Athena

0.1

Generated by Doxygen 1.8.14

Contents

1 Hierarchical Index **1**

1.1 Class Hierarchy 1

2 Class Index **3**

2.1 Class List 3

3 Class Documentation **5**

3.1 athena::backend::AbstractDevice Class Reference 5

3.2 athena::backend::AbstractExecutor Class Reference 5

3.3 athena::core::loss::AbstractLossFunction Class Reference 6

3.4 athena::backend::AbstractMemoryManager Class Reference 6

3.4.1 Detailed Description 7

3.4.2 Member Function Documentation 7

3.4.2.1 addTensor() 7

3.4.2.2 deleteFromMem() 7

3.4.2.3 getPhysicalAddress() 8

3.4.2.4 load() 8

3.4.2.5 resetTable() 8

3.4.2.6 unlock() 9

3.5 athena::core::optimizers::AbstractOptimizer Class Reference 9

3.6 athena::core::kernels::AddOpKernel Class Reference 10

3.6.1 Member Function Documentation 10

3.6.1.1 getDerivativeBytecode() 10

3.6.1.2 getDerivativeShape() 11

3.6.1.3 getOperandsCount() . . . 11
3.6.1.4 getOutputShape() . . . 11
3.7 athena::backend::generic::CPUDevice Class Reference . . . 12
3.7.1 Detailed Description . . . 12
3.8 athena::backend::generic::GenericExecutor Class Reference . . . 12
3.9 athena::backend::generic::GenericMemoryManager Class Reference . . . 13
3.9.1 Detailed Description . . . 14
3.9.2 Member Function Documentation . . . 14
3.9.2.1 deinit() . . . 14
3.9.2.2 deleteFromMem() . . . 14
3.9.2.3 getPhysicalAddress() . . . 14
3.9.2.4 init() . . . 15
3.9.2.5 load() [1/2] . . . 15
3.9.2.6 load() [2/2] . . . 15
3.9.2.7 processQueue() . . . 15
3.9.2.8 unlock() . . . 16
3.10 athena::core::optimizers::GradientDescent Class Reference . . . 16
3.11 athena::core::InputNode Class Reference . . . 17
3.11.1 Detailed Description . . . 17
3.11.2 Member Function Documentation . . . 17
3.11.2.1 after() . . . 17
3.11.2.2 getData() . . . 18
3.11.2.3 getMappedMemCell() . . . 18
3.11.2.4 isFrozen() . . . 18
3.11.2.5 isInputNode() . . . 18
3.11.2.6 setFrozen() . . . 18
3.11.2.7 setMappedMemCell() . . . 19
3.12 athena::core::kernels::MatMulOpKernel Class Reference . . . 19
3.12.1 Member Function Documentation . . . 19
3.12.1.1 getDerivativeBytecode() . . . 20

3.12.1.2 getDerivativeShape() . . . 20
3.12.1.3 getOperandsCount() . . . 20
3.12.1.4 getOutputShape() . . . 21
3.13 athena::backend::generic::MemoryChunk Struct Reference . . . 21
3.13.1 Detailed Description . . . 22
3.14 athena::core::loss::MSELoss Class Reference . . . 22
3.15 athena::core::loss::MSEOpKernel Class Reference . . . 22
3.15.1 Member Function Documentation . . . 23
3.15.1.1 getDerivativeBytecode() . . . 23
3.15.1.2 getOperandsCount() . . . 23
3.16 athena::core::Node Class Reference . . . 24
3.16.1 Detailed Description . . . 24
3.16.2 Member Function Documentation . . . 25
3.16.2.1 after() . . . 25
3.16.2.2 isInputNode() . . . 25
3.17 athena::core::OpKernel Class Reference . . . 25
3.17.1 Detailed Description . . . 26
3.17.2 Member Function Documentation . . . 26
3.17.2.1 getDerivativeBytecode() . . . 26
3.17.2.2 getDerivativeShape() . . . 27
3.17.2.3 getOperandsCount() . . . 27
3.17.2.4 getOutputShape() . . . 27
3.18 athena::backend::generic::QueueItem Struct Reference . . . 28
3.18.1 Detailed Description . . . 28
3.19 athena::core::kernels::ScaleOpKernel Class Reference . . . 28
3.19.1 Member Function Documentation . . . 29
3.19.1.1 getDerivativeBytecode() . . . 29
3.19.1.2 getDerivativeShape() . . . 29
3.19.1.3 getOperandsCount() . . . 30
3.19.1.4 getOutputShape() . . . 30

3.20 athena::core::Session Class Reference . . . 31
3.20.1 Detailed Description . . . 31
3.20.2 Member Function Documentation . . . 31
3.20.2.1 prepare() . . . 31
3.20.2.2 run() . . . 31
3.21 athena::core::optimizers::SGDOptimizer Class Reference . . . 32
3.22 athena::core::kernels::SigmoidOpKernel Class Reference . . . 32
3.22.1 Member Function Documentation . . . 32
3.22.1.1 getDerivativeBytecode() . . . 33
3.22.1.2 getDerivativeShape() . . . 33
3.22.1.3 getOperandsCount() . . . 33
3.22.1.4 getOutputShape() . . . 34
3.23 athena::backend::generic::SwapRecord Struct Reference . . . 34
3.23.1 Detailed Description . . . 34
3.24 athena::core::Tensor Class Reference . . . 35
3.24.1 Detailed Description . . . 35
3.25 athena::core::TensorShape Class Reference . . . 35
3.26 athena::backend::VirtualMemory Class Reference . . . 36
3.26.1 Detailed Description . . . 36
3.26.2 Member Function Documentation . . . 36
3.26.2.1 allocate() . . . 36
3.26.2.2 free() [1/2] . . . 36
3.26.2.3 free() [2/2] . . . 37
3.27 athena::backend::VMemoryBlock Struct Reference . . . 37

Index **39**

Chapter 1

Hierarchical Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

athena::backend::AbstractDevice 5
athena::backend::generic::CPUDevice 12
athena::backend::AbstractExecutor 5
athena::backend::generic::GenericExecutor 12
athena::backend::AbstractMemoryManager 6
athena::backend::generic::GenericMemoryManager 13
athena::core::optimizers::AbstractOptimizer 9
athena::core::optimizers::GradientDescent 16
athena::core::optimizers::SGDOptimizer 32
athena::backend::generic::MemoryChunk 21
athena::core::Node 24
athena::core::InputNode 17
athena::core::loss::AbstractLossFunction 6
athena::core::loss::MSELoss 22
athena::core::OpKernel 25
athena::core::kernels::AddOpKernel 10
athena::core::kernels::MatMulOpKernel 19
athena::core::kernels::ScaleOpKernel 28
athena::core::kernels::SigmoidOpKernel 32
athena::core::loss::MSEOpKernel 22
athena::backend::generic::QueueItem 28
athena::core::Session 31
athena::backend::generic::SwapRecord 34
athena::core::Tensor 35
athena::core::TensorShape 35
athena::backend::VirtualMemory 36
athena::backend::VMemoryBlock 37

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

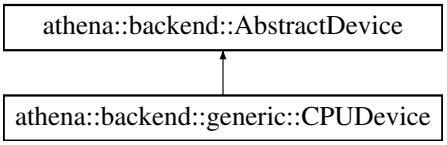
athena::backend::AbstractDevice 5
athena::backend::AbstractExecutor 5
athena::core::loss::AbstractLossFunction 6
athena::backend::AbstractMemoryManager 6
athena::core::optimizers::AbstractOptimizer 9
athena::core::kernels::AddOpKernel 10
athena::backend::generic::CPUDevice 12
athena::backend::generic::GenericExecutor 12
athena::backend::generic::GenericMemoryManager 13
athena::core::optimizers::GradientDescent 16
athena::core::InputNode 17
athena::core::kernels::MatMulOpKernel 19
athena::backend::generic::MemoryChunk 21
athena::core::loss::MSELoss 22
athena::core::loss::MSEOpKernel 22
athena::core::Node 24
athena::core::OpKernel 25
athena::backend::generic::QueueItem 28
athena::core::kernels::ScaleOpKernel 28
athena::core::Session 31
athena::core::optimizers::SGDOptimizer 32
athena::core::kernels::SigmoidOpKernel 32
athena::backend::generic::SwapRecord 34
athena::core::Tensor 35
athena::core::TensorShape 35
athena::backend::VirtualMemory 36
athena::backend::VMemoryBlock 37

Chapter 3

Class Documentation

3.1 athena::backend::AbstractDevice Class Reference

Inheritance diagram for athena::backend::AbstractDevice:



Public Member Functions

- unsigned long **getMaxThreadMemSize** ()
- void **setMaxThreadMemSize** (unsigned long size=0)
- virtual AbstractMemoryManager * **getMemoryManager** ()=0

Protected Attributes

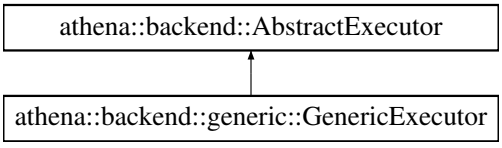
- unsigned long **maxThreadMemorySize**
- unsigned long **maxThreads**
- unsigned long **memorySize**

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

- backend/AbstractDevice.h
- backend/AbstractDevice.cpp

3.2 athena::backend::AbstractExecutor Class Reference

Inheritance diagram for athena::backend::AbstractExecutor:



Public Member Functions

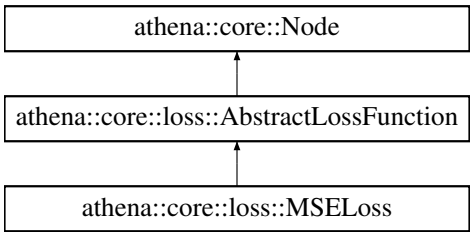
- virtual void **execute** ()=0
- virtual AbstractMemoryManager * **getMemoryManager** ()=0

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

- backend/AbstractExecutor.h

3.3 athena::core::loss::AbstractLossFunction Class Reference

Inheritance diagram for athena::core::loss::AbstractLossFunction:



Public Member Functions

- **AbstractLossFunction** (OpKernel *)

Additional Inherited Members

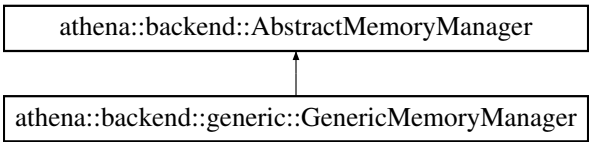
The documentation for this class was generated from the following files:

- core/loss/AbstractLossFunction.h
- core/loss/AbstractLossFunction.cpp

3.4 athena::backend::AbstractMemoryManager Class Reference

`#include <AbstractMemoryManager.h>`

Inheritance diagram for athena::backend::AbstractMemoryManager:



Public Member Functions

- void resetTable ()
- void addTensor (athena::core::Tensor *tensor)
- virtual void * getPhysicalAddress (vm_word virtualAddress)=0
- void **load** (athena::core::Tensor *tensor)
- void **load** (vm_word address)
- virtual void load (vm_word address, unsigned long length)=0
- virtual void unlock (vm_word address)=0
- virtual void deleteFromMem (vm_word address)=0
- athena::core::Tensor * **getTensor** (vm_word address)

Protected Attributes

- std::list< athena::core::Tensor *> **tensors**

3.4.1 Detailed Description

This class is an interface for physical memory managers. They provide conversion between virtual addresses and physical ones. A typical strategy for memory manager is to allocate as much memory as possible and then provide tensors with it. This class also encapsulates table of athena::core::Tensor objects. One can think of it as of variables table in a compiler.

3.4.2 Member Function Documentation

3.4.2.1 addTensor()

```
void athena::backend::AbstractMemoryManager::addTensor (
            athena::core::Tensor * tensor )
```

Adds Tensor to table

Parameters

tensor	Tensor, that will be added

3.4.2.2 deleteFromMem()

```
virtual void athena::backend::AbstractMemoryManager::deleteFromMem (
            vm_word address )  [pure virtual]
```

Mark corresponding memory chunk as free

Parameters

address	Virtual address

Implemented in athena::backend::generic::GenericMemoryManager.

3.4.2.3 getPhysicalAddress()

```
virtual void* athena::backend::AbstractMemoryManager::getPhysicalAddress (
            vm_word virtualAddress )  [pure virtual]
```

Convert virtual address to physical one

Parameters

virtualAddress	Virtual address, unsigned long from 0 to 2^64-1

Returns

Pointer to physical memory

Implemented in athena::backend::generic::GenericMemoryManager.

3.4.2.4 load()

```
virtual void athena::backend::AbstractMemoryManager::load (
            vm_word address,
            unsigned long length )  [pure virtual]
```

Move data to the fastest memory type available (e.g. from hard drive to RAM) and lock it (prevent from being offloaded)

Parameters

address	Virtual address
length	Size of Tensor in bytes

Implemented in athena::backend::generic::GenericMemoryManager.

3.4.2.5 resetTable()

```
void athena::backend::AbstractMemoryManager::resetTable ( )
```

Clears table of Tensors

3.4.2.6 unlock()

```
virtual void athena::backend::AbstractMemoryManager::unlock (
            vm_word address )  [pure virtual]
```

Lets data be offloaded to a slower memory type (e.g. from RAM to HDD)

Parameters

address	Virtual address

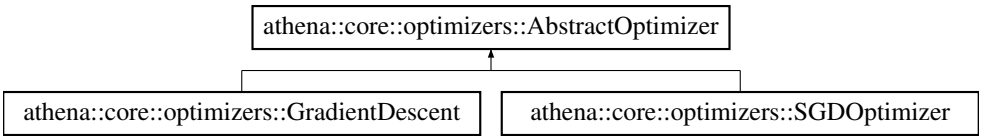
Implemented in athena::backend::generic::GenericMemoryManager.

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

- backend/AbstractMemoryManager.h
- backend/AbstractMemoryManager.cpp

3.5 athena::core::optimizers::AbstractOptimizer Class Reference

Inheritance diagram for athena::core::optimizers::AbstractOptimizer:



Public Member Functions

- **AbstractOptimizer** (athena::core::loss::AbstractLossFunction *loss)
- void **init** (Session *session)
- virtual void **prepare** ()=0
- virtual void **minimize** ()=0

Protected Attributes

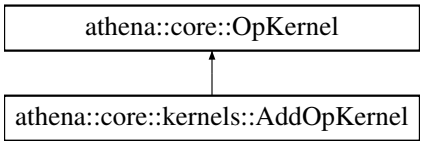
- std::vector< InputNode *> **headNodes**
- std::vector< vm_word > **bytecode**
- unsigned long **lastResultCell**
- Session * **session**
- athena::core::loss::AbstractLossFunction * **loss**

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

- core/optimizers/AbstractOptimizer.h
- core/optimizers/AbstractOptimizer.cpp

3.6 athena::core::kernels::AddOpKernel Class Reference

Inheritance diagram for athena::core::kernels::AddOpKernel:



Public Member Functions

- int getOperandsCount () override
- athena::core::TensorShape & getOutputShape (const std::vector< athena::core::TensorShape & > &shapes) override
- athena::core::TensorShape & getDerivativeShape (int d, const std::vector< athena::core::TensorShape & > &shapes) override
- std::vector< vm_word > **getOpBytecode** (std::vector< vm_word > args, vm_word resultCell) override
- std::vector< vm_word > getDerivativeBytecode (int d, std::vector< vm_word > args, vm_word resultCell) override

Additional Inherited Members

3.6.1 Member Function Documentation

3.6.1.1 getDerivativeBytecode()

```
std::vector< unsigned long > athena::core::kernels::AddOpKernel::getDerivativeBytecode (
            int d,
            std::vector< vm_word > args,
            vm_word resultCell )  [override], [virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implements athena::core::OpKernel.

3.6.1.2 getDerivativeShape()

```
athena::core::TensorShape & athena::core::kernels::AddOpKernel::getDerivativeShape (
            int d,
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

3.6.1.3 getOperandsCount()

```
int athena::core::kernels::AddOpKernel::getOperandsCount ( )  [override], [virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implements athena::core::OpKernel.

3.6.1.4 getOutputShape()

```
athena::core::TensorShape & athena::core::kernels::AddOpKernel::getOutputShape (
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

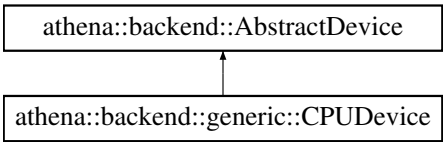
The documentation for this class was generated from the following files:

- core/kernels/AddOpKernel.h
- core/kernels/AddOpKernel.cpp

3.7 athena::backend::generic::CPUDevice Class Reference

`#include <CPUDevice.h>`

Inheritance diagram for athena::backend::generic::CPUDevice:



Public Member Functions

- AbstractMemoryManager * **getMemoryManager** () override

Additional Inherited Members

3.7.1 Detailed Description

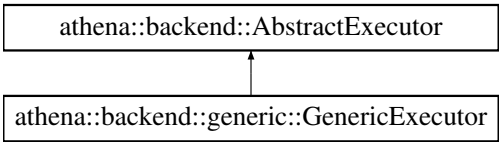
This class represents a CPU It encapsulates Memory Manager

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

- backend/generic/CPUDevice.h
- backend/generic/CPUDevice.cpp

3.8 athena::backend::generic::GenericExecutor Class Reference

Inheritance diagram for athena::backend::generic::GenericExecutor:



Public Member Functions

- **GenericExecutor** (std::vector< vm_word > &bytecode, unsigned long maxMem, CPUDevice *cpuDevice)
- void **execute** () override
- AbstractMemoryManager * **getMemoryManager** () override

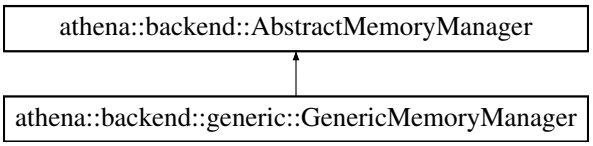
The documentation for this class was generated from the following files:

- backend/generic/GenericExecutor.h
- backend/generic/GenericExecutor.cpp

3.9 athena::backend::generic::GenericMemoryManager Class Reference

`#include <GenericMemoryManager.h>`

Inheritance diagram for athena::backend::generic::GenericMemoryManager:



Public Member Functions

- void init ()
- void deinit ()
- void * getPhysicalAddress (vm_word virtualAddress) override
- void load (vm_word address, unsigned long length) override
- void unlock (vm_word address) override
- void deleteFromMem (vm_word address) override
- void **setMemSize** (size_t memSize)
- void **load** (athena::core::Tensor *tensor)
- void **load** (vm_word address)
- virtual void load (vm_word address, unsigned long length)=0

Protected Member Functions

- void processQueue (int laneId)

Protected Attributes

- std::list< SwapRecord *> **swapRecords**
- MemoryChunk * **memoryChunksHead**
- void * **memory**
- std::unique_lock< std::mutex > **memoryChunksLock**
- std::list< std::thread > **memLanes**
- size_t **allocatedMemory**
- std::queue< QueueItem *> **loadQueue**
- std::vector< bool > **laneFinished**

3.9.1 Detailed Description

This class implements AbstractMemoryManager interface for GenericExecutor. It pre-allocates RAM and uses persistent memory for swap. There are couple memory lanes - threads, that manage RAM. They monitor load↩ Queue for new queries and move data from hard drive to RAM if needed.

3.9.2 Member Function Documentation

3.9.2.1 deinit()

```
void athena::backend::generic::GenericMemoryManager::deinit ( )
```

Free RAM and stop all threads-memory lanes

3.9.2.2 deleteFromMem()

```
void athena::backend::generic::GenericMemoryManager::deleteFromMem (
            vm_word address )  [override], [virtual]
```

Mark corresponding memory chunk as free

Parameters

address	Virtual address

Implements athena::backend::AbstractMemoryManager.

3.9.2.3 getPhysicalAddress()

```
void * athena::backend::generic::GenericMemoryManager::getPhysicalAddress (
            vm_word virtualAddress )  [override], [virtual]
```

Convert virtual address to physical one

Parameters

virtualAddress	Virtual address, unsigned long from 0 to 2^64-1

Returns

Pointer to physical memory

Implements athena::backend::AbstractMemoryManager.

3.9.2.4 init()

```
void athena::backend::generic::GenericMemoryManager::init ( )
```

Initialize memory manager. That's where actual memory allocation happens. All configurations should be done before this method is called.

3.9.2.5 load() [1/2]

```
void athena::backend::generic::GenericMemoryManager::load (
            vm_word address,
            unsigned long length )  [override], [virtual]
```

Move data to the fastest memory type available (e.g. from hard drive to RAM) and lock it (prevent from being offloaded)

Parameters

address	Virtual address
length	Size of Tensor in bytes

Implements athena::backend::AbstractMemoryManager.

3.9.2.6 load() [2/2]

```
virtual void athena::backend::AbstractMemoryManager::load
```

Move data to the fastest memory type available (e.g. from hard drive to RAM) and lock it (prevent from being offloaded)

Parameters

address	Virtual address
length	Size of Tensor in bytes

3.9.2.7 processQueue()

```
void athena::backend::generic::GenericMemoryManager::processQueue (
            int laneId )  [protected]
```

This is a thread function for memory lane-threads. It loads data to RAM and notifies corresponding threads

Parameters

laneId	

3.9.2.8 unlock()

```
void athena::backend::generic::GenericMemoryManager::unlock (
            vm_word address )  [override], [virtual]
```

Lets data be offloaded to a slower memory type (e.g. from RAM to HDD)

Parameters

address	Virtual address

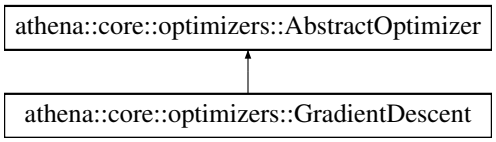
Implements athena::backend::AbstractMemoryManager.

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

- backend/generic/GenericMemoryManager.h
- backend/generic/GenericMemoryManager.cpp

3.10 athena::core::optimizers::GradientDescent Class Reference

Inheritance diagram for athena::core::optimizers::GradientDescent:



Public Member Functions

- **GradientDescent** (athena::core::loss::AbstractLossFunction *loss, float learningRate)
- void **prepare** () override
- void **minimize** () override

Protected Member Functions

- std::tuple< std::vector< unsigned long >, unsigned long > **getByteCode** (athena::core::loss::AbstractLossFunction *node)

Protected Attributes

- float **learningRate**

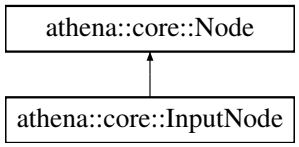
The documentation for this class was generated from the following files:

- core/optimizers/GradientDescent.h
- core/optimizers/GradientDescent.cpp

3.11 athena::core::InputNode Class Reference

`#include <InputNode.h>`

Inheritance diagram for athena::core::InputNode:



Public Member Functions

- **InputNode** (Tensor *input, bool isFrozen=true)
- bool isInputNode () override
- void setMappedMemCell (unsigned long cell)
- unsigned long getMappedMemCell ()
- void after (Node *) override
- Tensor * getData ()
- bool isFrozen ()
- void setFrozen (bool frozen)

Additional Inherited Members

3.11.1 Detailed Description

Subclass of athena::core::Node Represents a node that has no predecessors

3.11.2 Member Function Documentation

3.11.2.1 after()

```
void athena::core::InputNode::after (
            Node *  )  [inline], [override], [virtual]
```

InputNodes can't be placed after other nodes in Athena's execution graph. This method does nothing

Reimplemented from athena::core::Node.

3.11.2.2 getData()

```
athena::core::Tensor * athena::core::InputNode::getData ( )
```

Get data associated with this InputNode

Returns

Pointer to Tensor

3.11.2.3 getMappedMemCell()

```
unsigned long athena::core::InputNode::getMappedMemCell ( )
```

Get the number of memory cell that is used to store tensor for this node

Returns

Memory cell number

3.11.2.4 isFrozen()

```
bool athena::core::InputNode::isFrozen ( )
```

InputNodes can be frozen. This means their tensors won't be changed during back propagation process (e.g. InputNode contains your input data). By default new InputNodes are frozen.

Returns

Current freeze state

3.11.2.5 isInputNode()

```
bool athena::core::InputNode::isInputNode ( )  [override], [virtual]
```

Check if it is an input node

Returns

true

Reimplemented from athena::core::Node.

3.11.2.6 setFrozen()

```
void athena::core::InputNode::setFrozen (
            bool frozen )
```

InputNodes can be frozen. This means their tensors won't be changed during back propagation process (e.g. InputNode contains your input data). By default new InputNodes are frozen.

Parameters

frozen	True - freeze node, False - unfreeze node (make it variable)

3.11.2.7 setMappedMemCell()

```
void athena::core::InputNode::setMappedMemCell (
            unsigned long cell )
```

Specify which memory cell will be used to store tensor for this node

Parameters

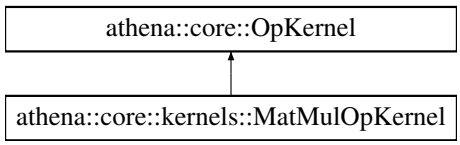
cell	Memory cell number

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

- core/InputNode.h
- core/InputNode.cpp

3.12 athena::core::kernels::MatMulOpKernel Class Reference

Inheritance diagram for athena::core::kernels::MatMulOpKernel:



Public Member Functions

- int getOperandsCount () override
- athena::core::TensorShape & getOutputShape (const std::vector< athena::core::TensorShape & > &shapes) override
- athena::core::TensorShape & getDerivativeShape (int d, const std::vector< athena::core::TensorShape & > &shapes) override
- std::vector< vm_word > **getOpBytecode** (std::vector< vm_word > args, vm_word resultCell) override
- std::vector< vm_word > getDerivativeBytecode (int d, std::vector< vm_word > args, vm_word resultCell) override

Additional Inherited Members

3.12.1 Member Function Documentation

3.12.1.1 getDerivativeBytecode()

```
std::vector< vm_word > athena::core::kernels::MatMulOpKernel::getDerivativeBytecode (
            int d,
            std::vector< vm_word > args,
            vm_word resultCell )  [override], [virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implements athena::core::OpKernel.

3.12.1.2 getDerivativeShape()

```
athena::core::TensorShape & athena::core::kernels::MatMulOpKernel::getDerivativeShape (
            int d,
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

3.12.1.3 getOperandsCount()

```
int athena::core::kernels::MatMulOpKernel::getOperandsCount ( )  [override], [virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implements athena::core::OpKernel.

3.12.1.4 getOutputShape()

```
athena::core::TensorShape & athena::core::kernels::MatMulOpKernel::getOutputShape (
            const std::vector< athena::core::TensorShape & > & shapes ) [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

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

- core/kernels/MatMulOpKernel.h
- core/kernels/MatMulOpKernel.cpp

3.13 athena::backend::generic::MemoryChunk Struct Reference

```
#include <GenericMemoryManager.h>
```

Public Attributes

- vm_word **virtualAddress**
- void * **begin**
- size_t **length**
- bool **isFree**
- bool **isLocked**
- MemoryChunk * **next**
- MemoryChunk * **prev**

3.13.1 Detailed Description

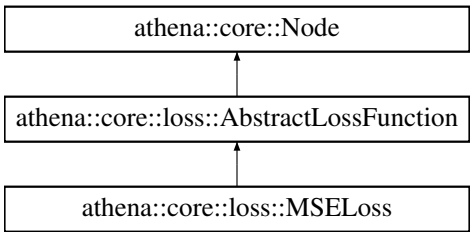
Describes single memory chunk that is allocated in RAM. Free status means there is no data in this chunk Locked status means this chunk is being used now and can't be unload to persistent memory.

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

- backend/generic/GenericMemoryManager.h

3.14 athena::core::loss::MSELoss Class Reference

Inheritance diagram for athena::core::loss::MSELoss:



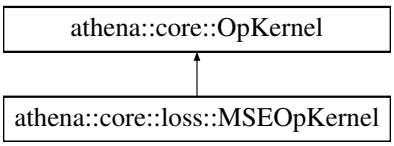
Additional Inherited Members

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

- core/loss/MSELoss.h
- core/loss/MSELoss.cpp

3.15 athena::core::loss::MSEOpKernel Class Reference

Inheritance diagram for athena::core::loss::MSEOpKernel:



Public Member Functions

- int getOperandsCount () override
- athena::core::TensorShape **getOutputShape** (athena::core::TensorShape ∗shapes, unsigned long) override
- std::vector< unsigned long > **getOpBytecode** (std::vector< unsigned long > args, unsigned long resultCell) override
- std::vector< unsigned long > getDerivativeBytecode (int d, std::vector< unsigned long > args, unsigned long resultCell) override

Additional Inherited Members

3.15.1 Member Function Documentation

3.15.1.1 getDerivativeBytecode()

```
std::vector< unsigned long > athena::core::loss::MSEOpKernel::getDerivativeBytecode (
            int d,
            std::vector< unsigned long > args,
            unsigned long resultCell )  [override], [virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implements athena::core::OpKernel.

3.15.1.2 getOperandsCount()

```
int athena::core::loss::MSEOpKernel::getOperandsCount ( )  [override], [virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implements athena::core::OpKernel.

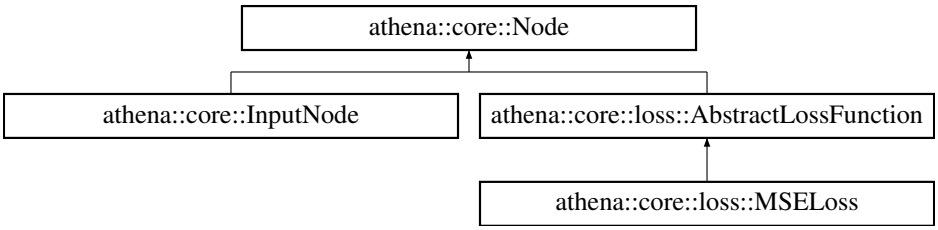
The documentation for this class was generated from the following files:

- core/loss/MSELoss.h
- core/loss/MSELoss.cpp

3.16 athena::core::Node Class Reference

`#include <Node.h>`

Inheritance diagram for athena::core::Node:



Public Member Functions

- **Node** (OpKernel ∗)
- virtual void after (Node ∗predecessor)
- virtual bool isInputNode ()
- OpKernel ∗ **getOp** ()
- std::vector< Node ∗> & **getIncomingNodes** ()
- std::string **getName** ()
- void **addDerivative** (unsigned long d)
- unsigned long **getDerivative** (int i)
- void **setCalculated** (unsigned long resCell)
- bool **isCalculated** ()
- unsigned long **getResult** ()
- void **updateUsageCount** ()
- bool **isGarbage** ()

Protected Member Functions

- std::string **getRandomNodeName** ()

Protected Attributes

- std::vector< Node ∗> **incomingNodes**
- std::vector< Node ∗> **outcomingNodes**
- OpKernel ∗ **operation**
- std::string **name**
- bool **calculated**
- std::vector< vm_word > **derivatives**
- unsigned long **resultCell**
- unsigned long **usageCount**
- bool **derivativeMark**

3.16.1 Detailed Description

A basic element of execution graph Each node has pointers to its predecessors and successors. It encapsulates operation and data.

3.16.2 Member Function Documentation

3.16.2.1 after()

```
void athena::core::Node::after (
            Node * predecessor )  [virtual]
```

Makes a new oriented edge in execution graph from predecessor to this node

Parameters

predecessor	A predecessor node

Reimplemented in athena::core::InputNode.

3.16.2.2 isInputNode()

```
bool athena::core::Node::isInputNode ( )  [virtual]
```

Check if it is an input node

Returns

false

Reimplemented in athena::core::InputNode.

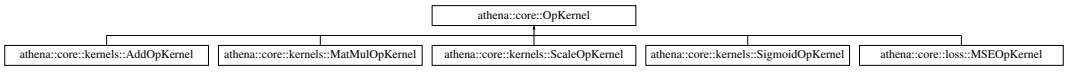
The documentation for this class was generated from the following files:

- core/Node.h
- core/Node.cpp

3.17 athena::core::OpKernel Class Reference

```
#include <OpKernel.h>
```

Inheritance diagram for athena::core::OpKernel:



Public Member Functions

- **OpKernel** (OpCode opCode, std::string name)
- virtual int getOperandsCount ()=0
- virtual athena::core::TensorShape & getOutputShape (const std::vector< athena::core::TensorShape & > &shapes)=0
- virtual athena::core::TensorShape & getDerivativeShape (int d, const std::vector< athena::core::TensorShape & > &shapes)=0
- virtual std::vector< vm_word > **getOpBytecode** (std::vector< vm_word > args, vm_word resultCell)=0
- virtual std::vector< vm_word > getDerivativeBytecode (int d, std::vector< vm_word > args, vm_word resultCell)=0

Protected Attributes

- OpCode **opCode**
- std::string **name**

3.17.1 Detailed Description

Operation skeleton Each operation has OpCode

3.17.2 Member Function Documentation

3.17.2.1 getDerivativeBytecode()

```
virtual std::vector< vm_word > athena::core::OpKernel::getDerivativeBytecode (
            int d,
            std::vector< vm_word > args,
            vm_word resultCell )  [pure virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implemented in athena::core::kernels::SigmoidOpKernel, athena::core::loss::MSEOpKernel, athena::core::kernels::MatMulOpKernel, athena::core::kernels::AddOpKernel, and athena::core::kernels::ScaleOpKernel.

3.17.2.2 getDerivativeShape()

```
virtual athena::core::TensorShape& athena::core::OpKernel::getDerivativeShape (
            int d,
            const std::vector< athena::core::TensorShape & > & shapes )  [pure virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implemented in athena::core::kernels::SigmoidOpKernel, athena::core::kernels::MatMulOpKernel, athena::core::kernels::AddOpKerne and athena::core::kernels::ScaleOpKernel.

3.17.2.3 getOperandsCount()

```
virtual int athena::core::OpKernel::getOperandsCount ( )  [pure virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implemented in athena::core::kernels::SigmoidOpKernel, athena::core::loss::MSEOpKernel, athena::core::kernels::MatMulOpKernel, athena::core::kernels::AddOpKernel, and athena::core::kernels::ScaleOpKernel.

3.17.2.4 getOutputShape()

```
virtual athena::core::TensorShape& athena::core::OpKernel::getOutputShape (
            const std::vector< athena::core::TensorShape & > & shapes )  [pure virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implemented in athena::core::kernels::SigmoidOpKernel, athena::core::kernels::MatMulOpKernel, athena::core::kernels::AddOpKerne
and athena::core::kernels::ScaleOpKernel.

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

- core/OpKernel.h

3.18 athena::backend::generic::QueueItem Struct Reference

`#include <GenericMemoryManager.h>`

Public Attributes

- vm_word **address**
- size_t **length**
- bool **alloc** = false
- std::condition_variable **loadHandle**
- std::unique_lock< std::mutex > **m**
- bool **notified** = false

3.18.1 Detailed Description

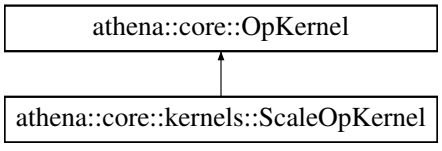
Describes which Tensors should be loaded to RAM Alloc flag means we should not search for data in Swap

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

- backend/generic/GenericMemoryManager.h

3.19 athena::core::kernels::ScaleOpKernel Class Reference

Inheritance diagram for athena::core::kernels::ScaleOpKernel:



Public Member Functions

- int getOperandsCount () override
- athena::core::TensorShape & getOutputShape (const std::vector< athena::core::TensorShape & > &shapes) override
- athena::core::TensorShape & getDerivativeShape (int d, const std::vector< athena::core::TensorShape & > &shapes) override
- std::vector< vm_word > **getOpBytecode** (std::vector< vm_word > args, vm_word resultCell) override
- std::vector< vm_word > getDerivativeBytecode (int d, std::vector< vm_word > args, vm_word resultCell) override

Additional Inherited Members

3.19.1 Member Function Documentation

3.19.1.1 getDerivativeBytecode()

```
std::vector< vm_word > athena::core::kernels::ScaleOpKernel::getDerivativeBytecode (
            int d,
            std::vector< vm_word > args,
            vm_word resultCell )  [override], [virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implements athena::core::OpKernel.

3.19.1.2 getDerivativeShape()

```
athena::core::TensorShape & athena::core::kernels::ScaleOpKernel::getDerivativeShape (
            int d,
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

3.19.1.3 getOperandsCount()

```
int athena::core::kernels::ScaleOpKernel::getOperandsCount ( )  [override], [virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implements athena::core::OpKernel.

3.19.1.4 getOutputShape()

```
athena::core::TensorShape & athena::core::kernels::ScaleOpKernel::getOutputShape (
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

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

- core/kernels/ScaleOpKernel.h
- core/kernels/ScaleOpKernel.cpp

3.20 athena::core::Session Class Reference

`#include <Session.h>`

Public Member Functions

- void prepare (Node *logits)
- Tensor * run ()
- unsigned long **getResultCell** ()
- void **setExecutor** (athena::backend::AbstractExecutor *exec)

3.20.1 Detailed Description

The class encapsulates everything needed for a single training step

3.20.2 Member Function Documentation

3.20.2.1 prepare()

```
void athena::core::Session::prepare (
            Node * logits )
```

Generates bytecode for the whole graph

Parameters

logits	

3.20.2.2 run()

```
athena::core::Tensor * athena::core::Session::run ( )
```

does single training step

Returns

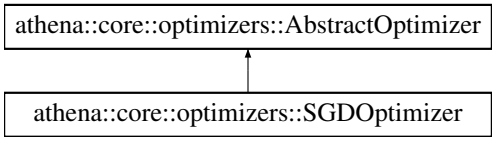
result tensor

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

- core/Session.h
- core/Session.cpp

3.21 athena::core::optimizers::SGDOptimizer Class Reference

Inheritance diagram for athena::core::optimizers::SGDOptimizer:



Public Member Functions

- **SGDOptimizer** (athena::core::loss::AbstractLossFunction *logits)

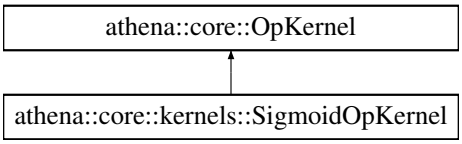
Additional Inherited Members

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

- core/optimizers/SGDOptimizer.h

3.22 athena::core::kernels::SigmoidOpKernel Class Reference

Inheritance diagram for athena::core::kernels::SigmoidOpKernel:



Public Member Functions

- int getOperandsCount () override
- athena::core::TensorShape & getOutputShape (const std::vector< athena::core::TensorShape & > &shapes) override
- athena::core::TensorShape & getDerivativeShape (int d, const std::vector< athena::core::TensorShape & > &shapes) override
- std::vector< vm_word > **getOpBytecode** (std::vector< vm_word > args, vm_word resultCell) override
- std::vector< vm_word > getDerivativeBytecode (int d, std::vector< vm_word > args, vm_word resultCell) override

Additional Inherited Members

3.22.1 Member Function Documentation

3.22.1.1 getDerivativeBytecode()

```
std::vector< vm_word > athena::core::kernels::SigmoidOpKernel::getDerivativeBytecode (
            int d,
            std::vector< vm_word > args,
            vm_word resultCell )  [override], [virtual]
```

Generates bytecode to calculate partial derivative

Parameters

d	Number of variable with respect to which derivative is calculated
args	Function arguments
resultCell	Number of memory cell where results are saved

Returns

Implements athena::core::OpKernel.

3.22.1.2 getDerivativeShape()

```
athena::core::TensorShape & athena::core::kernels::SigmoidOpKernel::getDerivativeShape (
            int d,
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

3.22.1.3 getOperandsCount()

```
int athena::core::kernels::SigmoidOpKernel::getOperandsCount ( )  [override], [virtual]
```

There can be unary, binary and other operations

Returns

Number of operands accepted

Implements athena::core::OpKernel.

3.22.1.4 getOutputShape()

```
athena::core::TensorShape & athena::core::kernels::SigmoidOpKernel::getOutputShape (
            const std::vector< athena::core::TensorShape & > & shapes )  [override], [virtual]
```

It is important for some operations to have certain size of their operands

Parameters

shape	Original operand shape
dim	Dimensionality

Returns

New shape

Implements athena::core::OpKernel.

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

- core/kernels/SigmoidOpKernel.h
- core/kernels/SigmoidOpKernel.cpp

3.23 athena::backend::generic::SwapRecord Struct Reference

```
#include <GenericMemoryManager.h>
```

Public Attributes

- vm_word **address**
- size_t **length**
- std::string **filename**

3.23.1 Detailed Description

Describes single swap record - a file, that stores Tensor data

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

- backend/generic/GenericMemoryManager.h

3.24 athena::core::Tensor Class Reference

`#include <Tensor.h>`

Public Member Functions

- **Tensor** (const TensorShape &shape, DataType dataType)
- const TensorShape & **getShape** () const
- DataType **getType** () const
- vm_word **getStartAddress** ()
- void **setStartAddress** (vm_word address)
- Tensor & **operator[ ]** (unsigned int idx)

3.24.1 Detailed Description

In mathematics **tensor** is an abstract object, expressing some definite type of multi-linear concept. See Wikipedia for more info.

In Athena Tensor is an abstraction to represent data inside computational graph. A 1-dimensional Tensor is either scalar or vector. A 2-dimensional Tensor is a matrix.

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

- core/Tensor.h
- core/Tensor.cpp

3.25 athena::core::TensorShape Class Reference

Public Member Functions

- **TensorShape** (std::vector< size_t > shape)
- **TensorShape** (unsigned long *shape, unsigned long length)
- **TensorShape** (const TensorShape &)
- TensorShape & **operator=** (const TensorShape &)
- unsigned long **dimensions** () const
- unsigned long **dim** (unsigned long n) const
- unsigned long **totalSize** () const
- const std::vector< unsigned long > & **getShape** () const
- bool **operator==** (const TensorShape &) const
- bool **operator!=** (const TensorShape &rhs) const

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

- core/TensorShape.h
- core/TensorShape.cpp

3.26 athena::backend::VirtualMemory Class Reference

`#include <VirtualMemory.h>`

Public Member Functions

- vm_word allocate (athena::core::Tensor *tensor)
- void free (athena::core::Tensor *tensor)
- void free (vm_word virtualAddress)

3.26.1 Detailed Description

Virtual memory is an abstraction of storage resources that are actually available on a given machine. Each thread has its own address space. In Athena's VM address space is linear. This means that valid addresses are 0 to 2^64 - 1. Address 0 is reserved for NULL value. When Tensor is initialized, it is given with a continuous block of virtual addresses. When one actually needs to access Tensor's data, Memory Manager allocates physical memory and converts virtual addresses to physical ones. This helps Athena to run in low-memory conditions. This class is heavily used in Session class to generate bytecode.
To discover more about Virtual Memory see article on Wikipedia

3.26.2 Member Function Documentation

3.26.2.1 allocate()

```
vm_word athena::backend::VirtualMemory::allocate (
            athena::core::Tensor * tensor )
```

Allocates virtual memory for given Tensor

Parameters

tensor	Tensor object

Returns

Virtual Address of 0 element of Tensor

3.26.2.2 free() [1/2]

```
void athena::backend::VirtualMemory::free (
            athena::core::Tensor * tensor )
```

Marks memory as free

Parameters

tensor	Corresponding tensor

3.26.2.3 free() [2/2]

```
void athena::backend::VirtualMemory::free (
            vm_word virtualAddress )
```

Marks memory as free

Parameters

virtualAddress	

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

- backend/VirtualMemory.h
- backend/VirtualMemory.cpp

3.27 athena::backend::VMemoryBlock Struct Reference

Public Attributes

- bool **isUsed**
- vm_word **startAddress**
- vm_word **endAddress**
- VMemoryBlock * **nextBlock**
- VMemoryBlock * **prevBlock**

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

- backend/VirtualMemory.h

Index

addTensor
    athena::backend::AbstractMemoryManager, 7
after
    athena::core::InputNode, 17
    athena::core::Node, 25
allocate
    athena::backend::VirtualMemory, 36
athena::backend::AbstractDevice, 5
athena::backend::AbstractExecutor, 5
athena::backend::AbstractMemoryManager, 6
    addTensor, 7
    deleteFromMem, 7
    getPhysicalAddress, 8
    load, 8
    resetTable, 8
    unlock, 8
athena::backend::VMemoryBlock, 37
athena::backend::VirtualMemory, 36
    allocate, 36
    free, 36, 37
athena::backend::generic::CPUDevice, 12
athena::backend::generic::GenericExecutor, 12
athena::backend::generic::GenericMemoryManager, 13
    deinit, 14
    deleteFromMem, 14
    getPhysicalAddress, 14
    init, 14
    load, 15
    processQueue, 15
    unlock, 16
athena::backend::generic::MemoryChunk, 21
athena::backend::generic::QueueItem, 28
athena::backend::generic::SwapRecord, 34
athena::core::InputNode, 17
    after, 17
    getData, 17
    getMappedMemCell, 18
    isFrozen, 18
    isInputNode, 18
    setFrozen, 18
    setMappedMemCell, 19
athena::core::Node, 24
    after, 25
    isInputNode, 25
athena::core::OpKernel, 25
    getDerivativeBytecode, 26
    getDerivativeShape, 26
    getOperandsCount, 27
    getOutputShape, 27
athena::core::Session, 31
    prepare, 31
    run, 31
athena::core::Tensor, 35
athena::core::TensorShape, 35
athena::core::kernels::AddOpKernel, 10
    getDerivativeBytecode, 10
    getDerivativeShape, 10
    getOperandsCount, 11
    getOutputShape, 11
athena::core::kernels::MatMulOpKernel, 19
    getDerivativeBytecode, 19
    getDerivativeShape, 20
    getOperandsCount, 20
    getOutputShape, 21
athena::core::kernels::ScaleOpKernel, 28
    getDerivativeBytecode, 29
    getDerivativeShape, 29
    getOperandsCount, 30
    getOutputShape, 30
athena::core::kernels::SigmoidOpKernel, 32
    getDerivativeBytecode, 32
    getDerivativeShape, 33
    getOperandsCount, 33
    getOutputShape, 34
athena::core::loss::AbstractLossFunction, 6
athena::core::loss::MSELoss, 22
athena::core::loss::MSEOpKernel, 22
    getDerivativeBytecode, 23
    getOperandsCount, 23
athena::core::optimizers::AbstractOptimizer, 9
athena::core::optimizers::GradientDescent, 16
athena::core::optimizers::SGDOptimizer, 32

deinit
    athena::backend::generic::GenericMemory↩
        Manager, 14
deleteFromMem
    athena::backend::AbstractMemoryManager, 7
    athena::backend::generic::GenericMemory↩
        Manager, 14

free
    athena::backend::VirtualMemory, 36, 37

getData
    athena::core::InputNode, 17
getDerivativeBytecode
    athena::core::OpKernel, 26
    athena::core::kernels::AddOpKernel, 10

athena::core::kernels::MatMulOpKernel, 19
athena::core::kernels::ScaleOpKernel, 29
athena::core::kernels::SigmoidOpKernel, 32
athena::core::loss::MSEOpKernel, 23
getDerivativeShape
athena::core::OpKernel, 26
athena::core::kernels::AddOpKernel, 10
athena::core::kernels::MatMulOpKernel, 20
athena::core::kernels::ScaleOpKernel, 29
athena::core::kernels::SigmoidOpKernel, 33
getMappedMemCell
athena::core::InputNode, 18
getOperandsCount
athena::core::OpKernel, 27
athena::core::kernels::AddOpKernel, 11
athena::core::kernels::MatMulOpKernel, 20
athena::core::kernels::ScaleOpKernel, 30
athena::core::kernels::SigmoidOpKernel, 33
athena::core::loss::MSEOpKernel, 23
getOutputShape
athena::core::OpKernel, 27
athena::core::kernels::AddOpKernel, 11
athena::core::kernels::MatMulOpKernel, 21
athena::core::kernels::ScaleOpKernel, 30
athena::core::kernels::SigmoidOpKernel, 34
getPhysicalAddress
athena::backend::AbstractMemoryManager, 8
athena::backend::generic::GenericMemory↩
Manager, 14

init
athena::backend::generic::GenericMemory↩
Manager, 14
isFrozen
athena::core::InputNode, 18
isInputNode
athena::core::InputNode, 18
athena::core::Node, 25

load
athena::backend::AbstractMemoryManager, 8
athena::backend::generic::GenericMemory↩
Manager, 15

prepare
athena::core::Session, 31
processQueue
athena::backend::generic::GenericMemory↩
Manager, 15

resetTable
athena::backend::AbstractMemoryManager, 8
run
athena::core::Session, 31

setFrozen
athena::core::InputNode, 18
setMappedMemCell
athena::core::InputNode, 19

unlock
athena::backend::AbstractMemoryManager, 8
athena::backend::generic::GenericMemory↩
Manager, 16