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Micromlp | Micropython, Neural Network, Multilayer Perceptron, Mlp, Ai

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Jczic / MicroMLP

A micro neural network multilayer perceptron for micropython (used on esp32 and pycom modules).

Homepage

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python

Issues (4)

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User Jczic

MicroMLP is a micro artificial neural network multilayer perceptron (principally used on ESP32 and Pycom modules)

Very easy to integrate and very light with one file only :

- `"microMLP.py"`

MicroMLP features :

- Modifiable multilayer and connections structure
- Integrated bias on neurons
- Plasticity of the connections included
- Activation functions by layer
- Parameters Alpha, Eta and Gain
- Managing set of examples and learning
- QLearning functions to use reinforcement learning
- Save and load all structure to/from json file
- Various activation functions :
    - Heaviside binary step
    - Logistic (sigmoid or soft step)
    - Hyperbolic tangent
    - SoftPlus rectifier
    - ReLU (rectified linear unit)
    - Gaussian function

Use deep learning for :

- Signal processing (speech processing, identification, filtering)
- Image processing (compression, recognition, patterns)
- Control (diagnosis, quality control, robotics)
- Optimization (planning, traffic regulation, finance)
- Simulation (black box simulation)
- Classification (DNA analysis)
- Approximation (unknown function, complex function)

Using *MicroMLP* static functions :

Name	Function
Create	`mlp = MicroMLP.Create(neuronsByLayers, activationFuncName, layersAutoConnectFunction=None, useBiasValue=1.0)`
LoadFromFile	`mlp = MicroMLP.LoadFromFile(filename)`

Using *MicroMLP* speedly creation of a neural network :

```
from microMLP import MicroMLP
mlp = MicroMLP.Create([3, 10, 2], "Sigmoid", MicroMLP.LayersFullConnect)
```

Using *MicroMLP* main class :

Name	Function
Constructor	`mlp = MicroMLP()`
GetLayer	`layer = mlp.GetLayer(layerIndex)`
GetLayerIndex	`idx = mlp.GetLayerIndex(layer)`
RemoveLayer	`mlp.RemoveLayer(layer)`
GetInputLayer	`inputLayer = mlp.GetInputLayer()`
GetOutputLayer	`outputLayer = mlp.GetOutputLayer()`
Learn	`ok = mlp.Learn(inputVectorNNValues, targetVectorNNValues)`
Test	`ok = mlp.Test(inputVectorNNValues, targetVectorNNV`
Predict	`outputVectorNNValues = mlp.Predict(inputVectorNNVa`
QLearningLearnForChosenAction	`ok = mlp.QLearningLearnForChosenAction(stateVectorNNVal rewardNNValue, pastStateVectorNNValues, chosenActionIndex, terminalState=True, discountFactorNNValue=None)`
QLearningPredictBestActionIndex	`bestActionIndex = mlp.QLearningPredictBestActionIndex(stateVectorNNV`
SaveToFile	`ok = mlp.SaveToFile(filename)`

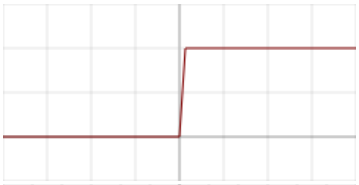
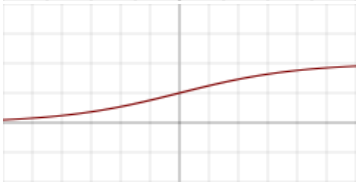
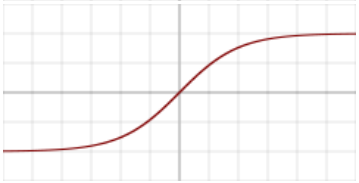
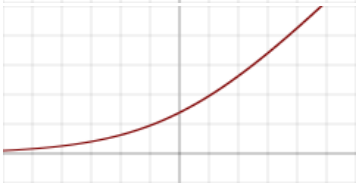
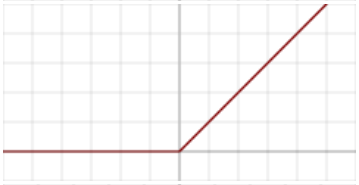
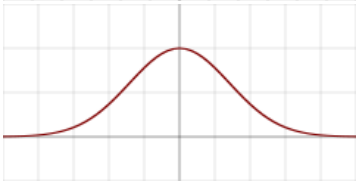
Name	Function
AddExample	`ok = mlp.AddExample(inputVectorNNValues, targetVectorNNValues)`
ClearExamples	`mlp.ClearExamples()`
LearnExamples	`learnCount = mlp.LearnExamples(maxSeconds=30, maxCount=None, stopWhenLearned=True, printMAEAverage=True)`

Property	Example	Read/Write
Layers	`mlp.Layers`	get
LayersCount	`mlp.LayersCount`	get
IsNetworkComplete	`mlp.IsNetworkComplete`	get
MSE	`mlp.MSE`	get
MAE	`mlp.MAE`	get
MSEPercent	`mlp.MSEPercent`	get
MAEPercent	`mlp.MAEPercent`	get
ExamplesCount	`mlp.ExamplesCount`	get

Using *MicroMLP* to learn the XOr problem (with hyperbolic tangent) :

```
from microMLP import MicroMLP

mlp = MicroMLP.Create( neuronsByLayers           = [2, 2, 1],
                       activationFuncName        = MicroMLP.ACTFUNC_TANH,
                       layersAutoConnectFunction = MicroMLP.LayersFullConnect )

nnFalse  = MicroMLP.NNValue.FromBool(False)
nnTrue   = MicroMLP.NNValue.FromBool(True)

mlp.AddExample( [nnFalse, nnFalse], [nnFalse] )
mlp.AddExample( [nnFalse, nnTrue ], [nnTrue ] )
mlp.AddExample( [nnTrue , nnTrue ], [nnFalse] )
mlp.AddExample( [nnTrue , nnFalse], [nnTrue ] )

learnCount = mlp.LearnExamples()

print( "LEARNED :" )
print( "  - False xor False = %s" % mlp.Predict([nnFalse, nnFalse])[0].AsBool )
print( "  - False xor True  = %s" % mlp.Predict([nnFalse, nnTrue] )[0].AsBool )
print( "  - True  xor True  = %s" % mlp.Predict([nnTrue , nnTrue] )[0].AsBool )
print( "  - True  xor False = %s" % mlp.Predict([nnTrue , nnFalse])[0].AsBool )

if mlp.SaveToFile("mlp.json") :
        print( "MicroMLP structure saved!" )
```

Variable	Description	Default
`mlp.Eta`	Weighting of the error correction	0.30
`mlp.Alpha`	Strength of connections plasticity	0.75
`mlp.Gain`	Network learning gain	0.99
`mlp.CorrectLearnedMAE`	Threshold of self-learning error	0.02

Graphe	Activation function name	Const	Detail
	`"Heaviside"`	MicroMLP.ACTFUNC_HEAVISIDE	Heaviside binary step
	`"Sigmoid"`	MicroMLP.ACTFUNC_SIGMOID	Logistic (sigmoid or soft step)
	`"TanH"`	MicroMLP.ACTFUNC_TANH	Hyperbolic tangent
	`"SoftPlus"`	MicroMLP.ACTFUNC_SOFTPLUS	SoftPlus rectifier
	`"ReLU"`	MicroMLP.ACTFUNC_RELU	Rectified linear unit
	`"Gaussian"`	MicroMLP.ACTFUNC_GAUSSIAN	Gaussian function

Layers auto-connect function	Detail
`MicroMLP.LayersFullConnect`	Network fully connected

Using *MicroMLP.Layer* class :

Name	Function
Constructor	`layer = MicroMLP.Layer(parentMicroMLP, activationFuncName=None, neuronsCount=0)`
GetLayerIndex	`idx = layer.GetLayerIndex()`
GetNeuron	`neuron = layer.GetNeuron(neuronIndex)`
GetNeuronIndex	`idx = layer.GetNeuronIndex(neuron)`
AddNeuron	`layer.AddNeuron(neuron)`
RemoveNeuron	`layer.RemoveNeuron(neuron)`

Name	Function
GetMeanSquareError	`mse = layer.GetMeanSquareError()`
GetMeanAbsoluteError	`mae = layer.GetMeanAbsoluteError()`
GetMeanSquareErrorAsPercent	`mseP = layer.GetMeanSquareErrorAsPercent()`
GetMeanAbsoluteErrorAsPercent	`maeP = layer.GetMeanAbsoluteErrorAsPercent()`
Remove	`layer.Remove()`

Property	Example	Read/Write
ParentMicroMLP	`layer.ParentMicroMLP`	get
ActivationFuncName	`layer.ActivationFuncName`	get
Neurons	`layer.Neurons`	get
NeuronsCount	`layer.NeuronsCount`	get

Using *MicroMLP.InputLayer(Layer)* class :

Name	Function
Constructor	`inputLayer = MicroMLP.InputLayer(parentMicroMLP, neuronsCount=0)`
SetInputVectorNNValues	`ok = inputLayer.SetInputVectorNNValues(inputVectorNNValues)`

Using *MicroMLP.OutputLayer(Layer)* class :

Name	Function
Constructor	`outputLayer = MicroMLP.OutputLayer(parentMicroMLP, activationFuncName, neuronsCount=0)`
GetOutputVectorNNValues	`outputVectorNNValues = outputLayer.GetOutputVectorNNValues()`
ComputeTargetLayerError	`ok = outputLayer.ComputeTargetLayerError(targetVectorNNValues`

Using *MicroMLP.Neuron* class :

Name	Function
Constructor	`neuron = MicroMLP.Neuron(parentLayer)`
GetNeuronIndex	`idx = neuron.GetNeuronIndex()`
GetInputConnections	`connections = neuron.GetInputConnections()`
GetOutputConnections	`connections = neuron.GetOutputConnections()`
AddInputConnection	`neuron.AddInputConnection(connection)`
AddOutputConnection	`neuron.AddOutputConnection(connection)`
RemoveInputConnection	`neuron.RemoveInputConnection(connection)`
RemoveOutputConnection	`neuron.RemoveOutputConnection(connection)`
SetBias	`neuron.SetBias(bias)`
GetBias	`neuron.GetBias()`
SetOutputNNValue	`neuron.SetOutputNNValue(nnvalue)`
ComputeValue	`neuron.ComputeValue()`

Name	Function
ComputeError	`neuron.ComputeError(targetNNValue=None)`
Remove	`neuron.Remove()`

Property	Example	Read/Write
ParentLayer	`neuron.ParentLayer`	get
ComputedOutput	`neuron.ComputedOutput`	get
ComputedDeltaError	`neuron.ComputedDeltaError`	get
ComputedSignalError	`neuron.ComputedSignalError`	get

Using *MicroMLP.Connection* class :

Name	Function
Constructor	`connection = MicroMLP.Connection(neuronSrc, neuronDst, weight=None)`
UpdateWeight	`connection.UpdateWeight(eta, alpha)`
Remove	`connection.Remove()`

Property	Example	Read/Write
NeuronSrc	`connection.NeuronSrc`	get
NeuronDst	`connection.NeuronDst`	get
Weight	`connection.Weight`	get

Using *MicroMLP.Bias* class :

Name	Function
Constructor	`bias = MicroMLP.Bias(neuronDst, value=1.0, weight=None)`
UpdateWeight	`bias.UpdateWeight(eta, alpha)`
Remove	`bias.Remove()`

Property	Example	Read/Write
NeuronDst	`bias.NeuronDst`	get
Value	`bias.Value`	get
Weight	`bias.Weight`	get

Using *MicroMLP.NNValue* static functions :

Name	Function
FromPercent	`nnvalue = MicroMLP.NNValue.FromPercent(value)`
NewPercent	`nnvalue = MicroMLP.NNValue.NewPercent()`
FromByte	`nnvalue = MicroMLP.NNValue.FromByte(value)`
NewByte	`nnvalue = MicroMLP.NNValue.NewByte()`
FromBool	`nnvalue = MicroMLP.NNValue.FromBool(value)`
NewBool	`nnvalue = MicroMLP.NNValue.NewBool()`
FromAnalogSignal	`nnvalue = MicroMLP.NNValue.FromAnalogSignal(value)`
NewAnalogSignal	`nnvalue = MicroMLP.NNValue.NewAnalogSignal()`

Using *MicroMLP.NNValue* class :

Name	Function

Name	Function
Constructor	`nnvalue = MicroMLP.NNValue(minValue, maxValue, value)`

Property	Example	Read/Write
AsFloat	`nnvalue.AsFloat = 639.513`	get / set
AsInt	`nnvalue.AsInt = 12345`	get / set
AsPercent	`nnvalue.AsPercent = 65`	get / set
AsByte	`nnvalue.AsByte = b'\x75'`	get / set
AsBool	`nnvalue.AsBool = True`	get / set
AsAnalogSignal	`nnvalue.AsAnalogSignal = 0.39472`	get / set

By JC`zic for HC² ;')

Keep it simple, stupid 👍

Issues

Issues

+ Example request for qlearning

+ How to image processing ?

+ Real values

+ List index out of range

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