function
Starting the obtainNeuralNetworkSizeSpecs() function

This network is set up to run the X-OR problem.
The numbers of nodes in the input, hidden, and output layers have been set to
2 each.
The number of input nodes is  2
The number of hidden nodes is  2
The number of output nodes is  2
Ending the obtainNeuralNetworkSizeSpecs() function

Flow-of-control trace: Back in main
I = number of nodes in input layer is 2
H = number of nodes in hidden layer is 2
O = number of nodes in output layer is 2

Calling initializeWeightArray for input-to-hidden weights
starting the initializeWeightArray() function
initialize wt00 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  -0.6954579402963563
ending the InitializWeight() function

initialize wt01 by calling initializeWeight() function
starting the InitializeWeight() function
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```
weight =  -0.8793557017139155
ending the InitializWeight() function

initialize wt02 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  0.16658496581980797
ending the InitializWeight() function

initialize wt03 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  0.10684671093329845
ending the InitializWeight() function


  Inside initializeWeightArray

    The weights just initialized are:
      weight00 = -0.6955,
      weight01 = -0.8794,
      weight10 = 0.1666,
      weight11 = 0.1068,

    The weightArray just established is:  [[-0.69545794  0.16658497]
 [-0.8793557   0.10684671]]

    Within this array:
       weight00 = -0.6955    weight10 = 0.1666
       weight01 = -0.8794    weight11 = 0.1068
  Returning to calling procedure

ending the initializeWeightArray() function and returning to main


Calling initializeWeightArray for Hidden-to-Output weights
starting the initializeWeightArray() function
initialize wt00 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  -0.5356810804367049
ending the InitializWeight() function

initialize wt01 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  -0.3611382433170296
ending the InitializWeight() function

initialize wt02 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  -0.9212188117273603
ending the InitializWeight() function

initialize wt03 by calling initializeWeight() function
starting the InitializeWeight() function
weight =  0.6010546248820672
ending the InitializWeight() function


  Inside initializeWeightArray
```

```
    The weights just initialized are:
      weight00 = -0.5357,
      weight01 = -0.3611,
      weight10 = -0.9212,
      weight11 = 0.6011,

    The weightArray just established is:  [[-0.53568108 -0.92121881]
 [-0.36113824  0.60105462]]

    Within this array:
       weight00 = -0.5357    weight10 = -0.9212
       weight01 = -0.3611    weight11 = 0.6011
  Returning to calling procedure
```

ending the initializeWeightArray() function and returning to main

```
calling initializeBiasWeightArray() function for Hidden nodes
```

starting initializeBiasWeightArray() function
initialize biasWeight0 by calling initializeWeight() function
starting the InitializeWeight() function
weight = 0.9068998322086128
ending the InitializWeight() function

initialize biasWeight1 by calling initializeWeight() function
starting the InitializeWeight() function
weight = -0.3474824569557424
ending the InitializWeight() function

biasWeight0 = 0.9068998322086128
biasWeight1 = -0.3474824569557424
The biasWeightArray = [0.90689983 -0.34748246]
ending initializeBiasWeightArray() function
returning to main

calling initializeBiasWeightArray() function for Output nodes

starting initializeBiasWeightArray() function
initialize biasWeight0 by calling initializeWeight() function
starting the InitializeWeight() function
weight = -0.39607338965336925
ending the InitializWeight() function

initialize biasWeight1 by calling initializeWeight() function
starting the InitializeWeight() function
weight = 0.8190414929407974
ending the InitializWeight() function

biasWeight0 = -0.39607338965336925
biasWeight1 = 0.8190414929407974
The biasWeightArray = [-0.39607339 0.81904149]
ending initializeBiasWeightArray() function

returning to main

The initial weights for this neural network are:

Input-to-Hidden		Hidden-to-Output	
w(0,0) = -0.6955	w(1,0) = 0.1666	v(0,0) = -0.5357	v(1,0) = -0.9212
w(0,1) = -0.8794	w(1,1) = 0.1068	v(0,1) = -0.3611	v(1,1) = 0.6011

Bias at Hidden Layer	Bias at Output Layer
b(hidden,0) = 0.9069	b(output,0) = -0.3961
b(hidden,1) = -0.3475	b(output,1) = 0.8190

Establishing parameters - epsilon, iteration counter, SSE_InitialTotal

Initialize SSE_InitialArray to zeros
calling the computeSSE_Values() function to initialize the SSE_InitialArray
starting the computeSSE_Values() function

Compute a single feed-forward pass and obtain the Actual Outputs for zeroth data set

Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 = 0
Input1 = 0

The initial weights for this neural network are:

Input-to-Hidden		Hidden-to-Output	
w(0,0) = -0.695	w(0,1) = 0.167	v(0,0) = -0.536	v(0,1) = -0.921
w(1,0) = -0.879	w(1,1) = 0.107	v(1,0) = -0.361	v(1,1) = 0.601

For hiddenActivation0 from input0, input1 = 0 , 0

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is 0.7123653538530115
ending the computeTransferFnction() function and returning the activation

In computeSingleNeuronActivation with input0, input 1 given as: 0 , 0
The summed neuron input is 0.9069
The activation (applied transfer function) for that neuron is 0.7124
ending computeSingleNeuronActivation() function and returning activation

For hiddenActivation1 from input0, input1 = 0 , 0
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is 0.41399305154644955
ending the computeTransferFnction() function and returning the activation

  In computeSingleNeuronActivation with input0, input 1 given as: 0 , 0
    The summed neuron input is -0.3475
    The activation (applied transfer function) for that neuron is 0.4140
ending computeSingleNeuronActivation() function and returning activation

  In computeSingleFeedforwardPass:
  Input node values: 0 , 0
  The activations for the hidden nodes are:
    Hidden0 = 0.7124 Hidden1 = 0.4140

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is 0.23883954454359838
ending the computeTransferFnction() function and returning the activation

  In computeSingleNeuronActivation with input0, input 1 given as:
0.7123653538530115 , 0.41399305154644955
    The summed neuron input is -1.1591
    The activation (applied transfer function) for that neuron is 0.2388
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is 0.6922398084516622
ending the computeTransferFnction() function and returning the activation

  In computeSingleNeuronActivation with input0, input 1 given as:
0.7123653538530115 , 0.41399305154644955
    The summed neuron input is 0.8106
    The activation (applied transfer function) for that neuron is 0.6922
ending computeSingleNeuronActivation() function and returning activation

  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2388 Output1 = 0.6922

```
creating the actualAllNodesOutputList
the hiddenActivation0 =  0.7123653538530115
the hiddenActivation1 =  0.41399305154644955
the outputActivation0 =  0.23883954454359838
the outputActivation1 =  0.6922398084516622
```

ending ComputeSingleFeedforwardPass() function and returning to main

```
  In computeSSE_Values

  Actual Node Outputs for (0,0) training set:
      input0 =  0    input1 =  0
      actualOutput0 = 0.2388   actualOutput1 = 0.6922
      error0 =        -0.2388   error1 =        0.3078
   Initial SSE for (0,0) = 0.1518
```

Ending a single feed-forward pass to obtain the Actual Outputs for zeroth data set

Compute a single feed-forward pass and obtain the Actual Outputs for first data set

```
Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  0
Input1 =  1

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  0 ,  1

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.7452590629885005
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  0 ,  1
    The summed neuron input is 1.0735
    The activation (applied transfer function) for that neuron is 0.7453
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  0 ,  1
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
```

```
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.4401296870720997
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  0 ,  1
    The summed neuron input is -0.2406
    The activation (applied transfer function) for that neuron is 0.4401
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  0 ,  1
  The activations for the hidden nodes are:
    Hidden0 = 0.7453 Hidden1 = 0.4401

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.2313417661625889
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.7452590629885005 ,  0.4401296870720997
    The summed neuron input is -1.2008
    The activation (applied transfer function) for that neuron is 0.2313
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6930552436611513
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.7452590629885005 ,  0.4401296870720997
    The summed neuron input is 0.8144
    The activation (applied transfer function) for that neuron is 0.6931
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
```

```
    Output0 = 0.2313 Output1 = 0.6931

creating the actualAllNodesOutputList
the hiddenActivation0 =  0.7452590629885005
the hiddenActivation1 =  0.4401296870720997
the outputActivation0 =  0.2313417661625889
the outputActivation1 =  0.6930552436611513

ending ComputeSingleFeedforwardPass() function and returning to main

  Actual Node Outputs for (0,1) training set:
     input0 =  0    input1 =  1
     actualOutput0 = 0.2313   actualOutput1 = 0.6931
     error0 =        0.7687   error1 =        -0.6931
  Initial SSE for (0,1) = 1.0712
```

Ending a single feed-forward pass to obtain the Actual Outputs for first data set

Compute a single feed-forward pass and obtain the Actual Outputs for second data set

```
Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  1
Input1 =  0

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  1 ,  0

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.5526644104169363
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  0
    The summed neuron input is 0.2114
    The activation (applied transfer function) for that neuron is 0.5527
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  1 ,  0
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()
```

```
starting the computeTransferFnction() function
The activation is  0.22673530098134942
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  0
    The summed neuron input is -1.2268
    The activation (applied transfer function) for that neuron is 0.2267
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  1 ,  0
  The activations for the hidden nodes are:
    Hidden0 = 0.5527 Hidden1 = 0.2267

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.28884543426726433
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5526644104169363 ,  0.22673530098134942
    The summed neuron input is -0.9010
    The activation (applied transfer function) for that neuron is 0.2888
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6804267232663936
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5526644104169363 ,  0.22673530098134942
    The summed neuron input is 0.7557
    The activation (applied transfer function) for that neuron is 0.6804
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2888 Output1 = 0.6804
```

```
creating the actualAllNodesOutputList
the hiddenActivation0 =  0.5526644104169363
the hiddenActivation1 =  0.22673530098134942
the outputActivation0 =  0.28884543426726433
the outputActivation1 =  0.6804267232663936

ending ComputeSingleFeedforwardPass() function and returning to main

  Actual Node Outputs for (1,0) training set:
     input0 =  1    input1 =  0
     actualOutput0 = 0.2888   actualOutput1 = 0.6804
     error0 =        0.7112   error1 =        -0.6804
  Initial SSE for (1,0) = 0.9687
```

Ending a single feed-forward pass to obtain the Actual Outputs for second data set

Compute a single feed-forward pass and obtain the Actual Outputs for third data set

```
Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  1
Input1 =  1

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  1 ,  1

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.5933971170013912
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is 0.3780
    The activation (applied transfer function) for that neuron is 0.5934
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  1 ,  1
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()
```

```
starting the computeTransferFnction() function
The activation is  0.24601286991158772
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is -1.1200
    The activation (applied transfer function) for that neuron is 0.2460
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  1 ,  1
  The activations for the hidden nodes are:
    Hidden0 = 0.5934 Hidden1 = 0.2460

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.28078387020502693
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is -0.9406
    The activation (applied transfer function) for that neuron is 0.2808
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6797471985466466
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is 0.7526
    The activation (applied transfer function) for that neuron is 0.6797
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2808 Output1 = 0.6797
```

```
creating the actualAllNodesOutputList
the hiddenActivation0 =  0.5933971170013912
the hiddenActivation1 =  0.24601286991158772
the outputActivation0 =  0.28078387020502693
the outputActivation1 =  0.6797471985466466

ending ComputeSingleFeedforwardPass() function and returning to main

  Actual Node Outputs for (1,1) training set:
     input0 =  1    input1 =  1
     actualOutput0 = 0.2808   actualOutput1 = 0.6797
     error0 =        -0.2808   error1 =        0.3203
  Initial SSE for (1,1) = 0.1814
```

Ending a single feed-forward pass to obtain the Actual Outputs for third data set

```
Initializing array of SSE values
the SSE_InitialArray[0] =  0.15176066353966305 the SSE_InitialArray[1] =
1.071161051212266
the SSE_InitialArray[2] =  0.9687213420975572 the SSE_InitialArray[3] =
0.18140143860603442

  The initial total of the SSEs is 2.3730

ending the computeSSE_Values() function and returning to main

The SSE_Array =  [0.15176066353966305, 1.071161051212266, 0.9687213420975572,
0.18140143860603442, 2.3730444954555208]
The SSE_InitialTotal =  2.3730444954555208

In main, SSE computations completed, Total of all SSEs = 2.3730
  For input nodes (0,0), SSE_Array[0] = 0.1518
  For input nodes (0,1), SSE_Array[1] = 1.0712
  For input nodes (1,0), SSE_Array[2] = 0.9687
  For input nodes (1,1), SSE_Array[3] = 0.1814
```

About to enter the while loop for 4 iterations

```
starting at top of while loop for first time

create random trainingDataList by calling obtainRandomXORTrainingValues()
function
starting obtainRandomXORTrainingValues() function
The trainingDataList =  (1, 1, 0, 1, 3)
ending obtainRandomXORTrainingValues() function and returning to main

Iteration number  0

Randomly selected training data set number  3
The inputs and desired outputs for the X-OR problem from this data set are:
          Input0 =  1             Input1 =  1
 Desired Output0 =  0    Desired Output1 =  1
```

```
calling ComputeSingleFeedforwardPass to obtain actual outputs for training
set

Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  1
Input1 =  1

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  1 ,  1

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.5933971170013912
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is 0.3780
    The activation (applied transfer function) for that neuron is 0.5934
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  1 ,  1
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.24601286991158772
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is -1.1200
    The activation (applied transfer function) for that neuron is 0.2460
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  1 ,  1
  The activations for the hidden nodes are:
    Hidden0 = 0.5934 Hidden1 = 0.2460

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
```

```
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.28078387020502693
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is -0.9406
    The activation (applied transfer function) for that neuron is 0.2808
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6797471985466466
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is 0.7526
    The activation (applied transfer function) for that neuron is 0.6797
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2808 Output1 = 0.6797

creating the actualAllNodesOutputList
the hiddenActivation0 =  0.5933971170013912
the hiddenActivation1 =  0.24601286991158772
the outputActivation0 =  0.28078387020502693
the outputActivation1 =  0.6797471985466466

ending ComputeSingleFeedforwardPass() function and returning to main

In main; have just completed a feedfoward pass with training set inputs 1 1
  The activations (actual outputs) for the two hidden neurons are:
    actualHiddenOutput0 = 0.5934
    actualHiddenOutput1 = 0.2460
  The activations (actual outputs) for the two output neurons are:
    actualOutput0 = 0.2808
    actualOutput1 = 0.6797'
  Initial SSE (before backpropagation) = 0.181401
  Corresponding SSE (from initial SSE determination) = 0.181401

SSE_Array[0] =  0.15176066353966305 SSE_Array[1] =  1.071161051212266
SSE_Array[2] =  0.9687213420975572 SSE_Array[3] =  0.18140143860603442
```

```
SSE_Array[4] =  2.3730444954555208
    For node 0: Desired Output =  0  New Output = 0.2808
    For node 1: Desired Output =  1  New Output = 0.6797
              Error(0) = -0.2808,           Error(1) = 0.3203
     Squared Error (0) = 0.0788,   Squared Error(1) = 0.1026

  The sum of these squared errors (SSE) for training set  3  is 2.3730
Will now add 1 to the iteration counter, and go back to the top of the while
loop
```

starting at the top of the while loop again

```
create random trainingDataList by calling obtainRandomXORTrainingValues()
function
starting obtainRandomXORTrainingValues() function
The trainingDataList =  (0, 0, 0, 1, 0)
ending obtainRandomXORTrainingValues() function and returning to main

Iteration number  1

Randomly selected training data set number  0
The inputs and desired outputs for the X-OR problem from this data set are:
          Input0 =  0             Input1 =  0
 Desired Output0 =  0    Desired Output1 =  1

calling ComputeSingleFeedforwardPass to obtain actual outputs for training
set

Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  0
Input1 =  0

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  0 ,  0

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.7123653538530115
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  0 ,  0
    The summed neuron input is 0.9069
    The activation (applied transfer function) for that neuron is 0.7124
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  0 ,  0
```

```
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.41399305154644955
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  0 ,  0
    The summed neuron input is -0.3475
    The activation (applied transfer function) for that neuron is 0.4140
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  0 ,  0
  The activations for the hidden nodes are:
    Hidden0 = 0.7124 Hidden1 = 0.4140

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.23883954454359838
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.7123653538530115 ,  0.41399305154644955
    The summed neuron input is -1.1591
    The activation (applied transfer function) for that neuron is 0.2388
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6922398084516622
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.7123653538530115 ,  0.41399305154644955
    The summed neuron input is 0.8106
    The activation (applied transfer function) for that neuron is 0.6922
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations
```

```
  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2388 Output1 = 0.6922

creating the actualAllNodesOutputList
the hiddenActivation0 =  0.7123653538530115
the hiddenActivation1 =  0.41399305154644955
the outputActivation0 =  0.23883954454359838
the outputActivation1 =  0.6922398084516622

ending ComputeSingleFeedforwardPass() function and returning to main

In main; have just completed a feedfoward pass with training set inputs 0 0
  The activations (actual outputs) for the two hidden neurons are:
    actualHiddenOutput0 = 0.7124
    actualHiddenOutput1 = 0.4140
  The activations (actual outputs) for the two output neurons are:
    actualOutput0 = 0.2388
    actualOutput1 = 0.6922'
  Initial SSE (before backpropagation) = 0.151761
  Corresponding SSE (from initial SSE determination) = 0.151761

SSE_Array[0] =  0.15176066353966305 SSE_Array[1] =  1.071161051212266
SSE_Array[2] =  0.9687213420975572 SSE_Array[3] =  0.18140143860603442
SSE_Array[4] =  2.3730444954555208
    For node 0: Desired Output =  0  New Output = 0.2388
    For node 1: Desired Output =  1  New Output = 0.6922
              Error(0) = -0.2388,           Error(1) = 0.3078
     Squared Error (0) = 0.0570,   Squared Error(1) = 0.0947

  The sum of these squared errors (SSE) for training set  0  is 2.3730
Will now add 1 to the iteration counter, and go back to the top of the while
loop
```

starting at the top of the while loop again

```
create random trainingDataList by calling obtainRandomXORTrainingValues()
function
starting obtainRandomXORTrainingValues() function
The trainingDataList =  (1, 1, 0, 1, 3)
ending obtainRandomXORTrainingValues() function and returning to main

Iteration number  2

Randomly selected training data set number  3
The inputs and desired outputs for the X-OR problem from this data set are:
          Input0 =  1             Input1 =  1
 Desired Output0 =  0    Desired Output1 =  1

calling ComputeSingleFeedforwardPass to obtain actual outputs for training
set

Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  1
Input1 =  1
```

```
The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  1 ,  1

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.5933971170013912
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is 0.3780
    The activation (applied transfer function) for that neuron is 0.5934
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  1 ,  1
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.24601286991158772
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is -1.1200
    The activation (applied transfer function) for that neuron is 0.2460
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  1 ,  1
  The activations for the hidden nodes are:
    Hidden0 = 0.5934 Hidden1 = 0.2460

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.28078387020502693
ending the computeTransferFnction() function and returning the activation
```

```
  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is -0.9406
    The activation (applied transfer function) for that neuron is 0.2808
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6797471985466466
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is 0.7526
    The activation (applied transfer function) for that neuron is 0.6797
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2808 Output1 = 0.6797

creating the actualAllNodesOutputList
the hiddenActivation0 =  0.5933971170013912
the hiddenActivation1 =  0.24601286991158772
the outputActivation0 =  0.28078387020502693
the outputActivation1 =  0.6797471985466466

ending ComputeSingleFeedforwardPass() function and returning to main

In main; have just completed a feedfoward pass with training set inputs 1 1
  The activations (actual outputs) for the two hidden neurons are:
    actualHiddenOutput0 = 0.5934
    actualHiddenOutput1 = 0.2460
  The activations (actual outputs) for the two output neurons are:
    actualOutput0 = 0.2808
    actualOutput1 = 0.6797'
  Initial SSE (before backpropagation) = 0.181401
  Corresponding SSE (from initial SSE determination) = 0.181401

SSE_Array[0] =  0.15176066353966305 SSE_Array[1] =  1.071161051212266
SSE_Array[2] =  0.9687213420975572 SSE_Array[3] =  0.18140143860603442
SSE_Array[4] =  2.3730444954555208
    For node 0: Desired Output =  0  New Output = 0.2808
    For node 1: Desired Output =  1  New Output = 0.6797
              Error(0) = -0.2808,           Error(1) = 0.3203
     Squared Error (0) = 0.0788,   Squared Error(1) = 0.1026

  The sum of these squared errors (SSE) for training set  3  is 2.3730
```

```
Will now add 1 to the iteration counter, and go back to the top of the while
loop
```

starting at the top of the while loop again

```
create random trainingDataList by calling obtainRandomXORTrainingValues()
function
starting obtainRandomXORTrainingValues() function
The trainingDataList =  (1, 1, 0, 1, 3)
ending obtainRandomXORTrainingValues() function and returning to main

Iteration number  3

Randomly selected training data set number  3
The inputs and desired outputs for the X-OR problem from this data set are:
          Input0 =  1             Input1 =  1
 Desired Output0 =  0    Desired Output1 =  1

calling ComputeSingleFeedforwardPass to obtain actual outputs for training
set

Starting ComputeSingleFeedforwardPass() function
The inputs transferred in are:
Input0 =  1
Input1 =  1

The initial weights for this neural network are:
     Input-to-Hidden             Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

  For hiddenActivation0 from input0, input1 =  1 ,  1

computing hiddenActivation0 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.5933971170013912
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is 0.3780
    The activation (applied transfer function) for that neuron is 0.5934
ending computeSingleNeuronActivation() function and returning activation


  For hiddenActivation1 from input0, input1 =  1 ,  1
computing hiddenActivation1 by calling computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.24601286991158772
```

```
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:  1 ,  1
    The summed neuron input is -1.1200
    The activation (applied transfer function) for that neuron is 0.2460
ending computeSingleNeuronActivation() function and returning activation


  In computeSingleFeedforwardPass:
  Input node values:  1 ,  1
  The activations for the hidden nodes are:
    Hidden0 = 0.5934 Hidden1 = 0.2460

computing the activation of output node0 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.28078387020502693
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is -0.9406
    The activation (applied transfer function) for that neuron is 0.2808
ending computeSingleNeuronActivation() function and returning activation

computing the activation of output node1 by calling
computeSingleNeuronActivation

starting computeSingleNeuronActivation() function
compute the activation by calling computeTransferFnctn()

starting the computeTransferFnction() function
The activation is  0.6797471985466466
ending the computeTransferFnction() function and returning the activation


  In computeSingleNeuronActivation with input0, input 1 given as:
0.5933971170013912 ,  0.24601286991158772
    The summed neuron input is 0.7526
    The activation (applied transfer function) for that neuron is 0.6797
ending computeSingleNeuronActivation() function and returning activation


  Computing the output neuron activations

  Back in ComputeSingleFeedforwardPass (for hidden-to-output computations)
  The activations for the output nodes are:
    Output0 = 0.2808 Output1 = 0.6797

creating the actualAllNodesOutputList
the hiddenActivation0 =  0.5933971170013912
```

```
the hiddenActivation1 =  0.24601286991158772
the outputActivation0 =  0.28078387020502693
the outputActivation1 =  0.6797471985466466

ending ComputeSingleFeedforwardPass() function and returning to main

In main; have just completed a feedfoward pass with training set inputs 1 1
  The activations (actual outputs) for the two hidden neurons are:
    actualHiddenOutput0 = 0.5934
    actualHiddenOutput1 = 0.2460
  The activations (actual outputs) for the two output neurons are:
    actualOutput0 = 0.2808
    actualOutput1 = 0.6797'
  Initial SSE (before backpropagation) = 0.181401
  Corresponding SSE (from initial SSE determination) = 0.181401

SSE_Array[0] =  0.15176066353966305 SSE_Array[1] =  1.071161051212266
SSE_Array[2] =  0.9687213420975572 SSE_Array[3] =  0.18140143860603442
SSE_Array[4] =  2.3730444954555208
    For node 0: Desired Output =  0  New Output = 0.2808
    For node 1: Desired Output =  1  New Output = 0.6797
              Error(0) = -0.2808,           Error(1) = 0.3203
     Squared Error (0) = 0.0788,   Squared Error(1) = 0.1026

  The sum of these squared errors (SSE) for training set  3  is 2.3730
Will now add 1 to the iteration counter, and go back to the top of the while
loop
```

Out of while loop after 4 iterations

```
The initial weights for this neural network are:
     Input-to-Hidden                        Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

The final weights for this neural network are:
     Input-to-Hidden                        Hidden-to-Output
w(0,0) = -0.695   w(0,1) = 0.167         v(0,0) = -0.536   v(0,1) = -0.921
w(1,0) = -0.879   w(1,1) = 0.107         v(1,0) = -0.361   v(1,1) = 0.601

The SSE values at the beginning of training were:
  SSE_Initial[0] = 0.1518
  SSE_Initial[1] = 1.0712
  SSE_Initial[2] = 0.9687
  SSE_Initial[3] = 0.1814

The total of the SSE values at the beginning of training is 2.3730

The SSE values at the end of training were:
  SSE[0] = 0.1518
  SSE[1] = 1.0712
  SSE[2] = 0.9687
  SSE[3] = 0.1814

The total of the SSE values at the end of training is 2.3730
```

```
ending main() function
```