NNetCpp

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3.1 Class List

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- double unitStep (double x)
- double sigmoid (double x)
- double squareError (const std::vector< double > &v1, const std::vector< double > &v2)

4.1.1 Detailed Description

Utility functions for neural networks

4.1.2 Function Documentation

4.1.2.1 double NNetUtil::sigmoid (double *x*)

Sigmoid function

y(x) = 1 / (1 + exp(-x))

Parameters

x	input to sigmoid

Returns

output of sigmoid

4.1.2.2 double NNetUtil::squareError (const std::vector< double > & *v1*, const std::vector< double > & *v2*)

Calculate the square error of two vectors Scaled with (1/2) to normalize derivative

E(v1, v2) = (1/2) |v2 - v1|^2

Parameters

v1	first vector
v2	second vector

Returns

the square error of the two vectors

4.1.2.3 double NNetUtil::unitStep (double *x*)

Unit step function

y(x) = 0 if x $<$ 0

y(x) = 1 if x $>$= 0

Parameters

x	input to step function

Returns

step function of input

Chapter 5

Class Documentation

5.1 ConnectedNet Class Reference

`#include <ConnectedNet.h>`

Public Member Functions

- ConnectedNet (int inputNodes, std::vector< int > hiddenLayers, int outputNodes, WeightGenerator *weightGen=nullptr)
- ~ConnectedNet ()
- std::vector< double > getOutput (std::vector< double > inputValues)
- void train (TrainingData &tData, double learningRate)
- std::vector< double > getDifference ()

5.1.1 Detailed Description

A fully connected Neural Network

5.1.2 Constructor & Destructor Documentation

5.1.2.1 ConnectedNet::ConnectedNet (int *inputNodes*, std::vector< int > *hiddenLayers*, int *outputNodes*, WeightGenerator * *weightGen* = `nullptr`)

Create a new ConnectedNet of given dimensions.

For example: For a 3x5x4x4x2 network one would put

inputNodes - 3

hiddenLayers - [5, 4, 4]

outputNodes - 2

Parameters

inputNodes	amount of inputs to the network
hiddenLayers	vector of dimensions of hidden layers, number at each index becomes amount of neurons in hidden layer at that index

outputNodes	amount of outputs from the network
weightGen	generator to use for initializing weights in the network, if left a nullptr it is replaced with a default random generator

5.1.2.2 ConnectedNet::~ConnectedNet ( )

Destructor for ConnectedNet, clears all memory allocated

5.1.3 Member Function Documentation

5.1.3.1 std::vector< double > ConnectedNet::getDifference ( )

Get a vector of difference between target and output

Returns

the difference vector

5.1.3.2 std::vector< double > ConnectedNet::getOutput (std::vector< double > *inputValues*)

Present an input to the ConnectedNet and get the output

Parameters

inputValues	input vector to the net

Returns

the output vector of the net

5.1.3.3 void ConnectedNet::train (TrainingData & *tData*, double *learningRate*)

Train the net on one input - target vector pair with speed learningrate returns the error

Parameters

tData	a piece of training data to use for training the net
learningRate	rate to adjust weights in training

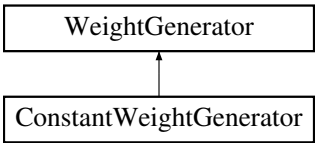
The documentation for this class was generated from the following files:

- src/ConnectedNet.h
- src/ConnectedNet.cpp

5.2 ConstantWeightGenerator Class Reference

`#include <ConstantWeightGenerator.h>`

Inheritance diagram for ConstantWeightGenerator:



Public Member Functions

- ConstantWeightGenerator (double weight)
- double getWeight ()

5.2.1 Detailed Description

WeightGenerator that always outputs a constant weight

5.2.2 Constructor & Destructor Documentation

5.2.2.1 ConstantWeightGenerator::ConstantWeightGenerator (double *weight*)

Create a new ConstantWeightGenerator that always outputs weight

Parameters

weight	the constant weight to output

5.2.3 Member Function Documentation

5.2.3.1 double ConstantWeightGenerator::getWeight ( ) [virtual]

Get the constant weight

Inherits:

Get a new weight from the generator

Returns

the new weight

Implements WeightGenerator.

The documentation for this class was generated from the following files:

- src/netbuilding/weightgenerators/ConstantWeightGenerator.h
- src/netbuilding/weightgenerators/ConstantWeightGenerator.cpp

5.3 Edge Class Reference

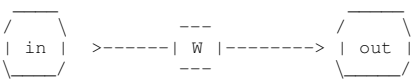
`#include <Edge.h>`

Public Member Functions

- Edge (double startWeight, Node *input=nullptr, Neuron *output=nullptr)
- void setInput (Node *input)
- void setOutput (Neuron *output)
- void updateWeight (double learningRate)
- double getWeightedOutput ()
- double getWeightedDelta ()

5.3.1 Detailed Description

Edge between two nodes with weight W



5.3.2 Constructor & Destructor Documentation

5.3.2.1 Edge::Edge (double *startWeight*, Node * *input* = nullptr, Neuron * *output* = nullptr)

Create a new Edge between 2 Nodes. Start with given weight

Parameters

startWeight	initial weight of the edge
input	start node of the edge
output	end node of the edge

5.3.3 Member Function Documentation

5.3.3.1 double Edge::getWeightedDelta ( )

Get the delta from the output Neuron weighted for back propagation

Returns

the delta of output node weighted with the current edge weight

5.3.3.2 double Edge::getWeightedOutput ( )

Get the output from the edge

Returns

the input weighted with the current edge weight

5.3.3.3 void Edge::setInput (Node * *input*)

Set the Node this Edge starts at

Parameters

input	node to set for input of edge

5.3.3.4 void Edge::setOutput (Neuron * *output*)

Set the Neuron this Edge ends at Note: must be Neuron (not just Node) to allow for retrieving delta for training

Parameters

output	node to set for output of edge, must be a neuron not just a node to allow for retrieving delta for training

5.3.3.5 void Edge::updateWeight (double *learningRate*)

Update the weight for the edge based on the backpropagation algorithm

Parameters

learningRate	distance to update weight

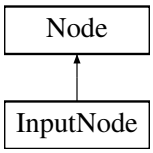
The documentation for this class was generated from the following files:

- src/netbuilding/Edge.h
- src/netbuilding/Edge.cpp

5.4 InputNode Class Reference

`#include <InputNode.h>`

Inheritance diagram for InputNode:



Public Member Functions

- InputNode ()
- InputNode (double value)
- double getOutput ()
- void setValue (double value)

5.4.1 Detailed Description

A node to be used for input to networks. Its output value can be set.

5.4.2 Constructor & Destructor Documentation

5.4.2.1 InputNode::InputNode ( )

Create a new input Node

5.4.2.2 InputNode::InputNode (double *value*)

Create a new input Node with the given value

Parameters

value	the value for the InputNode to output

5.4.3 Member Function Documentation

5.4.3.1 double InputNode::getOutput ( ) [virtual]

Get the output value of the input node

inherits:

Get the output of the node

Returns

the node's output

Implements Node.

5.4.3.2 void InputNode::setValue (double *value*)

Set value of the input node

Parameters

value	the value for the InputNode to output

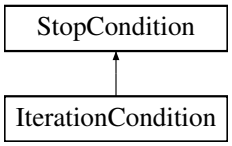
The documentation for this class was generated from the following files:

- src/netbuilding/InputNode.h
- src/netbuilding/InputNode.cpp

5.5 IterationCondition Class Reference

`#include <IterationCondition.h>`

Inheritance diagram for IterationCondition:



Public Member Functions

- IterationCondition (int allowedIterations)
- bool check (int iteration, double error)

5.5.1 Detailed Description

Condition for stopping Neural Network training after a fixed amount of training iterations

5.5.2 Constructor & Destructor Documentation

5.5.2.1 IterationCondition::IterationCondition (int *allowedIterations*)

Create a new IterationCondition that will allow given amount of iterations

Parameters

allowedIterations	amount of iterations to allow

5.5.3 Member Function Documentation

5.5.3.1 bool IterationCondition::check (int *iteration*, double *error*) [virtual]

Control if the last iteration has been met

Inherits:

Control if the condition has been met

Parameters

iteration	amount of training iterations ran
error	current error from evaluation

Returns

if training is done

Implements StopCondition.

The documentation for this class was generated from the following files:

- src/stopconditions/IterationCondition.h
- src/stopconditions/IterationCondition.cpp

5.6 NetTraining Class Reference

`#include <NetTraining.h>`

Public Member Functions

- NetTraining (ConnectedNet *net, std::vector< TrainingData > trainingData, std::vector< TrainingData > evalData, StopCondition *stopper, double learningRate, int trainingPerIteration=1)
- void run ()

5.6.1 Detailed Description

Training session of a neural net. Consists of a collection of data, net and some stop condition for how long to keep training.

5.6.2 Constructor & Destructor Documentation

5.6.2.1 NetTraining::NetTraining (ConnectedNet * *net*, std::vector< TrainingData > *trainingData*, std::vector< TrainingData > *evalData*, StopCondition * *stopper*, double *learningRate*, int *trainingPerIteration* = 1)

Create a new NetTraining session for the given net with the given data and stop condition

Parameters

net	the neural net to train
trainingData	vector of all data pieces to use for training
evalData	data pieces to use for evaluating performance of the net
stopper	condition for stopping training
learningRate	rate to adjust weights in backpropagation algorithm
trainingPer-Iteration	times training data should be iterated through before performace is evaluated

5.6.3 Member Function Documentation

5.6.3.1 void NetTraining::run ( )

Start the training and run until the stop condition is met

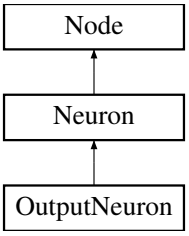
The documentation for this class was generated from the following files:

- src/NetTraining.h
- src/NetTraining.cpp

5.7 Neuron Class Reference

`#include <Neuron.h>`

Inheritance diagram for Neuron:



Public Member Functions

- Neuron (std::function< double(double)> activationFunc, std::vector< Edge * > inputs, std::vector< Edge * > outputs)
- Neuron (std::function< double(double)> activationFunc)
- void setInputs (std::vector< Edge * > inputs)
- void setOutputs (std::vector< Edge * > outputs)
- void calcOutput ()
- void calcDelta ()
- double getOutput ()
- double getDelta ()

Protected Member Functions

- double sigmoidDelta ()

Protected Attributes

- double delta = 0

5.7.1 Detailed Description

A neuron, part of a neural network.

5.7.2 Constructor & Destructor Documentation

5.7.2.1 Neuron::Neuron (std::function< double(double)> *activationFunc*, std::vector< Edge * > *inputs*, std::vector< Edge * > *outputs*)

Create a new Neuron with the given in- and outputs

Parameters

activationFunc	function to use for neuron activation
inputs	vector of pointers to incoming edges
outputs	vector of pointers to outgoing edges

5.7.2.2 Neuron::Neuron (std::function< double(double)> *activationFunc*)

Create a new Neuron

Parameters

activationFunc	function to use for neuron activation

5.7.3 Member Function Documentation

5.7.3.1 void Neuron::calcDelta ( )

Calculate and store the delta from this Neuron according to the GDR. All output Neurons should have their deltas updated before calculating this.

5.7.3.2 void Neuron::calcOutput ( )

Calculate and store the output from this Neuron. All input Neurons should have their outputs updated before calculating this.

5.7.3.3 double Neuron::getDelta ( )

Get delta for backpropagation

Returns

the delta of the Neuron

5.7.3.4 double Neuron::getOutput ( ) [virtual]

Get the output of this Neuron

Inherits:

Get the output of the node

Returns

the node's output

Implements Node.

5.7.3.5 void Neuron::setInputs (std::vector< Edge * > *inputs*)

Set the edges in to this Neuron

Parameters

inputs	vector of pointers to incoming edges

5.7.3.6 void Neuron::setOutputs (std::vector< Edge * > *outputs*)

Set the edges out from this Neuron

Parameters

outputs	vector of pointers to outgoing edges

5.7.3.7 double Neuron::sigmoidDelta ( ) [protected]

Get the derivative of a sigmoid activation function for this node

Returns

the derivative of the sigmoid

5.7.4 Member Data Documentation

5.7.4.1 double Neuron::delta = 0 [protected]

Delta for backpropagation

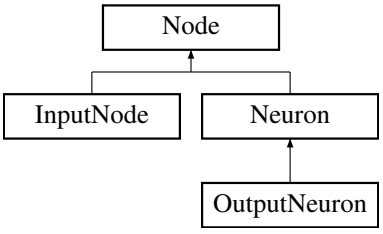
The documentation for this class was generated from the following files:

- src/netbuilding/Neuron.h
- src/netbuilding/Neuron.cpp

5.8 Node Class Reference

`#include <Node.h>`

Inheritance diagram for Node:



Public Member Functions

- virtual double getOutput ()=0

5.8.1 Detailed Description

Node of network

5.8.2 Member Function Documentation

5.8.2.1 virtual double Node::getOutput ( ) [pure virtual]

Get the output of the node

Returns

the node's output

Implemented in Neuron, and InputNode.

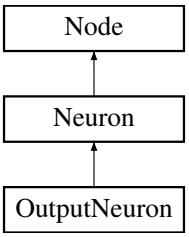
The documentation for this class was generated from the following file:

- src/netbuilding/Node.h

5.9 OutputNeuron Class Reference

`#include <OutputNeuron.h>`

Inheritance diagram for OutputNeuron:



Public Member Functions

- OutputNeuron (std::function< double(double)> activationFunc)
- OutputNeuron (std::function< double(double)> activationFunc, std::vector< Edge * > inputs)
- OutputNeuron (std::function< double(double)> activationFunc, double targetValue)
- void calcDelta ()
- void setTarget (double targetValue)
- double getDifference ()

Additional Inherited Members

5.9.1 Detailed Description

Neuron at end of Neural Network outputting the nets output

5.9.2 Constructor & Destructor Documentation

5.9.2.1 OutputNeuron::OutputNeuron (std::function< double(double)> *activationFunc*)

Create a new OutputNeuron using the given activation function

Parameters

activationFunc	function to use for neuron activation

5.9.2.2 OutputNeuron::OutputNeuron (std::function< double(double)> *activationFunc,* std::vector< Edge * > *inputs*)

Create a new OutputNeuron using the given activation function with given inputs

Parameters

activationFunc	function to use for neuron activation
inputs	vector of pointers to incoming edges

5.9.2.3 OutputNeuron::OutputNeuron (std::function< double(double)> *activationFunc,* double *targetValue*)

Create a new OutputNeuron using the given activation function and target value

Parameters

activationFunc	function to use for neuron activation
targetValue	target output value of the neuron

5.9.3 Member Function Documentation

5.9.3.1 void OutputNeuron::calcDelta ( )

Calculate delta for output Neuron according to the GDR

Inherits:

Calculate and store the delta from this Neuron according to the GDR. All output Neurons should have their deltas updated before calculating this.

5.9.3.2 double OutputNeuron::getDifference ( )

Get the difference between actual output and target

Returns

the difference for the Neurons current values

5.9.3.3 void OutputNeuron::setTarget (double *targetValue*)

Set the target value of the OutputNeuron

Parameters

targetValue	value to target as output

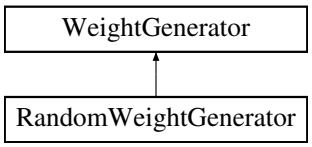
The documentation for this class was generated from the following files:

- src/netbuilding/OutputNeuron.h
- src/netbuilding/OutputNeuron.cpp

5.10 RandomWeightGenerator Class Reference

`#include <RandomWeightGenerator.h>`

Inheritance diagram for RandomWeightGenerator:



Public Member Functions

- RandomWeightGenerator (double weightMin=RandomWeightGenerator::DEFAULT_MIN, double weightMax=RandomWeightGenerator::DEFAULT_MAX)
- double getWeight ()

5.10.1 Detailed Description

Weight Generator for generating random weights

5.10.2 Constructor & Destructor Documentation

5.10.2.1 RandomWeightGenerator::RandomWeightGenerator (double *weightMin* = `RandomWeightGenerator::DEFAULT_MIN`, double *weightMax* = `RandomWeightGenerator::DEFAULT_MAX`)

Create new RandomWeightGenerator for generating weights in the interval [weightMin, weightMax)

Parameters

weightMin	bottom limit of random interval
weightMax	upper limit of random interval

5.10.3 Member Function Documentation

5.10.3.1 double RandomWeightGenerator::getWeight ( ) [virtual]

Generate a new random weight

Inherits:

Get a new weight from the generator

Returns

the new weight

Implements WeightGenerator.

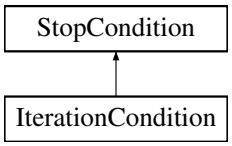
The documentation for this class was generated from the following files:

- src/netbuilding/weightgenerators/RandomWeightGenerator.h
- src/netbuilding/weightgenerators/RandomWeightGenerator.cpp

5.11 StopCondition Class Reference

`#include <StopCondition.h>`

Inheritance diagram for StopCondition:



Public Member Functions

- virtual bool check (int iteration, double error)=0

5.11.1 Detailed Description

Interface for classes describing conditions for whether to continue training Neural Nets

5.11.2 Member Function Documentation

5.11.2.1 virtual bool StopCondition::check (int *iteration,* double *error*) [pure virtual]

Control if the condition has been met

Parameters

iteration	amount of training iterations ran
error	current error from evaluation

Returns

if training is done

Implemented in IterationCondition.

The documentation for this class was generated from the following file:

- src/stopconditions/StopCondition.h

5.12 TrainingData Class Reference

`#include <TrainingData.h>`

Public Member Functions

- TrainingData (std::vector< double > input, std::vector< double > target)
- std::vector< double > getInput ()
- std::vector< double > getTarget ()

5.12.1 Detailed Description

Data to be used for training a neural net. Consist of a pair of input data and wanted output

5.12.2 Constructor & Destructor Documentation

5.12.2.1 TrainingData::TrainingData (std::vector< double > *input*, std::vector< double > *target*)

Create a new training data input-target pair

Parameters

input	the input to the neural net
target	the wanted output from the net

5.12.3 Member Function Documentation

5.12.3.1 std::vector< double > TrainingData::getInput ( )

Get the input vector of the training data

Returns

the input vector

5.12.3.2 std::vector< double > TrainingData::getTarget ( )

Get the known target vector of the training data

Returns

the (target) output vector

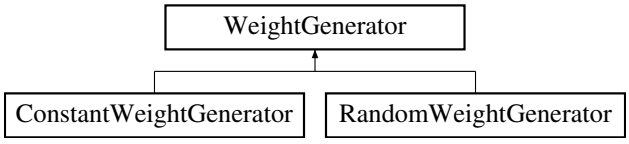
The documentation for this class was generated from the following files:

- src/TrainingData.h
- src/TrainingData.cpp

5.13 WeightGenerator Class Reference

`#include <WeightGenerator.h>`

Inheritance diagram for WeightGenerator:



Public Member Functions

- virtual double getWeight ()=0

5.13.1 Detailed Description

Generator of default weights for edges

5.13.2 Member Function Documentation

5.13.2.1 virtual double WeightGenerator::getWeight ( ) [pure virtual]

Get a new weight from the generator

Returns

the new weight

Implemented in RandomWeightGenerator, and ConstantWeightGenerator.

The documentation for this class was generated from the following file:

- src/netbuilding/weightgenerators/WeightGenerator.h

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