

# Package ‘mxnet’

March 30, 2020

**Type** Package

**Title** MXNet: A Flexible and Efficient Machine Learning Library for Heterogeneous Distributed Systems

**Version** 2.0.0

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**Repository** apache/incubator-mxnet

**Description** MXNet is a deep learning framework designed for both efficiency and flexibility. It allows you to mix the flavours of deep learning programs together to maximize the efficiency and your productivity.

**License** Apache License (== 2.0)

**URL** <https://github.com/apache/incubator-mxnet/tree/master/R-package>

**BugReports** <https://github.com/apache/incubator-mxnet/issues>

**Imports** methods,  
Rcpp (>= 0.12.1),  
DiagrammeR (>= 0.9.0),  
visNetwork (>= 1.0.3),  
data.table,  
jsonlite,  
magrittr,  
stringr

**Suggests** testthat,  
mlbench,  
knitr,  
rmarkdown,  
imager,  
covr

**Depends** R (>= 3.4.4)

**LinkingTo** Rcpp

**VignetteBuilder** knitr

**RoxygenNote** 7.1.0

**Encoding** UTF-8

## R topics documented:

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---

arguments	<i>Get the arguments of symbol.</i>
-----------	-------------------------------------

---

**Description**

Get the arguments of symbol.

**Usage**

arguments(x)

**Arguments**

x	The input symbol
---	------------------

---

as.array.MXNDArray	<i>as.array operator overload of mx.ndarray</i>
--------------------	---

---

**Description**

as.array operator overload of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'  
as.array(nd)
```

**Arguments**

nd                      The mx.ndarray

---

as.matrix.MXNDArray	<i>as.matrix operator overload of mx.ndarray</i>
---------------------	--

---

**Description**

as.matrix operator overload of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'  
as.matrix(nd)
```

**Arguments**

nd                      The mx.ndarray

---

children	<i>Gets a new grouped symbol whose output contains inputs to output nodes of the original symbol.</i>
----------	---

---

**Description**

Gets a new grouped symbol whose output contains inputs to output nodes of the original symbol.

**Usage**

```
children(x)
```

**Arguments**

x                      The input symbol



---

ctx	<i>Get the context of mx.ndarray</i>
-----	--------------------------------------

---

**Description**

Get the context of mx.ndarray

**Usage**

ctx(nd)

**Arguments**

nd                      The mx.ndarray

---

dim.MXNDArray	<i>Dimension operator overload of mx.ndarray</i>
---------------	--

---

**Description**

Dimension operator overload of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'  
dim(nd)
```

**Arguments**

nd                      The mx.ndarray

---

graph.viz	<i>Convert symbol to Graphviz or visNetwork visualisation.</i>
-----------	--

---

**Description**

Convert symbol to Graphviz or visNetwork visualisation.

**Usage**

```
graph.viz(
    symbol,
    shape = NULL,
    direction = "TD",
    type = "graph",
    graph.width.px = NULL,
    graph.height.px = NULL
)
```

**Arguments**

symbol	a string representing the symbol of a model.
shape	a numeric representing the input dimensions to the symbol.
direction	a string representing the direction of the graph, either TD or LR.
type	a string representing the rendering engine of the graph, either graph or vis.
graph.width.px	a numeric representing the size (width) of the graph. In pixels
graph.height.px	a numeric representing the size (height) of the graph. In pixels

**Value**

a graph object ready to be displayed with the print function.

---

im2rec	<i>Convert images into image recordio format</i>
--------	--

---

**Description**

Convert images into image recordio format

**Usage**

```
im2rec(
    image_lst,
    root,
    output_rec,
    label_width = 1L,
    pack_label = 0L,
    new_size = -1L,
    nsplit = 1L,
    partid = 0L,
    center_crop = 0L,
    quality = 95L,
    color_mode = 1L,
```

```

    unchanged = 0L,
    inter_method = 1L,
    encoding = ".jpg"
)

```

### Arguments

image_lst	The image lst file
root	The root folder for image files
output_rec	The output rec file
label_width	The label width in the list file. Default is 1.
pack_label	Whether to also pack multi dimensional label in the record file. Default is 0.
new_size	The shorter edge of image will be resized to the newsize. Original images will be packed by default.
nsplit	It is used for part generation, logically split the image.lst to NSPLIT parts by position. Default is 1.
partid	It is used for part generation, pack the images from the specific part in image.lst. Default is 0.
center_crop	Whether to crop the center image to make it square. Default is 0.
quality	JPEG quality for encoding (1-100, default: 95) or PNG compression for encoding (1-9, default: 3).
color_mode	Force color (1), gray image (0) or keep source unchanged (-1). Default is 1.
unchanged	Keep the original image encoding, size and color. If set to 1, it will ignore the others parameters.
inter_method	NN(0), BILINEAR(1), CUBIC(2), AREA(3), LANCZOS4(4), AUTO(9), RAND(10). Default is 1.
encoding	The encoding type for images. It can be '.jpg' or '.png'. Default is '.jpg'.

---

internals

---

*Get a symbol that contains all the internals*


---

### Description

Get a symbol that contains all the internals

### Usage

```
internals(x)
```

### Arguments

x	The input symbol
---	------------------

---

is.mx.context	<i>Check if the type is mxnet context.</i>
---------------	--

---

**Description**

Check if the type is mxnet context.

**Usage**

```
is.mx.context(x)
```

**Value**

Logical indicator

---

is.mx.dataiter	<i>Judge if an object is mx.dataiter</i>
----------------	--

---

**Description**

Judge if an object is mx.dataiter

**Usage**

```
is.mx.dataiter(x)
```

**Value**

Logical indicator

---

is.mx.ndarray	<i>Check if src.array is mx.ndarray</i>
---------------	---

---

**Description**

Check if src.array is mx.ndarray

**Usage**

```
is.mx.ndarray(src.array)
```

**Value**

Logical indicator

**Examples**

```
mat = mx.nd.array(1:10)
is.mx.ndarray(mat)
mat2 = 1:10
is.mx.ndarray(mat2)
```

---

`is.mx.symbol`*Judge if an object is mx.symbol*

---

**Description**

Judge if an object is mx.symbol

**Usage**

```
is.mx.symbol(x)
```

**Value**

Logical indicator

---

`is.serialized`*Check if the model has been serialized into RData-compatible format.*

---

**Description**

Check if the model has been serialized into RData-compatible format.

**Usage**

```
is.serialized(model)
```

**Value**

Logical indicator

---

length.MXNDArray	<i>Length operator overload of mx.ndarray</i>
------------------	---

---

**Description**

Length operator overload of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'  
length(nd)
```

**Arguments**

nd                      The mx.ndarray

---

mx.apply	<i>Apply symbol to the inputs.</i>
----------	------------------------------------

---

**Description**

Apply symbol to the inputs.

**Usage**

```
mx.apply(x, ...)
```

**Arguments**

x                      The symbol to be applied  
kwargs                The keyword arguments to the symbol

---

mx.callback.early.stop

*Early stop with different conditions*


---

### Description

Early stopping applying different conditions: hard thresholds or epochs number from the best score. Tested with "epoch.end.callback" function.

### Usage

```
mx.callback.early.stop(
    train.metric = NULL,
    eval.metric = NULL,
    bad.steps = NULL,
    maximize = FALSE,
    verbose = FALSE
)
```

### Arguments

train.metric	Numeric. Hard threshold for the metric of the training data set (optional)
eval.metric	Numeric. Hard threshold for the metric of the evaluating data set (if set, optional)
bad.steps	Integer. How much epochs should gone from the best score? Use this option with evaluation data set
maximize	Logical. Do your model use maximizing or minimizing optimization?
verbose	Logical

---

mx.callback.log.speedometer

*Calculate the training speed*


---

### Description

Calculate the training speed

### Usage

```
mx.callback.log.speedometer(batch.size, frequency = 50)
```

### Arguments

frequency	The frequency of the training speed update
batch_size	The batch size

---

`mx.callback.log.train.metric`*Log training metric each period*

---

**Description**

Log training metric each period

**Usage**

```
mx.callback.log.train.metric(period, logger = NULL)
```

**Arguments**

period	The number of batch to log the training evaluation metric
logger	The logger class

---

`mx.callback.save.checkpoint`*Save checkpoint to files each period iteration.*

---

**Description**

Save checkpoint to files each period iteration.

**Usage**

```
mx.callback.save.checkpoint(prefix, period = 1)
```

**Arguments**

prefix	The prefix of the model checkpoint.
--------	-------------------------------------



---

mx.cpu	Create a mxnet CPU context.
--------	-----------------------------

---

**Description**

Create a mxnet CPU context.

**Arguments**

dev.id	optional, default=0 The device ID, this is meaningless for CPU, included for interface compatibility.
--------	---

**Value**

The CPU context.

---

mx.ctx.default	Set/Get default context for array creation.
----------------	---

---

**Description**

Set/Get default context for array creation.

**Usage**

```
mx.ctx.default(new = NULL)
```

**Arguments**

new	optional takes mx.cpu() or mx.gpu(id), new default ctx.
-----	---

**Value**

The default context.

---

mx.exec.backward	Peform an backward on the executors This function will MUTATE the state of exec
------------------	---

---

**Description**

Peform an backward on the executors This function will MUTATE the state of exec

**Usage**

```
mx.exec.backward(exec, ...)
```

---

<code>mx.exec.forward</code>	<i>Perform an forward on the executors This function will MUTATE the state of exec</i>
------------------------------	--

---

### Description

Perform an forward on the executors This function will MUTATE the state of exec

### Usage

```
mx.exec.forward(exec, is.train = TRUE)
```

---

<code>mx.exec.update.arg.arrays</code>	<i>Update the executors with new arrays This function will MUTATE the state of exec</i>
--	---

---

### Description

Update the executors with new arrays This function will MUTATE the state of exec

### Usage

```
mx.exec.update.arg.arrays(
  exec,
  arg.arrays,
  match.name = FALSE,
  skip.null = FALSE
)
```

---

<code>mx.exec.update.aux.arrays</code>	<i>Update the executors with new arrays This function will MUTATE the state of exec</i>
--	---

---

### Description

Update the executors with new arrays This function will MUTATE the state of exec

**Usage**

```
mx.exec.update.aux.arrays(
    exec,
    arg.arrays,
    match.name = FALSE,
    skip.null = FALSE
)
```

---

```
mx.exec.update.grad.arrays
```

*Update the executors with new arrays This function will MUTATE the state of exec*

---

**Description**

Update the executors with new arrays This function will MUTATE the state of exec

**Usage**

```
mx.exec.update.grad.arrays(
    exec,
    arg.arrays,
    match.name = FALSE,
    skip.null = FALSE
)
```

---

```
mx.gpu
```

*Create a mxnet GPU context.*

---

**Description**

Create a mxnet GPU context.

**Arguments**

`dev.id` optional, default=0 The GPU device ID, starts from 0.

**Value**

The GPU context.

---

mx.infer.rnn	<i>Inference of RNN model</i>
--------------	-------------------------------

---

**Description**

Inference of RNN model

**Usage**

```
mx.infer.rnn(infer.data, model, ctx = mx.cpu())
```

**Arguments**

infer.data	DataIter
model	Model used for inference
ctx	

---

mx.infer.rnn.one	<i>Inference for one-to-one fusedRNN (CUDA) models</i>
------------------	--

---

**Description**

Inference for one-to-one fusedRNN (CUDA) models

**Usage**

```
mx.infer.rnn.one(  
  infer.data,  
  symbol,  
  arg.params,  
  aux.params,  
  input.params = NULL,  
  ctx = mx.cpu()  
)
```

**Arguments**

infer.data	Data iterator created by mx.io.bucket.iter
symbol	Symbol used for inference
ctx	

---

mx.infer.rnn.one.unroll	<i>Inference for one-to-one unroll models</i>
-------------------------	---

---

**Description**

Inference for one-to-one unroll models

**Usage**

```
mx.infer.rnn.one.unroll(  
    infer.data,  
    symbol,  
    num_hidden,  
    arg.params,  
    aux.params,  
    init_states = NULL,  
    ctx = mx.cpu()  
)
```

**Arguments**

infer.data	NDArray
symbol	Model used for inference
num_hidden	
ctx	

---

mx.init.create	<i>Create initialization of argument like arg.array</i>
----------------	---

---

**Description**

Create initialization of argument like arg.array

**Usage**

```
mx.init.create(initializer, shape.array, ctx = NULL, skip.unknown = TRUE)
```

**Arguments**

initializer	The initializer.
shape.array	A named list that represents the shape of the weights
ctx	mx.context The context of the weights
skip.unknown	Whether skip the unknown weight types

---

```
mx.init.internal.default
```

*Internal default value initialization scheme.*

---

### Description

Internal default value initialization scheme.

### Usage

```
mx.init.internal.default(name, shape, ctx, allow.unknown = FALSE)
```

### Arguments

name	the name of the variable.
shape	the shape of the array to be generated.

---

```
mx.init.normal
```

*Create a initializer that initialize the weight with normal(0, sd)*

---

### Description

Create a initializer that initialize the weight with normal(0, sd)

### Usage

```
mx.init.normal(sd)
```

### Arguments

sd	The standard deviation of normal distribution
----	---

---

```
mx.init.uniform
```

*Create a initializer that initialize the weight with uniform [-scale, scale]*

---

### Description

Create a initializer that initialize the weight with uniform [-scale, scale]

### Usage

```
mx.init.uniform(scale)
```

### Arguments

scale	The scale of uniform distribution
-------	-----------------------------------

---

mx.init.Xavier	<i>Xavier initializer</i>
----------------	---------------------------

---

**Description**

Create a initializer which initialize weight with Xavier or similar initialization scheme.

**Usage**

```
mx.init.Xavier(rnd_type = "uniform", factor_type = "avg", magnitude = 3)
```

**Arguments**

rnd_type	A string of character indicating the type of distribution from which the weights are initialized.
factor_type	A string of character.
magnitude	A numeric number indicating the scale of random number range.

---

mx.io.arrayiter	<i>Create MXDataIter compatible iterator from R's array</i>
-----------------	---

---

**Description**

Create MXDataIter compatible iterator from R's array

**Usage**

```
mx.io.arrayiter(data, label, batch.size = 128, shuffle = FALSE)
```

**Arguments**

data	The data array.
label	The label array.
batch.size	The batch size used to pack the array.
shuffle	Whether shuffle the data

---

mx.io.bucket.iter	Create Bucket Iter
-------------------	--------------------

---

### Description

Create Bucket Iter

### Usage

```
mx.io.bucket.iter(
    buckets,
    batch.size,
    data.mask.element = 0,
    shuffle = FALSE,
    seed = 123
)
```

### Arguments

buckets	The data array.
batch.size	The batch size used to pack the array.
data.mask.element	The element to mask
shuffle	Whether shuffle the data
seed	The random seed

---

mx.io.CSVIter	Returns the CSV file iterator.
---------------	--------------------------------

---

### Description

In this function, the 'data\_shape' parameter is used to set the shape of each line of the input data. If a row in an input file is '1,2,3,4,5,6' and 'data\_shape' is (3,2), that row will be reshaped, yielding the array [[1,2],[3,4],[5,6]] of shape (3,2).

### Usage

```
mx.io.CSVIter(...)
```



**Arguments**

<code>data.csv</code>	string, required The input CSV file or a directory path.
<code>data.shape</code>	Shape(tuple), required The shape of one example.
<code>label.csv</code>	string, optional, default='NULL' The input CSV file or a directory path. If NULL, all labels will be returned as 0.
<code>label.shape</code>	Shape(tuple), optional, default=[1] The shape of one label.
<code>batch.size</code>	int (non-negative), required Batch size.
<code>round.batch</code>	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
<code>prefetch.buffer</code>	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
<code>ctx</code>	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
<code>dtype</code>	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.

**Details**

By default, the 'CSVIter' has 'round\_batch' parameter set to "True". So, if 'batch\_size' is 3 and there are 4 total rows in CSV file, 2 more examples are consumed at the first round. If 'reset' function is called after first round, the call is ignored and remaining examples are returned in the second round.

If one wants all the instances in the second round after calling 'reset', make sure to set 'round\_batch' to False.

If "data\_csv = 'data/'" is set, then all the files in this directory will be read.

"reset()" is expected to be called only after a complete pass of data.

By default, the CSVIter parses all entries in the data file as float32 data type, if 'dtype' argument is set to be 'int32' or 'int64' then CSVIter will parse all entries in the file as int32 or int64 data type accordingly.

Examples::

```
// Contents of CSV file "data/data.csv". 1,2,3 2,3,4 3,4,5 4,5,6
// Creates a 'CSVIter' with 'batch_size'=2 and default 'round_batch'=True. CSVIter = mx.io.CSVIter(data_csv
= 'data/data.csv', data_shape = (3,), batch_size = 2)
// Two batches read from the above iterator are as follows: [[ 1.  2.  3.] [ 2.  3.  4.]] [[ 3.  4.  5.] [ 4.  5.
 6.]]
// Creates a 'CSVIter' with default 'round_batch' set to True. CSVIter = mx.io.CSVIter(data_csv =
'data/data.csv', data_shape = (3,), batch_size = 3)
// Two batches read from the above iterator in the first pass are as follows: [[1.  2.  3.] [2.  3.  4.] [3.
 4.  5.]]
[[4.  5.  6.] [1.  2.  3.] [2.  3.  4.]]
// Now, 'reset' method is called. CSVIter.reset()
// Batch read from the above iterator in the second pass is as follows: [[ 3.  4.  5.] [ 4.  5.  6.] [ 1.  2.
 3.]]
```

```
// Creates a 'CSVIter' with 'round_batch'=False. CSVIter = mx.io.CSVIter(data_csv = 'data/data.csv',
data_shape = (3,), batch_size = 3, round_batch=False)

// Contents of two batches read from the above iterator in both passes, after calling // 'reset' method
before second pass, is as follows: [[1. 2. 3.] [2. 3. 4.] [3. 4. 5.]]

[[4. 5. 6.] [2. 3. 4.] [3. 4. 5.]]

// Creates a 'CSVIter' with 'dtype'='int32' CSVIter = mx.io.CSVIter(data_csv = 'data/data.csv',
data_shape = (3,), batch_size = 3, round_batch=False, dtype='int32')

// Contents of two batches read from the above iterator in both passes, after calling // 'reset' method
before second pass, is as follows: [[1 2 3] [2 3 4] [3 4 5]]

[[4 5 6] [2 3 4] [3 4 5]]

Defined in src/io/iter_csv.cc:L308
```

**Value**

iter The result mx.dataiter

---

mx.io.extract	<i>Extract a certain field from DataIter.</i>
---------------	---

---

**Description**

Extract a certain field from DataIter.

**Usage**

```
mx.io.extract(iter, field)
```

---

mx.io.ImageDetRecordIter	<i>Create iterator for image detection dataset packed in recordio.</i>
--------------------------	--

---

**Description**

Create iterator for image detection dataset packed in recordio.

**Usage**

```
mx.io.ImageDetRecordIter(...)
```

**Arguments**

path.imglist	string, optional, default="" Dataset Param: Path to image list.
path.imgrec	string, optional, default='./data/imgrec.rec' Dataset Param: Path to image record file.
aug.seq	string, optional, default='det_aug_default' Augmentation Param: the augmenter names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters. Make sure you don't use normal augmenters for detection tasks.
label.width	int, optional, default=-1' Dataset Param: How many labels for an image, -1 for variable label size.
preprocess.threads	int, optional, default='4' Backend Param: Number of thread to do preprocessing.
verbose	boolean, optional, default=1 Auxiliary Param: Whether to output parser information.
num.parts	int, optional, default='1' partition the data into multiple parts
part.index	int, optional, default='0' the index of the part will read
shuffle.chunk.size	long (non-negative), optional, default=0 the size(MB) of the shuffle chunk, used with shuffle=True, it can enable global shuffling
shuffle.chunk.seed	int, optional, default='0' the seed for chunk shuffling
label.pad.width	int, optional, default='0' pad output label width if set larger than 0, -1 for auto estimate
label.pad.value	float, optional, default=-1 label padding value if enabled
shuffle	boolean, optional, default=0 Augmentation Param: Whether to shuffle data.
seed	int, optional, default='0' Augmentation Param: Random Seed.
batch.size	int (non-negative), required Batch size.
round.batch	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
prefetch.buffer	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
ctx	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
dtype	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
resize	int, optional, default='-1' Augmentation Param: scale shorter edge to size before applying other augmentations, -1 to disable.
rand.crop.prob	float, optional, default=0 Augmentation Param: Probability of random cropping, <= 0 to disable
min.crop.scales	tuple of <float>, optional, default=[0] Augmentation Param: Min crop scales.

`max.crop.scales`  
tuple of <float>, optional, default=[1] Augmentation Param: Max crop scales.

`min.crop.aspect.ratios`  
tuple of <float>, optional, default=[1] Augmentation Param: Min crop aspect ratios.

`max.crop.aspect.ratios`  
tuple of <float>, optional, default=[1] Augmentation Param: Max crop aspect ratios.

`min.crop.overlaps`  
tuple of <float>, optional, default=[0] Augmentation Param: Minimum crop IOU between crop\_box and ground-truths.

`max.crop.overlaps`  
tuple of <float>, optional, default=[1] Augmentation Param: Maximum crop IOU between crop\_box and ground-truth.

`min.crop.sample.coverages`  
tuple of <float>, optional, default=[0] Augmentation Param: Minimum ratio of intersect/crop\_area between crop box and ground-truths.

`max.crop.sample.coverages`  
tuple of <float>, optional, default=[1] Augmentation Param: Maximum ratio of intersect/crop\_area between crop box and ground-truths.

`min.crop.object.coverages`  
tuple of <float>, optional, default=[0] Augmentation Param: Minimum ratio of intersect/gt\_area between crop box and ground-truths.

`max.crop.object.coverages`  
tuple of <float>, optional, default=[1] Augmentation Param: Maximum ratio of intersect/gt\_area between crop box and ground-truths.

`num.crop.sampler`  
int, optional, default='1' Augmentation Param: Number of crop samplers.

`crop.emit.mode` 'center', 'overlap', optional, default='center' Augmentation Param: Emission mode for invalid ground-truths after crop. center: emit if centroid of object is out of crop region; overlap: emit if overlap is less than emit\_overlap\_thresh.

`emit.overlap.thresh`  
float, optional, default=0.300000012 Augmentation Param: Emit overlap thresh for emit mode overlap only.

`max.crop.trials`  
Shape(tuple), optional, default=[25] Augmentation Param: Skip cropping if fail crop trial count exceeds this number.

`rand.pad.prob` float, optional, default=0 Augmentation Param: Probability for random padding.

`max.pad.scale` float, optional, default=1 Augmentation Param: Maximum padding scale.

`max.random.hue` int, optional, default='0' Augmentation Param: Maximum random value of H channel in HSL color space.

`random.hue.prob`  
float, optional, default=0 Augmentation Param: Probability to apply random hue.

max.random.saturation	int, optional, default='0' Augmentation Param: Maximum random value of S channel in HSL color space.
random.saturation.prob	float, optional, default=0 Augmentation Param: Probability to apply random saturation.
max.random.illumination	int, optional, default='0' Augmentation Param: Maximum random value of L channel in HSL color space.
random.illumination.prob	float, optional, default=0 Augmentation Param: Probability to apply random illumination.
max.random.contrast	float, optional, default=0 Augmentation Param: Maximum random value of delta contrast.
random.contrast.prob	float, optional, default=0 Augmentation Param: Probability to apply random contrast.
rand.mirror.prob	float, optional, default=0 Augmentation Param: Probability to apply horizontal flip aka. mirror.
fill.value	int, optional, default='127' Augmentation Param: Filled color value while padding.
inter.method	int, optional, default='1' Augmentation Param: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
data.shape	Shape(tuple), required Dataset Param: Shape of each instance generated by the Datalter.
resize.mode	'fit', 'force', 'shrink', optional, default='force' Augmentation Param: How image data fit in data_shape. force: force reshape to data_shape regardless of aspect ratio; shrink: ensure each side fit in data_shape, preserve aspect ratio; fit: fit image to data_shape, preserve ratio, will upscale if applicable.
mean.img	string, optional, default="" Augmentation Param: Mean Image to be subtracted.
mean.r	float, optional, default=0 Augmentation Param: Mean value on R channel.
mean.g	float, optional, default=0 Augmentation Param: Mean value on G channel.
mean.b	float, optional, default=0 Augmentation Param: Mean value on B channel.
mean.a	float, optional, default=0 Augmentation Param: Mean value on Alpha channel.
std.r	float, optional, default=0 Augmentation Param: Standard deviation on R channel.
std.g	float, optional, default=0 Augmentation Param: Standard deviation on G channel.
std.b	float, optional, default=0 Augmentation Param: Standard deviation on B channel.
std.a	float, optional, default=0 Augmentation Param: Standard deviation on Alpha channel.
scale	float, optional, default=1 Augmentation Param: Scale in color space.

**Value**

iter The result mx.dataiter

---

mx.io.ImageRecordInt8Iter

*Iterating on image RecordIO files*

---

**Description**

.. note:: “ImageRecordInt8Iter“ is deprecated. Use ImageRecordIter(dtype='int8') instead.

**Usage**

```
mx.io.ImageRecordInt8Iter(...)
```

**Arguments**

path.imglist	string, optional, default="" Path to the image list (.lst) file. Generally created with tools/im2rec.py. Format (Tab separated): <index of record> <one or more labels> <relative path from root folder>.
path.imgrec	string, optional, default="" Path to the image RecordIO (.rec) file or a directory path. Created with tools/im2rec.py.
path.imgidx	string, optional, default="" Path to the image RecordIO index (.idx) file. Created with tools/im2rec.py.
aug.seq	string, optional, default='aug_default' The augmenter names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters.
label.width	int, optional, default='1' The number of labels per image.
preprocess.threads	int, optional, default='4' The number of threads to do preprocessing.
verbose	boolean, optional, default=1 If or not output verbose information.
num.parts	int, optional, default='1' Virtually partition the data into these many parts.
part.index	int, optional, default='0' The *i*-th virtual partition to be read.
device.id	int, optional, default='0' The device id used to create context for internal NDArray. Setting device_id to -1 will create Context::CPU(0). Setting device_id to valid positive device id will create Context::CPUPinned(device_id). Default is 0.
shuffle.chunk.size	long (non-negative), optional, default=0 The data shuffle buffer size in MB. Only valid if shuffle is true.
shuffle.chunk.seed	int, optional, default='0' The random seed for shuffling
seed.aug	int or None, optional, default='None' Random seed for augmentations.

shuffle	boolean, optional, default=0 Whether to shuffle data randomly or not.
seed	int, optional, default='0' The random seed.
batch.size	int (non-negative), required Batch size.
round.batch	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
prefetch.buffer	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
ctx	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
dtype	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
resize	int, optional, default='-1' Down scale the shorter edge to a new size before applying other augmentations.
rand.crop	boolean, optional, default=0 If or not randomly crop the image
random.resized.crop	boolean, optional, default=0 If or not perform random resized cropping on the image, as a standard preprocessing for resnet training on ImageNet data.
max.rotate.angle	int, optional, default='0' Rotate by a random degree in "[-v, v]"
max.aspect.ratio	float, optional, default=0 Change the aspect (namely width/height) to a random value. If min_aspect_ratio is None then the aspect ratio ins sampled from [1 - max_aspect_ratio, 1 + max_aspect_ratio], else it is in "[min_aspect_ratio, max_aspect_ratio]"
min.aspect.ratio	float or None, optional, default=None Change the aspect (namely width/height) to a random value in "[min_aspect_ratio, max_aspect_ratio]"
max.shear.ratio	float, optional, default=0 Apply a shear transformation (namely "(x,y)->(x+my,y)" with "m" randomly chose from "[-max_shear_ratio, max_shear_ratio]"
max.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
min.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
max.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
min.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]" Ignored if "random_resized_crop" is True.
max.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.

min.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in “[min_random_area, max_random_area]“. Ignored if “random_resized_crop“ is False.
max.img.size	float, optional, default=1e+10 Set the maximal width and height after all resize and rotate argumentation are applied
min.img.size	float, optional, default=0 Set the minimal width and height after all resize and rotate argumentation are applied
brightness	float, optional, default=0 Add a random value in “[-brightness, brightness]“ to the brightness of image.
contrast	float, optional, default=0 Add a random value in “[-contrast, contrast]“ to the contrast of image.
saturation	float, optional, default=0 Add a random value in “[-saturation, saturation]“ to the saturation of image.
pca.noise	float, optional, default=0 Add PCA based noise to the image.
random.h	int, optional, default='0' Add a random value in “[-random_h, random_h]“ to the H channel in HSL color space.
random.s	int, optional, default='0' Add a random value in “[-random_s, random_s]“ to the S channel in HSL color space.
random.l	int, optional, default='0' Add a random value in “[-random_l, random_l]“ to the L channel in HSL color space.
rotate	int, optional, default='-1' Rotate by an angle. If set, it overwrites the “max_rotate_angle“ option.
fill.value	int, optional, default='255' Set the padding pixels value to “fill_value“.
data.shape	Shape(tuple), required The shape of a output image.
inter.method	int, optional, default='1' The interpolation method: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
pad	int, optional, default='0' Change size from “[width, height]“ into “[pad + width + pad, pad + height + pad]“ by padding pixes

## Details

This iterator is identical to “ImageRecordIter“ except for using “int8“ as the data type instead of “float“.

Defined in src/io/iter\_image\_recordio\_2.cc:L948

## Value

iter The result mx.dataiter



---

mx.io.ImageRecordIter *Iterates on image RecordIO files*


---

**Usage**

```
mx.io.ImageRecordIter(...)
```

**Arguments**

path.imglist	string, optional, default="" Path to the image list (.lst) file. Generally created with tools/im2rec.py. Format (Tab separated): <index of record> <one or more labels> <relative path from root folder>.
path.imgrec	string, optional, default="" Path to the image RecordIO (.rec) file or a directory path. Created with tools/im2rec.py.
path.imgidx	string, optional, default="" Path to the image RecordIO index (.idx) file. Created with tools/im2rec.py.
aug.seq	string, optional, default='aug_default' The augementer names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters.
label.width	int, optional, default='1' The number of labels per image.
preprocess.threads	int, optional, default='4' The number of threads to do preprocessing.
verbose	boolean, optional, default=1 If or not output verbose information.
num.parts	int, optional, default='1' Virtually partition the data into these many parts.
part.index	int, optional, default='0' The *i*-th virtual partition to be read.
device.id	int, optional, default='0' The device id used to create context for internal NDArray. Setting device_id to -1 will create Context::CPU(0). Setting device_id to valid positive device id will create Context::CPUPinned(device_id). Default is 0.
shuffle.chunk.size	long (non-negative), optional, default=0 The data shuffle buffer size in MB. Only valid if shuffle is true.
shuffle.chunk.seed	int, optional, default='0' The random seed for shuffling
seed.aug	int or None, optional, default='None' Random seed for augmentations.
shuffle	boolean, optional, default=0 Whether to shuffle data randomly or not.
seed	int, optional, default='0' The random seed.
batch.size	int (non-negative), required Batch size.
round.batch	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
prefetch.buffer	long (non-negative), optional, default=4 Maximum number of batches to prefetch.

ctx	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
dtype	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
resize	int, optional, default='-1' Down scale the shorter edge to a new size before applying other augmentations.
rand.crop	boolean, optional, default=0 If or not randomly crop the image
random.resized.crop	boolean, optional, default=0 If or not perform random resized cropping on the image, as a standard preprocessing for resnet training on ImageNet data.
max.rotate.angle	int, optional, default='0' Rotate by a random degree in "[-v, v]"
max.aspect.ratio	float, optional, default=0 Change the aspect (namely width/height) to a random value. If min_aspect_ratio is None then the aspect ratio ins sampled from [1 - max_aspect_ratio, 1 + max_aspect_ratio], else it is in "[min_aspect_ratio, max_aspect_ratio]"
min.aspect.ratio	float or None, optional, default=None Change the aspect (namely width/height) to a random value in "[min_aspect_ratio, max_aspect_ratio]"
max.shear.ratio	float, optional, default=0 Apply a shear transformation (namely "(x,y)->(x+my,y)") with "m" randomly chose from "[-max_shear_ratio, max_shear_ratio]"
max.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
min.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
max.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
min.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
max.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
min.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
max.img.size	float, optional, default=1e+10 Set the maximal width and height after all resize and rotate argumentation are applied
min.img.size	float, optional, default=0 Set the minimal width and height after all resize and rotate argumentation are applied

brightness	float, optional, default=0 Add a random value in “[-brightness, brightness]” to the brightness of image.
contrast	float, optional, default=0 Add a random value in “[-contrast, contrast]” to the contrast of image.
saturation	float, optional, default=0 Add a random value in “[-saturation, saturation]” to the saturation of image.
pca.noise	float, optional, default=0 Add PCA based noise to the image.
random.h	int, optional, default='0' Add a random value in “[-random_h, random_h]” to the H channel in HSL color space.
random.s	int, optional, default='0' Add a random value in “[-random_s, random_s]” to the S channel in HSL color space.
random.l	int, optional, default='0' Add a random value in “[-random_l, random_l]” to the L channel in HSL color space.
rotate	int, optional, default='-1' Rotate by an angle. If set, it overwrites the “max_rotate_angle” option.
fill.value	int, optional, default='255' Set the padding pixels value to “fill_value”.
data.shape	Shape(tuple), required The shape of a output image.
inter.method	int, optional, default='1' The interpolation method: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
pad	int, optional, default='0' Change size from “[width, height]” into “[pad + width + pad, pad + height + pad]” by padding pixes
mirror	boolean, optional, default=0 Whether to mirror the image or not. If true, images are flipped along the horizontal axis.
rand.mirror	boolean, optional, default=0 Whether to randomly mirror images or not. If true, 50
	\itemmean.imgstring, optional, default="" Filename of the mean image.
	\itemmean.rfloat, optional, default=0 The mean value to be subtracted on the R channel
	\itemmean.gfloat, optional, default=0 The mean value to be subtracted on the G channel
	\itemmean.bfloat, optional, default=0 The mean value to be subtracted on the B channel
	\itemmean.afloat, optional, default=0 The mean value to be subtracted on the alpha channel
	\itemstd.rfloat, optional, default=1 Augmentation Param: Standard deviation on R channel.
	\itemstd.gfloat, optional, default=1 Augmentation Param: Standard deviation on G channel.
	\itemstd.bfloat, optional, default=1 Augmentation Param: Standard deviation on B channel.
	\itemstd.afloat, optional, default=1 Augmentation Param: Standard deviation on Alpha channel.
	\itemscalefloat, optional, default=1 Multiply the image with a scale value.

\itemmax.random.contrastfloat, optional, default=0 Change the contrast with a value randomly chosen from “[-max\_random\_contrast, max\_random\_contrast]”  
 \itemmax.random.illuminationfloat, optional, default=0 Change the illumination with a value randomly chosen from “[-max\_random\_illumination, max\_random\_illumination]”

iter The result mx.dataiter

Reads batches of images from .rec RecordIO files. One can use “im2rec.py” tool (in tools/) to pack raw image files into RecordIO files. This iterator is less flexible to customization but is fast and has lot of language bindings. To iterate over raw images directly use “ImageIter” instead (in Python).

Example::

```
data_iter = mx.io.ImageRecordIter( path_imgrec="/sample.rec", # The target
record file. data_shape=(3, 227, 227), # Output data shape; 227x227 region
will be cropped from the original image. batch_size=4, # Number of items per
batch. resize=256 # Resize the shorter edge to 256 before cropping. # You
can specify more augmentation options. Use help(mx.io.ImageRecordIter) to
see all the options. ) # You can now use the data_iter to access batches of
images. batch = data_iter.next() # first batch. images = batch.data[0] # This
will contain 4 (=batch_size) images each of 3x227x227. # process the images
... data_iter.reset() # To restart the iterator from the beginning.
```

Defined in src/io/iter\_image\_recordio\_2.cc:L911

---

mx.io.ImageRecordIter\_v1

*Iterating on image RecordIO files*

---

## Usage

```
mx.io.ImageRecordIter_v1(...)
```

## Arguments

path.imglist	string, optional, default="" Path to the image list (.lst) file. Generally created with tools/im2rec.py. Format (Tab separated): <index of record> <one or more labels> <relative path from root folder>.
path.imgrec	string, optional, default="" Path to the image RecordIO (.rec) file or a directory path. Created with tools/im2rec.py.
path.imgidx	string, optional, default="" Path to the image RecordIO index (.idx) file. Created with tools/im2rec.py.
aug.seq	string, optional, default='aug_default' The augmenter names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters.
label.width	int, optional, default='1' The number of labels per image.
preprocess.threads	int, optional, default='4' The number of threads to do preprocessing.

verbose	boolean, optional, default=1 If or not output verbose information.
num.parts	int, optional, default='1' Virtually partition the data into these many parts.
part.index	int, optional, default='0' The *i*-th virtual partition to be read.
device.id	int, optional, default='0' The device id used to create context for internal NDArray. Setting device_id to -1 will create Context::CPU(0). Setting device_id to valid positive device id will create Context::CUPinned(device_id). Default is 0.
shuffle.chunk.size	long (non-negative), optional, default=0 The data shuffle buffer size in MB. Only valid if shuffle is true.
shuffle.chunk.seed	int, optional, default='0' The random seed for shuffling
seed.aug	int or None, optional, default='None' Random seed for augmentations.
shuffle	boolean, optional, default=0 Whether to shuffle data randomly or not.
seed	int, optional, default='0' The random seed.
batch.size	int (non-negative), required Batch size.
round.batch	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
prefetch.buffer	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
ctx	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
dtype	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
resize	int, optional, default='-1' Down scale the shorter edge to a new size before applying other augmentations.
rand.crop	boolean, optional, default=0 If or not randomly crop the image
random.resized.crop	boolean, optional, default=0 If or not perform random resized cropping on the image, as a standard preprocessing for resnet training on ImageNet data.
max.rotate.angle	int, optional, default='0' Rotate by a random degree in "[-v, v]"
max.aspect.ratio	float, optional, default=0 Change the aspect (namely width/height) to a random value. If min_aspect_ratio is None then the aspect ratio ins sampled from [1 - max_aspect_ratio, 1 + max_aspect_ratio], else it is in "[min_aspect_ratio, max_aspect_ratio]"
min.aspect.ratio	float or None, optional, default=None Change the aspect (namely width/height) to a random value in "[min_aspect_ratio, max_aspect_ratio]"
max.shear.ratio	float, optional, default=0 Apply a shear transformation (namely "(x,y)->(x+my,y)" with "m" randomly chose from "[-max_shear_ratio, max_shear_ratio]"
max.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.

<code>min.crop.size</code>	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
<code>max.random.scale</code>	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
<code>min.random.scale</code>	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
<code>max.random.area</code>	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
<code>min.random.area</code>	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
<code>max.img.size</code>	float, optional, default=1e+10 Set the maximal width and height after all resize and rotate augmentation are applied
<code>min.img.size</code>	float, optional, default=0 Set the minimal width and height after all resize and rotate augmentation are applied
<code>brightness</code>	float, optional, default=0 Add a random value in "[-brightness, brightness]" to the brightness of image.
<code>contrast</code>	float, optional, default=0 Add a random value in "[-contrast, contrast]" to the contrast of image.
<code>saturation</code>	float, optional, default=0 Add a random value in "[-saturation, saturation]" to the saturation of image.
<code>pca.noise</code>	float, optional, default=0 Add PCA based noise to the image.
<code>random.h</code>	int, optional, default='0' Add a random value in "[-random_h, random_h]" to the H channel in HSL color space.
<code>random.s</code>	int, optional, default='0' Add a random value in "[-random_s, random_s]" to the S channel in HSL color space.
<code>random.l</code>	int, optional, default='0' Add a random value in "[-random_l, random_l]" to the L channel in HSL color space.
<code>rotate</code>	int, optional, default='-1' Rotate by an angle. If set, it overwrites the "max_rotate_angle" option.
<code>fill.value</code>	int, optional, default='255' Set the padding pixels value to "fill_value".
<code>data.shape</code>	Shape(tuple), required The shape of a output image.
<code>inter.method</code>	int, optional, default='1' The interpolation method: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
<code>pad</code>	int, optional, default='0' Change size from "[width, height]" into "[pad + width + pad, pad + height + pad]" by padding pixels

mirror	boolean, optional, default=0 Whether to mirror the image or not. If true, images are flipped along the horizontal axis.
rand.mirror	boolean, optional, default=0 Whether to randomly mirror images or not. If true, 50
	\itemmean.imgstring, optional, default="" Filename of the mean image.
	\itemmean.rfloat, optional, default=0 The mean value to be subtracted on the R channel
	\itemmean.gfloat, optional, default=0 The mean value to be subtracted on the G channel
	\itemmean.bfloat, optional, default=0 The mean value to be subtracted on the B channel
	\itemmean.afloat, optional, default=0 The mean value to be subtracted on the alpha channel
	\itemstd.rfloat, optional, default=1 Augmentation Param: Standard deviation on R channel.
	\itemstd.gfloat, optional, default=1 Augmentation Param: Standard deviation on G channel.
	\itemstd.bfloat, optional, default=1 Augmentation Param: Standard deviation on B channel.
	\itemstd.afloat, optional, default=1 Augmentation Param: Standard deviation on Alpha channel.
	\itemscalefloat, optional, default=1 Multiply the image with a scale value.
	\itemmax.random.contrastfloat, optional, default=0 Change the contrast with a value randomly chosen from "[-max_random_contrast, max_random_contrast]"
	\itemmax.random.illuminationfloat, optional, default=0 Change the illumination with a value randomly chosen from "[-max_random_illumination, max_random_illumination]"
	iter The result mx.dataiter
	.. note::
	"ImageRecordIter_v1" is deprecated. Use "ImageRecordIter" instead.
	Read images batches from RecordIO files with a rich of data augmentation options.
	One can use "tools/im2rec.py" to pack individual image files into RecordIO files.
	Defined in src/io/iter_image_recordio.cc:L352

---

mx.io.ImageRecordUInt8Iter

*Iterating on image RecordIO files*


---

## Description

.. note:: ImageRecordUInt8Iter is deprecated. Use ImageRecordIter(dtype='uint8') instead.

**Usage**

```
mx.io.ImageRecordUInt8Iter(...)
```

**Arguments**

<code>path.imglist</code>	string, optional, default="" Path to the image list (.lst) file. Generally created with tools/im2rec.py. Format (Tab separated): <index of record> <one or more labels> <relative path from root folder>.
<code>path.imgrec</code>	string, optional, default="" Path to the image RecordIO (.rec) file or a directory path. Created with tools/im2rec.py.
<code>path.imgidx</code>	string, optional, default="" Path to the image RecordIO index (.idx) file. Created with tools/im2rec.py.
<code>aug.seq</code>	string, optional, default='aug_default' The augmenter names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters.
<code>label.width</code>	int, optional, default='1' The number of labels per image.
<code>preprocess.threads</code>	int, optional, default='4' The number of threads to do preprocessing.
<code>verbose</code>	boolean, optional, default=1 If or not output verbose information.
<code>num.parts</code>	int, optional, default='1' Virtually partition the data into these many parts.
<code>part.index</code>	int, optional, default='0' The *i*-th virtual partition to be read.
<code>device.id</code>	int, optional, default='0' The device id used to create context for internal NDArray. Setting device_id to -1 will create Context::CPU(0). Setting device_id to valid positive device id will create Context::CPUPinned(device_id). Default is 0.
<code>shuffle.chunk.size</code>	long (non-negative), optional, default=0 The data shuffle buffer size in MB. Only valid if shuffle is true.
<code>shuffle.chunk.seed</code>	int, optional, default='0' The random seed for shuffling
<code>seed.aug</code>	int or None, optional, default='None' Random seed for augmentations.
<code>shuffle</code>	boolean, optional, default=0 Whether to shuffle data randomly or not.
<code>seed</code>	int, optional, default='0' The random seed.
<code>batch.size</code>	int (non-negative), required Batch size.
<code>round.batch</code>	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
<code>prefetch.buffer</code>	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
<code>ctx</code>	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
<code>dtype</code>	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
<code>resize</code>	int, optional, default='-1' Down scale the shorter edge to a new size before applying other augmentations.



rand.crop	boolean, optional, default=0 If or not randomly crop the image
random.resized.crop	boolean, optional, default=0 If or not perform random resized cropping on the image, as a standard preprocessing for resnet training on ImageNet data.
max.rotate.angle	int, optional, default='0' Rotate by a random degree in "[-v, v]"
max.aspect.ratio	float, optional, default=0 Change the aspect (namely width/height) to a random value. If min_aspect_ratio is None then the aspect ratio ins sampled from [1 - max_aspect_ratio, 1 + max_aspect_ratio], else it is in "[min_aspect_ratio, max_aspect_ratio]"
min.aspect.ratio	float or None, optional, default=None Change the aspect (namely width/height) to a random value in "[min_aspect_ratio, max_aspect_ratio]"
max.shear.ratio	float, optional, default=0 Apply a shear transformation (namely "(x,y)->(x+my,y)" with "m" randomly chose from "[-max_shear_ratio, max_shear_ratio]"
max.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
min.crop.size	int, optional, default='-1' Crop both width and height into a random size in "[min_crop_size, max_crop_size]". Ignored if "random_resized_crop" is True.
max.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]". Ignored if "random_resized_crop" is True.
min.random.scale	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[min_random_scale, max_random_scale]" Ignored if "random_resized_crop" is True.
max.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
min.random.area	float, optional, default=1 Change the area (namely width * height) to a random value in "[min_random_area, max_random_area]". Ignored if "random_resized_crop" is False.
max.img.size	float, optional, default=1e+10 Set the maximal width and height after all resize and rotate argumentation are applied
min.img.size	float, optional, default=0 Set the minimal width and height after all resize and rotate argumentation are applied
brightness	float, optional, default=0 Add a random value in "[-brightness, brightness]" to the brightness of image.
contrast	float, optional, default=0 Add a random value in "[-contrast, contrast]" to the contrast of image.

saturation	float, optional, default=0 Add a random value in “[-saturation, saturation]” to the saturation of image.
pca.noise	float, optional, default=0 Add PCA based noise to the image.
random.h	int, optional, default='0' Add a random value in “[-random_h, random_h]” to the H channel in HSL color space.
random.s	int, optional, default='0' Add a random value in “[-random_s, random_s]” to the S channel in HSL color space.
random.l	int, optional, default='0' Add a random value in “[-random_l, random_l]” to the L channel in HSL color space.
rotate	int, optional, default='-1' Rotate by an angle. If set, it overwrites the “max_rotate_angle” option.
fill.value	int, optional, default='255' Set the padding pixels value to “fill_value”.
data.shape	Shape(tuple), required The shape of a output image.
inter.method	int, optional, default='1' The interpolation method: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
pad	int, optional, default='0' Change size from “[width, height]” into “[pad + width + pad, pad + height + pad]” by padding pixes

## Details

This iterator is identical to “ImageRecordIter” except for using “uint8” as the data type instead of “float”.

Defined in src/io/iter\_image\_recordio\_2.cc:L930

## Value

iter The result mx.dataiter

---

mx.io.ImageRecordUInt8Iter\_v1

*Iterating on image RecordIO files*

---

## Description

.. note::

## Usage

```
mx.io.ImageRecordUInt8Iter_v1(...)
```

**Arguments**

path.imglist	string, optional, default="" Path to the image list (.lst) file. Generally created with tools/im2rec.py. Format (Tab separated): <index of record> <one or more labels> <relative path from root folder>.
path.imgrec	string, optional, default="" Path to the image RecordIO (.rec) file or a directory path. Created with tools/im2rec.py.
path.imgidx	string, optional, default="" Path to the image RecordIO index (.idx) file. Created with tools/im2rec.py.
aug.seq	string, optional, default='aug_default' The augementer names to represent sequence of augmenters to be applied, seperated by comma. Additional keyword parameters will be seen by these augmenters.
label.width	int, optional, default='1' The number of labels per image.
preprocess.threads	int, optional, default='4' The number of threads to do preprocessing.
verbose	boolean, optional, default=1 If or not output verbose information.
num.parts	int, optional, default='1' Virtually partition the data into these many parts.
part.index	int, optional, default='0' The *i*-th virtual partition to be read.
device.id	int, optional, default='0' The device id used to create context for internal NDArray. Setting device_id to -1 will create Context::CPU(0). Setting device_id to valid positive device id will create Context::CPUPinned(device_id). Default is 0.
shuffle.chunk.size	long (non-negative), optional, default=0 The data shuffle buffer size in MB. Only valid if shuffle is true.
shuffle.chunk.seed	int, optional, default='0' The random seed for shuffling
seed.aug	int or None, optional, default='None' Random seed for augmentations.
shuffle	boolean, optional, default=0 Whether to shuffle data randomly or not.
seed	int, optional, default='0' The random seed.
batch.size	int (non-negative), required Batch size.
round.batch	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
prefetch.buffer	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
ctx	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
dtype	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.
resize	int, optional, default='-1' Down scale the shorter edge to a new size before applying other augmentations.
rand.crop	boolean, optional, default=0 If or not randomly crop the image
random.resized.crop	boolean, optional, default=0 If or not perform random resized cropping on the image, as a standard preprocessing for resnet training on ImageNet data.

<code>max.rotate.angle</code>	int, optional, default='0' Rotate by a random degree in "[ -v, v]"
<code>max.aspect.ratio</code>	float, optional, default=0 Change the aspect (namely width/height) to a random value. If <code>min_aspect_ratio</code> is None then the aspect ratio is sampled from $[1 - \text{max\_aspect\_ratio}, 1 + \text{max\_aspect\_ratio}]$ , else it is in "[ <code>min_aspect_ratio</code> , <code>max_aspect_ratio</code> ]"
<code>min.aspect.ratio</code>	float or None, optional, default=None Change the aspect (namely width/height) to a random value in "[ <code>min_aspect_ratio</code> , <code>max_aspect_ratio</code> ]"
<code>max.shear.ratio</code>	float, optional, default=0 Apply a shear transformation (namely "(x,y)->(x+my,y)" with "m" randomly chose from "[ -max_shear_ratio, max_shear_ratio]"
<code>max.crop.size</code>	int, optional, default='-1' Crop both width and height into a random size in "[ <code>min_crop_size</code> , <code>max_crop_size</code> ]." Ignored if " <code>random_resized_crop</code> " is True.
<code>min.crop.size</code>	int, optional, default='-1' Crop both width and height into a random size in "[ <code>min_crop_size</code> , <code>max_crop_size</code> ]." Ignored if " <code>random_resized_crop</code> " is True.
<code>max.random.scale</code>	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[ <code>min_random_scale</code> , <code>max_random_scale</code> ]." Ignored if " <code>random_resized_crop</code> " is True.
<code>min.random.scale</code>	float, optional, default=1 Resize into "[width*s, height*s]" with "s" randomly chosen from "[ <code>min_random_scale</code> , <code>max_random_scale</code> ]." Ignored if " <code>random_resized_crop</code> " is True.
<code>max.random.area</code>	float, optional, default=1 Change the area (namely width * height) to a random value in "[ <code>min_random_area</code> , <code>max_random_area</code> ]." Ignored if " <code>random_resized_crop</code> " is False.
<code>min.random.area</code>	float, optional, default=1 Change the area (namely width * height) to a random value in "[ <code>min_random_area</code> , <code>max_random_area</code> ]." Ignored if " <code>random_resized_crop</code> " is False.
<code>max.img.size</code>	float, optional, default=1e+10 Set the maximal width and height after all resize and rotate argumentation are applied
<code>min.img.size</code>	float, optional, default=0 Set the minimal width and height after all resize and rotate argumentation are applied
<code>brightness</code>	float, optional, default=0 Add a random value in "[ -brightness, brightness]" to the brightness of image.
<code>contrast</code>	float, optional, default=0 Add a random value in "[ -contrast, contrast]" to the contrast of image.
<code>saturation</code>	float, optional, default=0 Add a random value in "[ -saturation, saturation]" to the saturation of image.
<code>pca.noise</code>	float, optional, default=0 Add PCA based noise to the image.
<code>random.h</code>	int, optional, default='0' Add a random value in "[ -random_h, random_h]" to the H channel in HSL color space.

random.s	int, optional, default='0' Add a random value in “[-random_s, random_s]” to the S channel in HSL color space.
random.l	int, optional, default='0' Add a random value in “[-random_l, random_l]” to the L channel in HSL color space.
rotate	int, optional, default='-1' Rotate by an angle. If set, it overwrites the “max_rotate_angle” option.
fill.value	int, optional, default='255' Set the padding pixels value to “fill_value”.
data.shape	Shape(tuple), required The shape of a output image.
inter.method	int, optional, default='1' The interpolation method: 0-NN 1-bilinear 2-cubic 3-area 4-lanczos4 9-auto 10-rand.
pad	int, optional, default='0' Change size from “[width, height]” into “[pad + width + pad, pad + height + pad]” by padding pixels

### Details

“ImageRecordUInt8Iter\_v1” is deprecated. Use “ImageRecordUInt8Iter” instead.

This iterator is identical to “ImageRecordIter” except for using “uint8” as the data type instead of “float”.

Defined in src/io/iter\_image\_recordio.cc:L377

### Value

iter The result mx.dataiter

---

mx.io.LibSVMIter	<i>Returns the LibSVM iterator which returns data with 'csr' storage type. This iterator is experimental and should be used with care.</i>
------------------	--

---

### Description

The input data is stored in a format similar to LibSVM file format, except that the **\*\*indices** are expected to be zero-based instead of one-based, and the column indices for each row are expected to be sorted in ascending order**\*\***. Details of the LibSVM format are available [here](https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/).  
<<https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/>>‘\_

### Usage

```
mx.io.LibSVMIter(...)
```

## Arguments

<code>data.libsvm</code>	string, required The input zero-base indexed LibSVM data file or a directory path.
<code>data.shape</code>	Shape(tuple), required The shape of one example.
<code>label.libsvm</code>	string, optional, default='NULL' The input LibSVM label file or a directory path. If NULL, all labels will be read from "data.libsvm".
<code>label.shape</code>	Shape(tuple), optional, default=[1] The shape of one label.
<code>num.parts</code>	int, optional, default='1' partition the data into multiple parts
<code>part.index</code>	int, optional, default='0' the index of the part will read
<code>batch.size</code>	int (non-negative), required Batch size.
<code>round.batch</code>	boolean, optional, default=1 Whether to use round robin to handle overflow batch or not.
<code>prefetch.buffer</code>	long (non-negative), optional, default=4 Maximum number of batches to prefetch.
<code>ctx</code>	'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.
<code>dtype</code>	None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.

## Details

The 'data\_shape' parameter is used to set the shape of each line of the data. The dimension of both 'data\_shape' and 'label\_shape' are expected to be 1.

The 'data\_libsvm' parameter is used to set the path input LibSVM file. When it is set to a directory, all the files in the directory will be read.

When 'label\_libsvm' is set to "NULL", both data and label are read from the file specified by 'data\_libsvm'. In this case, the data is stored in 'csr' storage type, while the label is a 1D dense array.

The 'LibSVMIter' only support 'round\_batch' parameter set to "True". Therefore, if 'batch\_size' is 3 and there are 4 total rows in libsvm file, 2 more examples are consumed at the first round.

When 'num\_parts' and 'part\_index' are provided, the data is split into 'num\_parts' partitions, and the iterator only reads the 'part\_index'-th partition. However, the partitions are not guaranteed to be even.

"reset()" is expected to be called only after a complete pass of data.

Example::

```
# Contents of libsvm file "data.t". 1.0 0:0.5 2:1.2 -2.0 -3.0 0:0.6 1:2.4 2:1.2 4 2:-1.2
# Creates a 'LibSVMIter' with 'batch_size'=3. >> data_iter = mx.io.LibSVMIter(data_libsvm =
'data.t', data_shape = (3,), batch_size = 3) # The data of the first batch is stored in csr storage type
>> batch = data_iter.next() >> csr = batch.data[0] <CSRNDArray 3x3 @cpu(0)> >> csr.asnumpy()
[[ 0.5 0. 1.2 ] [ 0. 0. 0. ] [ 0.6 2.4 1.2]] # The label of first batch >> label = batch.label[0] >> label [
1. -2. -3.] <NDArray 3 @cpu(0)>

>> second_batch = data_iter.next() # The data of the second batch >> second_batch.data[0].asnumpy()
[[ 0. 0. -1.2 ] [ 0.5 0. 1.2 ] [ 0. 0. 0. ]] # The label of the second batch >> second_batch.label[0].asnumpy()
[ 4. 1. -2.]
```

```
>> data_iter.reset() # To restart the iterator for the second pass of the data
```

When 'label\_libsvm' is set to the path to another LibSVM file, data is read from 'data\_libsvm' and label from 'label\_libsvm'. In this case, both data and label are stored in the csr format. If the label column in the 'data\_libsvm' file is ignored.

Example::

```
# Contents of libsvm file "label.t" 1.0 -2.0 0:0.125 -3.0 2:1.2 4 1:1.0 2:-1.2
# Creates a 'LibSVMIter' with specified label file >> data_iter = mx.io.LibSVMIter(data_libsvm =
'data.t', data_shape = (3,), label_libsvm = 'label.t', label_shape = (3,), batch_size = 3)
# Both data and label are in csr storage type >> batch = data_iter.next() >> csr_data = batch.data[0]
<CSRNDArray 3x3 @cpu(0)> >> csr_data.asnumpy() [[ 0.5 0. 1.2 ] [ 0. 0. 0. ] [ 0.6 2.4 1.2 ]]
>> csr_label = batch.label[0] <CSRNDArray 3x3 @cpu(0)> >> csr_label.asnumpy() [[ 0. 0. 0. ] [
0.125 0. 0. ] [ 0. 0. 1.2 ]]
Defined in src/io/iter_libsvm.cc:L298
```

## Value

iter The result mx.dataiter

---

mx.io.MNISTIter

*Iterating on the MNIST dataset.*

---

## Description

One can download the dataset from <http://yann.lecun.com/exdb/mnist/>

## Usage

```
mx.io.MNISTIter(...)
```

## Arguments

image	string, optional, default='./train-images-idx3-ubyte' Dataset Param: Mnist image path.
label	string, optional, default='./train-labels-idx1-ubyte' Dataset Param: Mnist label path.
batch.size	int, optional, default='128' Batch Param: Batch Size.
shuffle	boolean, optional, default=1 Augmentation Param: Whether to shuffle data.
flat	boolean, optional, default=0 Augmentation Param: Whether to flat the data into 1D.
seed	int, optional, default='0' Augmentation Param: Random Seed.
silent	boolean, optional, default=0 Auxiliary Param: Whether to print out data info.
num.parts	int, optional, default='1' partition the data into multiple parts
part.index	int, optional, default='0' the index of the part will read

`prefetch.buffer` long (non-negative), optional, default=4 Maximum number of batches to prefetch.  
`ctx` 'cpu', 'gpu', optional, default='gpu' Context data loader optimized for.  
`dtype` None, 'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='None' Output data type. "None" means no change.

### Details

Defined in `src/io/iter_mnist.cc:L265`

### Value

iter The result `mx.dataiter`

---

<code>mx.kv.create</code>	<i>Create a mxnet KVStore.</i>
---------------------------	--------------------------------

---

### Description

Create a mxnet KVStore.

### Arguments

`type` string(default="local") The type of kvstore.

### Value

The kvstore.

---

<code>mx.lr_scheduler.FactorScheduler</code>	<i>Learning rate scheduler. Reduction based on a factor value.</i>
--	--

---

### Description

Learning rate scheduler. Reduction based on a factor value.

### Usage

```

mx.lr_scheduler.FactorScheduler(
    step,
    factor_val,
    stop_factor_lr = 1e-08,
    verbose = TRUE
)
  
```



**Arguments**

step	(integer) Schedule learning rate after n updates
factor	(double) The factor for reducing the learning rate

**Value**

scheduler function

---

mx.lr\_scheduler.MultiFactorScheduler

*Multifactor learning rate scheduler. Reduction based on a factor value at different steps.*

---

**Description**

Multifactor learning rate scheduler. Reduction based on a factor value at different steps.

**Usage**

```
mx.lr_scheduler.MultiFactorScheduler(  
    step,  
    factor_val,  
    stop_factor_lr = 1e-08,  
    verbose = TRUE  
)
```

**Arguments**

step	(array of integer) Schedule learning rate after n updates
factor	(double) The factor for reducing the learning rate

**Value**

scheduler function

---

<code>mx.metric.accuracy</code>	<i>Accuracy metric for classification</i>
---------------------------------	---

---

**Description**

Accuracy metric for classification

**Usage**

`mx.metric.accuracy`

**Format**

An object of class `mx.metric` of length 3.

---

<code>mx.metric.custom</code>	<i>Helper function to create a customized metric</i>
-------------------------------	--

---

**Description**

Helper function to create a customized metric

**Usage**

`mx.metric.custom(name, feval)`

---

<code>mx.metric.logistic_acc</code>	<i>Accuracy metric for logistic regression</i>
-------------------------------------	--

---

**Description**

Accuracy metric for logistic regression

**Usage**

`mx.metric.logistic_acc`

**Format**

An object of class `mx.metric` of length 3.

---

mx.metric.logloss	<i>LogLoss metric for logistic regression</i>
-------------------	---

---

**Description**

LogLoss metric for logistic regression

**Usage**

mx.metric.logloss

**Format**

An object of class mx.metric of length 3.

---

mx.metric.mae	<i>MAE (Mean Absolute Error) metric for regression</i>
---------------	--

---

**Description**

MAE (Mean Absolute Error) metric for regression

**Usage**

mx.metric.mae

**Format**

An object of class mx.metric of length 3.

---

mx.metric.mse	<i>MSE (Mean Squared Error) metric for regression</i>
---------------	---

---

**Description**

MSE (Mean Squared Error) metric for regression

**Usage**

mx.metric.mse

**Format**

An object of class mx.metric of length 3.

---

<code>mx.metric.Perplexity</code>	<i>Perplexity metric for language model</i>
-----------------------------------	---

---

**Description**

Perplexity metric for language model

**Usage**

`mx.metric.Perplexity`

**Format**

An object of class `mx.metric` of length 3.

---

<code>mx.metric.rmse</code>	<i>RMSE (Root Mean Squared Error) metric for regression</i>
-----------------------------	---

---

**Description**

RMSE (Root Mean Squared Error) metric for regression

**Usage**

`mx.metric.rmse`

**Format**

An object of class `mx.metric` of length 3.

---

<code>mx.metric.rmsle</code>	<i>RMSLE (Root Mean Squared Logarithmic Error) metric for regression</i>
------------------------------	--

---

**Description**

RMSLE (Root Mean Squared Logarithmic Error) metric for regression

**Usage**

`mx.metric.rmsle`

**Format**

An object of class `mx.metric` of length 3.

---

mx.metric.top\_k\_accuracy

*Top-k accuracy metric for classification*


---

### Description

Top-k accuracy metric for classification

### Usage

```
mx.metric.top_k_accuracy
```

### Format

An object of class `mx.metric` of length 3.

---

mx.mlp

*Convenience interface for multiple layer perceptron*


---

### Description

Convenience interface for multiple layer perceptron

### Usage

```
mx.mlp(
  data,
  label,
  hidden_node = 1,
  out_node,
  dropout = NULL,
  activation = "tanh",
  out_activation = "softmax",
  ctx = mx.ctx.default(),
  ...
)
```

### Arguments

data	the input matrix. Only <code>mx.io.DataIter</code> and R array/matrix types supported.
label	the training label. Only R array type supported.
hidden_node	a vector containing number of hidden nodes on each hidden layer as well as the output layer.
out_node	the number of nodes on the output layer.

dropout	a number in [0,1) containing the dropout ratio from the last hidden layer to the output layer.
activation	either a single string or a vector containing the names of the activation functions.
out_activation	a single string containing the name of the output activation function.
ctx	whether train on cpu (default) or gpu.
...	other parameters passing to <code>mx.model.FeedForward.create/</code>
eval.metric	the evaluation metric/

## Examples

```
require(mlbench)
data(Sonar, package="mlbench")
Sonar[,61] = as.numeric(Sonar[,61])-1
train.ind = c(1:50, 100:150)
train.x = data.matrix(Sonar[train.ind, 1:60])
train.y = Sonar[train.ind, 61]
test.x = data.matrix(Sonar[-train.ind, 1:60])
test.y = Sonar[-train.ind, 61]
model = mx.mlp(train.x, train.y, hidden_node = 10, out_node = 2, out_activation = "softmax",
               learning.rate = 0.1)
preds = predict(model, test.x)
```

---

mx.model.buckets	<i>Train RNN with bucket support</i>
------------------	--------------------------------------

---

## Description

Train RNN with bucket support

## Usage

```
mx.model.buckets(
  symbol,
  train.data,
  eval.data = NULL,
  metric = NULL,
  arg.params = NULL,
  aux.params = NULL,
  fixed.params = NULL,
  num.round = 1,
  begin.round = 1,
  initializer = mx.init.uniform(0.01),
  optimizer = "sgd",
  ctx = NULL,
  batch.end.callback = NULL,
```

```

    epoch.end.callback = NULL,
    kvstore = "local",
    verbose = TRUE,
    metric_cpu = TRUE
)

```

### Arguments

symbol	Symbol or list of Symbols representing the model
train.data	Training data created by mx.io.bucket.iter
eval.data	Evaluation data created by mx.io.bucket.iter
num.round	int, number of epoch
verbose	

---

```
mx.model.FeedForward.create
```

*Create a MXNet Feedforward neural net model with the specified training.*

---

### Description

Create a MXNet Feedforward neural net model with the specified training.

### Usage

```

mx.model.FeedForward.create(
  symbol,
  X,
  y = NULL,
  ctx = NULL,
  begin.round = 1,
  num.round = 10,
  optimizer = "sgd",
  initializer = mx.init.uniform(0.01),
  eval.data = NULL,
  eval.metric = NULL,
  epoch.end.callback = NULL,
  batch.end.callback = NULL,
  array.batch.size = 128,
  array.layout = "auto",
  kvstore = "local",
  verbose = TRUE,
  arg.params = NULL,
  aux.params = NULL,
  input.names = NULL,
  output.names = NULL,

```

```

    fixed.param = NULL,
    allow.extra.params = FALSE,
    metric_cpu = TRUE,
    ...
)

```

## Arguments

<code>symbol</code>	The symbolic configuration of the neural network.
<code>X</code>	<code>mx.io.DataIter</code> or R array/matrix The training data.
<code>y</code>	R array, optional label of the data This is only used when X is R array.
<code>ctx</code>	<code>mx.context</code> or list of <code>mx.context</code> , optional The devices used to perform training.
<code>begin.round</code>	integer (default=1) The initial iteration over the training data to train the model.
<code>num.round</code>	integer (default=10) The number of iterations over training data to train the model.
<code>optimizer</code>	string, default="sgd" The optimization method.
<code>initializer,</code>	initializer object. default= <code>mx.init.uniform(0.01)</code> The initialization scheme for parameters.
<code>eval.data</code>	<code>mx.io.DataIter</code> or list( <code>data=R.array, label=R.array</code> ), optional The validation set used for validation evaluation during the progress
<code>eval.metric</code>	function, optional The evaluation function on the results.
<code>epoch.end.callback</code>	function, optional The callback when iteration ends.
<code>batch.end.callback</code>	function, optional The callback when one mini-batch iteration ends.
<code>array.batch.size</code>	integer (default=128) The batch size used for R array training.
<code>array.layout</code>	can be "auto", "colmajor", "rowmajor", (default=auto) The layout of array. "rowmajor" is only supported for two dimensional array. For matrix, "rowmajor" means $\text{dim}(X) = c(\text{nexample}, \text{nfeatures})$ , "colmajor" means $\text{dim}(X) = c(\text{nfeatures}, \text{nexample})$ "auto" will auto detect the layout by match the feature size, and will report error when X is a square matrix to ask user to explicitly specify layout.
<code>kvstore</code>	string (default="local") The parameter synchronization scheme in multiple devices.
<code>verbose</code>	logical (default=TRUE) Specifies whether to print information on the iterations during training.
<code>arg.params</code>	list, optional Model parameter, list of name to NDAarray of net's weights.
<code>aux.params</code>	list, optional Model parameter, list of name to NDAarray of net's auxiliary states.
<code>input.names</code>	optional The names of the input symbols.
<code>output.names</code>	optional The names of the output symbols.
<code>fixed.param</code>	The parameters to be fixed during training. For these parameters, not gradients will be calculated and thus no space will be allocated for the gradient.
<code>allow.extra.params</code>	Whether allow extra parameters that are not needed by symbol. If this is TRUE, no error will be thrown when <code>arg_params</code> or <code>aux_params</code> contain extra parameters that is not needed by the executor.



**Value**

model A trained mxnet model.

---

mx.model.init.params	<i>Parameter initialization</i>
----------------------	---------------------------------

---

**Description**

Parameter initialization

**Usage**

```
mx.model.init.params(symbol, input.shape, output.shape, initializer, ctx)
```

**Arguments**

symbol	The symbolic configuration of the neural network.
input.shape	The shape of the input for the neural network.
output.shape	The shape of the output for the neural network. It can be NULL.
initializer,	initializer object. The initialization scheme for parameters.
ctx	mx.context. The devices used to perform initialization.

---

mx.model.load	<i>Load model checkpoint from file.</i>
---------------	---

---

**Description**

Load model checkpoint from file.

**Usage**

```
mx.model.load(prefix, iteration)
```

**Arguments**

prefix	string prefix of the model name
iteration	integer Iteration number of model we would like to load.

---

mx.model.save	Save model checkpoint into file.
---------------	----------------------------------

---

**Description**

Save model checkpoint into file.

**Usage**

mx.model.save(model, prefix, iteration)

**Arguments**

- |           |  |
|-----------|--|
| model     | The feedforward model to be saved.                       |
| prefix    | string prefix of the model name                          |
| iteration | integer Iteration number of model we would like to load. |

---

mx.nd.abs	Returns element-wise absolute value of the input.
-----------	---

---

**Description**

Example::

**Arguments**

- |      |                                    |
|------|------------------------------------|
| data | NDArray-or-Symbol The input array. |
|------|------------------------------------|

**Details**

abs([-2, 0, 3]) = [2, 0, 3]  
The storage type of “abs“ output depends upon the input storage type:  
- abs(default) = default - abs(row\_sparse) = row\_sparse - abs(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L720

**Value**

out The result mx.ndarray

---

mx.nd.Activation	<i>Applies an activation function element-wise to the input.</i>
------------------	--

---

### Description

The following activation functions are supported:

### Arguments

data	NDArray-or-Symbol The input array.
act.type	'relu', 'sigmoid', 'softrelu', 'softsign', 'tanh', required Activation function to be applied.

### Details

- 'relu': Rectified Linear Unit,  $y = \max(x, 0)$
- 'sigmoid':  $y = \frac{1}{1 + \exp(-x)}$
- 'tanh': Hyperbolic tangent,  $y = \frac{\exp(x) - \exp(-x)}{\exp(x) + \exp(-x)}$
- 'softrelu': Soft ReLU, or SoftPlus,  $y = \log(1 + \exp(x))$
- 'softsign':  $y = \frac{x}{1 + \abs{x}}$

Defined in src/operator/nn/activation.cc:L165

### Value

out The result mx.ndarray

---

mx.nd.adam.update	<i>Update function for Adam optimizer. Adam is seen as a generalization of AdaGrad.</i>
-------------------	---

---

### Description

Adam update consists of the following steps, where g represents gradient and m, v are 1st and 2nd order moment estimates (mean and variance).

### Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
lr	float, required Learning rate
beta1	float, optional, default=0.899999976 The decay rate for the 1st moment estimates.

beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.99999994e-09 A small constant for numerical stability.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and all of w, m and v have the same stype

## Details

.. math::

$$\begin{aligned} \mathbf{g}_t &= \nabla J(\mathbf{W}_{t-1}) \\ \mathbf{m}_t &= \beta_1 \mathbf{m}_{t-1} + (1 - \beta_1) \mathbf{g}_t \\ \mathbf{v}_t &= \beta_2 \mathbf{v}_{t-1} + (1 - \beta_2) \mathbf{g}_t^2 \\ \mathbf{W}_t &= \mathbf{W}_{t-1} - \alpha \frac{\mathbf{m}_t}{\sqrt{\mathbf{v}_t}} + \epsilon \end{aligned}$$

It updates the weights using::

$$\mathbf{m} = \beta_1 * \mathbf{m} + (1 - \beta_1) * \text{grad} \quad \mathbf{v} = \beta_2 * \mathbf{v} + (1 - \beta_2) * (\text{grad} ** 2) \quad \mathbf{w} += - \text{learning\_rate} * \mathbf{m} / (\sqrt{\mathbf{v}} + \epsilon)$$

However, if grad's storage type is "row\_sparse", "lazy\_update" is True and the storage type of weight is the same as those of m and v, only the row slices whose indices appear in grad.indices are updated (for w, m and v)::

$$\text{for row in grad.indices: } \begin{aligned} \mathbf{m}[\text{row}] &= \beta_1 * \mathbf{m}[\text{row}] + (1 - \beta_1) * \text{grad}[\text{row}] \\ \mathbf{v}[\text{row}] &= \beta_2 * \mathbf{v}[\text{row}] + (1 - \beta_2) * (\text{grad}[\text{row}] ** 2) \\ \mathbf{w}[\text{row}] &+= - \text{learning\_rate} * \mathbf{m}[\text{row}] / (\sqrt{\mathbf{v}[\text{row}]} + \epsilon) \end{aligned}$$

Defined in src/operator/optimizer\_op.cc:L679

## Value

out The result mx.ndarray

---

mx.nd.add.n

Adds all input arguments element-wise.

---

## Description

$$\text{.. math:: } \text{add\_n}(\mathbf{a}_1, \mathbf{a}_2, \dots, \mathbf{a}_n) = \mathbf{a}_1 + \mathbf{a}_2 + \dots + \mathbf{a}_n$$

## Arguments

args NDAarray-or-Symbol[] Positional input arguments

Details

“add\_n” is potentially more efficient than calling “add” by ‘n’ times.  
The storage type of “add\_n” output depends on storage types of inputs  
- add\_n(row\_sparse, row\_sparse, ..) = row\_sparse - add\_n(default, csr, default) = default - add\_n(any input combinations longer than 4 (>4) with at least one default type) = default - otherwise, “add\_n” falls all inputs back to default storage and generates default storage  
Defined in src/operator/tensor/elemwise\_sum.cc:L155

Value

out The result mx.ndarray

---

mx.nd.all.finite	Check if all the float numbers in the array are finite (used for AMP)
------------------	---

---

Description

Defined in src/operator/contrib/all\_finite.cc:L101

Arguments

data                   NDArray Array  
init.output           boolean, optional, default=1 Initialize output to 1.

Value

out The result mx.ndarray

---

mx.nd.amp.cast	Cast function between low precision float/FP32 used by AMP.
----------------	---

---

Description

It casts only between low precision float/FP32 and does not do anything for other types.

Arguments

data                   NDArray-or-Symbol The input.  
dtype                  'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', required  
                         Output data type.

Details

Defined in src/operator/tensor/amp\_cast.cc:L121

**Value**

out The result mx.ndarray

---

mx.nd.amp.multicast	<i>Cast function used by AMP, that casts its inputs to the common widest type.</i>
---------------------	--

---

**Description**

It casts only between low precision float/FP32 and does not do anything for other types.

**Arguments**

data	NDArray-or-Symbol[] Weights
num.outputs	int, required Number of input/output pairs to be casted to the widest type.
cast.narrow	boolean, optional, default=0 Whether to cast to the narrowest type

**Details**

Defined in src/operator/tensor/amp\_cast.cc:L165

**Value**

out The result mx.ndarray

---

mx.nd.arccos	<i>Returns element-wise inverse cosine of the input array.</i>
--------------	--

---

**Description**

The input should be in range  $[-1, 1]$ . The output is in the closed interval  $[0, \pi]$ .

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

.. math:: \arccos([-1, -.707, 0, .707, 1]) = [\pi, 3\pi/4, \pi/2, \pi/4, 0]

The storage type of “arccos” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L233

**Value**

out The result mx.ndarray

---

mx.nd.arccosh	<i>Returns the element-wise inverse hyperbolic cosine of the input array, \ computed element-wise.</i>
---------------	--

---

**Description**

The storage type of “arccosh” output is always dense

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Defined in src/operator/tensor/elementwise\_unary\_op\_trig.cc:L535

**Value**

out The result mx.ndarray

---

mx.nd.arcsin	<i>Returns element-wise inverse sine of the input array.</i>
--------------	--

---

**Description**

The input should be in the range ‘[-1, 1]’. The output is in the closed interval of  $[-\pi/2, \pi/2]$ .

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

.. math:: \arcsin([-1, -.707, 0, .707, 1]) = [-\pi/2, -\pi/4, 0, \pi/4, \pi/2]

The storage type of “arcsin” output depends upon the input storage type:

- arcsin(default) = default - arcsin(row\_sparse) = row\_sparse - arcsin(csr) = csr

Defined in src/operator/tensor/elementwise\_unary\_op\_trig.cc:L187

**Value**

out The result mx.ndarray

---

mx.nd.arcsinh	<i>Returns the element-wise inverse hyperbolic sine of the input array, \ computed element-wise.</i>
---------------	--

---

### Description

The storage type of “arcsinh” output depends upon the input storage type:

### Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

### Details

- arcsinh(default) = default - arcsinh(row\_sparse) = row\_sparse - arcsinh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L494

### Value

out	The result mx.ndarray
-----	-----------------------

---

mx.nd.arctan	<i>Returns element-wise inverse tangent of the input array.</i>
--------------	---

---

### Description

The output is in the closed interval :math:‘[-\pi/2, \pi/2]’

### Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

### Details

.. math:: \arctan([-1, 0, 1]) = [-\pi/4, 0, \pi/4]

The storage type of “arctan” output depends upon the input storage type:

- arctan(default) = default - arctan(row\_sparse) = row\_sparse - arctan(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L282

### Value

out	The result mx.ndarray
-----	-----------------------



---

mx.nd.arctanh	Returns the element-wise inverse hyperbolic tangent of the input array, \ computed element-wise.
---------------	--

---

**Description**

The storage type of “arctanh” output depends upon the input storage type:

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

- arctanh(default) = default - arctanh(row\_sparse) = row\_sparse - arctanh(csr) = csr  
Defined in src/operator/tensor/elementwise\_unary\_op\_trig.cc:L579

**Value**

out The result mx.ndarray

---

mx.nd.argmax	Returns indices of the maximum values along an axis.
--------------	--

---

**Description**

In the case of multiple occurrences of maximum values, the indices corresponding to the first occurrence are returned.

**Arguments**

data                      NDAarray-or-Symbol The input  
axis                      int or None, optional, default='None' The axis along which to perform the reduction. Negative values means indexing from right to left. “Requires axis to be set as int, because global reduction is not supported yet.”  
keepdims                  boolean, optional, default=0 If this is set to ‘True’, the reduced axis is left in the result as dimension with size one.

**Details**

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
// argmax along axis 0 argmax(x, axis=0) = [ 1., 1., 1.]
```

```
// argmax along axis 1 argmax(x, axis=1) = [ 2., 2.]
```

```
// argmax along axis 1 keeping same dims as an input array argmax(x, axis=1, keepdims=True) = [[ 2.], [ 2.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L52

**Value**

out The result mx.ndarray

---

mx.nd.argmax.channel     *Returns argmax indices of each channel from the input array.*

---

**Description**

The result will be an NDAarray of shape (num\_channel,).

**Arguments**

data                      NDAarray-or-Symbol The input array

**Details**

In case of multiple occurrences of the maximum values, the indices corresponding to the first occurrence are returned.

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
argmax_channel(x) = [ 2., 2.]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L97

**Value**

out The result mx.ndarray

---

mx.nd.argmin	<i>Returns indices of the minimum values along an axis.</i>
--------------	---

---

## Description

In the case of multiple occurrences of minimum values, the indices corresponding to the first occurrence are returned.

## Arguments

data	NDArray-or-Symbol The input
axis	int or None, optional, default='None' The axis along which to perform the reduction. Negative values means indexing from right to left. "Requires axis to be set as int, because global reduction is not supported yet."
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axis is left in the result as dimension with size one.

## Details

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
// argmin along axis 0 argmin(x, axis=0) = [ 0., 0., 0.]
```

```
// argmin along axis 1 argmin(x, axis=1) = [ 0., 0.]
```

```
// argmin along axis 1 keeping same dims as an input array argmin(x, axis=1, keepdims=True) = [[ 0.], [ 0.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L77

## Value

out The result mx.ndarray

---

mx.nd.argsort	<i>Returns the indices that would sort an input array along the given axis.</i>
---------------	---

---

## Description

This function performs sorting along the given axis and returns an array of indices having same shape as an input array that index data in sorted order.

**Arguments**

data	NDArray-or-Symbol The input array
axis	int or None, optional, default='-1' Axis along which to sort the input tensor. If not given, the flattened array is used. Default is -1.
is.ascend	boolean, optional, default=1 Whether to sort in ascending or descending order.
dtype	'float16', 'float32', 'float64', 'int32', 'int64', 'uint8', optional, default='float32' DType of the output indices. It is only valid when ret_typ is "indices" or "both". An error will be raised if the selected data type cannot precisely represent the indices.

**Details**

Examples::

```
x = [[ 0.3, 0.2, 0.4], [ 0.1, 0.3, 0.2]]
// sort along axis -1 argsort(x) = [[ 1., 0., 2.], [ 0., 2., 1.]]
// sort along axis 0 argsort(x, axis=0) = [[ 1., 0., 1.] [ 0., 1., 0.]]
// flatten and then sort argsort(x, axis=None) = [ 3., 1., 5., 0., 4., 2.]
```

Defined in src/operator/tensor/ordering\_op.cc:L185

**Value**

out The result mx.ndarray

---

mx.nd.array

*Create a new mx.ndarray that copies the content from src on ctx.*

---

**Description**

Create a new mx.ndarray that copies the content from src on ctx.

**Usage**

```
mx.nd.array(src.array, ctx = NULL)
```

**Arguments**

src.array	Source array data of class array, vector or matrix.
ctx	optional The context device of the array. mx.ctx.default() will be used in default.

**Value**

An mx.ndarray

An Rcpp\_MXNDArray object

**Examples**

```
mat = mx.nd.array(x)
mat = 1 - mat + (2 * mat)/(mat + 0.5)
as.array(mat)
```

---

mx.nd.batch.dot	<i>Batchwise dot product.</i>
-----------------	-------------------------------

---

**Description**

“batch\_dot” is used to compute dot product of “x” and “y” when “x” and “y” are data in batch, namely N-D ( $N \geq 3$ ) arrays in shape of ‘(B0, ..., B\_i, :, :)’.

**Arguments**

lhs	NDArray-or-Symbol The first input
rhs	NDArray-or-Symbol The second input
transpose.a	boolean, optional, default=0 If true then transpose the first input before dot.
transpose.b	boolean, optional, default=0 If true then transpose the second input before dot.
forward.stype	None, 'csr', 'default', 'row_sparse', optional, default='None' The desired storage type of the forward output given by user, if the combination of input storage types and this hint does not match any implemented ones, the dot operator will perform fallback operation and still produce an output of the desired storage type.

**Details**

For example, given “x” with shape ‘(B\_0, ..., B\_i, N, M)’ and “y” with shape ‘(B\_0, ..., B\_i, M, K)’, the result array will have shape ‘(B\_0, ..., B\_i, N, K)’, which is computed by::

```
batch_dot(x,y)[b_0, ..., b_i, :, :] = dot(x[b_0, ..., b_i, :, :], y[b_0, ..., b_i, :, :])
```

Defined in src/operator/tensor/dot.cc:L127

**Value**

out The result mx.ndarray

---

mx.nd.batch.take	<i>Takes elements from a data batch.</i>
------------------	--

---

### Description

.. note:: ‘batch\_take’ is deprecated. Use ‘pick’ instead.

### Arguments

a	NDArray-or-Symbol The input array
indices	NDArray-or-Symbol The index array

### Details

Given an input array of shape “(d0, d1)” and indices of shape “(i0,)”, the result will be an output array of shape “(i0,)” with::

```
output[i] = input[i, indices[i]]
```

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// takes elements with specified indices batch_take(x, [0,1,0]) = [ 1. 4. 5.]
```

Defined in src/operator/tensor/indexing\_op.cc:L841

### Value

out The result mx.ndarray

---

mx.nd.BatchNorm	<i>Batch normalization.</i>
-----------------	-----------------------------

---

### Description

Normalizes a data batch by mean and variance, and applies a scale “gamma” as well as offset “beta”.

### Arguments

data	NDArray-or-Symbol Input data to batch normalization
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
moving.mean	NDArray-or-Symbol running mean of input
moving.var	NDArray-or-Symbol running variance of input
eps	double, optional, default=0.0010000000474974513 Epsilon to prevent div 0. Must be no less than CUDNN_BN_MIN_EPSILON defined in cudnn.h when using cudnn (usually 1e-5)

momentum	float, optional, default=0.899999976 Momentum for moving average
fix.gamma	boolean, optional, default=1 Fix gamma while training
use.global.stats	boolean, optional, default=0 Whether use global moving statistics instead of local batch-norm. This will force change batch-norm into a scale shift operator.
output.mean.var	boolean, optional, default=0 Output the mean and inverse std
axis	int, optional, default='1' Specify which shape axis the channel is specified
cudnn.off	boolean, optional, default=0 Do not select CUDNN operator, if available
min.calib.range	float or None, optional, default=None The minimum scalar value in the form of float32 obtained through calibration. If present, it will be used to by quantized batch norm op to calculate primitive scale.Note: this calib_range is to calib bn output.
max.calib.range	float or None, optional, default=None The maximum scalar value in the form of float32 obtained through calibration. If present, it will be used to by quantized batch norm op to calculate primitive scale.Note: this calib_range is to calib bn output.

## Details

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis:

```
.. math::
```

```
data_mean[i] = mean(data[:,i,:,...]) \ data_var[i] = var(data[:,i,:,...])
```

Then compute the normalized output, which has the same shape as input, as following:

```
.. math::
```

```
out[:,i,:,...] = \frac{data[:,i,:,...] - data_mean[i]}{\sqrt{data_var[i] + \epsilon}} * gamma[i] + beta[i]
```

Both `*mean*` and `*var*` returns a scalar by treating the input as a vector.

Assume the input has size `*k*` on axis 1, then both “gamma” and “beta” have shape `*(k,)*`. If “output\_mean\_var” is set to be true, then outputs both “data\_mean” and the inverse of “data\_var”, which are needed for the backward pass. Note that gradient of these two outputs are blocked.

Besides the inputs and the outputs, this operator accepts two auxiliary states, “moving\_mean” and “moving\_var”, which are `*k*`-length vectors. They are global statistics for the whole dataset, which are updated by::

```
moving_mean = moving_mean * momentum + data_mean * (1 - momentum)
moving_var = moving_var * momentum + data_var * (1 - momentum)
```

If “use\_global\_stats” is set to be true, then “moving\_mean” and “moving\_var” are used instead of “data\_mean” and “data\_var” to compute the output. It is often used during inference.

The parameter “axis” specifies which axis of the input shape denotes the ‘channel’ (separately normalized groups). The default is 1. Specifying -1 sets the channel axis to be the last item in the input shape.

Both “gamma” and “beta” are learnable parameters. But if “fix\_gamma” is true, then set “gamma” to 1 and its gradient to 0.

.. Note:: When “fix\_gamma” is set to True, no sparse support is provided. If “fix\_gamma is” set to False, the sparse tensors will fallback.

Defined in src/operator/nn/batch\_norm.cc:L545

## Value

out The result mx.ndarray

---

mx.nd.BatchNorm.v1	<i>Batch normalization.</i>
--------------------	-----------------------------

---

## Description

This operator is DEPRECATED. Perform BatchNorm on the input.

## Arguments

data	NDArray-or-Symbol Input data to batch normalization
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
eps	float, optional, default=0.00100000005 Epsilon to prevent div 0
momentum	float, optional, default=0.899999976 Momentum for moving average
fix.gamma	boolean, optional, default=1 Fix gamma while training
use.global.stats	boolean, optional, default=0 Whether use global moving statistics instead of local batch-norm. This will force change batch-norm into a scale shift operator.
output.mean.var	boolean, optional, default=0 Output All,normal mean and var

## Details

Normalizes a data batch by mean and variance, and applies a scale “gamma” as well as offset “beta”.

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis:

.. math::

$\text{data\_mean}[i] = \text{mean}(\text{data}[:,i,:,...])$  \  $\text{data\_var}[i] = \text{var}(\text{data}[:,i,:,...])$

Then compute the normalized output, which has the same shape as input, as following:

.. math::

$\text{out}[:,i,:,...] = \frac{\text{data}[:,i,:,...] - \text{data\_mean}[i]}{\sqrt{\text{data\_var}[i] + \epsilon}} * \text{gamma}[i] + \text{beta}[i]$

Both \*mean\* and \*var\* returns a scalar by treating the input as a vector.



Assume the input has size  $k$  on axis 1, then both “gamma” and “beta” have shape  $(k,)*$ . If “output\_mean\_var” is set to be true, then outputs both “data\_mean” and “data\_var” as well, which are needed for the backward pass.

Besides the inputs and the outputs, this operator accepts two auxiliary states, “moving\_mean” and “moving\_var”, which are  $k$ -length vectors. They are global statistics for the whole dataset, which are updated by::

$$\begin{aligned} \text{moving\_mean} &= \text{moving\_mean} * \text{momentum} + \text{data\_mean} * (1 - \text{momentum}) \\ \text{moving\_var} &= \text{moving\_var} * \text{momentum} + \text{data\_var} * (1 - \text{momentum}) \end{aligned}$$

If “use\_global\_stats” is set to be true, then “moving\_mean” and “moving\_var” are used instead of “data\_mean” and “data\_var” to compute the output. It is often used during inference.

Both “gamma” and “beta” are learnable parameters. But if “fix\_gamma” is true, then set “gamma” to 1 and its gradient to 0.

There’s no sparse support for this operator, and it will exhibit problematic behavior if used with sparse tensors.

Defined in src/operator/batch\_norm\_v1.cc:L95

## Value

out The result mx.ndarray

---

mx.nd.BilinearSampler *Applies bilinear sampling to input feature map.*

---

## Description

Bilinear Sampling is the key of [NIPS2015] “Spatial Transformer Networks”. The usage of the operator is very similar to remap function in OpenCV, except that the operator has the backward pass.

## Arguments

data	NDArray-or-Symbol Input data to the BilinearsamplerOp.
grid	NDArray-or-Symbol Input grid to the BilinearsamplerOp.grid has two channels: x_src, y_src
cudnn.off	boolean or None, optional, default=None whether to turn cudnn off

## Details

Given  $\text{data}$  and  $\text{grid}$ , then the output is computed by

$$\text{output}[\text{batch}, \text{channel}, \text{y\_dst}, \text{x\_dst}] = G(\text{data}[\text{batch}, \text{channel}, \text{y\_src}, \text{x\_src}])$$

$\text{output}$ ,  $\text{y\_dst}$  enumerate all spatial locations in  $\text{output}$ , and  $G()$  denotes the bilinear interpolation kernel. The out-boundary points will be padded with zeros. The shape of the output will be (data.shape[0], data.shape[1], grid.shape[2], grid.shape[3]).

The operator assumes that :math:`data` has 'NCHW' layout and :math:`grid` has been normalized to  $[-1, 1]$ .

BilinearSampler often cooperates with GridGenerator which generates sampling grids for BilinearSampler. GridGenerator supports two kinds of transformation: “affine” and “warp”. If users want to design a CustomOp to manipulate :math:`grid`, please firstly refer to the code of GridGenerator.

Example 1::

```
## Zoom out data two times data = array([[[[1, 4, 3, 6], [1, 8, 8, 9], [0, 4, 1, 5], [1, 0, 1, 3]]]])
affine_matrix = array([[2, 0, 0], [0, 2, 0]])
affine_matrix = reshape(affine_matrix, shape=(1, 6))
grid = GridGenerator(data=affine_matrix, transform_type='affine', target_shape=(4, 4))
out = BilinearSampler(data, grid)
out [[[ [ 0, 0, 0, 0], [ 0, 3.5, 6.5, 0], [ 0, 1.25, 2.5, 0], [ 0, 0, 0, 0]]]]
```

Example 2::

```
## shift data horizontally by -1 pixel
data = array([[[[1, 4, 3, 6], [1, 8, 8, 9], [0, 4, 1, 5], [1, 0, 1, 3]]]])
warp_matrix = array([[[[1, 1, 1, 1], [1, 1, 1, 1], [1, 1, 1, 1], [1, 1, 1, 1]], [[0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0]]]])
grid = GridGenerator(data=warp_matrix, transform_type='warp') out = BilinearSampler(data, grid)
out [[[ [ 4, 3, 6, 0], [ 8, 8, 9, 0], [ 4, 1, 5, 0], [ 0, 1, 3, 0]]]]
Defined in src/operator/bilinear_sampler.cc:L256
```

## Value

out The result mx.ndarray

---

mx.nd.BlockGrad	<i>Stops gradient computation.</i>
-----------------	------------------------------------

---

## Description

Stops the accumulated gradient of the inputs from flowing through this operator in the backward direction. In other words, this operator prevents the contribution of its inputs to be taken into account for computing gradients.

## Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

Example::

```
v1 = [1, 2] v2 = [0, 1] a = Variable('a') b = Variable('b') b_stop_grad = stop_gradient(3 * b) loss =
MakeLoss(b_stop_grad + a)
executor = loss.simple_bind(ctx=cpu(), a=(1,2), b=(1,2)) executor.forward(is_train=True, a=v1, b=v2)
executor.outputs [ 1. 5.]
executor.backward() executor.grad_arrays [ 0. 0.] [ 1. 1.]
Defined in src/operator/tensor/elemwise_unary_op_basic.cc:L325
```

**Value**

out The result mx.ndarray

---

mx.nd.broadcast.add	Returns element-wise sum of the input arrays with broadcasting.
---------------------	---

---

**Description**

'broadcast\_plus' is an alias to the function 'broadcast\_add'.

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
y = [[ 0.], [ 1.]]
broadcast_add(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
broadcast_plus(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_add(csr, dense(1D)) = dense broadcast_add(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L58

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.axes`    *Broadcasts the input array over particular axes.*

---

### Description

Broadcasting is allowed on axes with size 1, such as from ‘(2,1,3,1)’ to ‘(2,8,3,9)’. Elements will be duplicated on the broadcasted axes.

### Arguments

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	Shape(tuple), optional, default=[] The axes to perform the broadcasting.
<code>size</code>	Shape(tuple), optional, default=[] Target sizes of the broadcasting axes.

### Details

‘broadcast\_axes’ is an alias to the function ‘broadcast\_axis’.

Example::

```
// given x of shape (1,2,1) x = [[[ 1.], [ 2.]]]
```

```
// broadcast x on on axis 2 broadcast_axis(x, axis=2, size=3) = [[[ 1., 1., 1.], [ 2., 2., 2.]]] // broadcast
x on on axes 0 and 2 broadcast_axis(x, axis=(0,2), size=(2,3)) = [[[ 1., 1., 1.], [ 2., 2., 2.]], [[ 1., 1.,
1.], [ 2., 2., 2.]]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L93

### Value

out The result mx.ndarray

---

`mx.nd.broadcast.axis`    *Broadcasts the input array over particular axes.*

---

### Description

Broadcasting is allowed on axes with size 1, such as from ‘(2,1,3,1)’ to ‘(2,8,3,9)’. Elements will be duplicated on the broadcasted axes.

### Arguments

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	Shape(tuple), optional, default=[] The axes to perform the broadcasting.
<code>size</code>	Shape(tuple), optional, default=[] Target sizes of the broadcasting axes.

**Details**

‘broadcast\_axes’ is an alias to the function ‘broadcast\_axis’.

Example::

```
// given x of shape (1,2,1) x = [[[ 1.], [ 2.]]]
```

```
// broadcast x on on axis 2 broadcast_axis(x, axis=2, size=3) = [[[ 1., 1., 1.], [ 2., 2., 2.]]] // broadcast
x on on axes 0 and 2 broadcast_axis(x, axis=(0,2), size=(2,3)) = [[[ 1., 1., 1.], [ 2., 2., 2.]], [[ 1., 1.,
1.], [ 2., 2., 2.]]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L93

**Value**

out The result mx.ndarray

---

mx.nd.broadcast.div      *Returns element-wise division of the input arrays with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

```
x = [[ 6., 6., 6.], [ 6., 6., 6.]]
```

```
y = [[ 2.], [ 3.]]
```

```
broadcast_div(x, y) = [[ 3., 3., 3.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_div(csr, dense(1D)) = csr
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L187

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.equal` *Returns the result of element-wise **\*\*equal to\*\*** (==) comparison operation with broadcasting.*

---

### Description

Example::

### Arguments

<code>lhs</code>	NDArray-or-Symbol First input to the function
<code>rhs</code>	NDArray-or-Symbol Second input to the function

### Details

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`

`y = [[ 0.], [ 1.]]`

`broadcast_equal(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_logic.cc:L46`

### Value

`out` The result `mx.ndarray`

---

`mx.nd.broadcast.greater` *Returns the result of element-wise **\*\*greater than\*\*** (>) comparison operation with broadcasting.*

---

### Description

Example::

### Arguments

<code>lhs</code>	NDArray-or-Symbol First input to the function
<code>rhs</code>	NDArray-or-Symbol Second input to the function

### Details

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`

`y = [[ 0.], [ 1.]]`

`broadcast_greater(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_logic.cc:L82`

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.greater.equal
```

*Returns the result of element-wise \*\*greater than or equal to\*\* ( $\geq$ ) comparison operation with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_greater_equal(x, y) = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elementwise\_binary\_broadcast\_op\_logic.cc:L100

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.hypot
```

*Returns the hypotenuse of a right angled triangle, given its "legs" with broadcasting.*

---

**Description**

It is equivalent to doing  $\text{sqrt}(x_1^2 + x_2^2)$ .

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

```
x = [[ 3., 3., 3.]]
```

```
y = [[ 4.], [ 4.]]
```

```
broadcast_hypot(x, y) = [[ 5., 5., 5.], [ 5., 5., 5.]]
```

```
z = [[ 0.], [ 4.]]
```

```
broadcast_hypot(x, z) = [[ 3., 3., 3.], [ 5., 5., 5.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L158

**Value**

out The result mx.ndarray

---

mx.nd.broadcast.lessor

*Returns the result of element-wise \*\*lesser than\*\* (<) comparison operation with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs NDAarray-or-Symbol First input to the function

rhs NDAarray-or-Symbol Second input to the function

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_lessor(x, y) = [[ 0., 0., 0.], [ 0., 0., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L118

**Value**

out The result mx.ndarray



---

```
mx.nd.broadcast.lesserequal
```

*Returns the result of element-wise \*\*lesser than or equal to\*\* ( $\leq$ ) comparison operation with broadcasting.*

---

## Description

Example::

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

## Details

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_lesserequal(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elementwise\_binary\_broadcast\_op\_logic.cc:L136

## Value

out The result mx.ndarray

---

```
mx.nd.broadcast.like
```

*Broadcasts lhs to have the same shape as rhs.*


---

## Description

Broadcasting is a mechanism that allows NDArrays to perform arithmetic operations with arrays of different shapes efficiently without creating multiple copies of arrays. Also see, 'Broadcasting' <<https://docs.scipy.org/doc/numpy/user/basics.broadcasting.html>>\_ for more explanation.

## Arguments

lhs	NDArray-or-Symbol First input.
rhs	NDArray-or-Symbol Second input.
lhs.axes	Shape or None, optional, default=None Axes to perform broadcast on in the first input array
rhs.axes	Shape or None, optional, default=None Axes to copy from the second input array

**Details**

Broadcasting is allowed on axes with size 1, such as from '(2,1,3,1)' to '(2,8,3,9)'. Elements will be duplicated on the broadcasted axes.

For example::

```
broadcast_like([[1,2,3]], [[5,6,7],[7,8,9]]) = [[ 1., 2., 3.], [ 1., 2., 3.]]
```

```
broadcast_like([9], [1,2,3,4,5], lhs_axes=(0,), rhs_axes=(-1,)) = [9,9,9,9,9]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L171

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.logical.and
```

*Returns the result of element-wise **\*\*logical and\*\*** with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_logical_and(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L154

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.logical.or
```

*Returns the result of element-wise **\*\*logical or\*\*** with broadcasting.*

---

## Description

Example::

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

## Details

```
x = [[ 1., 1., 0.], [ 1., 1., 0.]]
```

```
y = [[ 1.], [ 0.]]
```

```
broadcast_logical_or(x, y) = [[ 1., 1., 1.], [ 1., 1., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L172

## Value

out The result mx.ndarray

---

```
mx.nd.broadcast.logical.xor
```

*Returns the result of element-wise **\*\*logical xor\*\*** with broadcasting.*

---

## Description

Example::

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

## Details

```
x = [[ 1., 1., 0.], [ 1., 1., 0.]]
```

```
y = [[ 1.], [ 0.]]
```

```
broadcast_logical_xor(x, y) = [[ 0., 0., 1.], [ 1., 1., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L190

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.maximum`

*Returns element-wise maximum of the input arrays with broadcasting.*

---

**Description**

This function compares two input arrays and returns a new array having the element-wise maxima.

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`

`y = [[ 0.], [ 1.]]`

`broadcast_maximum(x, y) = [[ 1., 1., 1.], [ 1., 1., 1.]]`

Defined in `src/operator/tensor/elementwise_binary_broadcast_op_extended.cc:L81`

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.minimum`

*Returns element-wise minimum of the input arrays with broadcasting.*

---

**Description**

This function compares two input arrays and returns a new array having the element-wise minima.

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_maximum(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L117

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.minus` *Returns element-wise difference of the input arrays with broadcasting.*

---

**Description**

‘broadcast\_minus’ is an alias to the function ‘broadcast\_sub’.

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_sub(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

```
broadcast_minus(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Supported sparse operations:

```
broadcast_sub/minus(csr, dense(1D)) = dense broadcast_sub/minus(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L106

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.mod`      *Returns element-wise modulo of the input arrays with broadcasting.*

---

### Description

Example::

### Arguments

<code>lhs</code>	NDArray-or-Symbol First input to the function
<code>rhs</code>	NDArray-or-Symbol Second input to the function

### Details

`x = [[ 8., 8., 8.], [ 8., 8., 8.]]`

`y = [[ 2.], [ 3.]]`

`broadcast_mod(x, y) = [[ 0., 0., 0.], [ 2., 2., 2.]]`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_basic.cc:L222`

### Value

`out` The result `mx.ndarray`

---

`mx.nd.broadcast.mul`      *Returns element-wise product of the input arrays with broadcasting.*

---

### Description

Example::

### Arguments

<code>lhs</code>	NDArray-or-Symbol First input to the function
<code>rhs</code>	NDArray-or-Symbol Second input to the function

### Details

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`

`y = [[ 0.], [ 1.]]`

`broadcast_mul(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]`

Supported sparse operations:

`broadcast_mul(csr, dense(1D)) = csr`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_basic.cc:L146`

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.not.equal
```

*Returns the result of element-wise **\*\*not equal to\*\*** (!=) comparison operation with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_not_equal(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L64

**Value**

out The result mx.ndarray

---

```
mx.nd.broadcast.plus
```

*Returns element-wise sum of the input arrays with broadcasting.*

---

**Description**

‘broadcast\_plus’ is an alias to the function ‘broadcast\_add’.

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_add(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

```
broadcast_plus(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_add(csr, dense(1D)) = dense broadcast_add(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L58

**Value**

out The result mx.ndarray

---

`mx.nd.broadcast.power` *Returns result of first array elements raised to powers from second array, element-wise with broadcasting.*

---

**Description**

Example::

**Arguments**

lhs                      NDAarray-or-Symbol First input to the function

rhs                      NDAarray-or-Symbol Second input to the function

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_power(x, y) = [[ 2., 2., 2.], [ 4., 4., 4.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L45

**Value**

out The result mx.ndarray



---

`mx.nd.broadcast.sub`      *Returns element-wise difference of the input arrays with broadcasting.*

---

### Description

‘broadcast\_minus’ is an alias to the function ‘broadcast\_sub’.

### Arguments

<code>lhs</code>	NDArray-or-Symbol First input to the function
<code>rhs</code>	NDArray-or-Symbol Second input to the function

### Details

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_sub(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

```
broadcast_minus(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Supported sparse operations:

```
broadcast_sub/minus(csr, dense(1D)) = dense broadcast_sub/minus(dense(1D), csr) = dense
```

Defined in `src/operator/tensor/elementwise_binary_broadcast_op_basic.cc:L106`

### Value

`out` The result `mx.ndarray`

---

`mx.nd.broadcast.to`      *Broadcasts the input array to a new shape.*

---

### Description

Broadcasting is a mechanism that allows NDArrays to perform arithmetic operations with arrays of different shapes efficiently without creating multiple copies of arrays. Also see, ‘Broadcasting’ <<https://docs.scipy.org/doc/numpy/user/basics.broadcasting.html>>\_ for more explanation.

### Arguments

<code>data</code>	NDArray-or-Symbol The input
<code>shape</code>	Shape(tuple), optional, default=[] The shape of the desired array. We can set the dim to zero if it’s same as the original. E.g ‘A = broadcast_to(B, shape=(10, 0, 0))’ has the same meaning as ‘A = broadcast_axis(B, axis=0, size=10)’.

**Details**

Broadcasting is allowed on axes with size 1, such as from ‘(2,1,3,1)’ to ‘(2,8,3,9)’. Elements will be duplicated on the broadcasted axes.

For example::

```
broadcast_to([[1,2,3]], shape=(2,3)) = [[ 1., 2., 3.], [ 1., 2., 3.]]
```

The dimension which you do not want to change can also be kept as ‘0’ which means copy the original value. So with ‘shape=(2,0)’, we will obtain the same result as in the above example.

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L117

**Value**

out The result mx.ndarray

---

mx.nd.Cast	<i>Casts all elements of the input to a new type.</i>
------------	---

---

**Description**

.. note:: “Cast“ is deprecated. Use “cast“ instead.

**Arguments**

data	NDArray-or-Symbol The input.
dtype	’bfloat16’, ’bool’, ’float16’, ’float32’, ’float64’, ’int32’, ’int64’, ’int8’, ’uint8’, required Output data type.

**Details**

Example::

```
cast([0.9, 1.3], dtype='int32') = [0, 1] cast([1e20, 11.1], dtype='float16') = [inf, 11.09375] cast([300, 11.1, 10.9, -1, -3], dtype='uint8') = [44, 11, 10, 255, 253]
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L664

**Value**

out The result mx.ndarray

---

mx.nd.cast	<i>Casts all elements of the input to a new type.</i>
------------	---

---

**Description**

.. note:: “Cast” is deprecated. Use “cast” instead.

**Arguments**

data	NDArray-or-Symbol The input.
dtype	'bfloat16', 'bool', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', required Output data type.

**Details**

Example::  
cast([0.9, 1.3], dtype='int32') = [0, 1] cast([1e20, 11.1], dtype='float16') = [inf, 11.09375] cast([300, 11.1, 10.9, -1, -3], dtype='uint8') = [44, 11, 10, 255, 253]  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L664

**Value**

out The result mx.ndarray

---

mx.nd.cast.storage	<i>Casts tensor storage type to the new type.</i>
--------------------	---

---

**Description**

When an NDArray with default storage type is cast to csr or row\_sparse storage, the result is compact, which means:

**Arguments**

data	NDArray-or-Symbol The input.
stype	'csr', 'default', 'row_sparse', required Output storage type.

**Details**

- for csr, zero values will not be retained - for row\_sparse, row slices of all zeros will not be retained

The storage type of “cast\_storage” output depends on stype parameter:

- cast\_storage(csr, 'default') = default - cast\_storage(row\_sparse, 'default') = default - cast\_storage(default, 'csr') = csr - cast\_storage(default, 'row\_sparse') = row\_sparse - cast\_storage(csr, 'csr') = csr - cast\_storage(row\_sparse, 'row\_sparse') = row\_sparse

Example::

```
dense = [[ 0., 1., 0.], [ 2., 0., 3.], [ 0., 0., 0.], [ 0., 0., 0.]]
```

```
# cast to row_sparse storage type rsp = cast_storage(dense, 'row_sparse')
rsp.indices = [0, 1]
rsp.values = [[ 0., 1., 0.], [ 2., 0., 3.]]
```

```
# cast to csr storage type csr = cast_storage(dense, 'csr')
csr.indices = [1, 0, 2]
csr.values = [ 1., 2., 3.]
csr.indptr = [0, 1, 3, 3, 3]
```

Defined in src/operator/tensor/cast\_storage.cc:L71

**Value**

out The result mx.ndarray

---

mx.nd.cbrt

*Returns element-wise cube-root value of the input.*

---

**Description**

.. math:: \text{cbrt}(x) = \sqrt[3]{x}

**Arguments**

data NDAarray-or-Symbol The input array.

**Details**

Example::

```
cbrt([1, 8, -125]) = [1, 2, -5]
```

The storage type of “cbrt” output depends upon the input storage type:

- cbrt(default) = default - cbrt(row\_sparse) = row\_sparse - cbrt(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L270

**Value**

out The result mx.ndarray

---

mx.nd.ceil	<i>Returns element-wise ceiling of the input.</i>
------------	---

---

**Description**

The ceil of the scalar  $x$  is the smallest integer  $i$ , such that  $i \geq x$ .

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

Example::

```
ceil([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-2., -1., 2., 2., 3.]
```

The storage type of “ceil” output depends upon the input storage type:

- ceil(default) = default - ceil(row\_sparse) = row\_sparse - ceil(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L817

**Value**

out	The result mx.ndarray
-----	-----------------------

---

mx.nd.choose.element.0index	<i>Picks elements from an input array according to the input indices along the given axis.</i>
-----------------------------	--

---

**Description**

Given an input array of shape “(d0, d1)” and indices of shape “(i0,)”, the result will be an output array of shape “(i0,)” with::

**Arguments**

data	NDArray-or-Symbol The input array
index	NDArray-or-Symbol The index array
axis	int or None, optional, default=-1' int or None. The axis to picking the elements. Negative values means indexing from right to left. If is 'None', the elements in the index w.r.t the flattened input will be picked.
keepdims	boolean, optional, default=0 If true, the axis where we pick the elements is left in the result as dimension with size one.
mode	'clip', 'wrap', optional, default='clip' Specify how out-of-bound indices behave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around.

**Details**

```
output[i] = input[i, indices[i]]
```

By default, if any index mentioned is too large, it is replaced by the index that addresses the last element along an axis (the ‘clip’ mode).

This function supports n-dimensional input and (n-1)-dimensional indices arrays.

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// picks elements with specified indices along axis 0 pick(x, y=[0,1], 0) = [ 1., 4.]
```

```
// picks elements with specified indices along axis 1 pick(x, y=[0,1,0], 1) = [ 1., 4., 5.]
```

```
// picks elements with specified indices along axis 1 using 'wrap' mode // to place indicies that would normally be out of bounds pick(x, y=[2,-1,-2], 1, mode='wrap') = [ 1., 4., 5.]
```

```
y = [[ 1.], [ 0.], [ 2.]]
```

```
// picks elements with specified indices along axis 1 and dims are maintained pick(x, y, 1, keep-dims=True) = [[ 2.], [ 3.], [ 6.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L151

**Value**

out The result mx.ndarray

---

mx.nd.clip

*Clips (limits) the values in an array. Given an interval, values outside the interval are clipped to the interval edges. Clipping “x” between ‘a\_min’ and ‘a\_max’ would be:: .. math:: clip(x, a\\_min, a\\_max) = \max(\min(x, a\\_max), a\\_min)* Example::  $x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]$   $clip(x, 1, 8) = [1., 1., 2., 3., 4., 5., 6., 7., 8., 8.]$  The storage type of “clip” output depends on storage types of inputs and the a\_min, a\_max\parameter values: - clip(default) = default - clip(row\_sparse, a\_min <= 0, a\_max >= 0) = row\_sparse - clip(csr, a\_min <= 0, a\_max >= 0) = csr - clip(row\_sparse, a\_min < 0, a\_max < 0) = default - clip(row\_sparse, a\_min > 0, a\_max > 0) = default - clip(csr, a\_min < 0, a\_max < 0) = csr - clip(csr, a\_min > 0, a\_max > 0) = csr

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L677

**Arguments**

data	NDArray-or-Symbol Input array.
a.min	float, required Minimum value
a.max	float, required Maximum value

**Value**

out The result mx.ndarray

---

mx.nd.col2im

---

Combining the output column matrix of im2col back to image array.

---

**Description**

Like :class:`~mxnet.ndarray.im2col`, this operator is also used in the vanilla convolution implementation. Despite the name, col2im is not the reverse operation of im2col. Since there may be overlaps between neighbouring sliding blocks, the column elements cannot be directly put back into image. Instead, they are accumulated (i.e., summed) in the input image just like the gradient computation, so col2im is the gradient of im2col and vice versa.

**Arguments**

data	NDArray-or-Symbol Input array to combine sliding blocks.
output.size	Shape(tuple), required The spatial dimension of image array: (w,), (h, w) or (d, h, w).
kernel	Shape(tuple), required Sliding kernel size: (w,), (h, w) or (d, h, w).
stride	Shape(tuple), optional, default=[] The stride between adjacent sliding blocks in spatial dimension: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] The spacing between adjacent kernel points: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
pad	Shape(tuple), optional, default=[] The zero-value padding size on both sides of spatial dimension: (w,), (h, w) or (d, h, w). Defaults to no padding.

**Details**

Using the notation in im2col, given an input column array of shape :math: '(N, C \times \prod(\text{kernel}), W) ', this operator accumulates the column elements into output array of shape :math: '(N, C, \text{output\\_size}[0], \text{output\\_size}[1], \dots) '. Only 1-D, 2-D and 3-D of spatial dimension is supported in this operator.

Defined in src/operator/nn/im2col.cc:L182

**Value**

out The result mx.ndarray

---

mx.nd.Concat

Joins input arrays along a given axis.

---

### Description

.. note:: ‘Concat’ is deprecated. Use ‘concat’ instead.

### Arguments

data	NDArray-or-Symbol[] List of arrays to concatenate
num. args	int, required Number of inputs to be concated.
dim	int, optional, default='1' the dimension to be concated.

### Details

The dimensions of the input arrays should be the same except the axis along which they will be concatenated. The dimension of the output array along the concatenated axis will be equal to the sum of the corresponding dimensions of the input arrays.

The storage type of “concat” output depends on storage types of inputs

- concat(csr, csr, ..., csr, dim=0) = csr - otherwise, “concat” generates output with default storage

Example::

```
x = [[1,1],[2,2]] y = [[3,3],[4,4],[5,5]] z = [[6,6], [7,7],[8,8]]
```

```
concat(x,y,z,dim=0) = [[ 1., 1.], [ 2., 2.], [ 3., 3.], [ 4., 4.], [ 5., 5.], [ 6., 6.], [ 7., 7.], [ 8., 8.]]
```

Note that you cannot concat x,y,z along dimension 1 since dimension 0 is not the same for all the input arrays.

```
concat(y,z,dim=1) = [[ 3., 3., 6., 6.], [ 4., 4., 7., 7.], [ 5., 5., 8., 8.]]
```

Defined in src/operator/nn/concat.cc:L385

### Value

out The result mx.ndarray

---

mx.nd.concat

Joins input arrays along a given axis.

---

### Description

.. note:: ‘Concat’ is deprecated. Use ‘concat’ instead.



**Arguments**

data	NDArray-or-Symbol[] List of arrays to concatenate
num. args	int, required Number of inputs to be concated.
dim	int, optional, default='1' the dimension to be concated.

**Details**

The dimensions of the input arrays should be the same except the axis along which they will be concatenated. The dimension of the output array along the concatenated axis will be equal to the sum of the corresponding dimensions of the input arrays.

The storage type of “concat” output depends on storage types of inputs

- concat(csr, csr, ..., csr, dim=0) = csr - otherwise, “concat” generates output with default storage

Example::

x = [[1,1],[2,2]] y = [[3,3],[4,4],[5,5]] z = [[6,6], [7,7],[8,8]]

concat(x,y,z,dim=0) = [[ 1., 1.], [ 2., 2.], [ 3., 3.], [ 4., 4.], [ 5., 5.], [ 6., 6.], [ 7., 7.], [ 8., 8.]]

Note that you cannot concat x,y,z along dimension 1 since dimension 0 is not the same for all the input arrays.

concat(y,z,dim=1) = [[ 3., 3., 6., 6.], [ 4., 4., 7., 7.], [ 5., 5., 8., 8.]]

Defined in src/operator/nn/concat.cc:L385

**Value**

out The result mx.ndarray

---

mx.nd.Convolution	<i>Compute <math>*N*-D</math> convolution on <math>*(N+2)*-D</math> input.</i>
-------------------	--

---

**Description**

In the 2-D convolution, given input data with shape  $*(batch\_size, channel, height, width)*$ , the output is computed by

**Arguments**

data	NDArray-or-Symbol Input data to the ConvolutionOp.
weight	NDArray-or-Symbol Weight matrix.
bias	NDArray-or-Symbol Bias parameter.
kernel	Shape(tuple), required Convolution kernel size: (w,), (h, w) or (d, h, w)
stride	Shape(tuple), optional, default=[] Convolution stride: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] Convolution dilate: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.

pad	Shape(tuple), optional, default=[] Zero pad for convolution: (w,), (h, w) or (d, h, w). Defaults to no padding.
num.filter	int (non-negative), required Convolution filter(channel) number
num.group	int (non-negative), optional, default=1 Number of group partitions.
workspace	long (non-negative), optional, default=1024 Maximum temporary workspace allowed (MB) in convolution. This parameter has two usages. When CUDNN is not used, it determines the effective batch size of the convolution kernel. When CUDNN is used, it controls the maximum temporary storage used for tuning the best CUDNN kernel when 'limited_workspace' strategy is used.
no.bias	boolean, optional, default=0 Whether to disable bias parameter.
cudnn.tune	None, 'fastest', 'limited_workspace', 'off', optional, default='None' Whether to pick convolution algo by running performance test.
cudnn.off	boolean, optional, default=0 Turn off cudnn for this layer.
layout	None, 'NCDHW', 'NCHW', 'NCW', 'NDHWC', 'NHWC', optional, default='None' Set layout for input, output and weight. Empty for default layout: NCW for 1d, NCHW for 2d and NCDHW for 3d. NHWC and NDHWC are only supported on GPU.

## Details

.. math::

$$\text{out}[n,i,:,:] = \text{bias}[i] + \sum_j \text{data}[n,j,:,:] \star \text{weight}[i,j,:,:]$$

where :math:\star is the 2-D cross-correlation operator.

For general 2-D convolution, the shapes are

- **data**: (batch\_size, channel, height, width) - **weight**: (num\_filter, channel, kernel[0], kernel[1]) - **bias**: (num\_filter,) - **out**: (batch\_size, num\_filter, out\_height, out\_width).

Define::

$$f(x,k,p,s,d) = \text{floor}((x+2*p-d*(k-1)-1)/s)+1$$

then we have::

out\_height=f(height, kernel[0], pad[0], stride[0], dilate[0]) out\_width=f(width, kernel[1], pad[1], stride[1], dilate[1])

If “no\_bias” is set to be true, then the “bias” term is ignored.

The default data “layout” is \*NCHW\*, namely (batch\_size, channel, height, width). We can choose other layouts such as \*NWC\*.

If “num\_group” is larger than 1, denoted by \*g\*, then split the input “data” evenly into \*g\* parts along the channel axis, and also evenly split “weight” along the first dimension. Next compute the convolution on the \*i\*-th part of the data with the \*i\*-th weight part. The output is obtained by concatenating all the \*g\* results.

1-D convolution does not have \*height\* dimension but only \*width\* in space.

- **data**: (batch\_size, channel, width) - **weight**: (num\_filter, channel, kernel[0]) - **bias**: (num\_filter,) - **out**: (batch\_size, num\_filter, out\_width).

3-D convolution adds an additional *depth* dimension besides *height* and *width*. The shapes are

- **data**: *(batch\_size, channel, depth, height, width)* - **weight**: *(num\_filter, channel, kernel[0], kernel[1], kernel[2])* - **bias**: *(num\_filter,)* - **out**: *(batch\_size, num\_filter, out\_depth, out\_height, out\_width)*.

Both “weight” and “bias” are learnable parameters.

There are other options to tune the performance.

- **cudnn\_tune**: enable this option leads to higher startup time but may give faster speed. Options are

- **off**: no tuning - **limited\_workspace**: run test and pick the fastest algorithm that doesn't exceed workspace limit. - **fastest**: pick the fastest algorithm and ignore workspace limit. - **None** (default): the behavior is determined by environment variable “MXNET\_CUDNN\_AUTOTUNE\_DEFAULT”. 0 for off, 1 for limited workspace (default), 2 for fastest.

- **workspace**: A large number leads to more (GPU) memory usage but may improve the performance.

Defined in src/operator/nn/convolution.cc:L469

## Value

out The result mx.ndarray

---

mx.nd.Convolution.v1	<i>This operator is DEPRECATED. Apply convolution to input then add a bias.</i>
----------------------	---

---

## Description

This operator is DEPRECATED. Apply convolution to input then add a bias.

## Arguments

data	NDArray-or-Symbol Input data to the ConvolutionV1Op.
weight	NDArray-or-Symbol Weight matrix.
bias	NDArray-or-Symbol Bias parameter.
kernel	Shape(tuple), required convolution kernel size: (h, w) or (d, h, w)
stride	Shape(tuple), optional, default=[] convolution stride: (h, w) or (d, h, w)
dilate	Shape(tuple), optional, default=[] convolution dilate: (h, w) or (d, h, w)
pad	Shape(tuple), optional, default=[] pad for convolution: (h, w) or (d, h, w)
num.filter	int (non-negative), required convolution filter(channel) number
num.group	int (non-negative), optional, default=1 Number of group partitions. Equivalent to slicing input into num_group partitions, apply convolution on each, then concatenate the results

workspace	long (non-negative), optional, default=1024 Maximum temporary workspace allowed for convolution (MB). This parameter determines the effective batch size of the convolution kernel, which may be smaller than the given batch size. Also, the workspace will be automatically enlarged to make sure that we can run the kernel with batch_size=1
no.bias	boolean, optional, default=0 Whether to disable bias parameter.
cudnn.tune	None, 'fastest', 'limited_workspace', 'off', optional, default='None' Whether to pick convolution algo by running performance test. Leads to higher startup time but may give faster speed. Options are: 'off': no tuning 'limited_workspace': run test and pick the fastest algorithm that doesn't exceed workspace limit. 'fastest': pick the fastest algorithm and ignore workspace limit. If set to None (default), behavior is determined by environment variable MXNET_CUDNN_AUTOTUNE_DEFAULT: 0 for off, 1 for limited workspace (default), 2 for fastest.
cudnn.off	boolean, optional, default=0 Turn off cudnn for this layer.
layout	None, 'NCDHW', 'NCHW', 'NDHWC', 'NHWC', optional, default='None' Set layout for input, output and weight. Empty for default layout: NCHW for 2d and NCDHW for 3d.

**Value**

out The result mx.ndarray

---

mx.nd.copyto

*Generate an mx.ndarray object on ctx, with data copied from src*

---

**Description**

Generate an mx.ndarray object on ctx, with data copied from src

**Usage**

```
mx.nd.copyto(src, ctx)
```

**Arguments**

src	The source mx.ndarray object.
ctx	The target context.

---

mx.nd.Correlation	<i>Applies correlation to inputs.</i>
-------------------	---------------------------------------

---

## Description

The correlation layer performs multiplicative patch comparisons between two feature maps.

## Arguments

data1	NDArray-or-Symbol Input data1 to the correlation.
data2	NDArray-or-Symbol Input data2 to the correlation.
kernel.size	int (non-negative), optional, default=1 kernel size for Correlation must be an odd number
max.displacement	int (non-negative), optional, default=1 Max displacement of Correlation
stride1	int (non-negative), optional, default=1 stride1 quantize data1 globally
stride2	int (non-negative), optional, default=1 stride2 quantize data2 within the neighborhood centered around data1
pad.size	int (non-negative), optional, default=0 pad for Correlation
is.multiply	boolean, optional, default=1 operation type is either multiplication or subduction

## Details

Given two multi-channel feature maps  $f_1, f_2$ , with  $w, h$ , and  $c$  being their width, height, and number of channels, the correlation layer lets the network compare each patch from  $f_1$  with each patch from  $f_2$ .

For now we consider only a single comparison of two patches. The 'correlation' of two patches centered at  $x_1$  in the first map and  $x_2$  in the second map is then defined as:

.. math::

$$c(x_1, x_2) = \sum_o \text{in } [-k, k] \times [-k, k] \langle f_1(x_1 + o), f_2(x_2 + o) \rangle$$

for a square patch of size  $K := 2k + 1$ .

Note that the equation above is identical to one step of a convolution in neural networks, but instead of convolving data with a filter, it convolves data with other data. For this reason, it has no training weights.

Computing  $c(x_1, x_2)$  involves  $c * K^2$  multiplications. Comparing all patch combinations involves  $w^2 * h^2$  such computations.

Given a maximum displacement  $d$ , for each location  $x_1$  it computes correlations  $c(x_1, x_2)$  only in a neighborhood of size  $D := 2d + 1$ , by limiting the range of  $x_2$ . We use strides  $s_1, s_2$ , to quantize  $x_1$  globally and to quantize  $x_2$  within the neighborhood centered around  $x_1$ .

The final output is defined by the following expression:

.. math:: \text{out}[n, q, i, j] = c(x\_i, j, x\_q)

where  $i$  and  $j$  enumerate spatial locations in  $f_1$ , and  $q$  denotes the  $q^{\text{th}}$  neighborhood of  $x_{ij}$ .

Defined in src/operator/correlation.cc:L198

### Value

out The result mx.ndarray

---

mx.nd.cos	<i>Computes the element-wise cosine of the input array.</i>
-----------	---

---

### Description

The input should be in radians ( $2\pi$  rad equals 360 degrees).

### Arguments

data                      NDAarray-or-Symbol The input array.

### Details

.. math:: \cos([0, \pi/4, \pi/2]) = [1, 0.707, 0]

The storage type of “cos” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L90

### Value

out The result mx.ndarray

---

mx.nd.cosh	<i>Returns the hyperbolic cosine of the input array, computed element-wise.</i>
------------	---

---

### Description

.. math:: \cosh(x) = 0.5 \times (\exp(x) + \exp(-x))

### Arguments

data                      NDAarray-or-Symbol The input array.

### Details

The storage type of “cosh” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L409

**Value**

out The result mx.ndarray

---

mx.nd.Crop

*.. note:: 'Crop' is deprecated. Use 'slice' instead.*


---

**Description**

Crop the 2nd and 3rd dim of input data, with the corresponding size of h\_w or with width and height of the second input symbol, i.e., with one input, we need h\_w to specify the crop height and width, otherwise the second input symbol's size will be used

**Arguments**

data	Symbol or Symbol[] Tensor or List of Tensors, the second input will be used as crop_like shape reference
num.args	int, required Number of inputs for crop, if equals one, then we will use the h_w for crop height and width, else if equals two, then we will use the height and width of the second input symbol, we name crop_like here
offset	Shape(tuple), optional, default=[0,0] crop offset coordinate: (y, x)
h.w	Shape(tuple), optional, default=[0,0] crop height and width: (h, w)
center.crop	boolean, optional, default=0 If set to true, then it will use be the center_crop, or it will crop using the shape of crop_like

**Details**

Defined in src/operator/crop.cc:L50

**Value**

out The result mx.ndarray

mx.nd.crop

*Slices a region of the array. .. note:: “crop” is deprecated. Use “slice” instead. This function returns a sliced array between the indices given by ‘begin’ and ‘end’ with the corresponding ‘step’. For an input array of “shape=(d\_0, d\_1, ..., d\_n-1)”, slice operation with “begin=(b\_0, b\_1...b\_m-1)”, “end=(e\_0, e\_1, ..., e\_m-1)”, and “step=(s\_0, s\_1, ..., s\_m-1)”, where  $m \leq n$ , results in an array with the shape “(l<sub>e\_0-b\_0</sub>∖s\_0, ..., l<sub>e\_m-1-b\_m-1</sub>∖s\_m-1, d\_m, ..., d\_n-1)”. The resulting array’s \*k\*-th dimension contains elements from the \*k\*-th dimension of the input array starting from index “b\_k” (inclusive) with step “s\_k” until reaching “e\_k” (exclusive). If the \*k\*-th elements are ‘None’ in the sequence of ‘begin’, ‘end’, and ‘step’, the following rule will be used to set default values. If ‘s\_k’ is ‘None’, set ‘s\_k=1’. If ‘s\_k > 0’, set ‘b\_k=0’, ‘e\_k=d\_k’; else, set ‘b\_k=d\_k-1’, ‘e\_k=-1’. The storage type of “slice” output depends on storage types of inputs - slice(csr) = csr - otherwise, “slice” generates output with default storage .. note:: When input data storage type is csr, it only supports step=(), or step=(None,), or step=(1,) to generate a csr output. For other step parameter values, it falls back to slicing a dense tensor. Example:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice(x, begin=(0,1), end=(2,4)) = [[ 2., 3., 4.], [ 6., 7., 8.]] slice(x, begin=(None, 0), end=(None, 3), step=(-1, 2)) = [[9., 11.], [5., 7.], [1., 3.]]*

## Description

Defined in src/operator/tensor/matrix\_op.cc:L482

## Arguments

data	NDArray-or-Symbol Source input
begin	Shape(tuple), required starting indices for the slice operation, supports negative indices.
end	Shape(tuple), required ending indices for the slice operation, supports negative indices.
step	Shape(tuple), optional, default=[] step for the slice operation, supports negative values.

## Value

out The result mx.ndarray



mx.nd.ctc.loss

*Connectionist Temporal Classification Loss.***Description**

.. note:: The existing alias “contrib\_CTCLoss” is deprecated.

**Arguments**

data	NDArray-or-Symbol Input ndarray
label	NDArray-or-Symbol Ground-truth labels for the loss.
data.lengths	NDArray-or-Symbol Lengths of data for each of the samples. Only required when use_data_lengths is true.
label.lengths	NDArray-or-Symbol Lengths of labels for each of the samples. Only required when use_label_lengths is true.
use.data.lengths	boolean, optional, default=0 Whether the data lengths are decided by ‘data_lengths’. If false, the lengths are equal to the max sequence length.
use.label.lengths	boolean, optional, default=0 Whether the label lengths are decided by ‘label_lengths’, or derived from ‘padding_mask’. If false, the lengths are derived from the first occurrence of the value of ‘padding_mask’. The value of ‘padding_mask’ is “0” when first CTC label is reserved for blank, and “-1” when last label is reserved for blank. See ‘blank_label’.
blank.label	‘first’, ‘last’, optional, default=‘first’ Set the label that is reserved for blank label. If “first”, 0-th label is reserved, and label values for tokens in the vocabulary are between “1” and “alphabet_size-1”, and the padding mask is “-1”. If “last”, last label value “alphabet_size-1” is reserved for blank label instead, and label values for tokens in the vocabulary are between “0” and “alphabet_size-2”, and the padding mask is “0”.

**Details**

The shapes of the inputs and outputs:

```
- **data** : (sequence_length, batch_size, alphabet_size)
- **label** : (batch_size, label_sequence_length)
- **out** : (batch_size)
```

The ‘data’ tensor consists of sequences of activation vectors (without applying softmax), with i-th channel in the last dimension corresponding to i-th label for i between 0 and alphabet\_size-1 (i.e always 0-indexed). Alphabet size should include one additional value reserved for blank label. When ‘blank\_label’ is “first”, the “0”-th channel is reserved for activation of blank label, or otherwise if it is “last”, “(alphabet\_size-1)”-th channel should be reserved for blank label.

‘label’ is an index matrix of integers. When ‘blank\_label’ is “first”, the value 0 is then reserved for blank label, and should not be passed in this matrix. Otherwise, when ‘blank\_label’ is “last”, the value ‘(alphabet\_size-1)’ is reserved for blank label.

If a sequence of labels is shorter than `*label_sequence_length*`, use the special padding value at the end of the sequence to conform it to the correct length. The padding value is `'0'` when `'blank_label'` is `""first""`, and `'-1'` otherwise.

For example, suppose the vocabulary is `'[a, b, c]'`, and in one batch we have three sequences `'ba'`, `'cbb'`, and `'abac'`. When `'blank_label'` is `""first""`, we can index the labels as `'a': 1, 'b': 2, 'c': 3`, and we reserve the 0-th channel for blank label in data tensor. The resulting `'label'` tensor should be padded to be::

```
[[2, 1, 0, 0], [3, 2, 2, 0], [1, 2, 1, 3]]
```

When `'blank_label'` is `""last""`, we can index the labels as `'a': 0, 'b': 1, 'c': 2`, and we reserve the channel index 3 for blank label in data tensor. The resulting `'label'` tensor should be padded to be::

```
[[1, 0, -1, -1], [2, 1, 1, -1], [0, 1, 0, 2]]
```

`"out"` is a list of CTC loss values, one per example in the batch.

See *\*Connectionist Temporal Classification: Labelling Unsegmented Sequence Data with Recurrent Neural Networks\**, A. Graves *et al*\*, for more information on the definition and the algorithm.

Defined in `src/operator/nn/ctc_loss.cc:L100`

## Value

out The result mx.ndarray

---

mx.nd.CTCLoss

*Connectionist Temporal Classification Loss.*

---

## Description

.. note:: The existing alias `"contrib_CTCLoss"` is deprecated.

## Arguments

<code>data</code>	NDArray-or-Symbol Input ndarray
<code>label</code>	NDArray-or-Symbol Ground-truth labels for the loss.
<code>data.lengths</code>	NDArray-or-Symbol Lengths of data for each of the samples. Only required when <code>use_data_lengths</code> is true.
<code>label.lengths</code>	NDArray-or-Symbol Lengths of labels for each of the samples. Only required when <code>use_label_lengths</code> is true.
<code>use.data.lengths</code>	boolean, optional, default=0 Whether the data lengths are decided by <code>'data_lengths'</code> . If false, the lengths are equal to the max sequence length.
<code>use.label.lengths</code>	boolean, optional, default=0 Whether the label lengths are decided by <code>'label_lengths'</code> , or derived from <code>'padding_mask'</code> . If false, the lengths are derived from the first occurrence of the value of <code>'padding_mask'</code> . The value of <code>'padding_mask'</code> is <code>"0"</code> when first CTC label is reserved for blank, and <code>"-1"</code> when last label is reserved for blank. See <code>'blank_label'</code> .

`blank_label` 'first', 'last', optional, default='first' Set the label that is reserved for blank label. If "first", 0-th label is reserved, and label values for tokens in the vocabulary are between "1" and "alphabet\_size-1", and the padding mask is "-1". If "last", last label value "alphabet\_size-1" is reserved for blank label instead, and label values for tokens in the vocabulary are between "0" and "alphabet\_size-2", and the padding mask is "0".

## Details

The shapes of the inputs and outputs:

- **data**: (sequence\_length, batch\_size, alphabet\_size) - **label**: (batch\_size, label\_sequence\_length)  
 - **out**: (batch\_size)

The 'data' tensor consists of sequences of activation vectors (without applying softmax), with i-th channel in the last dimension corresponding to i-th label for i between 0 and alphabet\_size-1 (i.e always 0-indexed). Alphabet size should include one additional value reserved for blank label. When 'blank\_label' is "'first'", the "0"-th channel is reserved for activation of blank label, or otherwise if it is "last", "(alphabet\_size-1)"-th channel should be reserved for blank label.

'label' is an index matrix of integers. When 'blank\_label' is "'first'", the value 0 is then reserved for blank label, and should not be passed in this matrix. Otherwise, when 'blank\_label' is "'last'", the value '(alphabet\_size-1)' is reserved for blank label.

If a sequence of labels is shorter than \*label\_sequence\_length\*, use the special padding value at the end of the sequence to conform it to the correct length. The padding value is '0' when 'blank\_label' is "'first'", and '-1' otherwise.

For example, suppose the vocabulary is '[a, b, c]', and in one batch we have three sequences 'ba', 'cbb', and 'abac'. When 'blank\_label' is "'first'", we can index the labels as 'a': 1, 'b': 2, 'c': 3, and we reserve the 0-th channel for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[2, 1, 0, 0], [3, 2, 2, 0], [1, 2, 1, 3]]
```

When 'blank\_label' is "'last'", we can index the labels as 'a': 0, 'b': 1, 'c': 2, and we reserve the channel index 3 for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[1, 0, -1, -1], [2, 1, 1, -1], [0, 1, 0, 2]]
```

'out' is a list of CTC loss values, one per example in the batch.

See \*Connectionist Temporal Classification: Labelling Unsegmented Sequence Data with Recurrent Neural Networks\*, A. Graves *et al*. for more information on the definition and the algorithm.

Defined in src/operator/nn/ctc\_loss.cc:L100

## Value

out The result mx.ndarray

---

mx.nd.cumsum

Return the cumulative sum of the elements along a given axis.

---

### Description

Defined in src/operator/numpy/np\_cumsum.cc:L70

### Arguments

a	NDArray-or-Symbol Input ndarray
axis	int or None, optional, default='None' Axis along which the cumulative sum is computed. The default (None) is to compute the cumsum over the flattened array.
dtype	None, 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', optional, default='None' Type of the returned array and of the accumulator in which the elements are summed. If dtype is not specified, it defaults to the dtype of a, unless a has an integer dtype with a precision less than that of the default platform integer. In that case, the default platform integer is used.

### Value

out The result mx.ndarray

---

mx.nd.Custom

Apply a custom operator implemented in a frontend language (like Python).

---

### Description

Custom operators should override required methods like 'forward' and 'backward'. The custom operator must be registered before it can be used. Please check the tutorial here: [https://mxnet.incubator.apache.org/api/faq/new\\_](https://mxnet.incubator.apache.org/api/faq/new_)

### Arguments

data	NDArray-or-Symbol[] Input data for the custom operator.
op. type	string Name of the custom operator. This is the name that is passed to 'mx.operator.register' to register the operator.

### Details

Defined in src/operator/custom/custom.cc:L547

### Value

out The result mx.ndarray

---

<code>mx.nd.Deconvolution</code>	<i>Computes 1D or 2D transposed convolution (aka fractionally strided convolution) of the input tensor. This operation can be seen as the gradient of Convolution operation with respect to its input. Convolution usually reduces the size of the input. Transposed convolution works the other way, going from a smaller input to a larger output while preserving the connectivity pattern.</i>
----------------------------------	--

---

## Description

Computes 1D or 2D transposed convolution (aka fractionally strided convolution) of the input tensor. This operation can be seen as the gradient of Convolution operation with respect to its input. Convolution usually reduces the size of the input. Transposed convolution works the other way, going from a smaller input to a larger output while preserving the connectivity pattern.

## Arguments

<code>data</code>	NDArray-or-Symbol Input tensor to the deconvolution operation.
<code>weight</code>	NDArray-or-Symbol Weights representing the kernel.
<code>bias</code>	NDArray-or-Symbol Bias added to the result after the deconvolution operation.
<code>kernel</code>	Shape(tuple), required Deconvolution kernel size: (w,), (h, w) or (d, h, w). This is same as the kernel size used for the corresponding convolution
<code>stride</code>	Shape(tuple), optional, default=[] The stride used for the corresponding convolution: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
<code>dilate</code>	Shape(tuple), optional, default=[] Dilation factor for each dimension of the input: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
<code>pad</code>	Shape(tuple), optional, default=[] The amount of implicit zero padding added during convolution for each dimension of the input: (w,), (h, w) or (d, h, w). “(kernel-1)/2” is usually a good choice. If ‘target_shape’ is set, ‘pad’ will be ignored and a padding that will generate the target shape will be used. Defaults to no padding.
<code>adj</code>	Shape(tuple), optional, default=[] Adjustment for output shape: (w,), (h, w) or (d, h, w). If ‘target_shape’ is set, ‘adj’ will be ignored and computed accordingly.
<code>target_shape</code>	Shape(tuple), optional, default=[] Shape of the output tensor: (w,), (h, w) or (d, h, w).
<code>num.filter</code>	int (non-negative), required Number of output filters.
<code>num.group</code>	int (non-negative), optional, default=1 Number of groups partition.
<code>workspace</code>	long (non-negative), optional, default=512 Maximum temporary workspace allowed (MB) in deconvolution. This parameter has two usages. When CUDNN is not used, it determines the effective batch size of the deconvolution kernel. When CUDNN is used, it controls the maximum temporary storage used for tuning the best CUDNN kernel when ‘limited_workspace’ strategy is used.

<code>no.bias</code>	boolean, optional, default=1 Whether to disable bias parameter.
<code>cuda.tune</code>	None, 'fastest', 'limited_workspace', 'off', optional, default='None' Whether to pick convolution algorithm by running performance test.
<code>cuda.off</code>	boolean, optional, default=0 Turn off cuda for this layer.
<code>layout</code>	None, 'NCDHW', 'NCHW', 'NCW', 'NDHWC', 'NHWC', optional, default='None' Set layout for input, output and weight. Empty for default layout, NCW for 1d, NCHW for 2d and NCDHW for 3d.NHWC and NDHWC are only supported on GPU.

**Value**

out The result `mx.nd.array`

---

<code>mx.nd.degrees</code>	<i>Converts each element of the input array from radians to degrees.</i>
----------------------------	--

---

**Description**

`.. math:: \text{degrees}([0, \pi/2, \pi, 3\pi/2, 2\pi]) = [0, 90, 180, 270, 360]`

**Arguments**

`data` NDAarray-or-Symbol The input array.

**Details**

The storage type of “degrees” output depends upon the input storage type:

- `degrees(default) = default` - `degrees(row_sparse) = row_sparse` - `degrees(csr) = csr`

Defined in `src/operator/tensor/elementwise_unary_op_trig.cc:L332`

**Value**

out The result `mx.nd.array`

---

`mx.nd.depth.to.space` *Rearranges(permutates) data from depth into blocks of spatial data. Similar to ONNX DepthToSpace operator: <https://github.com/onnx/onnx/blob/master/docs/Operators.md#DepthToSpace>. The output is a new tensor where the values from depth dimension are moved in spatial blocks to height and width dimension. The reverse of this operation is “space\_to\_depth“. ..  $\text{math}:: \backslash \text{begingather} * x \backslash \text{prime} = \text{reshape}(x, [N, \text{block\_size}, \text{block\_size}, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]) \backslash x \backslash \text{prime} \backslash \text{prime} = \text{transpose}(x \backslash \text{prime}, [0, 3, 4, 1, 5, 2]) \backslash y = \text{reshape}(x \backslash \text{prime} \backslash \text{prime}, [N, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]) \backslash \text{endgather} * \text{ where } : \text{math}:: 'x' \text{ is an input tensor with default layout as } : \text{math}:: '[N, C, H, W]': [batch, channels, height, width] \text{ and } : \text{math}:: 'y' \text{ is the output tensor of layout } : \text{math}:: '[N, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]'$*

*Example::  $x = [ [ [ [0, 1, 2], [3, 4, 5]], [ [6, 7, 8], [9, 10, 11]], [ [12, 13, 14], [15, 16, 17]], [ [18, 19, 20], [21, 22, 23]] ] ] ]$   $\text{depth\_to\_space}(x, 2) = [ [ [ [0, 6, 1, 7, 2, 8], [12, 18, 13, 19, 14, 20], [3, 9, 4, 10, 5, 11], [15, 21, 16, 22, 17, 23]] ] ] ]$*

---

### Description

Defined in `src/operator/tensor/matrix_op.cc:L972`

### Arguments

<code>data</code>	NDArray-or-Symbol Input ndarray
<code>block.size</code>	int, required Blocks of [block_size. block_size] are moved

### Value

out The result mx.ndarray

---

<code>mx.nd.diag</code>	<i>Extracts a diagonal or constructs a diagonal array.</i>
-------------------------	--

---

### Description

“diag”’s behavior depends on the input array dimensions:

### Arguments

<code>data</code>	NDArray-or-Symbol Input ndarray
<code>k</code>	int, optional, default='0' Diagonal in question. The default is 0. Use $k > 0$ for diagonals above the main diagonal, and $k < 0$ for diagonals below the main diagonal. If input has shape (S0 S1) k must be between -S0 and S1

axis1	int, optional, default='0' The first axis of the sub-arrays of interest. Ignored when the input is a 1-D array.
axis2	int, optional, default='1' The second axis of the sub-arrays of interest. Ignored when the input is a 1-D array.

### Details

- 1-D arrays: constructs a 2-D array with the input as its diagonal, all other elements are zero. - N-D arrays: extracts the diagonals of the sub-arrays with axes specified by “axis1” and “axis2”. The output shape would be decided by removing the axes numbered “axis1” and “axis2” from the input shape and appending to the result a new axis with the size of the diagonals in question.

For example, when the input shape is ‘(2, 3, 4, 5)’, “axis1” and “axis2” are 0 and 2 respectively and “k” is 0, the resulting shape would be ‘(3, 5, 2)’.

Examples::

```
x = [[1, 2, 3], [4, 5, 6]]
```

```
diag(x) = [1, 5]
```

```
diag(x, k=1) = [2, 6]
```

```
diag(x, k=-1) = [4]
```

```
x = [1, 2, 3]
```

```
diag(x) = [[1, 0, 0], [0, 2, 0], [0, 0, 3]]
```

```
diag(x, k=1) = [[0, 1, 0], [0, 0, 2], [0, 0, 0]]
```

```
diag(x, k=-1) = [[0, 0, 0], [1, 0, 0], [0, 2, 0]]
```

```
x = [[[1, 2], [3, 4]],
```

```
[[5, 6], [7, 8]]]
```

```
diag(x) = [[1, 7], [2, 8]]
```

```
diag(x, k=1) = [[3], [4]]
```

```
diag(x, axis1=-2, axis2=-1) = [[1, 4], [5, 8]]
```

Defined in src/operator/tensor/diag\_op.cc:L87

### Value

out The result mx.ndarray

---

mx.nd.dot

*Dot product of two arrays.*

---

### Description

“dot”’s behavior depends on the input array dimensions:



**Arguments**

lhs	NDArray-or-Symbol The first input
rhs	NDArray-or-Symbol The second input
transpose.a	boolean, optional, default=0 If true then transpose the first input before dot.
transpose.b	boolean, optional, default=0 If true then transpose the second input before dot.
forward.stype	None, 'csr', 'default', 'row_sparse', optional, default='None' The desired storage type of the forward output given by user, if the combination of input storage types and this hint does not match any implemented ones, the dot operator will perform fallback operation and still produce an output of the desired storage type.

**Details**

- 1-D arrays: inner product of vectors - 2-D arrays: matrix multiplication - N-D arrays: a sum product over the last axis of the first input and the first axis of the second input

For example, given 3-D “x” with shape ‘(n,m,k)’ and “y” with shape ‘(k,r,s)’, the result array will have shape ‘(n,m,r,s)’. It is computed by::

```
dot(x,y)[i,j,a,b] = sum(x[i,j,:]*y[:,a,b])
```

Example::

```
x = reshape([0,1,2,3,4,5,6,7], shape=(2,2,2)) y = reshape([7,6,5,4,3,2,1,0], shape=(2,2,2)) dot(x,y)[0,0,1,1] = 0 sum(x[0,0,:]*y[:,1,1]) = 0
```

The storage type of “dot” output depends on storage types of inputs, transpose option and forward\_stype option for output storage type. Implemented sparse operations include:

- dot(default, default, transpose\_a=True/False, transpose\_b=True/False) = default - dot(csr, default, transpose\_a=True) = default - dot(csr, default, transpose\_a=True) = row\_sparse - dot(csr, default) = default - dot(csr, row\_sparse) = default - dot(default, csr) = csr (CPU only) - dot(default, csr, forward\_stype='default') = default - dot(default, csr, transpose\_b=True, forward\_stype='default') = default

If the combination of input storage types and forward\_stype does not match any of the above patterns, “dot” will fallback and generate output with default storage.

.. Note::

If the storage type of the lhs is "csr", the storage type of gradient w.r.t rhs will be "row\_sparse". Only a subset of optimizers support sparse gradients, including SGD, AdaGrad and Adam. Note that by default lazy updates is turned on, which may perform differently from standard updates. For more details, please check the Optimization API at: <https://mxnet.incubator.apache.org/api/python/optimization/optimization.html>

Defined in src/operator/tensor/dot.cc:L77

**Value**

out The result mx.ndarray

mx.nd.Dropout

*Applies dropout operation to input array.***Description**

- During training, each element of the input is set to zero with probability  $p$ . The whole array is rescaled by  $1/(1-p)$  to keep the expected sum of the input unchanged.

**Arguments**

data	NDArray-or-Symbol Input array to which dropout will be applied.
p	float, optional, default=0.5 Fraction of the input that gets dropped out during training time.
mode	'always', 'training', optional, default='training' Whether to only turn on dropout during training or to also turn on for inference.
axes	Shape(tuple), optional, default=[] Axes for variational dropout kernel.
cudnn.off	boolean or None, optional, default=0 Whether to turn off cudnn in dropout operator. This option is ignored if axes is specified.

**Details**

- During testing, this operator does not change the input if mode is 'training'. If mode is 'always', the same computation as during training will be applied.

Example::

```
random.seed(998) input_array = array([[3., 0.5, -0.5, 2., 7.], [2., -0.4, 7., 3., 0.2]]) a = symbol.Variable('a') dropout = symbol.Dropout(a, p = 0.2) executor = dropout.simple_bind(a = input_array.shape)
```

```
## If training executor.forward(is_train = True, a = input_array) executor.outputs [[ 3.75 0.625 -0.25 8.75 ] [ 2.5 -0.5 8.75 3.75 0. ]]
```

```
## If testing executor.forward(is_train = False, a = input_array) executor.outputs [[ 3. 0.5 -0.5 2. 7. ] [ 2. -0.4 7. 3. 0.2 ]]
```

Defined in src/operator/nn/dropout.cc:L96

**Value**

out The result mx.ndarray

---

mx.nd.ElementWiseSum    *Adds all input arguments element-wise.*

---

### Description

.. math:: \text{add\\_n}(a\_1, a\_2, \dots, a\_n) = a\_1 + a\_2 + \dots + a\_n

### Arguments

args                      NDAarray-or-Symbol[] Positional input arguments

### Details

“add\_n” is potentially more efficient than calling “add” by ‘n’ times.

The storage type of “add\_n” output depends on storage types of inputs

- add\_n(row\_sparse, row\_sparse, ..) = row\_sparse - add\_n(default, csr, default) = default - add\_n(any input combinations longer than 4 (>4) with at least one default type) = default - otherwise, “add\_n” falls all inputs back to default storage and generates default storage

Defined in src/operator/tensor/elementwise\_sum.cc:L155

### Value

out The result mx.ndarray

---

mx.nd.elemwise.add        *Adds arguments element-wise.*

---

### Description

The storage type of “elemwise\_add” output depends on storage types of inputs

### Arguments

lhs                      NDAarray-or-Symbol first input  
rhs                      NDAarray-or-Symbol second input

### Details

- elemwise\_add(row\_sparse, row\_sparse) = row\_sparse - elemwise\_add(csr, csr) = csr - elemwise\_add(default, csr) = default - elemwise\_add(csr, default) = default - elemwise\_add(default, rsp) = default - elemwise\_add(rsp, default) = default - otherwise, “elemwise\_add” generates output with default storage

### Value

out The result mx.ndarray

---

<code>mx.nd.elemwise.div</code>	<i>Divides arguments element-wise.</i>
---------------------------------	--

---

**Description**

The storage type of “elemwise\_div“ output is always dense

**Arguments**

<code>lhs</code>	NDArray-or-Symbol first input
<code>rhs</code>	NDArray-or-Symbol second input

**Value**

out The result `mx.ndarray`

---

<code>mx.nd.elemwise.mul</code>	<i>Multiplies arguments element-wise.</i>
---------------------------------	---

---

**Description**

The storage type of “elemwise\_mul“ output depends on storage types of inputs

**Arguments**

<code>lhs</code>	NDArray-or-Symbol first input
<code>rhs</code>	NDArray-or-Symbol second input

**Details**

- `elemwise_mul(default, default) = default` - `elemwise_mul(row_sparse, row_sparse) = row_sparse` - `elemwise_mul(default, row_sparse) = row_sparse` - `elemwise_mul(row_sparse, default) = row_sparse` - `elemwise_mul(csr, csr) = csr` - otherwise, “elemwise\_mul“ generates output with default storage

**Value**

out The result `mx.ndarray`

---

mx.nd.elemwise.sub	<i>Subtracts arguments element-wise.</i>
--------------------	--

---

### Description

The storage type of “elemwise\_sub” output depends on storage types of inputs

### Arguments

lhs	NDArray-or-Symbol first input
rhs	NDArray-or-Symbol second input

### Details

- elemwise\_sub(row\_sparse, row\_sparse) = row\_sparse - elemwise\_sub(csr, csr) = csr - elemwise\_sub(default, csr) = default - elemwise\_sub(csr, default) = default - elemwise\_sub(default, rsp) = default - elemwise\_sub(rsp, default) = default - otherwise, “elemwise\_sub” generates output with default storage

### Value

out The result mx.ndarray

---

mx.nd.Embedding	<i>Maps integer indices to vector representations (embeddings).</i>
-----------------	---

---

### Description

This operator maps words to real-valued vectors in a high-dimensional space, called word embeddings. These embeddings can capture semantic and syntactic properties of the words. For example, it has been noted that in the learned embedding spaces, similar words tend to be close to each other and dissimilar words far apart.

### Arguments

data	NDArray-or-Symbol The input array to the embedding operator.
weight	NDArray-or-Symbol The embedding weight matrix.
input.dim	int, required Vocabulary size of the input indices.
output.dim	int, required Dimension of the embedding vectors.
dtype	'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='float32' Data type of weight.
sparse.grad	boolean, optional, default=0 Compute row sparse gradient in the backward calculation. If set to True, the grad's storage type is row_sparse.

**Details**

For an input array of shape (d1, ..., dK), the shape of an output array is (d1, ..., dK, output\_dim). All the input values should be integers in the range [0, input\_dim).

If the input\_dim is ip0 and output\_dim is op0, then shape of the embedding weight matrix must be (ip0, op0).

When "sparse\_grad" is False, if any index mentioned is too large, it is replaced by the index that addresses the last vector in an embedding matrix. When "sparse\_grad" is True, an error will be raised if invalid indices are found.

Examples::

```
input_dim = 4 output_dim = 5
```

```
// Each row in weight matrix y represents a word. So, y = (w0,w1,w2,w3) y = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.], [ 10., 11., 12., 13., 14.], [ 15., 16., 17., 18., 19.]]
```

```
// Input array x represents n-grams(2-gram). So, x = [(w1,w3), (w0,w2)] x = [[ 1., 3.], [ 0., 2.]]
```

```
// Mapped input x to its vector representation y. Embedding(x, y, 4, 5) = [[[ 5., 6., 7., 8., 9.], [ 15., 16., 17., 18., 19.]],
```

```
[[ 0., 1., 2., 3., 4.], [ 10., 11., 12., 13., 14.]]]
```

The storage type of weight can be either row\_sparse or default.

.. Note::

If "sparse\_grad" is set to True, the storage type of gradient w.r.t weights will be "row\_sparse". Only a subset of optimizers support sparse gradients, including SGD, AdaGrad and Adam. Note that by default lazy updates is turned on, which may perform differently from standard updates. For more details, please check the Optimization API at: <https://mxnet.incubator.apache.org/api/python/optimization/optimization.html>

Defined in src/operator/tensor/indexing\_op.cc:L603

**Value**

out The result mx.ndarray

---

mx.nd.erf

*Returns element-wise gauss error function of the input.*

---

**Description**

Example::

**Arguments**

data NDAarray-or-Symbol The input array.

**Details**

```
erf([0, -1., 10.]) = [0., -0.8427, 1.]
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L886

**Value**

out The result mx.ndarray

---

mx.nd.erfinv	Returns element-wise inverse gauss error function of the input.
--------------	---

---

**Description**

Example::

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

erfinv([0, 0.5., -1.]) = [0., 0.4769, -inf]  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L908

**Value**

out The result mx.ndarray

---

mx.nd.exp	Returns element-wise exponential value of the input.
-----------	--

---

**Description**

.. math:: \exp(x) = e^x \approx 2.718^x

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::  
exp([0, 1, 2]) = [1., 2.71828175, 7.38905621]  
The storage type of “exp“ output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L64

**Value**

out The result mx.ndarray

---

mx.nd.expand_dims	<i>Inserts a new axis of size 1 into the array shape For example, given “x” with shape “(2,3,4)”, then “expand_dims(x, axis=1)” will return a new array with shape “(2,1,3,4)”.</i>
-------------------	---

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L395

**Arguments**

data	NDArray-or-Symbol Source input
axis	int, required Position where new axis is to be inserted. Suppose that the input ‘NDArray’'s dimension is ‘ndim’, the range of the inserted axis is ‘[-ndim, ndim]’

**Value**

out The result mx.ndarray

---

mx.nd.expm1	<i>Returns “exp(x) - 1” computed element-wise on the input.</i>
-------------	---

---

**Description**

This function provides greater precision than “exp(x) - 1” for small values of “x”.

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

The storage type of “expm1” output depends upon the input storage type:  
- expm1(default) = default - expm1(row\_sparse) = row\_sparse - expm1(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L244

**Value**

out The result mx.ndarray



---

mx.nd.fill.element.0index

*Fill one element of each line(row for python, column for R/Julia) in lhs according to index indicated by rhs and values indicated by mhs. This function assume rhs uses 0-based index.*

---

### Description

Fill one element of each line(row for python, column for R/Julia) in lhs according to index indicated by rhs and values indicated by mhs. This function assume rhs uses 0-based index.

### Arguments

lhs	NDArray Left operand to the function.
mhs	NDArray Middle operand to the function.
rhs	NDArray Right operand to the function.

### Value

out The result mx.ndarray

---

mx.nd.fix

*Returns element-wise rounded value to the nearest \ integer towards zero of the input.*

---

### Description

Example::

### Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

### Details

fix([-2.1, -1.9, 1.9, 2.1]) = [-2., -1., 1., 2.]

The storage type of “fix“ output depends upon the input storage type:

- fix(default) = default - fix(row\_sparse) = row\_sparse - fix(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L874

### Value

out The result mx.ndarray

---

mx.nd.Flatten	<i>Flattens the input array into a 2-D array by collapsing the higher dimensions. .. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead. For an input array with shape “(d1, d2, ..., dk)“, ‘flatten’ operation reshapes the input array into an output array of shape “(d1, d2*...*dk)“. Note that the behavior of this function is different from numpy.ndarray.flatten, which behaves similar to mxnet.ndarray.reshape((-1,)). Example:: x = [[ [1,2,3], [4,5,6], [7,8,9] ], [ [1,2,3], [4,5,6], [7,8,9] ]], flatten(x) = [[ 1., 2., 3., 4., 5., 6., 7., 8., 9.], [ 1., 2., 3., 4., 5., 6., 7., 8., 9.]]</i>
---------------	--

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L250

**Arguments**

data                      NDArrary-or-Symbol Input array.

**Value**

out The result mx.ndarray

---

mx.nd.flatten	<i>Flattens the input array into a 2-D array by collapsing the higher dimensions. .. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead. For an input array with shape “(d1, d2, ..., dk)“, ‘flatten’ operation reshapes the input array into an output array of shape “(d1, d2*...*dk)“. Note that the behavior of this function is different from numpy.ndarray.flatten, which behaves similar to mxnet.ndarray.reshape((-1,)). Example:: x = [[ [1,2,3], [4,5,6], [7,8,9] ], [ [1,2,3], [4,5,6], [7,8,9] ]], flatten(x) = [[ 1., 2., 3., 4., 5., 6., 7., 8., 9.], [ 1., 2., 3., 4., 5., 6., 7., 8., 9.]]</i>
---------------	--

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L250

**Arguments**

data                      NDArrary-or-Symbol Input array.

**Value**

out The result mx.ndarray

---

mx.nd.flip	<i>Reverses the order of elements along given axis while preserving array shape. Note: reverse and flip are equivalent. We use reverse in the following examples. Examples:: x = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.]] reverse(x, axis=0) = [[ 5., 6., 7., 8., 9.], [ 0., 1., 2., 3., 4.]] reverse(x, axis=1) = [[ 4., 3., 2., 1., 0.], [ 9., 8., 7., 6., 5.]]</i>
------------	---

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L832

**Arguments**

data	NDArray-or-Symbol Input data array
axis	Shape(tuple), required The axis which to reverse elements.

**Value**

out The result mx.ndarray

---

mx.nd.floor	<i>Returns element-wise floor of the input.</i>
-------------	---

---

**Description**

The floor of the scalar x is the largest integer i, such that  $i \leq x$ .

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

Example::

`floor([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-3., -2., 1., 1., 2.]`

The storage type of “floor” output depends upon the input storage type:

- floor(default) = default - floor(row\_sparse) = row\_sparse - floor(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L836

**Value**

out The result mx.ndarray

---

mx.nd.ftml.update	<i>The FTML optimizer described in <a href="http://proceedings.mlr.press/v70/zheng17a/zheng17a.pdf">*FTML - Follow the Moving Leader in Deep Learning*</a>, available at <a href="http://proceedings.mlr.press/v70/zheng17a/zheng17a.pdf">http://proceedings.mlr.press/v70/zheng17a/zheng17a.pdf</a>.</i>
-------------------	---

---

## Description

.. math::

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
d	NDArray-or-Symbol Internal state “d_t”
v	NDArray-or-Symbol Internal state “v_t”
z	NDArray-or-Symbol Internal state “z_t”
lr	float, required Learning rate.
beta1	float, optional, default=0.600000024 Generally close to 0.5.
beta2	float, optional, default=0.999000013 Generally close to 1.
epsilon	double, optional, default=9.9999999392252903e-09 Epsilon to prevent div 0.
t	int, required Number of update.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip.grad	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).

## Details

$$\begin{aligned} g_t &= \nabla J(W_{t-1}) \\ v_t &= \beta_2 v_{t-1} + (1 - \beta_2) g_t^2 \\ d_t &= \frac{1 - \beta_1^t}{\sqrt{\frac{v_t}{1 - \beta_2^t} + \epsilon}} \sigma_t \\ \sigma_t &= d_t - \beta_1 d_{t-1} \\ z_t &= \beta_1 z_{t-1} + (1 - \beta_1^t) g_t - \sigma_t \\ W_t &= -\frac{z_t}{d_t} \end{aligned}$$

Defined in src/operator/optimizer\_op.cc:L631

## Value

out The result mx.ndarray

---

mx.nd.ftrl.update	<i>Update function for Ftrl optimizer. Referenced from *Ad Click Prediction: a View from the Trenches*, available at <a href="http://dl.acm.org/citation.cfm?id=2488200">http://dl.acm.org/citation.cfm?id=2488200</a>.</i>
-------------------	---

---

## Description

It updates the weights using::

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
z	NDArray-or-Symbol z
n	NDArray-or-Symbol Square of grad
lr	float, required Learning rate
lamda1	float, optional, default=0.00999999978 The L1 regularization coefficient.
beta	float, optional, default=1 Per-Coordinate Learning Rate beta.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .

## Details

```
rescaled_grad = clip(grad * rescale_grad, clip_gradient)
z += rescaled_grad - (sqrt(n + rescaled_grad**2) - sqrt(n)) * weight / learning_rate
n += rescaled_grad**2
w = (sign(z) * lamda1 - z) / ((beta + sqrt(n)) / learning_rate + wd) * (abs(z) > lamda1)
```

If w, z and n are all of “row\_sparse” storage type, only the row slices whose indices appear in grad.indices are updated (for w, z and n)::

```
for row in grad.indices:
    rescaled_grad[row] = clip(grad[row] * rescale_grad, clip_gradient)
    z[row] += rescaled_grad[row] - (sqrt(n[row] + rescaled_grad[row]**2) - sqrt(n[row])) * weight[row] / learning_rate
    n[row] += rescaled_grad[row]**2
    w[row] = (sign(z[row]) * lamda1 - z[row]) / ((beta + sqrt(n[row])) / learning_rate + wd) * (abs(z[row]) > lamda1)
```

Defined in src/operator/optimizer\_op.cc:L867

## Value

out The result mx.ndarray

---

mx.nd.FullyConnected    *Applies a linear transformation:  $Y = XW^T + b$ .*

---

## Description

If “flatten” is set to be true, then the shapes are:

## Arguments

data	NDArray-or-Symbol Input data.
weight	NDArray-or-Symbol Weight matrix.
bias	NDArray-or-Symbol Bias parameter.
num_hidden	int, required Number of hidden nodes of the output.
no_bias	boolean, optional, default=0 Whether to disable bias parameter.
flatten	boolean, optional, default=1 Whether to collapse all but the first axis of the input data tensor.

## Details

- **data**: (batch\_size, x1, x2, ..., xn) - **weight**: (num\_hidden, x1 \* x2 \* ... \* xn) - **bias**: (num\_hidden,) - **out**: (batch\_size, num\_hidden)

If “flatten” is set to be false, then the shapes are:

- **data**: (x1, x2, ..., xn, input\_dim) - **weight**: (num\_hidden, input\_dim) - **bias**: (num\_hidden,) - **out**: (x1, x2, ..., xn, num\_hidden)

The learnable parameters include both “weight” and “bias”.

If “no\_bias” is set to be true, then the “bias” term is ignored.

.. Note::

The sparse support for FullyConnected is limited to forward evaluation with ‘row\_sparse’ weight and bias, where the length of ‘weight.indices’ and ‘bias.indices’ must be equal to ‘num\_hidden’. This could be useful for model inference with ‘row\_sparse’ weights trained with importance sampling or noise contrastive estimation.

To compute linear transformation with ‘csr’ sparse data, sparse.dot is recommended instead of sparse.FullyConnected.

Defined in src/operator/nn/fully\_connected.cc:L287

## Value

out The result mx.ndarray

---

mx.nd.gamma	Returns the gamma function (extension of the factorial function $\Gamma$ to the reals), computed element-wise on the input array.
-------------	---

---

**Description**

The storage type of “gamma” output is always dense

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Value**

out The result mx.ndarray

---

mx.nd.gammaln	Returns element-wise log of the absolute value of the gamma function $\Gamma$ of the input.
---------------	---

---

**Description**

The storage type of “gammaln” output is always dense

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Value**

out The result mx.ndarray

---

mx.nd.gather.nd	<i>Gather elements or slices from 'data' and store to a tensor whose shape is defined by 'indices'.</i>
-----------------	---

---

### Description

Given 'data' with shape '(X\_0, X\_1, ..., X\_N-1)' and indices with shape '(M, Y\_0, ..., Y\_K-1)', the output will have shape '(Y\_0, ..., Y\_K-1, X\_M, ..., X\_N-1)', where 'M <= N'. If 'M == N', output shape will simply be '(Y\_0, ..., Y\_K-1)'.

### Arguments

data	NDArray-or-Symbol data
indices	NDArray-or-Symbol indices

### Details

The elements in output is defined as follows::

output[y\_0, ..., y\_K-1, x\_M, ..., x\_N-1] = data[indices[0, y\_0, ..., y\_K-1], ..., indices[M-1, y\_0, ..., y\_K-1], x\_M, ..., x\_N-1]

Examples::

data = [[0, 1], [2, 3]] indices = [[1, 1, 0], [0, 1, 0]] gather\_nd(data, indices) = [2, 3, 0]

data = [[[1, 2], [3, 4]], [[5, 6], [7, 8]]] indices = [[0, 1], [1, 0]] gather\_nd(data, indices) = [[3, 4], [5, 6]]

### Value

out The result mx.ndarray

---

mx.nd.GridGenerator	<i>Generates 2D sampling grid for bilinear sampling.</i>
---------------------	--

---

### Description

Generates 2D sampling grid for bilinear sampling.

### Arguments

data	NDArray-or-Symbol Input data to the function.
transform.type	'affine', 'warp', required The type of transformation. For 'affine', input data should be an affine matrix of size (batch, 6). For 'warp', input data should be an optical flow of size (batch, 2, h, w).
target.shape	Shape(tuple), optional, default=[0,0] Specifies the output shape (H, W). This is required if transformation type is 'affine'. If transformation type is 'warp', this parameter is ignored.



Value

out The result mx.ndarray

---

mx.nd.GroupNorm	Group normalization.
-----------------	----------------------

---

Description

The input channels are separated into “num\_groups“ groups, each containing “num\_channels / num\_groups“ channels. The mean and standard-deviation are calculated separately over the each group.

Arguments

data	NDArray-or-Symbol Input data
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
num.groups	int, optional, default='1' Total number of groups.
eps	float, optional, default=9.9999975e-06 An ‘epsilon‘ parameter to prevent division by 0.
output.mean.var	boolean, optional, default=0 Output the mean and std calculated along the given axis.

Details

.. math::

$$\text{data} = \text{data.reshape}((N, \text{num\_groups}, C // \text{num\_groups}, \dots)) \text{ out} = \frac{\text{data} - \text{mean}(\text{data}, \text{axis})}{\sqrt{\text{var}(\text{data}, \text{axis}) + \epsilon}} * \text{gamma} + \text{beta}$$

Both “gamma“ and “beta“ are learnable parameters.

Defined in src/operator/nn/group\_norm.cc:L77

Value

out The result mx.ndarray

---

mx.nd.hard.sigmoid	<i>Computes hard sigmoid of x element-wise.</i>
--------------------	---

---

### Description

.. math:: y = \max(0, \min(1, \alpha \* x + \beta))

### Arguments

data	NDArray-or-Symbol The input array.
alpha	float, optional, default=0.200000003 Slope of hard sigmoid
beta	float, optional, default=0.5 Bias of hard sigmoid.

### Details

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L161

### Value

out The result mx.ndarray

---

mx.nd.identity	<i>Returns a copy of the input.</i>
----------------	-------------------------------------

---

### Description

From:src/operator/tensor/elemwise\_unary\_op\_basic.cc:244

### Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

### Value

out The result mx.ndarray

---

mx.nd.IdentityAttachKLSparseReg

*Apply a sparse regularization to the output a sigmoid activation function.*

---

### Description

Apply a sparse regularization to the output a sigmoid activation function.

### Arguments

data	NDArray-or-Symbol Input data.
sparseness.target	float, optional, default=0.100000001 The sparseness target
penalty	float, optional, default=0.00100000005 The tradeoff parameter for the sparseness penalty
momentum	float, optional, default=0.899999976 The momentum for running average

### Value

out The result mx.ndarray

---

mx.nd.im2col

*Extract sliding blocks from input array.*

---

### Description

This operator is used in vanilla convolution implementation to transform the sliding blocks on image to column matrix, then the convolution operation can be computed by matrix multiplication between column and convolution weight. Due to the close relation between im2col and convolution, the concept of **kernel**, **stride**, **dilate** and **pad** in this operator are inherited from convolution operation.

### Arguments

data	NDArray-or-Symbol Input array to extract sliding blocks.
kernel	Shape(tuple), required Sliding kernel size: (w,), (h, w) or (d, h, w).
stride	Shape(tuple), optional, default=[] The stride between adjacent sliding blocks in spatial dimension: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] The spacing between adjacent kernel points: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
pad	Shape(tuple), optional, default=[] The zero-value padding size on both sides of spatial dimension: (w,), (h, w) or (d, h, w). Defaults to no padding.

**Details**

Given the input data of shape  $(N, C, *)$ , where  $N$  is the batch size,  $C$  is the channel size, and  $*$  is the arbitrary spatial dimension, the output column array is always with shape  $(N, C \times \prod(\text{kernel}), W)$ , where  $C \times \prod(\text{kernel})$  is the block size, and  $W$  is the block number which is the spatial size of the convolution output with same input parameters. Only 1-D, 2-D and 3-D of spatial dimension is supported in this operator.

Defined in src/operator/nn/im2col.cc:L100

**Value**

out The result mx.ndarray

---

mx.nd.InstanceNorm	<i>Applies instance normalization to the n-dimensional input array.</i>
--------------------	---

---

**Description**

This operator takes an n-dimensional input array where  $(n > 2)$  and normalizes the input using the following formula:

**Arguments**

data	NDArray-or-Symbol An n-dimensional input array $(n > 2)$ of the form [batch, channel, spatial_dim1, spatial_dim2, ...].
gamma	NDArray-or-Symbol A vector of length 'channel', which multiplies the normalized input.
beta	NDArray-or-Symbol A vector of length 'channel', which is added to the product of the normalized input and the weight.
eps	float, optional, default=0.00100000005 An 'epsilon' parameter to prevent division by 0.

**Details**

.. math::

out =  $\frac{x - \text{mean}[data]}{\sqrt{\text{Var}[data] + \epsilon}} * \text{gamma} + \text{beta}$

This layer is similar to batch normalization layer ('BatchNorm') with two differences: first, the normalization is carried out per example (instance), not over a batch. Second, the same normalization is applied both at test and train time. This operation is also known as 'contrast normalization'.

If the input data is of shape [batch, channel, spacial\_dim1, spacial\_dim2, ...], 'gamma' and 'beta' parameters must be vectors of shape [channel].

This implementation is based on this paper [1]

.. [1] Instance Normalization: The Missing Ingredient for Fast Stylization, D. Ulyanov, A. Vedaldi, V. Lempitsky, 2016 (arXiv:1607.08022v2).

Examples::

```
// Input of shape (2,1,2) x = [[[ 1.1, 2.2]], [[ 3.3, 4.4]]]
// gamma parameter of length 1 gamma = [1.5]
// beta parameter of length 1 beta = [0.5]
// Instance normalization is calculated with the above formula InstanceNorm(x,gamma,beta) = [[[-0.997527 , 1.99752665]], [[-0.99752653, 1.99752724]]]
Defined in src/operator/instance_norm.cc:L95
```

## Value

out The result mx.ndarray

---

mx.nd.khatri.rao

*Computes the Khatri-Rao product of the input matrices.*

---

## Description

Given a collection of  $n$  input matrices,

## Arguments

args                      NDAarray-or-Symbol[] Positional input matrices

## Details

..  $A_1 \in \mathbb{R}^{M_1 \times M}, \dots, A_n \in \mathbb{R}^{M_n \times N}$ ,  
the (column-wise) Khatri-Rao product is defined as the matrix,  
..  $X = A_1 \otimes \dots \otimes A_n \in \mathbb{R}^{(M_1 \dots M_n) \times N}$ ,  
where the  $k$ th column is equal to the column-wise outer product  $A_{1,k} \otimes \dots \otimes A_{n,k}$  where  $A_{i,k}$  is the  $k$ th column of the  $i$ th matrix.

Example::

```
>> A = mx.nd.array([[1, -1], >> [2, -3]]) >> B = mx.nd.array([[1, 4], >> [2, 5], >> [3, 6]]) >> C =
mx.nd.khatri_rao(A, B) >> print(C.asnumpy()) [[ 1. -4.] [ 2. -5.] [ 3. -6.] [ 2. -12.] [ 4. -15.] [ 6.
-18.]]
```

Defined in src/operator/contrib/krprod.cc:L108

## Value

out The result mx.ndarray

---

mx.nd.L2Normalization *Normalize the input array using the L2 norm.*

---

## Description

For 1-D NDAarray, it computes::

## Arguments

data	NDAarray-or-Symbol Input array to normalize.
eps	float, optional, default=1.00000001e-10 A small constant for numerical stability.
mode	'channel', 'instance', 'spatial', optional, default='instance' Specify the dimension along which to compute L2 norm.

## Details

out = data / sqrt(sum(data \*\* 2) + eps)

For N-D NDAarray, if the input array has shape (N, N, ..., N),

with “mode“ = “instance“, it normalizes each instance in the multidimensional array by its L2 norm.::

for i in 0...N out[i,:,:,...,:] = data[i,:,:,...,:] / sqrt(sum(data[i,:,:,...,:] \*\* 2) + eps)

with “mode“ = “channel“, it normalizes each channel in the array by its L2 norm.::

for i in 0...N out[:,i,:,:,...,:] = data[:,i,:,:,...,:] / sqrt(sum(data[:,i,:,:,...,:] \*\* 2) + eps)

with “mode“ = “spatial“, it normalizes the cross channel norm for each position in the array by its L2 norm.::

for dim in 2...N for i in 0...N out[.....i,...] = take(out, indices=i, axis=dim) / sqrt(sum(take(out, indices=i, axis=dim) \*\* 2) + eps) -dim-

Example::

x = [[[1,2], [3,4]], [[2,2], [5,6]]]

L2Normalization(x, mode='instance') = [[[ 0.18257418 0.36514837] [ 0.54772252 0.73029673]] [[ 0.24077171 0.24077171] [ 0.60192931 0.72231513]]]

L2Normalization(x, mode='channel') = [[[ 0.31622776 0.44721359] [ 0.94868326 0.89442718]] [[ 0.37139067 0.31622776] [ 0.92847669 0.94868326]]]

L2Normalization(x, mode='spatial') = [[[ 0.44721359 0.89442718] [ 0.60000002 0.80000001]] [[ 0.70710677 0.70710677] [ 0.6401844 0.76822126]]]

Defined in src/operator/l2\_normalization.cc:L196

## Value

out The result mx.ndarray

---

mx.nd.lamb.update.phase1

*Phase I of lamb update it performs the following operations and returns g:.*

---

## Description

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
beta1	float, optional, default=0.899999976 The decay rate for the 1st moment estimates.
beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.99999997e-07 A small constant for numerical stability.
t	int, required Index update count.
bias.correction	boolean, optional, default=1 Whether to use bias correction.
wd	float, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .

## Details

```
.. math:: \backslash \text{begingather*} \text{grad} = \text{grad} * \text{rescale\_grad} \text{ if } (\text{grad} < -\text{clip\_gradient}) \text{ then } \text{grad} = -\text{clip\_gradient} \\ \text{ if } (\text{grad} > \text{clip\_gradient}) \text{ then } \text{grad} = \text{clip\_gradient} \\ \text{mean} = \text{beta1} * \text{mean} + (1 - \text{beta1}) * \text{grad}; \text{variance} = \text{beta2} * \text{variance} + (1 - \text{beta2}) * \text{grad}^2; \\ \text{ if } (\text{bias\_correction}) \text{ then } \text{mean\_hat} = \text{mean} / (1 - \text{beta1}^t); \text{var\_hat} = \text{var} / (1 - \text{beta2}^t); \text{g} = \text{mean\_hat} \\ / (\text{var\_hat}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight}; \text{ else } \text{g} = \text{mean} / (\text{var\_data}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight}; \\ \backslash \text{endgather*}
```

Defined in src/operator/optimizer\_op.cc:L944

## Value

out The result mx.ndarray

---

```
mx.nd.lamb.update.phase2
```

*Phase II of lamb update it performs the following operations and updates grad.*

---

### Description

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

### Arguments

weight	NDArray-or-Symbol Weight
g	NDArray-or-Symbol Output of lamb_update_phase 1
r1	NDArray-or-Symbol r1
r2	NDArray-or-Symbol r2
lr	float, required Learning rate
lower_bound	float, optional, default=-1 Lower limit of norm of weight. If lower_bound <= 0, Lower limit is not set
upper_bound	float, optional, default=-1 Upper limit of norm of weight. If upper_bound <= 0, Upper limit is not set

### Details

```
.. math:: \begin{gather*} \text{if } (\text{lower\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{lower\_bound}) \text{ if } (\text{upper\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{upper\_bound}) \end{gather*}
```

```
\text{if } (r1 == 0 \text{ or } r2 == 0) \text{ then } lr = lr \text{ else } lr = lr * (r1/r2) \text{ weight} = \text{weight} - lr * g \end{gather*}
```

Defined in src/operator/optimizer\_op.cc:L983

### Value

out The result mx.ndarray

---

```
mx.nd.LayerNorm
```

*Layer normalization.*

---

### Description

Normalizes the channels of the input tensor by mean and variance, and applies a scale “gamma” as well as offset “beta”.



**Arguments**

data	NDArray-or-Symbol Input data to layer normalization
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
axis	int, optional, default='-1' The axis to perform layer normalization. Usually, this should be be axis of the channel dimension. Negative values means indexing from right to left.
eps	float, optional, default=9.99999975e-06 An 'epsilon' parameter to prevent division by 0.
output.mean.var	boolean, optional, default=0 Output the mean and std calculated along the given axis.

**Details**

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis and then compute the normalized output, which has the same shape as input, as following:

.. math::

$$\text{out} = \frac{\text{data} - \text{mean}(\text{data}, \text{axis})}{\sqrt{\text{var}(\text{data}, \text{axis})}} + \text{epsilon} * \text{gamma} + \text{beta}$$

Both “gamma“ and “beta“ are learnable parameters.

Unlike BatchNorm and InstanceNorm, the *\*mean\** and *\*var\** are computed along the channel dimension.

Assume the input has size *\*k\** on axis 1, then both “gamma“ and “beta“ have shape *\*(k,)\**. If “output\_mean\_var“ is set to be true, then outputs both “data\_mean“ and “data\_std“. Note that no gradient will be passed through these two outputs.

The parameter “axis“ specifies which axis of the input shape denotes the 'channel' (separately normalized groups). The default is -1, which sets the channel axis to be the last item in the input shape.

Defined in src/operator/nn/layer\_norm.cc:L158

**Value**

out The result mx.ndarray

---

mx.nd.LeakyReLU

*Applies Leaky rectified linear unit activation element-wise to the input.*


---

**Description**

Leaky ReLUs attempt to fix the "dying ReLU" problem by allowing a small 'slope' when the input is negative and has a slope of one when input is positive.

**Arguments**

data	NDArray-or-Symbol Input data to activation function.
gamma	NDArray-or-Symbol Input data to activation function.
act.type	'elu', 'gelu', 'leaky', 'prelu', 'rrelu', 'selu', optional, default='leaky' Activation function to be applied.
slope	float, optional, default=0.25 Init slope for the activation. (For leaky and elu only)
lower_bound	float, optional, default=0.125 Lower bound of random slope. (For rrelu only)
upper_bound	float, optional, default=0.333999991 Upper bound of random slope. (For rrelu only)

**Details**

The following modified ReLU Activation functions are supported:

- *\*elu\**: Exponential Linear Unit. 'y = x > 0 ? x : slope \* (exp(x)-1)' - *\*selu\**: Scaled Exponential Linear Unit. 'y = lambda \* (x > 0 ? x : alpha \* (exp(x) - 1))' where *\*lambda* = 1.0507009873554804934193349852946\* and *\*alpha* = 1.6732632423543772848170429916717\*.
- *\*leaky\**: Leaky ReLU. 'y = x > 0 ? x : slope \* x' - *\*prelu\**: Parametric ReLU. This is same as *\*leaky\** except that 'slope' is learnt during training.
- *\*rrelu\**: Randomized ReLU. same as *\*leaky\** but the 'slope' is uniformly and randomly chosen from *\*[lower\_bound, upper\_bound)\** for training, while fixed to be *\*(lower\_bound+upper\_bound)/2\** for inference.

Defined in src/operator/leaky\_relu.cc:L161

**Value**

out The result mx.ndarray

---

mx.nd.linalg.det	<i>Compute the determinant of a matrix. Input is a tensor *A* of dimension *n* &gt;= 2*.</i>
------------------	--

---

**Description**

If *\*n\*=2\**, *\*A\** is a square matrix. We compute:

**Arguments**

A	NDArray-or-Symbol Tensor of square matrix
---	---

**Details**

`*out* = *det(A)*`

If `*n>2*`, `*det*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only. .. note:: There is no gradient backwarded when A is non-invertible (which is equivalent to  $\det(A) = 0$ ) because zero is rarely hit upon in float point computation and the Jacobi's formula on determinant gradient is not computationally efficient when A is non-invertible.

Examples::

Single matrix determinant  $A = \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix}$   $\det(A) = [-5.]$

Batch matrix determinant  $A = \begin{bmatrix} \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix}, \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix} \end{bmatrix}$   $\det(A) = [-5., 5.]$

Defined in `src/operator/tensor/la_op.cc:L975`

**Value**

out The result mx.ndarray

---

`mx.nd.linalg.extractdiag`

*Extracts the diagonal entries of a square matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

**Description**

If `*n=2*`, then `*A*` represents a single square matrix which diagonal elements get extracted as a 1-dimensional tensor.

**Arguments**

A	NDArray-or-Symbol Tensor of square matrices
offset	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.

**Details**

If `*n>2*`, then `*A*` represents a batch of square matrices on the trailing two dimensions. The extracted diagonals are returned as an `*n-1*`-dimensional tensor.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix diagonal extraction  $A = \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix}$

`extractdiag(A) = [1.0, 4.0]`

`extractdiag(A, 1) = [2.0]`

Batch matrix diagonal extraction  $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix}, \begin{bmatrix} 5.0 & 6.0 \\ 7.0 & 8.0 \end{bmatrix} \end{bmatrix}$

```
extractdiag(A) = [[1.0, 4.0], [5.0, 8.0]]
```

Defined in src/operator/tensor/la\_op.cc:L495

## Value

out The result mx.ndarray

---

```
mx.nd.linalg.extracttrian
```

*Extracts a triangular sub-matrix from a square matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

## Description

If  $n=2$ , then  $A$  represents a single square matrix from which a triangular sub-matrix is extracted as a 1-dimensional tensor.

## Arguments

A	NDArray-or-Symbol Tensor of square matrices
offset	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
lower	boolean, optional, default=1 Refer to the lower triangular matrix if lower=true, refer to the upper otherwise. Only relevant when offset=0

## Details

If  $n>2$ , then  $A$  represents a batch of square matrices on the trailing two dimensions. The extracted triangular sub-matrices are returned as an  $n-1$ -dimensional tensor.

The `offset` and `lower` parameters determine the triangle to be extracted:

- When `offset = 0` either the lower or upper triangle with respect to the main diagonal is extracted depending on the value of parameter `lower`.
- When `offset = k > 0` the upper triangle with respect to the  $k$ -th diagonal above the main diagonal is extracted.
- When `offset = k < 0` the lower triangle with respect to the  $k$ -th diagonal below the main diagonal is extracted.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single triangular extraction  $A = [[1.0, 2.0], [3.0, 4.0]]$

$\text{extracttrian}(A) = [1.0, 3.0, 4.0]$   $\text{extracttrian}(A, \text{lower}=\text{False}) = [1.0, 2.0, 4.0]$   $\text{extracttrian}(A, 1) = [2.0]$   $\text{extracttrian}(A, -1) = [3.0]$

Batch triangular extraction  $A = [[[1.0, 2.0], [3.0, 4.0]], [[5.0, 6.0], [7.0, 8.0]]]$

$\text{extracttrian}(A) = [[1.0, 3.0, 4.0], [5.0, 7.0, 8.0]]$

Defined in src/operator/tensor/la\_op.cc:L605

**Value**

out The result mx.ndarray

---

mx.nd.linalg.gelqf	<i>LQ factorization for general matrix. Input is a tensor *A* of dimension *n* <math>\geq 2</math>.</i>
--------------------	---

---

**Description**

If  $n=2$ , we compute the LQ factorization (LAPACK `*gelqf*`, followed by `*orglq*`). `*A*` must have shape  $(x, y)$  with  $x \leq y$ , and must have full rank  $=x$ . The LQ factorization consists of `*L*` with shape  $(x, x)$  and `*Q*` with shape  $(x, y)$ , so that:

**Arguments**

A NDAarray-or-Symbol Tensor of input matrices to be factorized

**Details**

$$*A* = *L* \setminus *Q*$$

Here, `*L*` is lower triangular (upper triangle equal to zero) with nonzero diagonal, and `*Q*` is row-orthonormal, meaning that

$$*Q* \setminus *Q*^{\text{sup:} \text{'T'}}$$

is equal to the identity matrix of shape  $(x, x)$ .

If  $n > 2$ , `*gelqf*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single LQ factorization `A = [[1., 2., 3.], [4., 5., 6.]]` `Q, L = gelqf(A)` `Q = [[-0.26726124, -0.53452248, -0.80178373], [0.87287156, 0.21821789, -0.43643578]]` `L = [[-3.74165739, 0.], [-8.55235974, 1.96396101]]`

Batch LQ factorization `A = [[[1., 2., 3.], [4., 5., 6.]], [[7., 8., 9.], [10., 11., 12.]]]` `Q, L = gelqf(A)` `Q = [[[-0.26726124, -0.53452248, -0.80178373], [0.87287156, 0.21821789, -0.43643578]], [[-0.50257071, -0.57436653, -0.64616234], [0.7620735, 0.05862104, -0.64483142]]]` `L = [[[-3.74165739, 0.], [-8.55235974, 1.96396101]], [[-13.92838828, 0.], [-19.09768702, 0.52758934]]]`

Defined in `src/operator/tensor/la_op.cc:L798`

**Value**

out The result mx.ndarray

---

mx.nd.linalg.gemm	<i>Performs general matrix multiplication and accumulation. Input are tensors *A*, *B*, *C*, each of dimension *n* &gt;= 2* and having the same shape on the leading *n-2* dimensions.</i>
-------------------	--

---

## Description

If  $n=2$ , the BLAS3 function `*gemm*` is performed:

## Arguments

A	NDArray-or-Symbol Tensor of input matrices
B	NDArray-or-Symbol Tensor of input matrices
C	NDArray-or-Symbol Tensor of input matrices
transpose.a	boolean, optional, default=0 Multiply with transposed of first input (A).
transpose.b	boolean, optional, default=0 Multiply with transposed of second input (B).
alpha	double, optional, default=1 Scalar factor multiplied with A*B.
beta	double, optional, default=1 Scalar factor multiplied with C.
axis	int, optional, default='-2' Axis corresponding to the matrix rows.

## Details

$$*out* = *alpha* \cdot (*op*(*A*) \cdot (*op*(*B*) + *beta* \cdot *C*)$$

Here, `*alpha*` and `*beta*` are scalar parameters, and `*op()*` is either the identity or matrix transposition (depending on `*transpose_a*`, `*transpose_b*`).

If  $n > 2$ , `*gemm*` is performed separately for a batch of matrices. The column indices of the matrices are given by the last dimensions of the tensors, the row indices by the axis specified with the `*axis*` parameter. By default, the trailing two dimensions will be used for matrix encoding.

For a non-default axis parameter, the operation performed is equivalent to a series of swapaxes/gemm/swapaxes calls. For example let `*A*`, `*B*`, `*C*` be 5 dimensional tensors. Then `gemm(*A*, *B*, *C*, axis=1)` is equivalent to the following without the overhead of the additional swapaxis operations::

```
A1 = swapaxes(A, dim1=1, dim2=3) B1 = swapaxes(B, dim1=1, dim2=3) C = swapaxes(C, dim1=1, dim2=3)
C = gemm(A1, B1, C) C = swapaxis(C, dim1=1, dim2=3)
```

When the input data is of type float32 and the environment variables `MXNET_CUDA_ALLOW_TENSOR_CORE` and `MXNET_CUDA_TENSOR_OP_MATH_ALLOW_CONVERSION` are set to 1, this operator will try to use pseudo-float16 precision (float32 math with float16 I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

.. note:: The operator supports float32 and float64 data types only.

Examples::

```
Single matrix multiply-add A = [[1.0, 1.0], [1.0, 1.0]] B = [[1.0, 1.0], [1.0, 1.0], [1.0, 1.0]] C =
[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]] gemm(A, B, C, transpose_b=True, alpha=2.0, beta=10.0) = [[14.0,
14.0, 14.0], [14.0, 14.0, 14.0]]
```

Batch matrix multiply-add A = [[[1.0, 1.0]], [[0.1, 0.1]]] B = [[[1.0, 1.0]], [[0.1, 0.1]]] C = [[[10.0]], [[0.01]]] `gemm(A, B, C, transpose_b=True, alpha=2.0, beta=10.0)` = [[[104.0]], [[0.14]]]

Defined in `src/operator/tensor/la_op.cc:L89`

## Value

out The result `mx.ndarray`

---

<code>mx.nd.linalg.gemm2</code>	<i>Performs general matrix multiplication. Input are tensors <code>*A*</code>, <code>*B*</code>, each of dimension <code>*n &gt;= 2*</code> and having the same shape on the leading <code>*n-2*</code> dimensions.</i>
---------------------------------	---

---

## Description

If `*n=2*`, the BLAS3 function `*gemm*` is performed:

## Arguments

A	NDArray-or-Symbol Tensor of input matrices
B	NDArray-or-Symbol Tensor of input matrices
<code>transpose.a</code>	boolean, optional, default=0 Multiply with transposed of first input (A).
<code>transpose.b</code>	boolean, optional, default=0 Multiply with transposed of second input (B).
<code>alpha</code>	double, optional, default=1 Scalar factor multiplied with <code>A*B</code> .
<code>axis</code>	int, optional, default='-2' Axis corresponding to the matrix row indices.

## Details

$$*out* = *alpha* \cdot (*op* \backslash (*A*) \cdot (*op* \backslash (*B*)))$$

Here `*alpha*` is a scalar parameter and `*op()*` is either the identity or the matrix transposition (depending on `*transpose_a*`, `*transpose_b*`).

If `*n>2*`, `*gemm*` is performed separately for a batch of matrices. The column indices of the matrices are given by the last dimensions of the tensors, the row indices by the axis specified with the `*axis*` parameter. By default, the trailing two dimensions will be used for matrix encoding.

For a non-default axis parameter, the operation performed is equivalent to a series of `swapaxes/gemm/swapaxes` calls. For example let `*A*`, `*B*` be 5 dimensional tensors. Then `gemm(*A*, *B*, axis=1)` is equivalent to the following without the overhead of the additional `swapaxis` operations::

`A1 = swapaxes(A, dim1=1, dim2=3)` `B1 = swapaxes(B, dim1=1, dim2=3)` `C = gemm2(A1, B1)` `C = swapaxis(C, dim1=1, dim2=3)`

When the input data is of type `float32` and the environment variables `MXNET_CUDA_ALLOW_TENSOR_CORE` and `MXNET_CUDA_TENSOR_OP_MATH_ALLOW_CONVERSION` are set to 1, this operator will try to use pseudo-`float16` precision (`float32` math with `float16` I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

.. note:: The operator supports `float32` and `float64` data types only.

Examples::

Single matrix multiply  $A = \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 1.0 \end{bmatrix}$   $B = \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 1.0 \\ 1.0 & 1.0 \end{bmatrix}$   $\text{gemm2}(A, B, \text{transpose\_b}=\text{True}, \text{alpha}=2.0) = \begin{bmatrix} 4.0 & 4.0 & 4.0 \\ 4.0 & 4.0 & 4.0 \end{bmatrix}$

Batch matrix multiply  $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 1.0 \end{bmatrix} \\ \begin{bmatrix} 0.1 & 0.1 \end{bmatrix} \end{bmatrix}$   $B = \begin{bmatrix} \begin{bmatrix} 1.0 & 1.0 \end{bmatrix} \\ \begin{bmatrix} 0.1 & 0.1 \end{bmatrix} \end{bmatrix}$   $\text{gemm2}(A, B, \text{transpose\_b}=\text{True}, \text{alpha}=2.0) = \begin{bmatrix} \begin{bmatrix} 4.0 \end{bmatrix} \\ \begin{bmatrix} 0.04 \end{bmatrix} \end{bmatrix}$

Defined in src/operator/tensor/la\_op.cc:L163

## Value

out The result mx.ndarray

---

mx.nd.linalg.inverse	<i>Compute the inverse of a matrix. Input is a tensor *A* of dimension *n* <math>\geq 2</math>.</i>
----------------------	---

---

## Description

If  $*n=2*$ ,  $*A*$  is a square matrix. We compute:

## Arguments

A NDAarray-or-Symbol Tensor of square matrix

## Details

$*out* = *A*^{-1}$

If  $*n>2*$ ,  $*inverse*$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix inverse  $A = \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix}$   $\text{inverse}(A) = \begin{bmatrix} -0.6 & 0.8 \\ 0.4 & -0.2 \end{bmatrix}$

Batch matrix inverse  $A = \begin{bmatrix} \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix} \\ \begin{bmatrix} 1. & 3. \\ 2. & 4. \end{bmatrix} \end{bmatrix}$   $\text{inverse}(A) = \begin{bmatrix} \begin{bmatrix} -0.6 & 0.8 \\ 0.4 & -0.2 \end{bmatrix} \\ \begin{bmatrix} -2. & 1.5 \\ 1. & -0.5 \end{bmatrix} \end{bmatrix}$

Defined in src/operator/tensor/la\_op.cc:L920

## Value

out The result mx.ndarray



---

`mx.nd.linalg.makediag` *Constructs a square matrix with the input as diagonal. Input is a tensor \*A\* of dimension \*n\*  $\geq 1$ .*

---

### Description

If  $n=1$ , then *A* represents the diagonal entries of a single square matrix. This matrix will be returned as a 2-dimensional tensor. If  $n>1$ , then *A* represents a batch of diagonals of square matrices. The batch of diagonal matrices will be returned as an  $n+1$ -dimensional tensor.

### Arguments

<i>A</i>	NDArray-or-Symbol Tensor of diagonal entries
<i>offset</i>	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.

### Details

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single diagonal matrix construction *A* = [1.0, 2.0]

`makediag(A)` = [[1.0, 0.0], [0.0, 2.0]]

`makediag(A, 1)` = [[0.0, 1.0, 0.0], [0.0, 0.0, 2.0], [0.0, 0.0, 0.0]]

Batch diagonal matrix construction *A* = [[1.0, 2.0], [3.0, 4.0]]

`makediag(A)` = [[[1.0, 0.0], [0.0, 2.0]], [[3.0, 0.0], [0.0, 4.0]]]

Defined in `src/operator/tensor/la_op.cc:L547`

### Value

out The result `mx.ndarray`

---

`mx.nd.linalg.maketrian` *Constructs a square matrix with the input representing a specific triangular sub-matrix. This is basically the inverse of \*linalg.extracttrian\*. Input is a tensor \*A\* of dimension \*n\*  $\geq 1$ .*

---

### Description

If  $n=1$ , then *A* represents the entries of a triangular matrix which is lower triangular if *offset*<0 or *offset*=0, *lower*=true. The resulting matrix is derived by first constructing the square matrix with the entries outside the triangle set to zero and then adding *offset*-times an additional diagonal with zero entries to the square matrix.

**Arguments**

A	NDArray-or-Symbol Tensor of triangular matrices stored as vectors
offset	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
lower	boolean, optional, default=1 Refer to the lower triangular matrix if lower=true, refer to the upper otherwise. Only relevant when offset=0

**Details**

If  $*n > 1*$ , then  $*A*$  represents a batch of triangular sub-matrices. The batch of corresponding square matrices is returned as an  $*n+1*$ -dimensional tensor.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix construction  $A = [1.0, 2.0, 3.0]$

$\text{maketrian}(A) = [[1.0, 0.0], [2.0, 3.0]]$

$\text{maketrian}(A, \text{lower}=\text{false}) = [[1.0, 2.0], [0.0, 3.0]]$

$\text{maketrian}(A, \text{offset}=1) = [[0.0, 1.0, 2.0], [0.0, 0.0, 3.0], [0.0, 0.0, 0.0]]$   $\text{maketrian}(A, \text{offset}=-1) = [[0.0, 0.0, 0.0], [1.0, 0.0, 0.0], [2.0, 3.0, 0.0]]$

Batch matrix construction  $A = [[1.0, 2.0, 3.0], [4.0, 5.0, 6.0]]$

$\text{maketrian}(A) = [[[1.0, 0.0], [2.0, 3.0]], [[4.0, 0.0], [5.0, 6.0]]]$

$\text{maketrian}(A, \text{offset}=1) = [[[0.0, 1.0, 2.0], [0.0, 0.0, 3.0], [0.0, 0.0, 0.0]], [[0.0, 4.0, 5.0], [0.0, 0.0, 6.0], [0.0, 0.0, 0.0]]]$

Defined in `src/operator/tensor/la_op.cc:L673`

**Value**

out The result `mx.ndarray`

---

<code>mx.nd.linalg.potrf</code>	<i>Performs Cholesky factorization of a symmetric positive-definite matrix. Input is a tensor <math>*A*</math> of dimension <math>*n \geq 2*</math>.</i>
---------------------------------	--

---

**Description**

If  $*n=2*$ , the Cholesky factor  $*B*$  of the symmetric, positive definite matrix  $*A*$  is computed.  $*B*$  is triangular (entries of upper or lower triangle are all zero), has positive diagonal entries, and:

**Arguments**

A	NDArray-or-Symbol Tensor of input matrices to be decomposed
---	---

**Details**

$*A* = *B* \backslash *B* \backslash \text{sup: 'T' if } *lower* = *true* \quad *A* = *B* \backslash \text{sup: 'T' } \backslash *B* \text{ if } *lower* = *false*$   
 If  $*n > 2*$ ,  $*potrf*$  is performed separately on the trailing two dimensions for all inputs (batch mode).  
 .. note:: The operator supports float32 and float64 data types only.  
 Examples::  
 Single matrix factorization  $A = \begin{bmatrix} 4.0 & 1.0 \\ 1.0 & 4.25 \end{bmatrix}$   $\text{potrf}(A) = \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix}$   
 Batch matrix factorization  $A = \begin{bmatrix} \begin{bmatrix} 4.0 & 1.0 \\ 1.0 & 4.25 \end{bmatrix} & \begin{bmatrix} 16.0 & 4.0 \\ 4.0 & 17.0 \end{bmatrix} \end{bmatrix}$   $\text{potrf}(A) = \begin{bmatrix} \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix} & \begin{bmatrix} 4.0 & 0 \\ 1.0 & 4.0 \end{bmatrix} \end{bmatrix}$   
 Defined in `src/operator/tensor/la_op.cc:L214`

**Value**

out The result mx.ndarray

---

mx.nd.linalg.potri	<i>Performs matrix inversion from a Cholesky factorization. Input is a tensor <math>*A*</math> of dimension <math>*n \geq 2*</math>.</i>
--------------------	--

---

**Description**

If  $*n=2*$ ,  $*A*$  is a triangular matrix (entries of upper or lower triangle are all zero) with positive diagonal. We compute:

**Arguments**

A NDAarray-or-Symbol Tensor of lower triangular matrices

**Details**

$*out* = *A* \backslash \text{sup: 'T' } \backslash *A* \backslash \text{sup: '-1' if } *lower* = *true* \quad *out* = *A* \backslash \text{sup: '-1' } \backslash *A* \backslash \text{sup: 'T' if } *lower* = *false*$

In other words, if  $*A*$  is the Cholesky factor of a symmetric positive definite matrix  $*B*$  (obtained by  $*potrf*$ ), then

$*out* = *B* \backslash \text{sup: '-1'}$

If  $*n > 2*$ ,  $*potri*$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

.. note:: Use this operator only if you are certain you need the inverse of  $*B*$ , and cannot use the Cholesky factor  $*A*$  ( $*potrf*$ ), together with backsubstitution ( $*trsm*$ ). The latter is numerically much safer, and also cheaper.

Examples::

Single matrix inverse  $A = \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix}$   $\text{potri}(A) = \begin{bmatrix} 0.26563 & -0.0625 \\ -0.0625 & 0.25 \end{bmatrix}$

Batch matrix inverse  $A = \begin{bmatrix} \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix} & \begin{bmatrix} 4.0 & 0 \\ 1.0 & 4.0 \end{bmatrix} \end{bmatrix}$   $\text{potri}(A) = \begin{bmatrix} \begin{bmatrix} 0.26563 & -0.0625 \\ -0.0625 & 0.25 \end{bmatrix} & \begin{bmatrix} 0.06641 & -0.01562 \\ -0.01562 & 0.0625 \end{bmatrix} \end{bmatrix}$

Defined in `src/operator/tensor/la_op.cc:L275`

**Value**

out The result mx.ndarray

---

`mx.nd.linalg.slogdet`    *Compute the sign and log of the determinant of a matrix. Input is a tensor `*A*` of dimension `*n`  $\geq 2$ .*

---

**Description**

If `*n=2*`, `*A*` is a square matrix. We compute:

**Arguments**

A                      NDArray-or-Symbol Tensor of square matrix

**Details**

`*sign* = *sign(det(A))*` `*logabsdet* = *log(abs(det(A)))*`

If `*n>2*`, `*slogdet*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only. .. note:: The gradient is not properly defined on sign, so the gradient of it is not backwarded. .. note:: No gradient is backwarded when A is non-invertible. Please see the docs of operator det for detail.

Examples::

Single matrix signed log determinant A = `[[2., 3.], [1., 4.]]` sign, logabsdet = `slogdet(A)` sign = `[1.]` logabsdet = `[1.609438]`

Batch matrix signed log determinant A = `[[[2., 3.], [1., 4.]], [[1., 2.], [2., 4.]], [[1., 2.], [4., 3.]]]` sign, logabsdet = `slogdet(A)` sign = `[1., 0., -1.]` logabsdet = `[1.609438, -inf, 1.609438]`

Defined in `src/operator/tensor/la_op.cc:L1034`

**Value**

out The result mx.ndarray

---

mx.nd.linalg.sumlogdiag

*Computes the sum of the logarithms of the diagonal elements of a square matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

### Description

If  $n=2$ , \*A\* must be square with positive diagonal entries. We sum the natural logarithms of the diagonal elements, the result has shape (1,).

### Arguments

A                      NDAarray-or-Symbol Tensor of square matrices

### Details

If  $n>2$ , \*sumlogdiag\* is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix reduction A = [[1.0, 1.0], [1.0, 7.0]] sumlogdiag(A) = [1.9459]

Batch matrix reduction A = [[[1.0, 1.0], [1.0, 7.0]], [[3.0, 0], [0, 17.0]]] sumlogdiag(A) = [1.9459, 3.9318]

Defined in src/operator/tensor/la\_op.cc:L445

### Value

out The result mx.ndarray

---

mx.nd.linalg.syrk

*Multiplication of matrix with its transpose. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

### Description

If  $n=2$ , the operator performs the BLAS3 function \*syrk\*:

### Arguments

A                      NDAarray-or-Symbol Tensor of input matrices

transpose            boolean, optional, default=0 Use transpose of input matrix.

alpha                double, optional, default=1 Scalar factor to be applied to the result.

## Details

`*out* = *alpha* \* *A* \* *A* \:sup:‘T‘`

if `*transpose=False*`, or

`*out* = *alpha* \* *A* \:sup:‘T‘ \* *A*`

if `*transpose=True*`.

If `*n>2*`, `*syrk*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix multiply `A = [[1., 2., 3.], [4., 5., 6.]]` `syrk(A, alpha=1., transpose=False) = [[14., 32.], [32., 77.]]` `syrk(A, alpha=1., transpose=True) = [[17., 22., 27.], [22., 29., 36.], [27., 36., 45.]]`

Batch matrix multiply `A = [[[1., 1.]], [[0.1, 0.1]]]` `syrk(A, alpha=2., transpose=False) = [[[4.]], [[0.04]]]`

Defined in `src/operator/tensor/la_op.cc:L730`

## Value

out The result `mx.ndarray`

---

<code>mx.nd.linalg.trmm</code>	<i>Performs multiplication with a lower triangular matrix. Input are tensors <code>*A*</code>, <code>*B*</code>, each of dimension <code>*n &gt;= 2*</code> and having the same shape on the leading <code>*n-2*</code> dimensions.</i>
--------------------------------	---

---

## Description

If `*n=2*`, `*A*` must be triangular. The operator performs the BLAS3 function `*trmm*`:

## Arguments

A	NDArray-or-Symbol Tensor of lower triangular matrices
B	NDArray-or-Symbol Tensor of matrices
transpose	boolean, optional, default=0 Use transposed of the triangular matrix
rightside	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
lower	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
alpha	double, optional, default=1 Scalar factor to be applied to the result.

**Details**

`*out* = *alpha* \* *op* \ (*A*) \* *B*`

if `*rightside=False*`, or

`*out* = *alpha* \* *B* \* *op* \ (*A*)`

if `*rightside=True*`. Here, `*alpha*` is a scalar parameter, and `*op()*` is either the identity or the matrix transposition (depending on `*transpose*`).

If `*n>2*`, `*trmm*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single triangular matrix multiply `A = [[1.0, 0], [1.0, 1.0]]` `B = [[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]]`  
`trmm(A, B, alpha=2.0) = [[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]]`

Batch triangular matrix multiply `A = [[[1.0, 0], [1.0, 1.0]], [[1.0, 0], [1.0, 1.0]]]` `B = [[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]], [[0.5, 0.5, 0.5], [0.5, 0.5, 0.5]]]`  
`trmm(A, B, alpha=2.0) = [[[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]], [[1.0, 1.0, 1.0], [2.0, 2.0, 2.0]]]`

Defined in `src/operator/tensor/la_op.cc:L333`

**Value**

out The result `mx.ndarray`

---

`mx.nd.linalg.trsm`

*Solves matrix equation involving a lower triangular matrix. Input are tensors `*A*`, `*B*`, each of dimension `*n >= 2*` and having the same shape on the leading `*n-2*` dimensions.*

---

**Description**

If `*n=2*`, `*A*` must be triangular. The operator performs the BLAS3 function `*trsm*`, solving for `*out*` in:

**Arguments**

A	NDArray-or-Symbol Tensor of lower triangular matrices
B	NDArray-or-Symbol Tensor of matrices
transpose	boolean, optional, default=0 Use transposed of the triangular matrix
rightside	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
lower	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
alpha	double, optional, default=1 Scalar factor to be applied to the result.

**Details**

$*op \setminus (*A*) \setminus *out* = *alpha* \setminus *B*$

if `*rightside=False*`, or

$*out* \setminus *op \setminus (*A*) = *alpha* \setminus *B*$

if `*rightside=True*`. Here, `*alpha*` is a scalar parameter, and `*op()` is either the identity or the matrix transposition (depending on `*transpose*`).

If `*n>2*`, `*trsm*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix solve `A = [[1.0, 0], [1.0, 1.0]] B = [[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]] trsm(A, B, alpha=0.5) = [[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]]`

Batch matrix solve `A = [[[1.0, 0], [1.0, 1.0]], [[1.0, 0], [1.0, 1.0]]] B = [[[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]], [[4.0, 4.0, 4.0], [8.0, 8.0, 8.0]]] trsm(A, B, alpha=0.5) = [[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]], [[2.0, 2.0, 2.0], [2.0, 2.0, 2.0]]]`

Defined in `src/operator/tensor/la_op.cc:L396`

**Value**

out The result `mx.ndarray`

---

`mx.nd.LinearRegressionOutput`

*Computes and optimizes for squared loss during backward propagation. Just outputs “data” during forward propagation.*

---

**Description**

If `:math:\hat{y}_i` is the predicted value of the `i`-th sample, and `:math:y_i` is the corresponding target value, then the squared loss estimated over `:math:n` samples is defined as

**Arguments**

<code>data</code>	NDArray-or-Symbol Input data to the function.
<code>label</code>	NDArray-or-Symbol Input label to the function.
<code>grad.scale</code>	float, optional, default=1 Scale the gradient by a float factor

**Details**

$$\text{SquaredLoss}(\text{Y}, \hat{\text{Y}}) = \frac{1}{n} \sum_{i=0}^{n-1} \|\text{Y}_i - \hat{\text{Y}}_i\|_2^2$$

.. note:: Use the `LinearRegressionOutput` as the final output layer of a net.

The storage type of “label” can be “default” or “csr”



- LinearRegressionOutput(default, default) = default - LinearRegressionOutput(default, csr) = default

By default, gradients of this loss function are scaled by factor '1/m', where m is the number of regression outputs of a training example. The parameter 'grad\_scale' can be used to change this scale to 'grad\_scale/m'.

Defined in src/operator/regression\_output.cc:L92

### Value

out The result mx.ndarray

---

mx.nd.load	<i>Load an mx.nd.array object on disk</i>
------------	---

---

### Description

Load an mx.nd.array object on disk

### Usage

```
mx.nd.load(filename)
```

### Arguments

filename            the filename (including the path)

### Examples

```
mat = mx.nd.array(1:3)
mx.nd.save(mat, 'temp.mat')
mat2 = mx.nd.load('temp.mat')
as.array(mat)
as.array(mat2)
```

---

mx.nd.log	<i>Returns element-wise Natural logarithmic value of the input.</i>
-----------	---

---

### Description

The natural logarithm is logarithm in base \*e\*, so that "log(exp(x)) = x"

### Arguments

data                NDAarray-or-Symbol The input array.

**Details**

The storage type of “log” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L77

**Value**

out The result mx.ndarray

---

mx.nd.log.softmax	<i>Computes the log softmax of the input. This is equivalent to computing softmax followed by log.</i>
-------------------	--

---

**Description**

Examples::

**Arguments**

data	NDArray-or-Symbol The input array.
axis	int, optional, default='-1' The axis along which to compute softmax.
temperature	double or None, optional, default=None Temperature parameter in softmax
dtype	None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None).
use.length	boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.

**Details**

```
>> x = mx.nd.array([1, 2, .1]) >> mx.nd.log_softmax(x).asnumpy() array([-1.41702998, -0.41702995, -2.31702995], dtype=float32)
```

```
>> x = mx.nd.array( [[1, 2, .1],[.1, 2, 1]] ) >> mx.nd.log_softmax(x, axis=0).asnumpy() array([[ -0.34115392, -0.69314718, -1.24115396], [-1.24115396, -0.69314718, -0.34115392]], dtype=float32)
```

**Value**

out The result mx.ndarray

---

mx.nd.log10

Returns element-wise Base-10 logarithmic value of the input.

---

**Description**

$10^{\log_{10}(x)} = x$

**Arguments**

data NDAarray-or-Symbol The input array.

**Details**

The storage type of “log10” output is always dense

Defined in src/operator/tensor/elementwise\_unary\_op\_logexp.cc:L94

**Value**

out The result mx.ndarray

---

mx.nd.log1p

Returns element-wise “log(1 + x)” value of the input.

---

**Description**

This function is more accurate than “log(1 + x)” for small “x” so that  $1+x \approx e^x$

**Arguments**

data NDAarray-or-Symbol The input array.

**Details**

The storage type of “log1p” output depends upon the input storage type:

- log1p(default) = default - log1p(row\_sparse) = row\_sparse - log1p(csr) = csr

Defined in src/operator/tensor/elementwise\_unary\_op\_logexp.cc:L199

**Value**

out The result mx.ndarray

---

mx.nd.log2	Returns element-wise Base-2 logarithmic value of the input.
------------	---

---

**Description**

“ $2^{\log_2(x)} = x$ ”

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Details**

The storage type of “log2” output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L106

**Value**

out The result mx.ndarray

---

mx.nd.logical.not	Returns the result of logical NOT (!) function
-------------------	--

---

**Description**

Example: logical\_not([-2., 0., 1.]) = [0., 1., 0.]

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Value**

out The result mx.ndarray

---

mx.nd.LogisticRegressionOutput

*Applies a logistic function to the input.*


---

## Description

The logistic function, also known as the sigmoid function, is computed as  $\frac{1}{1+\exp(-\text{textbf{x}})}$ .

## Arguments

data	NDArray-or-Symbol Input data to the function.
label	NDArray-or-Symbol Input label to the function.
grad.scale	float, optional, default=1 Scale the gradient by a float factor

## Details

Commonly, the sigmoid is used to squash the real-valued output of a linear model  $\text{wTx}+\text{b}$  into the  $[0,1]$  range so that it can be interpreted as a probability. It is suitable for binary classification or probability prediction tasks.

.. note:: Use the LogisticRegressionOutput as the final output layer of a net.

The storage type of “label” can be “default” or “csr”

- LogisticRegressionOutput(default, default) = default - LogisticRegressionOutput(default, csr) = default

The loss function used is the Binary Cross Entropy Loss:

$-(y\log(p) + (1 - y)\log(1 - p))$

Where ‘y’ is the ground truth probability of positive outcome for a given example, and ‘p’ the probability predicted by the model. By default, gradients of this loss function are scaled by factor ‘1/m’, where m is the number of regression outputs of a training example. The parameter ‘grad\_scale’ can be used to change this scale to ‘grad\_scale/m’.

Defined in src/operator/regression\_output.cc:L152

## Value

out The result mx.ndarray

---

mx.nd.LRN

Applies local response normalization to the input.

---

### Description

The local response normalization layer performs "lateral inhibition" by normalizing over local input regions.

### Arguments

data	NDArray-or-Symbol Input data to LRN
alpha	float, optional, default=9.9999975e-05 The variance scaling parameter $\alpha$ in the LRN expression.
beta	float, optional, default=0.75 The power parameter $\beta$ in the LRN expression.
knorm	float, optional, default=2 The parameter $k$ in the LRN expression.
nsiz	int (non-negative), required normalization window width in elements.

### Details

If  $a_{x,y,i}$  is the activity of a neuron computed by applying kernel  $i$  at position  $(x, y)$  and then applying the ReLU nonlinearity, the response-normalized activity  $b_{x,y,i}$  is given by the expression:

$$b_{x,y,i} = \frac{a_{x,y,i}}{\left( k + \frac{\alpha}{\sum_{j=\max(0, i-\frac{n}{2})}^{\min(N-1, i+\frac{n}{2})} (a_{x,y,j})^2} \right)^\beta}$$

where the sum runs over  $n$  "adjacent" kernel maps at the same spatial position, and  $N$  is the total number of kernels in the layer.

Defined in src/operator/nn/lrn.cc:L158

### Value

out The result mx.ndarray

---

mx.nd.MAERegressionOutput

Computes mean absolute error of the input.

---

### Description

MAE is a risk metric corresponding to the expected value of the absolute error.

**Arguments**

data	NDArray-or-Symbol Input data to the function.
label	NDArray-or-Symbol Input label to the function.
grad.scale	float, optional, default=1 Scale the gradient by a float factor

**Details**

If  $\hat{y}_i$  is the predicted value of the  $i$ -th sample, and  $y_i$  is the corresponding target value, then the mean absolute error (MAE) estimated over  $n$  samples is defined as

$$\text{MAE}(\mathbf{Y}, \hat{\mathbf{Y}}) = \frac{1}{n} \sum_{i=0}^{n-1} |\text{Y}_i - \hat{\text{Y}}_i|$$

.. note:: Use the MAERegressionOutput as the final output layer of a net.

The storage type of “label” can be “default” or “csr”

- MAERegressionOutput(default, default) = default - MAERegressionOutput(default, csr) = default

By default, gradients of this loss function are scaled by factor ‘1/m’, where m is the number of regression outputs of a training example. The parameter ‘grad\_scale’ can be used to change this scale to ‘grad\_scale/m’.

Defined in src/operator/regression\_output.cc:L120

**Value**

out The result mx.ndarray

---

mx.nd.make.loss	<i>Make your own loss function in network construction.</i>
-----------------	---

---

**Description**

This operator accepts a customized loss function symbol as a terminal loss and the symbol should be an operator with no backward dependency. The output of this function is the gradient of loss with respect to the input data.

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

For example, if you are making a cross entropy loss function. Assume “out” is the predicted output and “label” is the true label, then the cross entropy can be defined as:

$$\text{cross\_entropy} = \text{label} * \log(\text{out}) + (1 - \text{label}) * \log(1 - \text{out})$$

loss = make\_loss(cross\_entropy)

We will need to use “make\_loss” when we are creating our own loss function or we want to combine multiple loss functions. Also we may want to stop some variables’ gradients from backpropagation. See more detail in “BlockGrad” or “stop\_gradient”.

The storage type of “make\_loss” output depends upon the input storage type:

- make\_loss(default) = default - make\_loss(row\_sparse) = row\_sparse

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L358

### Value

out The result mx.ndarray

---

mx.nd.MakeLoss

*Make your own loss function in network construction.*

---

### Description

This operator accepts a customized loss function symbol as a terminal loss and the symbol should be an operator with no backward dependency. The output of this function is the gradient of loss with respect to the input data.

### Arguments

data	NDArray-or-Symbol Input array.
grad.scale	float, optional, default=1 Gradient scale as a supplement to unary and binary operators
valid.thresh	float, optional, default=0 clip each element in the array to 0 when it is less than “valid_thresh”. This is used when “normalization” is set to “valid”.
normalization	’batch’, ’null’, ’valid’, optional, default=’null’ If this is set to null, the output gradient will not be normalized. If this is set to batch, the output gradient will be divided by the batch size. If this is set to valid, the output gradient will be divided by the number of valid input elements.

### Details

For example, if you are making a cross entropy loss function. Assume “out” is the predicted output and “label” is the true label, then the cross entropy can be defined as::

$\text{cross\_entropy} = \text{label} * \log(\text{out}) + (1 - \text{label}) * \log(1 - \text{out})$  loss = MakeLoss(cross\_entropy)

We will need to use “MakeLoss” when we are creating our own loss function or we want to combine multiple loss functions. Also we may want to stop some variables’ gradients from backpropagation. See more detail in “BlockGrad” or “stop\_gradient”.

In addition, we can give a scale to the loss by setting “grad\_scale”, so that the gradient of the loss will be rescaled in the backpropagation.

.. note:: This operator should be used as a Symbol instead of NDArray.

Defined in src/operator/make\_loss.cc:L71

### Value

out The result mx.ndarray



---

mx.nd.max

---

*Computes the max of array elements over given axes.*


---

### Description

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L32

### Arguments

data	NDArray-or-Symbol The input
axis	<p>Shape or None, optional, default=None The axis or axes along which to perform the reduction.</p> <p>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.</p> <p>If 'axis' is int, a reduction is performed on a particular axis.</p> <p>If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.</p> <p>If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.</p> <p>Negative values means indexing from right to left.</p>
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

### Value

out The result mx.ndarray

---

mx.nd.max.axis

---

*Computes the max of array elements over given axes.*


---

### Description

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L32

### Arguments

data	NDArray-or-Symbol The input
------	-----------------------------

axis	<p>Shape or None, optional, default=None The axis or axes along which to perform the reduction.</p> <p>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.</p> <p>If 'axis' is int, a reduction is performed on a particular axis.</p> <p>If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.</p> <p>If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.</p> <p>Negative values means indexing from right to left.</p>
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Value**

out The result mx.ndarray

---

mx.nd.mean

*Computes the mean of array elements over given axes.*

---

**Description**

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L84

**Arguments**

data	NDArray-or-Symbol The input
axis	<p>Shape or None, optional, default=None The axis or axes along which to perform the reduction.</p> <p>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.</p> <p>If 'axis' is int, a reduction is performed on a particular axis.</p> <p>If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.</p> <p>If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.</p> <p>Negative values means indexing from right to left.</p>
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Value**

out The result mx.ndarray

---

mx.nd.min	<i>Computes the min of array elements over given axes.</i>
-----------	--

---

**Description**

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L47

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction.  The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'.  If 'axis' is int, a reduction is performed on a particular axis.  If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.  If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.  Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Value**

out The result mx.ndarray

---

mx.nd.min.axis	<i>Computes the min of array elements over given axes.</i>
----------------	--

---

**Description**

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L47

**Arguments**

data	NDArray-or-Symbol The input
------	-----------------------------

axis	<p>Shape or None, optional, default=None The axis or axes along which to perform the reduction.</p> <p>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'.          If 'axis' is int, a reduction is performed on a particular axis.          If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.          If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.          Negative values means indexing from right to left.</p>
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Value**

out The result mx.ndarray

---

mx.nd.moments	<i>Calculate the mean and variance of 'data'.</i>
---------------	---

---

**Description**

The mean and variance are calculated by aggregating the contents of data across axes. If x is 1-D and axes = [0] this is just the mean and variance of a vector.

**Arguments**

data	NDArray-or-Symbol Input ndarray
axes	Shape or None, optional, default=None Array of ints. Axes along which to compute mean and variance.
keepdims	boolean, optional, default=0 produce moments with the same dimensionality as the input.

**Details**

Example:

x = [[1, 2, 3], [4, 5, 6]] mean, var = moments(data=x, axes=[0]) mean = [2.5, 3.5, 4.5] var = [2.25, 2.25, 2.25] mean, var = moments(data=x, axes=[1]) mean = [2.0, 5.0] var = [0.66666667, 0.66666667] mean, var = moments(data=x, axis=[0, 1]) mean = [3.5] var = [2.9166667]

Defined in src/operator/nn/moments.cc:L54

**Value**

out The result mx.ndarray

---

mx.nd.mp.lamb.update.phase1

*Mixed Precision version of Phase I of lamb update it performs the following operations and returns g:.*

---

## Description

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
weight32	NDArray-or-Symbol Weight32
beta1	float, optional, default=0.999999976 The decay rate for the 1st moment estimates.
beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.9999997e-07 A small constant for numerical stability.
t	int, required Index update count.
bias.correction	boolean, optional, default=1 Whether to use bias correction.
wd	float, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .

## Details

```

.. math:: \backslash \text{begingather} * \text{grad32} = \text{grad}(\text{float16}) * \text{rescale\_grad} \text{ if } (\text{grad} < -\text{clip\_gradient}) \text{ then } \text{grad} = \\
-\text{clip\_gradient} \text{ if } (\text{grad} > \text{clip\_gradient}) \text{ then } \text{grad} = \text{clip\_gradient} \\
\text{mean} = \text{beta1} * \text{mean} + (1 - \text{beta1}) * \text{grad}; \text{variance} = \text{beta2} * \text{variance} + (1 - \text{beta2}) * \text{grad}^2; \\
\text{if } (\text{bias\_correction}) \text{ then } \text{mean\_hat} = \text{mean} / (1 - \text{beta1}^t); \text{var\_hat} = \text{var} / (1 - \text{beta2}^t); \text{g} = \\
\text{mean\_hat} / (\text{var\_hat}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight32}; \text{else } \text{g} = \text{mean} / (\text{var\_data}^{1/2} + \text{epsilon}) \\
+ \text{wd} * \text{weight32}; \backslash \text{endgather} * \\
\text{Defined in src/operator/optimizer\_op.cc:L1024}

```

## Value

out The result mx.ndarray

---

mx.nd.mp.lamb.update.phase2

*Mixed Precision version Phase II of lamb update it performs the following operations and updates grad.*

---

## Description

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

## Arguments

weight	NDArray-or-Symbol Weight
g	NDArray-or-Symbol Output of mp_lamb_update_phase 1
r1	NDArray-or-Symbol r1
r2	NDArray-or-Symbol r2
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
lower_bound	float, optional, default=-1 Lower limit of norm of weight. If lower_bound <= 0, Lower limit is not set
upper_bound	float, optional, default=-1 Upper limit of norm of weight. If upper_bound <= 0, Upper limit is not set

## Details

```
.. math:: \begin{gather*} \text{if } (\text{lower\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{lower\_bound}) \text{ if } (\text{upper\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{upper\_bound}) \end{gather*}
```

```
\text{if } (r1 == 0 \text{ or } r2 == 0) \text{ then } lr = lr \text{ else } lr = lr * (r1/r2) \text{ weight32} = \text{weight32} - lr * g \text{ weight(float16)} = \text{weight32} \end{gather*}
```

Defined in src/operator/optimizer\_op.cc:L1066

## Value

out The result mx.ndarray

---

mx.nd.mp.nag.mom.update

*Update function for multi-precision Nesterov Accelerated Gradient(NAG) optimizer.*

---

## Description

Defined in src/operator/optimizer\_op.cc:L736

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).

## Value

out The result mx.ndarray

---

mx.nd.mp.sgd.mom.update

*Updater function for multi-precision sgd optimizer*

---

## Description

Updater function for multi-precision sgd optimizer

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and both weight and momentum have the same stype

**Value**

out The result mx.ndarray

---

mx.nd.mp.sgd.update      *Updater function for multi-precision sgd optimizer*

---

**Description**

Updater function for multi-precision sgd optimizer

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol gradient
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse.



**Value**

out The result mx.ndarray

---

mx.nd.multi.all.finite

*Check if all the float numbers in all the arrays are finite (used for AMP)*

---

**Description**

Defined in src/operator/contrib/all\_finite.cc:L133

**Arguments**

data	NDArray-or-Symbol[] Arrays
num.arrays	int, optional, default='1' Number of arrays.
init.output	boolean, optional, default=1 Initialize output to 1.

**Value**

out The result mx.ndarray

---

mx.nd.multi.lars

*Compute the LARS coefficients of multiple weights and grads from their sums of square"*

---

**Description**

Defined in src/operator/contrib/multi\_lars.cc:L37

**Arguments**

lrs	NDArray-or-Symbol Learning rates to scale by LARS coefficient
weights.sum.sq	NDArray-or-Symbol sum of square of weights arrays
grads.sum.sq	NDArray-or-Symbol sum of square of gradients arrays
wds	NDArray-or-Symbol weight decays
eta	float, required LARS eta
eps	float, required LARS eps
rescale.grad	float, optional, default=1 Gradient rescaling factor

**Value**

out The result mx.ndarray

---

mx.nd.multi.mp.sgd.mom.update

*Momentum update function for multi-precision Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Arguments

data	NDArray-or-Symbol[] Weights
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
num.weights	int, optional, default='1' Number of updated weights.

## Details

.. math::

$$v_1 = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient weight} \quad += v$$

Where the parameter “momentum“ is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer\_op.cc:L463

## Value

out The result mx.ndarray

---

mx.nd.multi.mp.sgd.update

*Update function for multi-precision Stochastic Gradient Descent (SDG) optimizer.*

---

## Description

It updates the weights using::

## Arguments

data	NDArray-or-Symbol[] Weights
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

## Details

$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$

Defined in src/operator/optimizer\_op.cc:L408

## Value

out The result mx.ndarray

---

mx.nd.multi.sgd.mom.update

*Momentum update function for Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

**Arguments**

data	NDArray-or-Symbol[] Weights, gradients and momentum
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

**Details**

.. math::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$w = \text{momentum} * w - \text{learning\_rate} * \text{gradient weight} \quad w += w$$

Where the parameter “momentum“ is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer\_op.cc:L365

**Value**

out The result mx.ndarray

---

mx.nd.multi.sgd.update

*Update function for Stochastic Gradient Descent (SDG) optimizer.*

---

**Description**

It updates the weights using::

**Arguments**

data	NDArray-or-Symbol[] Weights
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .

`clip.gradient` float, optional, default=-1 Clip gradient to the range of  $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If `clip_gradient`  $\leq 0$ , gradient clipping is turned off. `grad = max(min(grad, clip_gradient), -clip_gradient)`.

`num.weights` int, optional, default='1' Number of updated weights.

### Details

`weight = weight - learning_rate * (gradient + wd * weight)`

Defined in `src/operator/optimizer_op.cc:L320`

### Value

out The result `mx.ndarray`

---

<code>mx.nd.multi.sum.sq</code>	<i>Compute the sums of squares of multiple arrays</i>
---------------------------------	---

---

### Description

Defined in `src/operator/contrib/multi_sum_sq.cc:L36`

### Arguments

`data` NDAarray-or-Symbol[] Arrays

`num.arrays` int, required number of input arrays.

### Value

out The result `mx.ndarray`

---

<code>mx.nd.nag.mom.update</code>	<i>Update function for Nesterov Accelerated Gradient( NAG) optimizer. It updates the weights using the following formula,</i>
-----------------------------------	---

---

### Description

.. math:: v\_t = \gamma v\_{t-1} + \eta \* \nabla J(W\_{t-1} - \gamma v\_{t-1}) \ W\_t = W\_{t-1} - v\_t

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .

**Details**

Where  $\eta$  is the learning rate of the optimizer  $\gamma$  is the decay rate of the momentum estimate  $v_t$  is the update vector at time step  $t$   $W_t$  is the weight vector at time step  $t$

Defined in src/operator/optimizer\_op.cc:L717

**Value**

out The result mx.ndarray

---

mx.nd.nanprod	<i>Computes the product of array elements over given axes treating Not a Numbers ("NaN") as one.</i>
---------------	--

---

**Description**

Computes the product of array elements over given axes treating Not a Numbers ("NaN") as one.

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.

keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

Details

Defined in src/operator/tensor/broadcast\_reduce\_prod\_value.cc:L47

Value

out The result mx.ndarray

---

mx.nd.nansum	<i>Computes the sum of array elements over given axes treating Not a Numbers ("NaN") as zero.</i>
--------------	---

---

Description

Computes the sum of array elements over given axes treating Not a Numbers ("NaN") as zero.

Arguments

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction.  The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.  If 'axis' is int, a reduction is performed on a particular axis.  If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.  If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.  Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

Details

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L102

Value

out The result mx.ndarray

---

<code>mx.nd.negative</code>	<i>Numerical negative of the argument, element-wise.</i>
-----------------------------	--

---

**Description**

The storage type of “negative“ output depends upon the input storage type:

**Arguments**

`data`                      NDAarray-or-Symbol The input array.

**Details**

- `negative(default) = default - negative(row_sparse) = row_sparse - negative(csr) = csr`

**Value**

`out` The result `mx.ndarray`

---

<code>mx.nd.norm</code>	<i>Computes the norm on an NDAarray.</i>
-------------------------	--

---

**Description**

This operator computes the norm on an NDAarray with the specified axis, depending on the value of the `ord` parameter. By default, it computes the L2 norm on the entire array. Currently only `ord=2` supports sparse ndarrays.

**Arguments**

`data`                      NDAarray-or-Symbol The input

`ord`                        int, optional, default='2' Order of the norm. Currently `ord=1` and `ord=2` is supported.

`axis`                      Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, '`axis=()`', will compute over all elements into a scalar array with shape '`(1,)`'. If '`axis`' is int, a reduction is performed on a particular axis. If '`axis`' is a 2-tuple, it specifies the axes that hold 2-D matrices, and the matrix norms of these matrices are computed.

`out.dtype`                None, 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', optional, default='None' The data type of the output.

`keepdims`                boolean, optional, default=0 If this is set to 'True', the reduced axis is left in the result as dimension with size one.



**Details**

Examples::

```
x = [[[1, 2], [3, 4]], [[2, 2], [5, 6]]]
norm(x, ord=2, axis=1) = [[3.1622777 4.472136 ] [5.3851647 6.3245554]]
norm(x, ord=1, axis=1) = [[4., 6.], [7., 8.]]
rsp = x.cast_storage('row_sparse')
norm(rsp) = [5.47722578]
csr = x.cast_storage('csr')
norm(csr) = [5.47722578]
Defined in src/operator/tensor/broadcast_reduce_norm_value.cc:L89
```

**Value**

out The result mx.ndarray

---

mx.nd.normal

---

*Draw random samples from a normal (Gaussian) distribution.*


---

**Description**

.. note:: The existing alias “normal” is deprecated.

**Arguments**

loc	float, optional, default=0 Mean of the distribution.
scale	float, optional, default=1 Standard deviation of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Samples are distributed according to a normal distribution parametrized by *\*loc\** (mean) and *\*scale\** (standard deviation).

Example::

```
normal(loc=0, scale=1, shape=(2,2)) = [[ 1.89171135, -1.16881478], [-1.23474145, 1.55807114]]
Defined in src/operator/random/sample_op.cc:L113
```

**Value**

out The result mx.ndarray

---

mx.nd.one.hot	Returns a one-hot array.
---------------	--------------------------

---

## Description

The locations represented by ‘indices’ take value ‘on\_value’, while all other locations take value ‘off\_value’.

## Arguments

indices	NDArray-or-Symbol array of locations where to set on_value
depth	int, required Depth of the one hot dimension.
on.value	double, optional, default=1 The value assigned to the locations represented by indices.
off.value	double, optional, default=0 The value assigned to the locations not represented by indices.
dtype	‘bfloat16’, ‘float16’, ‘float32’, ‘float64’, ‘int32’, ‘int64’, ‘int8’, ‘uint8’, optional, default=‘float32’ DType of the output

## Details

‘one\_hot’ operation with ‘indices’ of shape “(i0, i1)” and ‘depth’ of “d” would result in an output array of shape “(i0, i1, d)” with::

output[i,j,:] = off\_value output[i,j,indices[i,j]] = on\_value

Examples::

```
one_hot([1,0,2,0], 3) = [[ 0.  1.  0.] [ 1.  0.  0.] [ 0.  0.  1.] [ 1.  0.  0.]]
```

```
one_hot([1,0,2,0], 3, on_value=8, off_value=1, dtype='int32') = [[1 8 1] [8 1 1] [1 1 8] [8 1 1]]
```

```
one_hot([[1,0],[1,0],[2,0]], 3) = [[[ 0.  1.  0.] [ 1.  0.  0.]
```

```
[[ 0.  1.  0.] [ 1.  0.  0.]]
```

```
[[ 0.  0.  1.] [ 1.  0.  0.]]]
```

Defined in src/operator/tensor/indexing\_op.cc:L888

## Value

out The result mx.ndarray

---

mx.nd.ones	Generate an mx.ndarray object with ones
------------	---

---

**Description**

Generate an mx.ndarray object with ones

**Usage**

mx.nd.ones(shape, ctx = NULL)

**Arguments**

- shape                    the dimension of the mx.ndarray
- ctx                     optional The context device of the array. mx.ctx.default() will be used in default.

**Examples**

```
mat = mx.nd.ones(10)
as.array(mat)
mat2 = mx.nd.ones(c(5,5))
as.array(mat)
mat3 = mx.nd.ones(c(3,3,3))
as.array(mat3)
```

---

mx.nd.ones.like	Return an array of ones with the same shape and type as the input array.
-----------------	--

---

**Description**

Examples::

**Arguments**

- data                    NDAarray-or-Symbol The input

**Details**

```
x = [[ 0., 0., 0.], [ 0., 0., 0.]]
ones_like(x) = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

**Value**

- out The result mx.ndarray

---

mx.nd.Pad

*Pads an input array with a constant or edge values of the array.*


---

## Description

.. note:: ‘Pad’ is deprecated. Use ‘pad’ instead.

## Arguments

data	NDArray-or-Symbol An n-dimensional input array.
mode	‘constant’, ‘edge’, ‘reflect’, required Padding type to use. "constant" pads with ‘constant_value’ "edge" pads using the edge values of the input array "reflect" pads by reflecting values with respect to the edges.
pad.width	Shape(tuple), required Widths of the padding regions applied to the edges of each axis. It is a tuple of integer padding widths for each axis of the format “(before_1, after_1, ... , before_N, after_N)“. It should be of length “2*N“ where “N“ is the number of dimensions of the array. This is equivalent to pad_width in numpy.pad, but flattened.
constant.value	double, optional, default=0 The value used for padding when ‘mode’ is "constant".

## Details

.. note:: Current implementation only supports 4D and 5D input arrays with padding applied only on axes 1, 2 and 3. Expects axes 4 and 5 in ‘pad\_width’ to be zero.

This operation pads an input array with either a ‘constant\_value’ or edge values along each axis of the input array. The amount of padding is specified by ‘pad\_width’.

‘pad\_width’ is a tuple of integer padding widths for each axis of the format “(before\_1, after\_1, ... , before\_N, after\_N)“. The ‘pad\_width’ should be of length “2\*N“ where “N“ is the number of dimensions of the array.

For dimension “N“ of the input array, “before\_N“ and “after\_N“ indicates how many values to add before and after the elements of the array along dimension “N“. The widths of the higher two dimensions “before\_1“, “after\_1“, “before\_2“, “after\_2“ must be 0.

Example::

```
x = [[[ 1.  2.  3.] [ 4.  5.  6.]]
      [[ 7.  8.  9.] [10. 11. 12.]]]
[[[ 11. 12. 13.] [14. 15. 16.]]
 [[ 17. 18. 19.] [20. 21. 22.]]]
pad(x,mode="edge", pad_width=(0,0,0,0,1,1,1,1)) =
[[[ 1.  1.  2.  3.  3.] [ 1.  1.  2.  3.  3.] [ 4.  4.  5.  6.  6.] [ 4.  4.  5.  6.  6.]]
 [[ 7.  7.  8.  9.  9.] [ 7.  7.  8.  9.  9.] [10. 10. 11. 12. 12.] [10. 10. 11. 12. 12.]]]
[[[ 11. 11. 12. 13. 13.] [11. 11. 12. 13. 13.] [14. 14. 15. 16. 16.] [14. 14. 15. 16. 16.]
```

```
[[ 17. 17. 18. 19. 19.] [ 17. 17. 18. 19. 19.] [ 20. 20. 21. 22. 22.] [ 20. 20. 21. 22. 22.]]]]
pad(x, mode="constant", constant_value=0, pad_width=(0,0,0,0,1,1,1,1)) =
[[[[[ 0. 0. 0. 0. 0.] [ 0. 1. 2. 3. 0.] [ 0. 4. 5. 6. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 7. 8. 9. 0.] [ 0. 10. 11. 12. 0.] [ 0. 0. 0. 0. 0.]]]]
[[[ 0. 0. 0. 0. 0.] [ 0. 11. 12. 13. 0.] [ 0. 14. 15. 16. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 17. 18. 19. 0.] [ 0. 20. 21. 22. 0.] [ 0. 0. 0. 0. 0.]]]]
Defined in src/operator/pad.cc:L766
```

## Value

out The result mx.ndarray

---

mx.nd.pad	<i>Pads an input array with a constant or edge values of the array.</i>
-----------	---

---

## Description

.. note:: ‘Pad’ is deprecated. Use ‘pad’ instead.

## Arguments

data	NDArray-or-Symbol An n-dimensional input array.
mode	‘constant’, ‘edge’, ‘reflect’, required Padding type to use. "constant" pads with ‘constant_value’ "edge" pads using the edge values of the input array "reflect" pads by reflecting values with respect to the edges.
pad.width	Shape(tuple), required Widths of the padding regions applied to the edges of each axis. It is a tuple of integer padding widths for each axis of the format “(before_1, after_1, ... , before_N, after_N)“. It should be of length “2*N“ where “N“ is the number of dimensions of the array. This is equivalent to pad_width in numpy.pad, but flattened.
constant.value	double, optional, default=0 The value used for padding when ‘mode’ is "constant".

## Details

.. note:: Current implementation only supports 4D and 5D input arrays with padding applied only on axes 1, 2 and 3. Expects axes 4 and 5 in ‘pad\_width’ to be zero.

This operation pads an input array with either a ‘constant\_value’ or edge values along each axis of the input array. The amount of padding is specified by ‘pad\_width’.

‘pad\_width’ is a tuple of integer padding widths for each axis of the format “(before\_1, after\_1, ... , before\_N, after\_N)“. The ‘pad\_width’ should be of length “2\*N“ where “N“ is the number of dimensions of the array.

For dimension “N” of the input array, “before\_N” and “after\_N” indicates how many values to add before and after the elements of the array along dimension “N”. The widths of the higher two dimensions “before\_1”, “after\_1”, “before\_2”, “after\_2” must be 0.

Example::

```
x = [[[ 1. 2. 3.] [ 4. 5. 6.]]
[[ 7. 8. 9.] [10. 11. 12.]]]
[[[ 11. 12. 13.] [14. 15. 16.]]
[[ 17. 18. 19.] [20. 21. 22.]]]]
pad(x,mode="edge", pad_width=(0,0,0,0,1,1,1,1)) =
[[[ 1. 1. 2. 3. 3.] [ 1. 1. 2. 3. 3.] [ 4. 4. 5. 6. 6.] [ 4. 4. 5. 6. 6.]]
[[ 7. 7. 8. 9. 9.] [ 7. 7. 8. 9. 9.] [10. 10. 11. 12. 12.] [10. 10. 11. 12. 12.]]]
[[[ 11. 11. 12. 13. 13.] [11. 11. 12. 13. 13.] [14. 14. 15. 16. 16.] [14. 14. 15. 16. 16.]]
[[ 17. 17. 18. 19. 19.] [17. 17. 18. 19. 19.] [20. 20. 21. 22. 22.] [20. 20. 21. 22. 22.]]]]
pad(x, mode="constant", constant_value=0, pad_width=(0,0,0,0,1,1,1,1)) =
[[[ 0. 0. 0. 0. 0.] [ 0. 1. 2. 3. 0.] [ 0. 4. 5. 6. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 7. 8. 9. 0.] [ 0. 10. 11. 12. 0.] [ 0. 0. 0. 0. 0.]]]
[[[ 0. 0. 0. 0. 0.] [ 0. 11. 12. 13. 0.] [ 0. 14. 15. 16. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 17. 18. 19. 0.] [ 0. 20. 21. 22. 0.] [ 0. 0. 0. 0. 0.]]]]
Defined in src/operator/pad.cc:L766
```

## Value

out The result mx.ndarray

---

mx.nd.pick	<i>Picks elements from an input array according to the input indices along the given axis.</i>
------------	--

---

## Description

Given an input array of shape “(d0, d1)” and indices of shape “(i0,)”, the result will be an output array of shape “(i0,)” with::

## Arguments

data	NDArray-or-Symbol The input array
index	NDArray-or-Symbol The index array
axis	int or None, optional, default='-1' int or None. The axis to picking the elements. Negative values means indexing from right to left. If is 'None', the elements in the index w.r.t the flattened input will be picked.

keepdims	boolean, optional, default=0 If true, the axis where we pick the elements is left in the result as dimension with size one.
mode	'clip', 'wrap', optional, default='clip' Specify how out-of-bound indices behave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around.

### Details

```
output[i] = input[i, indices[i]]
```

By default, if any index mentioned is too large, it is replaced by the index that addresses the last element along an axis (the 'clip' mode).

This function supports n-dimensional input and (n-1)-dimensional indices arrays.

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// picks elements with specified indices along axis 0 pick(x, y=[0,1], 0) = [ 1., 4.]
```

```
// picks elements with specified indices along axis 1 pick(x, y=[0,1,0], 1) = [ 1., 4., 5.]
```

```
// picks elements with specified indices along axis 1 using 'wrap' mode // to place indices that would normally be out of bounds pick(x, y=[2,-1,-2], 1, mode='wrap') = [ 1., 4., 5.]
```

```
y = [[ 1.], [ 0.], [ 2.]]
```

```
// picks elements with specified indices along axis 1 and dims are maintained pick(x, y, 1, keepdims=True) = [[ 2.], [ 3.], [ 6.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L151

### Value

out The result mx.ndarray

---

mx.nd.Pooling	<i>Performs pooling on the input.</i>
---------------	---------------------------------------

---

### Description

The shapes for 1-D pooling are

### Arguments

data	NDArray-or-Symbol Input data to the pooling operator.
kernel	Shape(tuple), optional, default=[] Pooling kernel size: (y, x) or (d, y, x)
pool.type	'avg', 'lp', 'max', 'sum', optional, default='max' Pooling type to be applied.
global.pool	boolean, optional, default=0 Ignore kernel size, do global pooling based on current input feature map.

<code>cudnn.off</code>	boolean, optional, default=0 Turn off cudnn pooling and use MXNet pooling operator.
<code>pooling.convention</code>	'full', 'same', 'valid', optional, default='valid' Pooling convention to be applied.
<code>stride</code>	Shape(tuple), optional, default=[] Stride: for pooling (y, x) or (d, y, x). Defaults to 1 for each dimension.
<code>pad</code>	Shape(tuple), optional, default=[] Pad for pooling: (y, x) or (d, y, x). Defaults to no padding.
<code>p.value</code>	int or None, optional, default='None' Value of p for Lp pooling, can be 1 or 2, required for Lp Pooling.
<code>count.include.pad</code>	boolean or None, optional, default=None Only used for AvgPool, specify whether to count padding elements for average calculation. For example, with a 5*5 kernel on a 3*3 corner of a image, the sum of the 9 valid elements will be divided by 25 if this is set to true, or it will be divided by 9 if this is set to false. Defaults to true.
<code>layout</code>	None, 'NCDHW', 'NCHW', 'NCW', 'NDHWC', 'NHWC', 'NWC', optional, default='None' Set layout for input and output. Empty for default layout: NCW for 1d, NCHW for 2d and NCDHW for 3d.

## Details

- **data** and **out**:  $*(batch\_size, channel, width)*$  (NCW layout) or  $*(batch\_size, width, channel)*$  (NWC layout),

The shapes for 2-D pooling are

- **data** and **out**:  $*(batch\_size, channel, height, width)*$  (NCHW layout) or  $*(batch\_size, height, width, channel)*$  (NHWC layout),

$out\_height = f(height, kernel[0], pad[0], stride[0])$   $out\_width = f(width, kernel[1], pad[1], stride[1])$

The definition of  $f$  depends on “pooling\_convention“, which has two options:

- **valid** (default):

$f(x, k, p, s) = \text{floor}((x+2*p-k)/s)+1$

- **full**, which is compatible with Caffe:

$f(x, k, p, s) = \text{ceil}((x+2*p-k)/s)+1$

When “global\_pool“ is set to be true, then global pooling is performed. It will reset “kernel=(height, width)“ and set the appropriate padding to 0.

Three pooling options are supported by “pool\_type“:

- **avg**: average pooling - **max**: max pooling - **sum**: sum pooling - **lp**: Lp pooling

For 3-D pooling, an additional **depth** dimension is added before **height**. Namely the input data and output will have shape  $*(batch\_size, channel, depth, height, width)*$  (NCDHW layout) or  $*(batch\_size, depth, height, width, channel)*$  (NDHWC layout).

Notes on Lp pooling:



Lp pooling was first introduced by this paper: <https://arxiv.org/pdf/1204.3968.pdf>. L-1 pooling is simply sum pooling, while L-inf pooling is simply max pooling. We can see that Lp pooling stands between those two, in practice the most common value for p is 2.

For each window “X”, the mathematical expression for Lp pooling is:

$$f(X) = \sqrt[p]{\sum x^p}$$

Defined in src/operator/nn/pooling.cc:L416

## Value

out The result mx.ndarray

---

mx.nd.Pooling.v1	<i>This operator is DEPRECATED. Perform pooling on the input.</i>
------------------	---

---

## Description

The shapes for 2-D pooling is

## Arguments

data	NDArray-or-Symbol Input data to the pooling operator.
kernel	Shape(tuple), optional, default=[] pooling kernel size: (y, x) or (d, y, x)
pool.type	'avg', 'max', 'sum', optional, default='max' Pooling type to be applied.
global.pool	boolean, optional, default=0 Ignore kernel size, do global pooling based on current input feature map.
pooling.convention	'full', 'valid', optional, default='valid' Pooling convention to be applied.
stride	Shape(tuple), optional, default=[] stride: for pooling (y, x) or (d, y, x)
pad	Shape(tuple), optional, default=[] pad for pooling: (y, x) or (d, y, x)

## Details

- **data**: \*(batch\_size, channel, height, width)\* - **out**: \*(batch\_size, num\_filter, out\_height, out\_width)\*, with::

out\_height = f(height, kernel[0], pad[0], stride[0]) out\_width = f(width, kernel[1], pad[1], stride[1])

The definition of \*f\* depends on “pooling\_convention“, which has two options:

- **valid** (default)::

$$f(x, k, p, s) = \text{floor}((x+2*p-k)/s)+1$$

- **full**, which is compatible with Caffe::

$$f(x, k, p, s) = \text{ceil}((x+2*p-k)/s)+1$$

But “global\_pool“ is set to be true, then do a global pooling, namely reset “kernel=(height, width)“.

Three pooling options are supported by “pool\_type“:

- **avg**: average pooling - **max**: max pooling - **sum**: sum pooling

1-D pooling is special case of 2-D pooling with *weight=1* and *kernel[1]=1*.

For 3-D pooling, an additional *depth* dimension is added before *height*. Namely the input data will have shape *(batch\_size, channel, depth, height, width)*.

Defined in src/operator/pooling\_v1.cc:L104

## Value

out The result mx.ndarray

---

mx.nd.preloaded.multi.mp.sgd.mom.update

*Momentum update function for multi-precision Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Arguments

data	NDArray-or-Symbol[] Weights, gradients, momentums, learning rates and weight decays
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

## Details

.. math::

$$v_t = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient weight} \quad += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L200

## Value

out The result mx.ndarray

---

mx.nd.preloaded.multi.mp.sgd.update

*Update function for multi-precision Stochastic Gradient Descent (SDG) optimizer.*

---

## Description

It updates the weights using::

## Arguments

data	NDArray-or-Symbol[] Weights, gradients, learning rates and weight decays
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

## Details

$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L140

## Value

out The result mx.ndarray

---

mx.nd.preloaded.multi.sgd.mom.update

*Momentum update function for Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

**Arguments**

data	NDArray-or-Symbol[] Weights, gradients, momentum, learning rates and weight decays
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

**Details**

.. math::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$w = \text{momentum} * w - \text{learning\_rate} * \text{gradient} \quad w_t += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L91

**Value**

out The result mx.ndarray

---

mx.nd.preloaded.multi.sgd.update

*Update function for Stochastic Gradient Descent (SDG) optimizer.*

---

**Description**

It updates the weights using::

**Arguments**

data	NDArray-or-Symbol[] Weights, gradients, learning rates and weight decays
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.

**Details**

$$w_t = w_t - \text{learning\_rate} * (\text{gradient} + \text{wd} * w_t)$$

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L42

Value

out The result mx.ndarray

---

mx.nd.prod	<i>Computes the product of array elements over given axes.</i>
------------	--

---

Description

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L31

Arguments

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

Value

out The result mx.ndarray

---

mx.nd.radians	<i>Converts each element of the input array from degrees to radians.</i>
---------------	--

---

Description

.. math:: \text{radians}([0, 90, 180, 270, 360]) = [0, \pi/2, \pi, 3\pi/2, 2\pi]

Arguments

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

The storage type of “radians” output depends upon the input storage type:

- radians(default) = default - radians(row\_sparse) = row\_sparse - radians(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L351

**Value**

out The result mx.ndarray

---

mx.nd.random.exponential

*Draw random samples from an exponential distribution.*

---

**Description**

Samples are distributed according to an exponential distribution parametrized by *\*lambda\** (rate).

**Arguments**

lam	float, optional, default=1 Lambda parameter (rate) of the exponential distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Example::

exponential(lam=4, shape=(2,2)) = [[ 0.0097189 , 0.08999364], [ 0.04146638, 0.31715935]]

Defined in src/operator/random/sample\_op.cc:L137

**Value**

out The result mx.ndarray

---

mx.nd.random.gamma	<i>Draw random samples from a gamma distribution.</i>
--------------------	---

---

## Description

Samples are distributed according to a gamma distribution parametrized by *\*alpha\** (shape) and *\*beta\** (scale).

## Arguments

alpha	float, optional, default=1 Alpha parameter (shape) of the gamma distribution.
beta	float, optional, default=1 Beta parameter (scale) of the gamma distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

## Details

Example::

```
gamma(alpha=9, beta=0.5, shape=(2,2)) = [[ 7.10486984, 3.37695289], [ 3.91697288, 3.65933681]]
```

Defined in src/operator/random/sample\_op.cc:L125

## Value

out The result mx.ndarray

---

mx.nd.random.generalized.negative.binomial	<i>Draw random samples from a generalized negative binomial distribution.</i>
--	---

---

## Description

Samples are distributed according to a generalized negative binomial distribution parametrized by *\*mu\** (mean) and *\*alpha\** (dispersion). *\*alpha\** is defined as *\*1/k\** where *\*k\** is the failure limit of the number of unsuccessful experiments (generalized to real numbers). Samples will always be returned as a floating point data type.

**Arguments**

mu	float, optional, default=1 Mean of the negative binomial distribution.
alpha	float, optional, default=1 Alpha (dispersion) parameter of the negative binomial distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Example::

```
generalized_negative_binomial(mu=2.0, alpha=0.3, shape=(2,2)) = [[ 2., 1.], [ 6., 4.]]
```

Defined in src/operator/random/sample\_op.cc:L179

**Value**

out The result mx.ndarray

---

```
mx.nd.random.negative.binomial
```

*Draw random samples from a negative binomial distribution.*

---

**Description**

Samples are distributed according to a negative binomial distribution parametrized by \*k\* (limit of unsuccessful experiments) and \*p\* (failure probability in each experiment). Samples will always be returned as a floating point data type.

**Arguments**

k	int, optional, default='1' Limit of unsuccessful experiments.
p	float, optional, default=1 Failure probability in each experiment.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Example::

```
negative_binomial(k=3, p=0.4, shape=(2,2)) = [[ 4., 7.], [ 2., 5.]]
```

Defined in src/operator/random/sample\_op.cc:L164



**Value**

out The result mx.ndarray

---

mx.nd.random.normal     *Draw random samples from a normal (Gaussian) distribution.*

---

**Description**

.. note:: The existing alias “normal” is deprecated.

**Arguments**

loc	float, optional, default=0 Mean of the distribution.
scale	float, optional, default=1 Standard deviation of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Samples are distributed according to a normal distribution parametrized by \*loc\* (mean) and \*scale\* (standard deviation).

Example::

```
normal(loc=0, scale=1, shape=(2,2)) = [[ 1.89171135, -1.16881478], [-1.23474145, 1.55807114]]
```

Defined in src/operator/random/sample\_op.cc:L113

**Value**

out The result mx.ndarray

---

```
mx.nd.random.pdf.dirichlet
```

*Computes the value of the PDF of \*sample\* of Dirichlet distributions with parameter \*alpha\*.*

---

## Description

The shape of *alpha* must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *alpha*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the value of *alpha* at index *i*.

## Arguments

<code>sample</code>	NDArray-or-Symbol Samples from the distributions.
<code>alpha</code>	NDArray-or-Symbol Concentration parameters of the distributions.
<code>is.log</code>	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.

## Details

Examples::

```
random_pdf_dirichlet(sample=[[1,2],[2,3],[3,4]], alpha=[2.5, 2.5]) = [38.413498, 199.60245, 564.56085]
```

```
sample = [[[1, 2, 3], [10, 20, 30], [100, 200, 300]], [[0.1, 0.2, 0.3], [0.01, 0.02, 0.03], [0.001, 0.002, 0.003]]]
```

```
random_pdf_dirichlet(sample=sample, alpha=[0.1, 0.4, 0.9]) = [[2.3257459e-02, 5.8420084e-04, 1.4674458e-05], [9.2589635e-01, 3.6860607e+01, 1.4674468e+03]]
```

Defined in src/operator/random/pdf\_op.cc:L316

## Value

out The result mx.ndarray

---

```
mx.nd.random.pdf.exponential
```

*Computes the value of the PDF of \*sample\* of exponential distributions with parameters \*lam\* (rate).*

---

**Description**

The shape of *\*lam\** must match the leftmost subshape of *\*sample\**. That is, *\*sample\** can have the same shape as *\*lam\**, in which case the output contains one density per distribution, or *\*sample\** can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *\*i\** in the output are given by the samples at index *\*i\** in *\*sample\** parameterized by the value of *\*lam\** at index *\*i\**.

**Arguments**

<code>sample</code>	NDArray-or-Symbol Samples from the distributions.
<code>lam</code>	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
<code>is.log</code>	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.

**Details**

Examples::

```
random_pdf_exponential(sample=[[1, 2, 3]], lam=[1]) = [[0.36787945, 0.13533528, 0.04978707]]
```

```
sample = [[1,2,3], [1,2,3], [1,2,3]]
```

```
random_pdf_exponential(sample=sample, lam=[1,0.5,0.25]) = [[0.36787945, 0.13533528, 0.04978707],
[0.30326533, 0.18393973, 0.11156508], [0.1947002, 0.15163267, 0.11809164]]
```

Defined in src/operator/random/pdf\_op.cc:L305

**Value**

out The result mx.ndarray

---

`mx.nd.random.pdf.gamma`

*Computes the value of the PDF of *\*sample\** of gamma distributions with parameters *\*alpha\** (shape) and *\*beta\** (rate).*

---

**Description**

*\*alpha\** and *\*beta\** must have the same shape, which must match the leftmost subshape of *\*sample\**. That is, *\*sample\** can have the same shape as *\*alpha\** and *\*beta\**, in which case the output contains one density per distribution, or *\*sample\** can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *\*i\** in the output are given by the samples at index *\*i\** in *\*sample\** parameterized by the values of *\*alpha\** and *\*beta\** at index *\*i\**.

**Arguments**

sample	NDArray-or-Symbol Samples from the distributions.
alpha	NDArray-or-Symbol Alpha (shape) parameters of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
beta	NDArray-or-Symbol Beta (scale) parameters of the distributions.

**Details**

Examples::

```
random_pdf_gamma(sample=[[1,2,3,4,5]], alpha=[5], beta=[1]) = [[0.01532831, 0.09022352, 0.16803136,
0.19536681, 0.17546739]]
```

```
sample = [[1, 2, 3, 4, 5], [2, 3, 4, 5, 6], [3, 4, 5, 6, 7]]
```

```
random_pdf_gamma(sample=sample, alpha=[5,6,7], beta=[1,1,1]) = [[0.01532831, 0.09022352,
0.16803136, 0.19536681, 0.17546739], [0.03608941, 0.10081882, 0.15629345, 0.17546739, 0.16062315],
[0.05040941, 0.10419563, 0.14622283, 0.16062315, 0.14900276]]
```

Defined in src/operator/random/pdf\_op.cc:L303

**Value**

out The result mx.ndarray

---

mx.nd.random.pdf.generalized.negative.binomial

*Computes the value of the PDF of \*sample\* of generalized negative binomial distributions with parameters \*mu\* (mean) and \*alpha\* (dispersion). This can be understood as a reparameterization of the negative binomial, where  $k = 1 / \alpha$  and  $p = 1 / (\mu \backslash \alpha + 1)$ .*

---

**Description**

\*mu\* and \*alpha\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*mu\* and \*alpha\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*mu\* and \*alpha\* at index \*i\*.

**Arguments**

sample	NDArray-or-Symbol Samples from the distributions.
mu	NDArray-or-Symbol Means of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
alpha	NDArray-or-Symbol Alpha (dispersion) parameters of the distributions.

**Details**

Examples::

```
random_pdf_generalized_negative_binomial(sample=[[1, 2, 3, 4]], alpha=[1], mu=[1]) = [[0.25, 0.125, 0.0625, 0.03125]]
```

```
sample = [[1,2,3,4], [1,2,3,4]] random_pdf_generalized_negative_binomial(sample=sample, alpha=[1, 0.6666], mu=[1, 1.5]) = [[0.25, 0.125, 0.0625, 0.03125 ], [0.26517063, 0.16573331, 0.09667706, 0.05437994]]
```

Defined in src/operator/random/pdf\_op.cc:L314

**Value**

out The result mx.ndarray

---

```
mx.nd.random.pdf.negative.binomial
```

*Computes the value of the PDF of samples of negative binomial distributions with parameters \*k\* (failure limit) and \*p\* (failure probability).*

---

**Description**

\*k\* and \*p\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*k\* and \*p\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*k\* and \*p\* at index \*i\*.

**Arguments**

sample	NDArray-or-Symbol Samples from the distributions.
k	NDArray-or-Symbol Limits of unsuccessful experiments.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
p	NDArray-or-Symbol Failure probabilities in each experiment.

**Details**

Examples::

```
random_pdf_negative_binomial(sample=[[1,2,3,4]], k=[1], p=a[0.5]) = [[0.25, 0.125, 0.0625, 0.03125]]
```

```
# Note that k may be real-valued sample = [[1,2,3,4], [1,2,3,4]] random_pdf_negative_binomial(sample=sample, k=[1, 1.5], p=[0.5, 0.5]) = [[0.25, 0.125, 0.0625, 0.03125 ], [0.26516506, 0.16572815, 0.09667476, 0.05437956]]
```

Defined in src/operator/random/pdf\_op.cc:L310

**Value**

out The result mx.ndarray

---

```
mx.nd.random.pdf.normal
```

*Computes the value of the PDF of \*sample\* of normal distributions with parameters \*mu\* (mean) and \*sigma\* (standard deviation).*

---

**Description**

\*mu\* and \*sigma\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*mu\* and \*sigma\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*mu\* and \*sigma\* at index \*i\*.

**Arguments**

sample	NDArray-or-Symbol Samples from the distributions.
mu	NDArray-or-Symbol Means of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
sigma	NDArray-or-Symbol Standard deviations of the distributions.

**Details**

Examples::

```
sample = [[-2, -1, 0, 1, 2]] random_pdf_normal(sample=sample, mu=[0], sigma=[1]) = [[0.05399097, 0.24197073, 0.3989423, 0.24197073, 0.05399097]]
```

```
random_pdf_normal(sample=sample*2, mu=[0,0], sigma=[1,2]) = [[0.05399097, 0.24197073, 0.3989423, 0.24197073, 0.05399097], [0.12098537, 0.17603266, 0.19947115, 0.17603266, 0.12098537]]
```

Defined in src/operator/random/pdf\_op.cc:L300

**Value**

out The result mx.ndarray

---

mx.nd.random.pdf.poisson

*Computes the value of the PDF of \*sample\* of Poisson distributions with parameters \*lam\* (rate).*

---

## Description

The shape of *lam* must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *lam*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the value of *lam* at index *i*.

## Arguments

<i>sample</i>	NDArray-or-Symbol Samples from the distributions.
<i>lam</i>	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
<i>is.log</i>	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.

## Details

Examples::

```
random_pdf_poisson(sample=[[0,1,2,3]], lam=[1]) = [[0.36787945, 0.36787945, 0.18393973, 0.06131324]]
```

```
sample = [[0,1,2,3], [0,1,2,3], [0,1,2,3]]
```

```
random_pdf_poisson(sample=sample, lam=[1,2,3]) = [[0.36787945, 0.36787945, 0.18393973, 0.06131324],
[0.13533528, 0.27067056, 0.27067056, 0.18044704], [0.04978707, 0.14936121, 0.22404182, 0.22404182]]
```

Defined in src/operator/random/pdf\_op.cc:L307

## Value

out The result mx.ndarray

---

mx.nd.random.pdf.uniform

*Computes the value of the PDF of \*sample\* of uniform distributions on the intervals given by \*[low,high)\*.*

---

## Description

*low* and *high* must have the same shape, which must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *low* and *high*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the values of *low* and *high* at index *i*.

**Arguments**

sample	NDArray-or-Symbol Samples from the distributions.
low	NDArray-or-Symbol Lower bounds of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
high	NDArray-or-Symbol Upper bounds of the distributions.

**Details**

Examples::

```
random_pdf_uniform(sample=[[1,2,3,4]], low=[0], high=[10]) = [0.1, 0.1, 0.1, 0.1]
```

```
sample = [[[1, 2, 3], [1, 2, 3]], [[1, 2, 3], [1, 2, 3]]] low = [[0, 0], [0, 0]] high = [[ 5, 10], [15, 20]]
random_pdf_uniform(sample=sample, low=low, high=high) = [[[0.2, 0.2, 0.2 ], [0.1, 0.1, 0.1 ]], [[0.06667, 0.06667, 0.06667], [0.05, 0.05, 0.05 ]]]
```

Defined in src/operator/random/pdf\_op.cc:L298

**Value**

out The result mx.ndarray

---

`mx.nd.random.poisson`    *Draw random samples from a Poisson distribution.*

---

**Description**

Samples are distributed according to a Poisson distribution parametrized by *\*lambda\** (rate). Samples will always be returned as a floating point data type.

**Arguments**

lam	float, optional, default=1 Lambda parameter (rate) of the Poisson distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Example::

```
poisson(lam=4, shape=(2,2)) = [[ 5., 2.], [ 4., 6.]]
```

Defined in src/operator/random/sample\_op.cc:L150

**Value**

out The result mx.ndarray



---

`mx.nd.random.randint`    *Draw random samples from a discrete uniform distribution.*

---

### Description

Samples are uniformly distributed over the half-open interval `*[low, high)*` (includes `*low*`, but excludes `*high*`).

### Arguments

<code>low</code>	long, required Lower bound of the distribution.
<code>high</code>	long, required Upper bound of the distribution.
<code>shape</code>	Shape(tuple), optional, default=None Shape of the output.
<code>ctx</code>	string, optional, default="" Context of output, in format <code>[cpulgpulcpu_pinned](n)</code> . Only used for imperative calls.
<code>dtype</code>	'None', 'int32', 'int64', optional, default='None' DType of the output in case this can't be inferred. Defaults to int32 if not defined (dtype=None).

### Details

Example::

```
randint(low=0, high=5, shape=(2,2)) = [[ 0, 2], [ 3, 1]]
```

Defined in `src/operator/random/sample_op.cc:L194`

### Value

out The result `mx.ndarray`

---

`mx.nd.random.uniform`    *Draw random samples from a uniform distribution.*

---

### Description

.. note:: The existing alias “uniform“ is deprecated.

### Arguments

<code>low</code>	float, optional, default=0 Lower bound of the distribution.
<code>high</code>	float, optional, default=1 Upper bound of the distribution.
<code>shape</code>	Shape(tuple), optional, default=None Shape of the output.
<code>ctx</code>	string, optional, default="" Context of output, in format <code>[cpulgpulcpu_pinned](n)</code> . Only used for imperative calls.
<code>dtype</code>	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Samples are uniformly distributed over the half-open interval `*[low, high)*` (includes `*low*`, but excludes `*high*`).

Example::

```
uniform(low=0, high=1, shape=(2,2)) = [[ 0.60276335, 0.85794562], [ 0.54488319, 0.84725171]]
```

Defined in `src/operator/random/sample_op.cc:L96`

**Value**

out The result mx.ndarray

---

`mx.nd.ravel.multi.index`

*Converts a batch of index arrays into an array of flat indices. The operator follows numpy conventions so a single multi index is given by a column of the input matrix. The leading dimension may be left unspecified by using -1 as placeholder.*

---

**Description**

Examples::

```
A = [[3,6,6],[4,5,1]] ravel(A, shape=(7,6)) = [22,41,37] ravel(A, shape=(-1,6)) = [22,41,37]
```

**Arguments**

<code>data</code>	NDArray-or-Symbol Batch of multi-indices
<code>shape</code>	Shape(tuple), optional, default=None Shape of the array into which the multi-indices apply.

**Details**

Defined in `src/operator/tensor/ravel.cc:L42`

**Value**

out The result mx.ndarray

---

mx.nd.rcbrt

*Returns element-wise inverse cube-root value of the input.*


---

**Description**

.. math:: \text{rcbrt}(x) = 1/\sqrt[3]{x}

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::

rcbrt([1,8,-125]) = [1.0, 0.5, -0.2]

Defined in src/operator/tensor/elementwise\_unary\_op\_pow.cc:L323

**Value**

out The result mx.ndarray

---

mx.nd.reciprocal

*Returns the reciprocal of the argument, element-wise.*


---

**Description**

Calculates  $1/x$ .

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::

reciprocal([-2, 1, 3, 1.6, 0.2]) = [-0.5, 1.0, 0.33333334, 0.625, 5.0]

Defined in src/operator/tensor/elementwise\_unary\_op\_pow.cc:L43

**Value**

out The result mx.ndarray

---

mx.nd.relu	Computes rectified linear activation.
------------	---------------------------------------

---

**Description**

.. math:: \max(\text{features}, 0)

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

The storage type of “relu“ output depends upon the input storage type:  
- relu(default) = default - relu(row\_sparse) = row\_sparse - relu(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L85

**Value**

out The result mx.ndarray

---

mx.nd.repeat	<i>Repeats elements of an array. By default, “repeat“ flattens the input array into 1-D and then repeats the elements:: <math>x = [[1, 2], [3, 4]]</math> repeat(<math>x</math>, repeats=2) = [ 1., 1., 2., 2., 3., 3., 4., 4.] The parameter “axis“ specifies the axis along which to perform repeat:: repeat(<math>x</math>, repeats=2, axis=1) = [[ 1., 1., 2., 2.], [ 3., 3., 4., 4.]] repeat(<math>x</math>, repeats=2, axis=0) = [[ 1., 2.], [ 1., 2.], [ 3., 4.], [ 3., 4.]] repeat(<math>x</math>, repeats=2, axis=-1) = [[ 1., 1., 2., 2.], [ 3., 3., 4., 4.]]</i>
--------------	---

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L744

**Arguments**

data                      NDAarray-or-Symbol Input data array  
repeats                   int, required The number of repetitions for each element.  
axis                      int or None, optional, default='None' The axis along which to repeat values. The negative numbers are interpreted counting from the backward. By default, use the flattened input array, and return a flat output array.

**Value**

out The result mx.ndarray

---

mx.nd.reset.arrays	<i>Set to zero multiple arrays</i>
--------------------	------------------------------------

---

**Description**

Defined in src/operator/contrib/reset\_arrays.cc:L36

**Arguments**

- data           NDArray-or-Symbol[] Arrays
- num.arrays     int, required number of input arrays.

**Value**

out The result mx.ndarray

---

mx.nd.Reshape

*Reshapes the input array. .. note:: “Reshape” is deprecated, use “reshape”* Given an array and a shape, this function returns a copy of the array in the new shape. The shape is a tuple of integers such as (2,3,4). The size of the new shape should be same as the size of the input array. Example:: `reshape([1,2,3,4], shape=(2,2)) = [[1,2], [3,4]]` Some dimensions of the shape can take special values from the set 0, -1, -2, -3, -4. The significance of each is explained below: - “0” copy this dimension from the input to the output shape. Example:: - input shape = (2,3,4), shape = (4,0,2), output shape = (4,3,2) - input shape = (2,3,4), shape = (2,0,0), output shape = (2,3,4) - “-1” infers the dimension of the output shape by using the remainder of the input dimensions keeping the size of the new array same as that of the input array. At most one dimension of shape can be -1. Example:: - input shape = (2,3,4), shape = (6,1,-1), output shape = (6,1,4) - input shape = (2,3,4), shape = (3,-1,8), output shape = (3,1,8) - input shape = (2,3,4), shape=(-1,), output shape = (24,) - “-2” copy all/remainder of the input dimensions to the output shape. Example:: - input shape = (2,3,4), shape = (-2,), output shape = (2,3,4) - input shape = (2,3,4), shape = (2,-2), output shape = (2,3,4) - input shape = (2,3,4), shape = (-2,1,1), output shape = (2,3,4,1,1) - “-3” use the product of two consecutive dimensions of the input shape as the output dimension. Example:: - input shape = (2,3,4), shape = (-3,4), output shape = (6,4) - input shape = (2,3,4,5), shape = (-3,-3), output shape = (6,20) - input shape = (2,3,4), shape = (0,-3), output shape = (2,12) - input shape = (2,3,4), shape = (-3,-2), output shape = (6,4) - “-4” split one dimension of the input into two dimensions passed subsequent to -4 in shape (can contain -1). Example:: - input shape = (2,3,4), shape = (-4,1,2,-2), output shape = (1,2,3,4) - input shape = (2,3,4), shape = (2,-4,-1,3,-2), output shape = (2,1,3,4) If the argument ‘reverse’ is set to 1, then the special values are inferred from right to left. Example:: - without reverse=1, for input shape = (10,5,4), shape = (-1,0), output shape would be (40,5) - with reverse=1, output shape will be (50,4).

## Description

Defined in `src/operator/tensor/matrix_op.cc:L175`

## Arguments

data	NDArray-or-Symbol Input data to reshape.
shape	Shape(tuple), optional, default=[] The target shape
reverse	boolean, optional, default=0 If true then the special values are inferred from right to left
target.shape	Shape(tuple), optional, default=[] (Deprecated! Use “shape” instead.) Target new shape. One and only one dim can be 0, in which case it will be inferred from the rest of dims

`keep.highest` boolean, optional, default=0 (Deprecated! Use “shape” instead.) Whether keep the highest dim unchanged. If set to true, then the first dim in `target_shape` is ignored, and always fixed as input

## Value

out The result mx.ndarray

---

`mx.nd.reshape` *Reshapes the input array. .. note:: “Reshape” is deprecated, use “reshape” Given an array and a shape, this function returns a copy of the array in the new shape. The shape is a tuple of integers such as (2,3,4). The size of the new shape should be same as the size of the input array. Example:: `reshape([1,2,3,4], shape=(2,2)) = [[1,2], [3,4]]` Some dimensions of the shape can take special values from the set 0, -1, -2, -3, -4. The significance of each is explained below: - “0” copy this dimension from the input to the output shape. Example:: - input shape = (2,3,4), shape = (4,0,2), output shape = (4,3,2) - input shape = (2,3,4), shape = (2,0,0), output shape = (2,3,4) - “-1” infers the dimension of the output shape by using the remainder of the input dimensions keeping the size of the new array same as that of the input array. At most one dimension of shape can be -1. Example:: - input shape = (2,3,4), shape = (6,1,-1), output shape = (6,1,4) - input shape = (2,3,4), shape = (3,-1,8), output shape = (3,1,8) - input shape = (2,3,4), shape=(-1,), output shape = (24,) - “-2” copy all/remainder of the input dimensions to the output shape. Example:: - input shape = (2,3,4), shape = (-2,), output shape = (2,3,4) - input shape = (2,3,4), shape = (2,-2), output shape = (2,3,4) - input shape = (2,3,4), shape = (-2,1,1), output shape = (2,3,4,1,1) - “-3” use the product of two consecutive dimensions of the input shape as the output dimension. Example:: - input shape = (2,3,4), shape = (-3,4), output shape = (6,4) - input shape = (2,3,4,5), shape = (-3,-3), output shape = (6,20) - input shape = (2,3,4), shape = (0,-3), output shape = (2,12) - input shape = (2,3,4), shape = (-3,-2), output shape = (6,4) - “-4” split one dimension of the input into two dimensions passed subsequent to -4 in shape (can contain -1). Example:: - input shape = (2,3,4), shape = (-4,1,2,-2), output shape = (1,2,3,4) - input shape = (2,3,4), shape = (2,-4,-1,3,-2), output shape = (2,1,3,4) If the argument ‘reverse’ is set to 1, then the special values are inferred from right to left. Example:: - without reverse=1, for input shape = (10,5,4), shape = (-1,0), output shape would be (40,5) - with reverse=1, output shape will be (50,4).*

---

## Description

Defined in `src/operator/tensor/matrix_op.cc:L175`

**Arguments**

data	NDArray-or-Symbol Input data to reshape.
shape	Shape(tuple), optional, default=[] The target shape
reverse	boolean, optional, default=0 If true then the special values are inferred from right to left
target.shape	Shape(tuple), optional, default=[] (Deprecated! Use “shape“ instead.) Target new shape. One and only one dim can be 0, in which case it will be inferred from the rest of dims
keep.highest	boolean, optional, default=0 (Deprecated! Use “shape“ instead.) Whether keep the highest dim unchanged.If set to true, then the first dim in target_shape is ignored,and always fixed as input

**Value**

out The result mx.ndarray

---

mx.nd.reshape.like	<i>Reshape some or all dimensions of ‘lhs’ to have the same shape as some or all dimensions of ‘rhs’.</i>
--------------------	---

---

**Description**

Returns a **view** of the ‘lhs’ array with a new shape without altering any data.

**Arguments**

lhs	NDArray-or-Symbol First input.
rhs	NDArray-or-Symbol Second input.
lhs.begin	int or None, optional, default='None' Defaults to 0. The beginning index along which the lhs dimensions are to be reshaped. Supports negative indices.
lhs.end	int or None, optional, default='None' Defaults to None. The ending index along which the lhs dimensions are to be used for reshaping. Supports negative indices.
rhs.begin	int or None, optional, default='None' Defaults to 0. The beginning index along which the rhs dimensions are to be used for reshaping. Supports negative indices.
rhs.end	int or None, optional, default='None' Defaults to None. The ending index along which the rhs dimensions are to be used for reshaping. Supports negative indices.



**Details**

Example::

```
x = [1, 2, 3, 4, 5, 6] y = [[0, -4], [3, 2], [2, 2]] reshape_like(x, y) = [[1, 2], [3, 4], [5, 6]]
```

More precise control over how dimensions are inherited is achieved by specifying \ slices over the 'lhs' and 'rhs' array dimensions. Only the sliced 'lhs' dimensions \ are reshaped to the 'rhs' sliced dimensions, with the non-sliced 'lhs' dimensions staying the same.

Examples::

```
- lhs shape = (30,7), rhs shape = (15,2,4), lhs_begin=0, lhs_end=1, rhs_begin=0, rhs_end=2, output shape = (15,2,7)
- lhs shape = (3, 5), rhs shape = (1,15,4), lhs_begin=0, lhs_end=2, rhs_begin=1, rhs_end=2, output shape = (15)
```

Negative indices are supported, and 'None' can be used for either 'lhs\_end' or 'rhs\_end' to indicate the end of the range.

Example::

```
- lhs shape = (30, 12), rhs shape = (4, 2, 2, 3), lhs_begin=-1, lhs_end=None, rhs_begin=1, rhs_end=None, output shape = (30, 2, 2, 3)
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L511

**Value**

out The result mx.ndarray

---

mx.nd.reverse

*Reverses the order of elements along given axis while preserving array shape. Note: reverse and flip are equivalent. We use reverse in the following examples. Examples:: x = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.]] reverse(x, axis=0) = [[ 5., 6., 7., 8., 9.], [ 0., 1., 2., 3., 4.]] reverse(x, axis=1) = [[ 4., 3., 2., 1., 0.], [ 9., 8., 7., 6., 5.]]*

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L832

**Arguments**

data	NDArray-or-Symbol Input data array
axis	Shape(tuple), required The axis which to reverse elements.

**Value**

out The result mx.ndarray

---

<code>mx.nd rint</code>	<i>Returns element-wise rounded value to the nearest integer of the input.</i>
-------------------------	--

---

**Description**

.. note:: - For input “n.5” “rint” returns “n” while “round” returns “n+1”. - For input “-n.5” both “rint” and “round” returns “-n-1”.

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::  
`rint([-1.5, 1.5, -1.9, 1.9, 2.1]) = [-2., 1., -2., 2., 2.]`  
The storage type of “rint” output depends upon the input storage type:  
- `rint(default) = default` - `rint(row_sparse) = row_sparse` - `rint(csr) = csr`  
Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L798`

**Value**

out The result `mx.ndarray`

---

<code>mx.nd.rmsprop.update</code>	<i>Update function for ‘RMSProp’ optimizer.</i>
-----------------------------------	---

---

**Description**

‘RMSprop’ is a variant of stochastic gradient descent where the gradients are divided by a cache which grows with the sum of squares of recent gradients?

**Arguments**

<code>weight</code>	NDAarray-or-Symbol Weight
<code>grad</code>	NDAarray-or-Symbol Gradient
<code>n</code>	NDAarray-or-Symbol n
<code>lr</code>	float, required Learning rate
<code>rho</code>	float, optional, default=0.949999988 The decay rate of momentum estimates.
<code>epsilon</code>	float, optional, default=9.99999994e-09 A small constant for numerical stability.
<code>wd</code>	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.

rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
clip.weights	float, optional, default=-1 Clip weights to the range of $[-\text{clip\_weights}, \text{clip\_weights}]$ If $\text{clip\_weights} \leq 0$ , weight clipping is turned off. $\text{weights} = \max(\min(\text{weights}, \text{clip\_weights}), -\text{clip\_weights})$ .

## Details

‘RMSProp’ is similar to ‘AdaGrad’, a popular variant of ‘SGD’ which adaptively tunes the learning rate of each parameter. ‘AdaGrad’ lowers the learning rate for each parameter monotonically over the course of training. While this is analytically motivated for convex optimizations, it may not be ideal for non-convex problems. ‘RMSProp’ deals with this heuristically by allowing the learning rates to rebound as the denominator decays over time.

Define the Root Mean Square (RMS) error criterion of the gradient as  $\text{RMS}[g]_t = \sqrt{E[g^2]_t + \epsilon}$ , where  $g$  represents gradient and  $E[g^2]_t$  is the decaying average over past squared gradient.

The  $E[g^2]_t$  is given by:

$$E[g^2]_t = \rho * E[g^2]_{t-1} + (1-\rho) * g_t^2$$

The update step is

$$\theta_{t+1} = \theta_t - \frac{\eta \text{RMS}[g]_t}{g_t} g_t$$

The RMSProp code follows the version in [http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture\\_slides\\_lec6.pdf](http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture_slides_lec6.pdf) Tieleman & Hinton, 2012.

Hinton suggests the momentum term  $\rho$  to be 0.9 and the learning rate  $\eta$  to be 0.001.

Defined in `src/operator/optimizer_op.cc:L788`

## Value

out The result `mx.ndarray`

---

`mx.nd.rmspropalex.update`

*Update function for RMSPropAlex optimizer.*

---

## Description

‘RMSPropAlex’ is non-centered version of ‘RMSProp’.

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
n	NDArray-or-Symbol n
g	NDArray-or-Symbol g
delta	NDArray-or-Symbol delta
lr	float, required Learning rate
rho	float, optional, default=0.949999988 Decay rate.
momentum	float, optional, default=0.899999976 Decay rate.
epsilon	float, optional, default=9.99999994e-09 A small constant for numerical stability.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
clip.weights	float, optional, default=-1 Clip weights to the range of $[-\text{clip\_weights}, \text{clip\_weights}]$ . If $\text{clip\_weights} \leq 0$ , weight clipping is turned off. $\text{weights} = \max(\min(\text{weights}, \text{clip\_weights}), -\text{clip\_weights})$ .

**Details**

Define  $E[g^2]_t$  is the decaying average over past squared gradient and  $E[g]_t$  is the decaying average over past gradient.

$$\begin{aligned} \text{.. math:: } E[g^2]_t &= \rho * E[g^2]_{t-1} + (1 - \rho) * g_t^2 \\ E[g]_t &= \rho * E[g]_{t-1} + (1 - \rho) * g_t \\ \text{momentum}_t &= \gamma * \text{momentum}_{t-1} - \frac{\eta}{\sqrt{E[g^2]_t - E[g]_t^2 + \epsilon}} g_t \end{aligned}$$

The update step is

$$\text{.. math:: } \theta_{t+1} = \theta_t + \text{momentum}_t$$

The RMSPropAlex code follows the version in <http://arxiv.org/pdf/1308.0850v5.pdf> Eq(38) - Eq(45) by Alex Graves, 2013.

Graves suggests the momentum term  $\rho$  to be 0.95,  $\gamma$  to be 0.9 and the learning rate  $\eta$  to be 0.0001.

Defined in src/operator/optimizer\_op.cc:L827

**Value**

out The result mx.ndarray

---

mx.nd.RNN	<i>Applies recurrent layers to input data. Currently, vanilla RNN, LSTM and GRU are implemented, with both multi-layer and bidirectional support.</i>
-----------	---

---

## Description

When the input data is of type float32 and the environment variables MXNET\_CUDA\_ALLOW\_TENSOR\_CORE and MXNET\_CUDA\_TENSOR\_OP\_MATH\_ALLOW\_CONVERSION are set to 1, this operator will try to use pseudo-float16 precision (float32 math with float16 I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

## Arguments

data	NDArray-or-Symbol Input data to RNN
parameters	NDArray-or-Symbol Vector of all RNN trainable parameters concatenated
state	NDArray-or-Symbol initial hidden state of the RNN
state.cell	NDArray-or-Symbol initial cell state for LSTM networks (only for LSTM)
sequence.length	NDArray-or-Symbol Vector of valid sequence lengths for each element in batch. (Only used if use_sequence_length kwarg is True)
state.size	int (non-negative), required size of the state for each layer
num.layers	int (non-negative), required number of stacked layers
bidirectional	boolean, optional, default=0 whether to use bidirectional recurrent layers
mode	'gru', 'lstm', 'rnn_relu', 'rnn_tanh', required the type of RNN to compute
p	float, optional, default=0 drop rate of the dropout on the outputs of each RNN layer, except the last layer.
state.outputs	boolean, optional, default=0 Whether to have the states as symbol outputs.
projection.size	int or None, optional, default='None' size of project size
lstm.state.clip.min	double or None, optional, default=None Minimum clip value of LSTM states. This option must be used together with lstm_state_clip_max.
lstm.state.clip.max	double or None, optional, default=None Maximum clip value of LSTM states. This option must be used together with lstm_state_clip_min.
lstm.state.clip.nan	boolean, optional, default=0 Whether to stop NaN from propagating in state by clipping it to min/max. If clipping range is not specified, this option is ignored.
use.sequence.length	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter 'sequence_length' to specify variable length sequence

## Details

### \*\*Vanilla RNN\*\*

Applies a single-gate recurrent layer to input X. Two kinds of activation function are supported: ReLU and Tanh.

With ReLU activation function:

$$\text{.. math:: } h_t = \text{relu}(W_{ih} * x_t + b_{ih} + W_{hh} * h_{(t-1)} + b_{hh})$$

With Tanh activation function:

$$\text{.. math:: } h_t = \tanh(W_{ih} * x_t + b_{ih} + W_{hh} * h_{(t-1)} + b_{hh})$$

Reference paper: Finding structure in time - Elman, 1988. <https://crl.ucsd.edu/~elman/Papers/fsit.pdf>

### \*\*LSTM\*\*

Long Short-Term Memory - Hochreiter, 1997. <http://www.bioinf.jku.at/publications/older/2604.pdf>

$$\text{.. math:: } \begin{array}{l} i_t = \text{mathrmsigmoid}(W_{ii} x_t + b_{ii} + W_{hi} h_{(t-1)} + b_{hi}) \quad f_t = \text{mathrmsigmoid}(W_{if} x_t + b_{if} + W_{hf} h_{(t-1)} + b_{hf}) \\ g_t = \tanh(W_{ig} x_t + b_{ig} + W_{hc} h_{(t-1)} + b_{hg}) \\ o_t = \text{mathrmsigmoid}(W_{io} x_t + b_{io} + W_{ho} h_{(t-1)} + b_{ho}) \quad c_t = f_t * c_{(t-1)} + i_t * g_t \\ h_t = o_t * \tanh(c_t) \end{array}$$

With the projection size being set, LSTM could use the projection feature to reduce the parameters size and give some speedups without significant damage to the accuracy.

Long Short-Term Memory Based Recurrent Neural Network Architectures for Large Vocabulary Speech Recognition - Sak et al. 2014. <https://arxiv.org/abs/1402.1128>

$$\text{.. math:: } \begin{array}{l} i_t = \text{mathrmsigmoid}(W_{ii} x_t + b_{ii} + W_{ri} r_{(t-1)} + b_{ri}) \quad f_t = \text{mathrmsigmoid}(W_{if} x_t + b_{if} + W_{rf} r_{(t-1)} + b_{rf}) \\ g_t = \tanh(W_{ig} x_t + b_{ig} + W_{rc} r_{(t-1)} + b_{rg}) \\ o_t = \text{mathrmsigmoid}(W_{io} x_t + b_{io} + W_{ro} r_{(t-1)} + b_{ro}) \quad c_t = f_t * c_{(t-1)} + i_t * g_t \\ h_t = o_t * \tanh(c_t) \quad r_t = W_{hr} h_t \end{array}$$

### \*\*GRU\*\*

Gated Recurrent Unit - Cho et al. 2014. <http://arxiv.org/abs/1406.1078>

The definition of GRU here is slightly different from paper but compatible with CUDNN.

$$\text{.. math:: } \begin{array}{l} r_t = \text{mathrmsigmoid}(W_{ir} x_t + b_{ir} + W_{hr} h_{(t-1)} + b_{hr}) \quad z_t = \text{mathrmsigmoid}(W_{iz} x_t + b_{iz} + W_{hz} h_{(t-1)} + b_{hz}) \\ n_t = \tanh(W_{in} x_t + b_{in} + r_t * (W_{hn} h_{(t-1)} + b_{hn})) \\ h_t = (1 - z_t) * n_t + z_t * h_{(t-1)} \end{array}$$

Defined in src/operator/rnn.cc:L368

## Value

out The result mx.ndarray

---

mx.nd.ROIPooling	<i>Performs region of interest(ROI) pooling on the input array.</i>
------------------	---

---

## Description

ROI pooling is a variant of a max pooling layer, in which the output size is fixed and region of interest is a parameter. Its purpose is to perform max pooling on the inputs of non-uniform sizes to obtain fixed-size feature maps. ROI pooling is a neural-net layer mostly used in training a ‘Fast R-CNN’ network for object detection.

## Arguments

data	NDArray-or-Symbol The input array to the pooling operator, a 4D Feature maps
rois	NDArray-or-Symbol Bounding box coordinates, a 2D array of [[batch_index, x1, y1, x2, y2]], where (x1, y1) and (x2, y2) are top left and bottom right corners of designated region of interest. ‘batch_index’ indicates the index of corresponding image in the input array
pooled.size	Shape(tuple), required ROI pooling output shape (h,w)
spatial.scale	float, required Ratio of input feature map height (or w) to raw image height (or w). Equals the reciprocal of total stride in convolutional layers

## Details

This operator takes a 4D feature map as an input array and region proposals as ‘rois’, then it pools over sub-regions of input and produces a fixed-sized output array regardless of the ROI size.

To crop the feature map accordingly, you can resize the bounding box coordinates by changing the parameters ‘rois’ and ‘spatial\_scale’.

The cropped feature maps are pooled by standard max pooling operation to a fixed size output indicated by a ‘pooled\_size’ parameter. batch\_size will change to the number of region bounding boxes after ‘ROIPooling’.

The size of each region of interest doesn’t have to be perfectly divisible by the number of pooling sections(‘pooled\_size’).

Example::

```
x = [[[[ 0., 1., 2., 3., 4., 5.], [ 6., 7., 8., 9., 10., 11.], [ 12., 13., 14., 15., 16., 17.], [ 18., 19., 20., 21., 22., 23.], [ 24., 25., 26., 27., 28., 29.], [ 30., 31., 32., 33., 34., 35.], [ 36., 37., 38., 39., 40., 41.], [ 42., 43., 44., 45., 46., 47.]]]]]
```

```
// region of interest i.e. bounding box coordinates. y = [[0,0,0,4,4]]
```

```
// returns array of shape (2,2) according to the given roi with max pooling. ROIPooling(x, y, (2,2), 1.0) = [[[[ 14., 16.], [ 26., 28.]]]]
```

```
// region of interest is changed due to the change in ‘spacial_scale’ parameter. ROIPooling(x, y, (2,2), 0.7) = [[[[ 7., 9.], [ 19., 21.]]]]
```

Defined in src/operator/roi\_pooling.cc:L225

**Value**

out The result mx.ndarray

---

<code>mx.nd.round</code>	<i>Returns element-wise rounded value to the nearest integer of the input.</i>
--------------------------	--

---

**Description**

Example::

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

`round([-1.5, 1.5, -1.9, 1.9, 2.1]) = [-2., 2., -2., 2., 2.]`  
The storage type of “round“ output depends upon the input storage type:  
- `round(default) = default` - `round(row_sparse) = row_sparse` - `round(csr) = csr`  
Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L777`

**Value**

out The result mx.ndarray

---

<code>mx.nd.rsqrt</code>	<i>Returns element-wise inverse square-root value of the input.</i>
--------------------------	---

---

**Description**

.. math:: \text{rsqrt}(x) = 1/\sqrt{x}

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::  
`rsqrt([4,9,16]) = [0.5, 0.33333334, 0.25]`  
The storage type of “rsqrt“ output is always dense  
Defined in `src/operator/tensor/elemwise_unary_op_pow.cc:L221`

**Value**

out The result mx.ndarray



---

mx.nd.sample.exponential

*Concurrent sampling from multiple exponential distributions with parameters lambda (rate).*

---

## Description

The parameters of the distributions are provided as an input array. Let  $[s]$  be the shape of the input array,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

lam	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input array,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input value at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input array.

Examples::

```
lam = [ 1.0, 8.5 ]
```

```
// Draw a single sample for each distribution sample_exponential(lam) = [ 0.51837951, 0.09994757]
```

```
// Draw a vector containing two samples for each distribution sample_exponential(lam, shape=(2))
= [[ 0.51837951, 0.19866663], [ 0.09994757, 0.50447971]]
```

Defined in src/operator/random/multisample\_op.cc:L284

## Value

out The result mx.ndarray

---

mx.nd.sample.gamma	<i>Concurrent sampling from multiple gamma distributions with parameters <math>\alpha</math> (shape) and <math>\beta</math> (scale).</i>
--------------------	--

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

alpha	NDArray-or-Symbol Alpha (shape) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
beta	NDArray-or-Symbol Beta (scale) parameters of the distributions.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
alpha = [ 0.0, 2.5 ] beta = [ 1.0, 0.7 ]
```

```
// Draw a single sample for each distribution sample_gamma(alpha, beta) = [ 0. , 2.25797319]
```

```
// Draw a vector containing two samples for each distribution sample_gamma(alpha, beta, shape=(2))
= [[ 0. , 0. ], [ 2.25797319, 1.70734084]]
```

Defined in src/operator/random/multisample\_op.cc:L282

## Value

out The result mx.ndarray

---

mx.nd.sample.generalized.negative.binomial

*Concurrent sampling from multiple generalized negative binomial distributions with parameters  $\mu$  (mean) and  $\alpha$  (dispersion).*

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

mu	NDArray-or-Symbol Means of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
alpha	NDArray-or-Symbol Alpha (dispersion) parameters of the distributions.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Samples will always be returned as a floating point data type.

Examples::

```
mu = [ 2.0, 2.5 ] alpha = [ 1.0, 0.1 ]
```

```
// Draw a single sample for each distribution sample_generalized_negative_binomial(mu, alpha) = [ 0., 3.]
```

```
// Draw a vector containing two samples for each distribution sample_generalized_negative_binomial(mu, alpha, shape=(2)) = [[ 0., 3.], [ 3., 1.]]
```

Defined in src/operator/random/multisample\_op.cc:L293

## Value

out The result mx.ndarray

---

mx.nd.sample.multinomial

*Concurrent sampling from multiple multinomial distributions.*


---

## Description

*\*data\** is an *\*n\** dimensional array whose last dimension has length *\*k\**, where *\*k\** is the number of possible outcomes of each multinomial distribution. This operator will draw *\*shape\** samples from each distribution. If *shape* is empty one sample will be drawn from each distribution.

## Arguments

<code>data</code>	NDArray-or-Symbol Distribution probabilities. Must sum to one on the last axis.
<code>shape</code>	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
<code>get_prob</code>	boolean, optional, default=0 Whether to also return the log probability of sampled result. This is usually used for differentiating through stochastic variables, e.g. in reinforcement learning.
<code>dtype</code>	'float16', 'float32', 'float64', 'int32', 'uint8', optional, default='int32' DType of the output in case this can't be inferred.

## Details

If *\*get\_prob\** is true, a second array containing log likelihood of the drawn samples will also be returned. This is usually used for reinforcement learning where you can provide reward as head gradient for this array to estimate gradient.

Note that the input distribution must be normalized, i.e. *\*data\** must sum to 1 along its last axis.

Examples::

```
probs = [[0, 0.1, 0.2, 0.3, 0.4], [0.4, 0.3, 0.2, 0.1, 0]]
```

```
// Draw a single sample for each distribution sample_multinomial(probs) = [3, 0]
```

```
// Draw a vector containing two samples for each distribution sample_multinomial(probs, shape=(2))
= [[4, 2], [0, 0]]
```

```
// requests log likelihood sample_multinomial(probs, get_prob=True) = [2, 1], [0.2, 0.3]
```

## Value

out The result mx.ndarray

---

mx.nd.sample.negative.binomial

*Concurrent sampling from multiple negative binomial distributions with parameters \*k\* (failure limit) and \*p\* (failure probability).*

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

k	NDArray-or-Symbol Limits of unsuccessful experiments.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
p	NDArray-or-Symbol Failure probabilities in each experiment.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Samples will always be returned as a floating point data type.

Examples::

```
k = [ 20, 49 ] p = [ 0.4 , 0.77 ]
```

```
// Draw a single sample for each distribution sample_negative_binomial(k, p) = [ 15., 16.]
```

```
// Draw a vector containing two samples for each distribution sample_negative_binomial(k, p,
shape=(2)) = [[ 15., 50.], [ 16., 12.]]
```

Defined in src/operator/random/multisample\_op.cc:L289

## Value

out The result mx.ndarray

---

mx.nd.sample.normal	<i>Concurrent sampling from multiple normal distributions with parameters <math>\mu</math> (mean) and <math>\sigma</math> (standard deviation).</i>
---------------------	---

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

mu	NDArray-or-Symbol Means of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
sigma	NDArray-or-Symbol Standard deviations of the distributions.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
mu = [ 0.0, 2.5 ] sigma = [ 1.0, 3.7 ]
```

```
// Draw a single sample for each distribution sample_normal(mu, sigma) = [-0.56410581, 0.95934606]
```

```
// Draw a vector containing two samples for each distribution sample_normal(mu, sigma, shape=(2))
= [[-0.56410581, 0.2928229 ], [ 0.95934606, 4.48287058]]
```

Defined in src/operator/random/multisample\_op.cc:L279

## Value

out The result mx.ndarray

---

mx.nd.sample.poisson	<i>Concurrent sampling from multiple Poisson distributions with parameters lambda (rate).</i>
----------------------	---

---

## Description

The parameters of the distributions are provided as an input array. Let  $[s]$  be the shape of the input array,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

lam	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input array,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input value at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input array.

Samples will always be returned as a floating point data type.

Examples::

```
lam = [ 1.0, 8.5 ]
```

```
// Draw a single sample for each distribution sample_poisson(lam) = [ 0., 13.]
```

```
// Draw a vector containing two samples for each distribution sample_poisson(lam, shape=(2)) = [[
0., 4.], [ 13., 8.]]
```

Defined in src/operator/random/multisample\_op.cc:L286

## Value

out The result mx.ndarray

---

mx.nd.sample.uniform	<i>Concurrent sampling from multiple uniform distributions on the intervals given by *[low,high]*.</i>
----------------------	--

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Arguments

low	NDArray-or-Symbol Lower bounds of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
high	NDArray-or-Symbol Upper bounds of the distributions.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
low = [ 0.0, 2.5 ] high = [ 1.0, 3.7 ]
```

```
// Draw a single sample for each distribution sample_uniform(low, high) = [ 0.40451524, 3.18687344]
```

```
// Draw a vector containing two samples for each distribution sample_uniform(low, high, shape=(2))
= [[ 0.40451524, 0.18017688], [ 3.18687344, 3.68352246]]
```

Defined in src/operator/random/multisample\_op.cc:L277

## Value

out The result mx.ndarray



---

mx.nd.save	Save an mx.nd.array object
------------	----------------------------

---

**Description**

Save an mx.nd.array object

**Usage**

mx.nd.save(ndarray, filename)

**Arguments**

- ndarray            the mx.nd.array object
- filename           the filename (including the path)

**Examples**

```
mat = mx.nd.array(1:3)
mx.nd.save(mat, 'temp.mat')
mat2 = mx.nd.load('temp.mat')
as.array(mat)
as.array(mat2[[1]])
```

---

mx.nd.scatter.nd	Scatters data into a new tensor according to indices.
------------------	---

---

**Description**

Given ‘data’ with shape ‘(Y\_0, ..., Y\_K-1, X\_M, ..., X\_N-1)’ and indices with shape ‘(M, Y\_0, ..., Y\_K-1)’, the output will have shape ‘(X\_0, X\_1, ..., X\_N-1)’, where ‘M <= N’. If ‘M == N’, data shape should simply be ‘(Y\_0, ..., Y\_K-1)’.

**Arguments**

- data                NDArry-or-Symbol data
- indices            NDArry-or-Symbol indices
- shape              Shape(tuple), required Shape of output.

**Details**

The elements in output is defined as follows::

```
output[indices[0, y_0, ..., y_K-1], ..., indices[M-1, y_0, ..., y_K-1], x_M, ..., x_N-1] = data[y_0, ...,
y_K-1, x_M, ..., x_N-1]
```

all other entries in output are 0.

.. warning::

If the indices have duplicates, the result will be non-deterministic and the gradient of ‘scatter\_nd’ will not be correct!!

Examples::

```
data = [2, 3, 0] indices = [[1, 1, 0], [0, 1, 0]] shape = (2, 2) scatter_nd(data, indices, shape) = [[0,
0], [2, 3]]
```

```
data = [[[1, 2], [3, 4]], [[5, 6], [7, 8]]] indices = [[0, 1], [1, 1]] shape = (2, 2, 2, 2) scatter_nd(data,
indices, shape) = [[[[0, 0], [0, 0]],
```

```
[[[1, 2], [3, 4]]],
```

```
[[[0, 0], [0, 0]],
```

```
[[[5, 6], [7, 8]]]]
```

**Value**

out The result mx.ndarray

---

mx.nd.SequenceLast	<i>Takes the last element of a sequence.</i>
--------------------	--

---

**Description**

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns a (n-1)-dimensional array of the form [batch\_size, other\_feature\_dims].

**Arguments**

data	NDArray-or-Symbol n-dimensional input array of the form [max_sequence_length, batch_size, other_feature_dims] where n>2
sequence.length	NDArray-or-Symbol vector of sequence lengths of the form [batch_size]
use.sequence.length	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter ‘sequence_length’ to specify variable length sequence
axis	int, optional, default='0' The sequence axis. Only values of 0 and 1 are currently supported.

## Details

Parameter ‘sequence\_length’ is used to handle variable-length sequences. ‘sequence\_length’ should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set ‘use\_sequence\_length’ to ‘True’, otherwise each example in the batch is assumed to have the max sequence length.

.. note:: Alternatively, you can also use ‘take’ operator.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.], [ 7., 8., 9.]],
      [[ 10., 11., 12.], [ 13., 14., 15.], [ 16., 17., 18.]],
      [[ 19., 20., 21.], [ 22., 23., 24.], [ 25., 26., 27.]]]

// returns last sequence when sequence_length parameter is not used SequenceLast(x) = [[ 19., 20.,
21.], [ 22., 23., 24.], [ 25., 26., 27.]]

// sequence_length is used SequenceLast(x, sequence_length=[1,1,1], use_sequence_length=True)
= [[ 1., 2., 3.], [ 4., 5., 6.], [ 7., 8., 9.]]

// sequence_length is used SequenceLast(x, sequence_length=[1,2,3], use_sequence_length=True)
= [[ 1., 2., 3.], [ 13., 14., 15.], [ 25., 26., 27.]]

Defined in src/operator/sequence_last.cc:L106
```

## Value

out The result mx.ndarray

---

mx.nd.SequenceMask	<i>Sets all elements outside the sequence to a constant value.</i>
--------------------	--

---

## Description

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns an array of the same shape.

## Arguments

data	NDArray-or-Symbol n-dimensional input array of the form [max_sequence_length, batch_size, other_feature_dims] where n>2
sequence.length	NDArray-or-Symbol vector of sequence lengths of the form [batch_size]
use.sequence.length	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter ‘sequence_length’ to specify variable length sequence
value	float, optional, default=0 The value to be used as a mask.
axis	int, optional, default=’0’ The sequence axis. Only values of 0 and 1 are currently supported.

## Details

Parameter ‘sequence\_length’ is used to handle variable-length sequences. ‘sequence\_length’ should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set ‘use\_sequence\_length’ to ‘True’, otherwise each example in the batch is assumed to have the max sequence length and this operator works as the ‘identity’ operator.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.]],
      [[ 7., 8., 9.], [10., 11., 12.]],
      [[13., 14., 15.], [16., 17., 18.]]]
// Batch 1 B1 = [[ 1., 2., 3.], [ 7., 8., 9.], [13., 14., 15.]]
// Batch 2 B2 = [[ 4., 5., 6.], [10., 11., 12.], [16., 17., 18.]]
// works as identity operator when sequence_length parameter is not used SequenceMask(x) = [[[
1., 2., 3.], [ 4., 5., 6.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[13., 14., 15.], [16., 17., 18.]]]
// sequence_length [1,1] means 1 of each batch will be kept // and other rows are masked with
default mask value = 0 SequenceMask(x, sequence_length=[1,1], use_sequence_length=True) = [[[
1., 2., 3.], [ 4., 5., 6.]],
[[ 0., 0., 0.], [ 0., 0., 0.]],
[[ 0., 0., 0.], [ 0., 0., 0.]]]
// sequence_length [2,3] means 2 of batch B1 and 3 of batch B2 will be kept // and other rows
are masked with value = 1 SequenceMask(x, sequence_length=[2,3], use_sequence_length=True,
value=1) = [[[ 1., 2., 3.], [ 4., 5., 6.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[ 1., 1., 1.], [16., 17., 18.]]]
Defined in src/operator/sequence_mask.cc:L186
```

## Value

out The result mx.ndarray

---

mx.nd.SequenceReverse *Reverses the elements of each sequence.*

---

## Description

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns an array of the same shape.

**Arguments**

<code>data</code>	NDArray-or-Symbol n-dimensional input array of the form [max_sequence_length, batch_size, other dims] where n>2
<code>sequence.length</code>	NDArray-or-Symbol vector of sequence lengths of the form [batch_size]
<code>use.sequence.length</code>	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter 'sequence_length' to specify variable length sequence
<code>axis</code>	int, optional, default='0' The sequence axis. Only 0 is currently supported.

**Details**

Parameter 'sequence\_length' is used to handle variable-length sequences. 'sequence\_length' should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set 'use\_sequence\_length' to 'True', otherwise each example in the batch is assumed to have the max sequence length.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.]],
      [[ 7., 8., 9.], [10., 11., 12.]],
      [[13., 14., 15.], [16., 17., 18.]]]
// Batch 1 B1 = [[ 1., 2., 3.], [ 7., 8., 9.], [13., 14., 15.]]
// Batch 2 B2 = [[ 4., 5., 6.], [10., 11., 12.], [16., 17., 18.]]
// returns reverse sequence when sequence_length parameter is not used SequenceReverse(x) = [[[
13., 14., 15.], [16., 17., 18.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[ 1., 2., 3.], [ 4., 5., 6.]]]
// sequence_length [2,2] means 2 rows of // both batch B1 and B2 will be reversed. SequenceRe-
verse(x, sequence_length=[2,2], use_sequence_length=True) = [[[ 7., 8., 9.], [10., 11., 12.]],
[[ 1., 2., 3.], [ 4., 5., 6.]],
[[13., 14., 15.], [16., 17., 18.]]]
// sequence_length [2,3] means 2 of batch B2 and 3 of batch B3 // will be reversed. SequenceRe-
verse(x, sequence_length=[2,3], use_sequence_length=True) = [[[ 7., 8., 9.], [16., 17., 18.]],
[[ 1., 2., 3.], [10., 11., 12.]],
[[13., 14., 15.], [ 4., 5., 6.]]]
Defined in src/operator/sequence_reverse.cc:L122
```

**Value**

out The result mx.ndarray

---

mx.nd.sgd.mom.update	<i>Momentum update function for Stochastic Gradient Descent (SGD) optimizer.</i>
----------------------	--

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and both weight and momentum have the same stype

## Details

.. math::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient} \quad \text{weight} += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

However, if grad's storage type is “row\_sparse“, “lazy\_update“ is True and weight's storage type is the same as momentum's storage type, only the row slices whose indices appear in grad.indices are updated (for both weight and momentum)::

```
for row in gradient.indices: v[row] = momentum[row] * v[row] - learning_rate * gradient[row]
weight[row] += v[row]
```

Defined in src/operator/optimizer\_op.cc:L556

## Value

out The result mx.ndarray

mx.nd.sgd.update

*Update function for Stochastic Gradient Descent (SGD) optimizer.***Description**

It updates the weights using::

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
lr	float, required Learning rate
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy_update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse.

**Details**

$$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$$

However, if gradient is of “row\_sparse” storage type and “lazy\_update” is True, only the row slices whose indices appear in grad.indices are updated::

```
for row in gradient.indices: weight[row] = weight[row] - learning_rate * (gradient[row] + wd * weight[row])
```

Defined in src/operator/optimizer\_op.cc:L515

**Value**

out The result mx.ndarray

---

<code>mx.nd.shape.array</code>	<i>Returns a 1D int64 array containing the shape of data.</i>
--------------------------------	---

---

### Description

Example::

### Arguments

<code>data</code>	NDArray-or-Symbol Input Array.
-------------------	--------------------------------

### Details

`shape_array([[1,2,3,4], [5,6,7,8]]) = [2,4]`

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L573`

### Value

<code>out</code>	The result mx.ndarray
------------------	-----------------------

---

<code>mx.nd.shuffle</code>	<i>Randomly shuffle the elements.</i>
----------------------------	---------------------------------------

---

### Description

This shuffles the array along the first axis. The order of the elements in each subarray does not change. For example, if a 2D array is given, the order of the rows randomly changes, but the order of the elements in each row does not change.

### Arguments

<code>data</code>	NDArray-or-Symbol Data to be shuffled.
-------------------	--

### Value

<code>out</code>	The result mx.ndarray
------------------	-----------------------



---

mx.nd.sigmoid	<i>Computes sigmoid of x element-wise.</i>
---------------	--

---

**Description**

.. math:: y = 1 / (1 + \exp(-x))

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Details**

The storage type of “sigmoid“ output is always dense  
Defined in src/operator/tensor/elementwise\_unary\_op\_basic.cc:L119

**Value**

out The result mx.ndarray

---

mx.nd.sign	<i>Returns element-wise sign of the input.</i>
------------	--

---

**Description**

Example::

**Arguments**

data                  NDAarray-or-Symbol The input array.

**Details**

sign([-2, 0, 3]) = [-1, 0, 1]  
The storage type of “sign“ output depends upon the input storage type:  
- sign(default) = default - sign(row\_sparse) = row\_sparse - sign(csr) = csr  
Defined in src/operator/tensor/elementwise\_unary\_op\_basic.cc:L758

**Value**

out The result mx.ndarray

---

<code>mx.nd.signsgd.update</code>	<i>Update function for SignSGD optimizer.</i>
-----------------------------------	---

---

**Description**

.. math::

**Arguments**

<code>weight</code>	NDArray-or-Symbol Weight
<code>grad</code>	NDArray-or-Symbol Gradient
<code>lr</code>	float, required Learning rate
<code>wd</code>	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
<code>rescale_grad</code>	float, optional, default=1 Rescale gradient to <code>grad = rescale_grad*grad</code> .
<code>clip_gradient</code>	float, optional, default=-1 Clip gradient to the range of <code>[-clip_gradient, clip_gradient]</code> If <code>clip_gradient &lt;= 0</code> , gradient clipping is turned off. <code>grad = max(min(grad, clip_gradient), -clip_gradient)</code> .

**Details**

$$g_t = \nabla J(W_{t-1}) \setminus W_t = W_{t-1} - \eta_t \text{sign}(g_t)$$
  
It updates the weights using::  
`weight = weight - learning_rate * sign(gradient)`  
.. note:: - sparse ndarray not supported for this optimizer yet.  
Defined in `src/operator/optimizer_op.cc:L63`

**Value**

out The result `mx.ndarray`

---

<code>mx.nd.signum.update</code>	<i>SIGN momentUM (Signum) optimizer.</i>
----------------------------------	--

---

**Description**

.. math::

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
wd.lh	float, optional, default=0 The amount of weight decay that does not go into gradient/momentum calculations otherwise do weight decay algorithmically only.

**Details**

$$\mathbf{g}_t = \nabla J(\mathbf{W}_{t-1}) \quad \mathbf{m}_t = \beta \mathbf{m}_{t-1} + (1 - \beta) \mathbf{g}_t \quad \mathbf{W}_t = \mathbf{W}_{t-1} - \eta_t \text{sign}(\mathbf{m}_t)$$

It updates the weights using::  $\text{state} = \text{momentum} * \text{state} + (1 - \text{momentum}) * \text{gradient}$   $\text{weight} = \text{weight} - \text{learning\_rate} * \text{sign}(\text{state})$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

.. note:: - sparse ndarray not supported for this optimizer yet.

Defined in src/operator/optimizer\_op.cc:L92

**Value**

out The result mx.ndarray

---

mx.nd.sin

*Computes the element-wise sine of the input array.*


---

**Description**

The input should be in radians ( $2\pi$  rad equals 360 degrees).

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

.. math:: \sin([0, \pi/4, \pi/2]) = [0, 0.707, 1]

The storage type of “sin” output depends upon the input storage type:

- sin(default) = default - sin(row\_sparse) = row\_sparse - sin(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L47

**Value**

out The result mx.ndarray

---

mx.nd.sinh	Returns the hyperbolic sine of the input array, computed element-wise.
------------	--

---

**Description**

.. math:: \sinh(x) = 0.5 \times (\exp(x) - \exp(-x))

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

The storage type of “sinh” output depends upon the input storage type:

- sinh(default) = default - sinh(row\_sparse) = row\_sparse - sinh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L371

**Value**

out The result mx.ndarray

---

mx.nd.size.array	Returns a 1D int64 array containing the size of data.
------------------	---

---

**Description**

Example::

**Arguments**

data                      NDAarray-or-Symbol Input Array.

Details

size\_array([[1,2,3,4], [5,6,7,8]]) = [8]  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L624

Value

out The result mx.ndarray

---

mx.nd.slice.axis	<i>Slices along a given axis. Returns an array slice along a given 'axis' starting from the 'begin' index to the 'end' index. Examples:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice_axis(x, axis=0, begin=1, end=3) = [[ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice_axis(x, axis=1, begin=0, end=2) = [[ 1., 2.], [ 5., 6.], [ 9., 10.]] slice_axis(x, axis=1, begin=-3, end=-1) = [[ 2., 3.], [ 6., 7.], [ 10., 11.]]</i>
------------------	--

---

Description

Defined in src/operator/tensor/matrix\_op.cc:L571

Arguments

data	NDArray-or-Symbol Source input
axis	int, required Axis along which to be sliced, supports negative indexes.
begin	int, required The beginning index along the axis to be sliced, supports negative indexes.
end	int or None, required The ending index along the axis to be sliced, supports negative indexes.

Value

out The result mx.ndarray

mx.nd.slice.like

*Slices a region of the array like the shape of another array. This function is similar to “slice“, however, the ‘begin‘ are always ‘0’s and ‘end‘ of specific axes are inferred from the second input ‘shape\_like‘. Given the second ‘shape\_like‘ input of “shape=(d\_0, d\_1, ..., d\_n-1)“, a “slice\_like“ operator with default empty ‘axes‘, it performs the following operation: “ out = slice(input, begin=(0, 0, ..., 0), end=(d\_0, d\_1, ..., d\_n-1))“. When ‘axes‘ is not empty, it is used to specify which axes are being sliced. Given a 4-d input data, “slice\_like“ operator with “axes=(0, 2, -1)“ will perform the following operation: “ out = slice(input, begin=(0, 0, 0, 0), end=(d\_0, None, d\_2, d\_3))“. Note that it is allowed to have first and second input with different dimensions, however, you have to make sure the ‘axes‘ are specified and not exceeding the dimension limits. For example, given ‘input\_1‘ with “shape=(2,3,4,5)“ and ‘input\_2‘ with “shape=(1,2,3)“, it is not allowed to use: “ out = slice\_like(a, b)“ because ndim of ‘input\_1‘ is 4, and ndim of ‘input\_2‘ is 3. The following is allowed in this situation: “ out = slice\_like(a, b, axes=(0, 2))“ Example:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] y = [[ 0., 0., 0.], [ 0., 0., 0.]] slice\_like(x, y) = [[ 1., 2., 3.] [ 5., 6., 7.]] slice\_like(x, y, axes=(0, 1)) = [[ 1., 2., 3.] [ 5., 6., 7.]] slice\_like(x, y, axes=(0)) = [[ 1., 2., 3., 4.] [ 5., 6., 7., 8.]] slice\_like(x, y, axes=(-1)) = [[ 1., 2., 3.] [ 5., 6., 7.] [ 9., 10., 11.]]*

## Description

Defined in src/operator/tensor/matrix\_op.cc:L625

## Arguments

data	NDArray-or-Symbol Source input
shape.like	NDArray-or-Symbol Shape like input
axes	Shape(tuple), optional, default=[] List of axes on which input data will be sliced according to the corresponding size of the second input. By default will slice on all axes. Negative axes are supported.

## Value

out The result mx.ndarray

---

mx.nd.SliceChannel      *Splits an array along a particular axis into multiple sub-arrays.*


---

## Description

.. note:: “SliceChannel” is deprecated. Use “split” instead.

## Arguments

data	NDArray-or-Symbol The input
num.outputs	int, required Number of splits. Note that this should evenly divide the length of the ‘axis’.
axis	int, optional, default=’1’ Axis along which to split.
squeeze.axis	boolean, optional, default=0 If true, Removes the axis with length 1 from the shapes of the output arrays. <b>Note</b> that setting ‘squeeze_axis’ to “true” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze_axis’ can be set to “true” only if “input.shape[axis] == num_outputs”.

## Details

**Note** that ‘num\_outputs’ should evenly divide the length of the axis along which to split the array.

Example::

```
x = [[[ 1.] [ 2.]] [[ 3.] [ 4.]] [[ 5.] [ 6.]]] x.shape = (3, 2, 1)
y = split(x, axis=1, num_outputs=2) // a list of 2 arrays with shape (3, 1, 1) y = [[[ 1.]] [[ 3.]] [[ 5.]]
[[[ 2.]] [[ 4.]] [[ 6.]]]
y[0].shape = (3, 1, 1)
z = split(x, axis=0, num_outputs=3) // a list of 3 arrays with shape (1, 2, 1) z = [[[ 1.] [ 2.]]
[[[ 3.] [ 4.]]]
[[[ 5.] [ 6.]]]
z[0].shape = (1, 2, 1)
```

‘squeeze\_axis=1’ removes the axis with length 1 from the shapes of the output arrays. **Note** that setting ‘squeeze\_axis’ to “1” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze\_axis’ can be set to true only if “input.shape[axis] == num\_outputs”.

Example::

```
z = split(x, axis=0, num_outputs=3, squeeze_axis=1) // a list of 3 arrays with shape (2, 1) z = [[ 1.]
[ 2.]]
[[ 3.] [ 4.]]
[[ 5.] [ 6.]] z[0].shape = (2, 1)
```

Defined in src/operator/slice\_channel.cc:L107

**Value**

out The result mx.ndarray

---

<code>mx.nd.smooth_l1</code>	<i>Calculate Smooth L1 Loss(lhs, scalar) by summing</i>
------------------------------	---

---

**Description**

.. math::

**Arguments**

data	NDArray-or-Symbol source input
scalar	float scalar input

**Details**

$$f(x) = \begin{cases} (\sigma x)^2/2, & \text{if } x < 1/\sigma^2 \\ |x|-0.5/\sigma^2, & \text{otherwise} \end{cases}$$

where :math:`x` is an element of the tensor \*lhs\* and :math:`\sigma` is the scalar.

Example::

`smooth_l1([1, 2, 3, 4]) = [0.5, 1.5, 2.5, 3.5]` `smooth_l1([1, 2, 3, 4], scalar=1) = [0.5, 1.5, 2.5, 3.5]`

Defined in `src/operator/tensor/elemwise_binary_scalar_op_extended.cc:L108`

**Value**

out The result mx.ndarray

---

<code>mx.nd.Softmax</code>	<i>Computes the gradient of cross entropy loss with respect to softmax output.</i>
----------------------------	--

---

**Description**

- This operator computes the gradient in two steps. The cross entropy loss does not actually need to be computed.



**Arguments**

data	NDArray-or-Symbol Input array.
label	NDArray-or-Symbol Ground truth label.
grad.scale	float, optional, default=1 Scales the gradient by a float factor.
ignore.label	float, optional, default=-1 The instances whose 'labels' == 'ignore_label' will be ignored during backward, if 'use_ignore' is set to "true".
multi.output	boolean, optional, default=0 If set to "true", the softmax function will be computed along axis "1". This is applied when the shape of input array differs from the shape of label array.
use.ignore	boolean, optional, default=0 If set to "true", the 'ignore_label' value will not contribute to the backward gradient.
preserve.shape	boolean, optional, default=0 If set to "true", the softmax function will be computed along the last axis ("-1").
normalization	'batch', 'null', 'valid', optional, default='null' Normalizes the gradient.
out.grad	boolean, optional, default=0 Multiplies gradient with output gradient element-wise.
smooth.alpha	float, optional, default=0 Constant for computing a label smoothed version of cross-entropy for the backwards pass. This constant gets subtracted from the one-hot encoding of the gold label and distributed uniformly to all other labels.

**Details**

- Applies softmax function on the input array. - Computes and returns the gradient of cross entropy loss w.r.t. the softmax output.

- The softmax function, cross entropy loss and gradient is given by:

- Softmax Function:

$$\text{softmax}(x)_i = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$

- Cross Entropy Function:

$$\text{CE}(\text{label}, \text{output}) = - \sum_i \text{label}_i \log(\text{output}_i)$$

- The gradient of cross entropy loss w.r.t softmax output:

$$\text{gradient} = \text{output} - \text{label}$$

- During forward propagation, the softmax function is computed for each instance in the input array.

For general \*N\*-D input arrays with shape  $(d_1, d_2, \dots, d_n)$ . The size is  $s=d_1 \cdot d_2 \cdot \dots \cdot d_n$ . We can use the parameters 'preserve\_shape' and 'multi\_output' to specify the way to compute softmax:

- By default, 'preserve\_shape' is "false". This operator will reshape the input array into a 2-D array with shape  $(d_1, \frac{s}{d_1})$  and then compute the softmax function for each row in the reshaped array, and afterwards reshape it back to the original shape  $(d_1, d_2, \dots, d_n)$ .

- If 'preserve\_shape' is "true", the softmax function will be computed along the last axis ('axis' = "-1"). - If 'multi\_output' is "true", the softmax function will be computed along the second axis ('axis' = "1").

- During backward propagation, the gradient of cross-entropy loss w.r.t softmax output array is computed. The provided label can be a one-hot label array or a probability label array.
- If the parameter 'use\_ignore' is "true", 'ignore\_label' can specify input instances with a particular label to be ignored during backward propagation. \*\*This has no effect when softmax 'output' has same shape as 'label'\*\*.

Example::

```
data = [[1,2,3,4],[2,2,2,2],[3,3,3,3],[4,4,4,4]] label = [1,0,2,3] ignore_label = 1 SoftmaxOutput(data=data,
label = label,\ multi_output=true, use_ignore=true,\ ignore_label=ignore_label) ## forward softmax
output [[ 0.0320586 0.08714432 0.23688284 0.64391428] [ 0.25 0.25 0.25 0.25 ] [ 0.25 0.25 0.25
0.25 ] [ 0.25 0.25 0.25 0.25 ]] ## backward gradient output [[ 0. 0. 0. 0. ] [-0.75 0.25 0.25 0.25] [
0.25 0.25 -0.75 0.25] [ 0.25 0.25 0.25 -0.75]] ## notice that the first row is all 0 because label[0] is
1, which is equal to ignore_label.
```

- The parameter 'grad\_scale' can be used to rescale the gradient, which is often used to give each loss function different weights.
- This operator also supports various ways to normalize the gradient by 'normalization', The 'normalization' is applied if softmax output has different shape than the labels. The 'normalization' mode can be set to the followings:
  - "null": do nothing.
  - "batch": divide the gradient by the batch size.
  - "valid": divide the gradient by the number of instances which are not ignored.

Defined in src/operator/softmax\_output.cc:L231

**Value**

out The result mx.ndarray

---

mx.nd.softmax	<i>Applies the softmax function.</i>
---------------	--------------------------------------

---

**Description**

The resulting array contains elements in the range (0,1) and the elements along the given axis sum up to 1.

**Arguments**

data	NDArray-or-Symbol The input array.
length	NDArray-or-Symbol The length array.
axis	int, optional, default='-1' The axis along which to compute softmax.
temperature	double or None, optional, default=None Temperature parameter in softmax
dtype	None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None).
use.length	boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.

**Details**

.. math:: \text{softmax}(\frac{z\_j}{t}) = \frac{e^{z\_j/t}}{\sum\_{k=1}^K e^{z\_k/t}}

for :math:'j = 1, \dots, K'

t is the temperature parameter in softmax function. By default, t equals 1.0

Example::

x = [[ 1. 1. 1.] [ 1. 1. 1.]]

softmax(x,axis=0) = [[ 0.5 0.5 0.5] [ 0.5 0.5 0.5]]

softmax(x,axis=1) = [[ 0.33333334, 0.33333334, 0.33333334], [ 0.33333334, 0.33333334, 0.33333334]]

Defined in src/operator/nn/softmax.cc:L134

**Value**

out The result mx.ndarray

---

mx.nd.softmax.cross.entropy

*Calculate cross entropy of softmax output and one-hot label.*

---

**Description**

- This operator computes the cross entropy in two steps: - Applies softmax function on the input array. - Computes and returns the cross entropy loss between the softmax output and the labels.

**Arguments**

data                      NDAarray-or-Symbol Input data

label                     NDAarray-or-Symbol Input label

**Details**

- The softmax function and cross entropy loss is given by:

- Softmax Function:

.. math:: \text{softmax}(x)\_i = \frac{\exp(x\_i)}{\sum\_j \exp(x\_j)}

- Cross Entropy Function:

.. math:: \text{CE}(\text{label}, \text{output}) = - \sum\_i \text{label}\_i \log(\text{output}\_i)

Example::

x = [[1, 2, 3], [11, 7, 5]]

label = [2, 0]

softmax(x) = [[0.09003057, 0.24472848, 0.66524094], [0.97962922, 0.01794253, 0.00242826]]

softmax\_cross\_entropy(data, label) = - log(0.66524084) - log(0.97962922) = 0.4281871

Defined in src/operator/loss\_binary\_op.cc:L59

**Value**

out The result mx.ndarray

---

mx.nd.SoftmaxActivation

*Applies softmax activation to input. This is intended for internal layers.*

---

**Description**

.. note::

**Arguments**

data	NDArray-or-Symbol The input array.
mode	'channel', 'instance', optional, default='instance' Specifies how to compute the softmax. If set to "instance", it computes softmax for each instance. If set to "channel", It computes cross channel softmax for each position of each instance.

**Details**

This operator has been deprecated, please use 'softmax'.

If 'mode' = "instance", this operator will compute a softmax for each instance in the batch. This is the default mode.

If 'mode' = "channel", this operator will compute a k-class softmax at each position of each instance, where 'k' = "num\_channel". This mode can only be used when the input array has at least 3 dimensions. This can be used for 'fully convolutional network', 'image segmentation', etc.

Example::

```
>>> input_array = mx.nd.array([[3., 0.5, -0.5, 2., 7.], >> [2., -.4, 7., 3., 0.2]]) >>> softmax_act =
mx.nd.SoftmaxActivation(input_array) >>> print softmax_act.asnumpy() [[ 1.78322066e-02 1.46375655e-
03 5.38485940e-04 6.56010211e-03 9.73605454e-01] [ 6.56221947e-03 5.95310994e-04 9.73919690e-
01 1.78379621e-02 1.08472735e-03]]
```

Defined in src/operator/nn/softmax\_activation.cc:L59

**Value**

out The result mx.ndarray

---

mx.nd.SoftmaxOutput	<i>Computes the gradient of cross entropy loss with respect to softmax output.</i>
---------------------	--

---

## Description

- This operator computes the gradient in two steps. The cross entropy loss does not actually need to be computed.

## Arguments

data	NDArray-or-Symbol Input array.
label	NDArray-or-Symbol Ground truth label.
grad.scale	float, optional, default=1 Scales the gradient by a float factor.
ignore.label	float, optional, default=-1 The instances whose 'labels' == 'ignore_label' will be ignored during backward, if 'use_ignore' is set to "true".
multi.output	boolean, optional, default=0 If set to "true", the softmax function will be computed along axis "1". This is applied when the shape of input array differs from the shape of label array.
use.ignore	boolean, optional, default=0 If set to "true", the 'ignore_label' value will not contribute to the backward gradient.
preserve.shape	boolean, optional, default=0 If set to "true", the softmax function will be computed along the last axis ("-1").
normalization	'batch', 'null', 'valid', optional, default='null' Normalizes the gradient.
out.grad	boolean, optional, default=0 Multiplies gradient with output gradient element-wise.
smooth.alpha	float, optional, default=0 Constant for computing a label smoothed version of cross-entropy for the backwards pass. This constant gets subtracted from the one-hot encoding of the gold label and distributed uniformly to all other labels.

## Details

- Applies softmax function on the input array. - Computes and returns the gradient of cross entropy loss w.r.t. the softmax output.

- The softmax function, cross entropy loss and gradient is given by:

- Softmax Function:

$$\text{softmax}(x)_i = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$

- Cross Entropy Function:

$$\text{CE}(\text{label}, \text{output}) = - \sum_i \text{label}_i \log(\text{output}_i)$$

- The gradient of cross entropy loss w.r.t softmax output:

$$\text{gradient} = \text{output} - \text{label}$$

- During forward propagation, the softmax function is computed for each instance in the input array. For general  $N \times D$  input arrays with shape  $(d_1, d_2, \dots, d_n)$ . The size is  $s=d_1 \cdot d_2 \cdot \dots \cdot d_n$ . We can use the parameters 'preserve\_shape' and 'multi\_output' to specify the way to compute softmax:

- By default, 'preserve\_shape' is "false". This operator will reshape the input array into a 2-D array with shape  $(d_1, \frac{d_2 \cdot \dots \cdot d_n}{d_1})$  and then compute the softmax function for each row in the reshaped array, and afterwards reshape it back to the original shape  $(d_1, d_2, \dots, d_n)$ .  
 - If 'preserve\_shape' is "true", the softmax function will be computed along the last axis ('axis' = "-1").  
 - If 'multi\_output' is "true", the softmax function will be computed along the second axis ('axis' = "1").

- During backward propagation, the gradient of cross-entropy loss w.r.t softmax output array is computed. The provided label can be a one-hot label array or a probability label array.

- If the parameter 'use\_ignore' is "true", 'ignore\_label' can specify input instances with a particular label to be ignored during backward propagation. **\*\*This has no effect when softmax 'output' has same shape as 'label'\*\*.**

Example::

```
data = [[1,2,3,4],[2,2,2,2],[3,3,3,3],[4,4,4,4]] label = [1,0,2,3] ignore_label = 1
SoftmaxOutput(data=data, label=label, \ multi_output=true, use_ignore=true, \ ignore_label=ignore_label) ## forward softmax
output [[ 0.0320586 0.08714432 0.23688284 0.64391428] [ 0.25 0.25 0.25 0.25 ] [ 0.25 0.25 0.25 0.25 ] [ 0.25 0.25 0.25 0.25 ]] ## backward gradient output [[ 0. 0. 0. 0. ] [-0.75 0.25 0.25 0.25] [ 0.25 0.25 -0.75 0.25] [ 0.25 0.25 0.25 -0.75]] ## notice that the first row is all 0 because label[0] is 1, which is equal to ignore_label.
```

- The parameter 'grad\_scale' can be used to rescale the gradient, which is often used to give each loss function different weights.

- This operator also supports various ways to normalize the gradient by 'normalization'. The 'normalization' is applied if softmax output has different shape than the labels. The 'normalization' mode can be set to the followings:

- "null": do nothing. - "batch": divide the gradient by the batch size. - "valid": divide the gradient by the number of instances which are not ignored.

Defined in src/operator/softmax\_output.cc:L231

## Value

out The result mx.ndarray

---

mx.nd.softmax

*Applies the softmax function.*

---

## Description

The resulting array contains elements in the range (0,1) and the elements along the given axis sum up to 1.

**Arguments**

data	NDArray-or-Symbol The input array.
axis	int, optional, default='-1' The axis along which to compute softmax.
temperature	double or None, optional, default=None Temperature parameter in softmax
dtype	None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None).
use.length	boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.

**Details**

.. math:: \text{softmax}(\mathbf{z})\_j = \frac{e^{-z\_j}}{\sum\_{k=1}^K e^{-z\_k}}

for :math:j = 1, \dots, K

t is the temperature parameter in softmax function. By default, t equals 1.0

Example::

```
x = [[ 1.  2.  3.] [ 3.  2.  1.]]
```

```
softmax(x,axis=0) = [[ 0.88079703, 0.5, 0.11920292], [ 0.11920292, 0.5, 0.88079703]]
```

```
softmax(x,axis=1) = [[ 0.66524094, 0.24472848, 0.09003057], [ 0.09003057, 0.24472848, 0.66524094]]
```

Defined in src/operator/nn/softmax.cc:L57

**Value**

out The result mx.ndarray

---

mx.nd.softsign	<i>Computes softsign of x element-wise.</i>
----------------	---

---

**Description**

.. math:: y = x / (1 + \text{abs}(x))

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

The storage type of “softsign” output is always dense

Defined in src/operator/tensor/elementwise\_unary\_op\_basic.cc:L191

**Value**

out The result mx.ndarray

---

mx.nd.sort	Returns a sorted copy of an input array along the given axis.
------------	---

---

## Description

Examples::

## Arguments

data	NDArray-or-Symbol The input array
axis	int or None, optional, default='-1' Axis along which to choose sort the input tensor. If not given, the flattened array is used. Default is -1.
is.ascend	boolean, optional, default=1 Whether to sort in ascending or descending order.

## Details

```
x = [[ 1, 4], [ 3, 1]]
// sorts along the last axis sort(x) = [[ 1., 4.], [ 1., 3.]]
// flattens and then sorts sort(x, axis=None) = [ 1., 1., 3., 4.]
// sorts along the first axis sort(x, axis=0) = [[ 1., 1.], [ 3., 4.]]
// in a descend order sort(x, is_ascend=0) = [[ 4., 1.], [ 3., 1.]]
Defined in src/operator/tensor/ordering_op.cc:L133
```

## Value

out The result mx.ndarray

---

mx.nd.space.to.depth	<i>Rearranges(permutates) blocks of spatial data into depth. Similar to ONNX SpaceToDepth operator: <a href="https://github.com/onnx/onnx/blob/master/docs/Operators.md#SpaceToDepth">https://github.com/onnx/onnx/blob/master/docs/Operators.md#SpaceToDepth</a> The output is a new tensor where the values from height and width dimension are moved to the depth dimension. The reverse of this operation is “depth_to_space“. .. <math display="block">\text{math::} \backslash \text{begingather} * x \backslash \text{prime} = \text{reshape}(x, [N, C, H / \text{block\_size}, \text{block\_size}, W / \text{block\_size}, \text{block\_size}]) \backslash x \backslash \text{prime} \backslash \text{prime} = \text{transpose}(x \backslash \text{prime}, [0, 3, 5, 1, 2, 4]) \backslash y = \text{reshape}(x \backslash \text{prime} \backslash \text{prime}, [N, C * (\text{block\_size}^2), H / \text{block\_size}, W / \text{block\_size}]) \backslash \text{endgather} * \text{where} : \text{math:} 'x' \text{ is an input tensor with default layout as :math: '[N, C, H, W]': [\text{batch}, \text{channels}, \text{height}, \text{width}] \text{ and :math: 'y' is the output tensor of layout :math: '[N, C * (\text{block\_size}^2), H / \text{block\_size}, W / \text{block\_size}]'</math> Example:: <math>x = [[[[[0, 6, 1, 7, 2, 8], [12, 18, 13, 19, 14, 20], [3, 9, 4, 10, 5, 11], [15, 21, 16, 22, 17, 23]]]]]</math> <math>\text{space\_to\_depth}(x, 2) = [[[[[0, 1, 2], [3, 4, 5]], [6, 7, 8], [9, 10, 11]], [[12, 13, 14], [15, 16, 17]], [[18, 19, 20], [21, 22, 23]]]]]</math></i>
----------------------	---

---



**Description**

Defined in src/operator/tensor/matrix\_op.cc:L1019

**Arguments**

- data                    NDArry-or-Symbol Input ndarray
- block.size            int, required Blocks of [block\_size. block\_size] are moved

**Value**

out The result mx.ndarray

---

mx.nd.SpatialTransformer
<i>Applies a spatial transformer to input feature map.</i>

---

**Description**

Applies a spatial transformer to input feature map.

**Arguments**

- data                    NDArry-or-Symbol Input data to the SpatialTransformerOp.
- loc                    NDArry-or-Symbol localisation net, the output dim should be 6 when transform\_type is affine. You shold initialize the weight and bias with identity transform.
- target.shape          Shape(tuple), optional, default=[0,0] output shape(h, w) of spatial transformer: (y, x)
- transform.type        'affine', required transformation type
- sampler.type          'bilinear', required sampling type
- cudnn.off            boolean or None, optional, default=None whether to turn cudnn off

**Value**

out The result mx.ndarray

---

mx.nd.split

*Splits an array along a particular axis into multiple sub-arrays.*


---

## Description

.. note:: “SliceChannel” is deprecated. Use “split” instead.

## Arguments

data	NDArray-or-Symbol The input
num.outputs	int, required Number of splits. Note that this should evenly divide the length of the ‘axis’.
axis	int, optional, default=’1’ Axis along which to split.
squeeze.axis	boolean, optional, default=0 If true, Removes the axis with length 1 from the shapes of the output arrays. <b>Note</b> that setting ‘squeeze_axis’ to “true” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze_axis’ can be set to “true” only if “input.shape[axis] == num_outputs”.

## Details

**Note** that ‘num\_outputs’ should evenly divide the length of the axis along which to split the array.

Example::

```
x = [[[ 1.] [ 2.]] [[ 3.] [ 4.]] [[ 5.] [ 6.]]] x.shape = (3, 2, 1)
y = split(x, axis=1, num_outputs=2) // a list of 2 arrays with shape (3, 1, 1) y = [[[ 1.]] [[ 3.]] [[ 5.]]
[[[ 2.]] [[ 4.]] [[ 6.]]]
y[0].shape = (3, 1, 1)
z = split(x, axis=0, num_outputs=3) // a list of 3 arrays with shape (1, 2, 1) z = [[[ 1.] [ 2.]]
[[[ 3.] [ 4.]]]
[[[ 5.] [ 6.]]]
z[0].shape = (1, 2, 1)
```

‘squeeze\_axis=1’ removes the axis with length 1 from the shapes of the output arrays. **Note** that setting ‘squeeze\_axis’ to “1” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze\_axis’ can be set to true only if “input.shape[axis] == num\_outputs”.

Example::

```
z = split(x, axis=0, num_outputs=3, squeeze_axis=1) // a list of 3 arrays with shape (2, 1) z = [[ 1.]
[ 2.]]
[[ 3.] [ 4.]]
[[ 5.] [ 6.]] z[0].shape = (2, 1)
```

Defined in src/operator/slice\_channel.cc:L107

**Value**

out The result mx.ndarray

---

mx.nd.sqrt

*Returns element-wise square-root value of the input.*

---

**Description**

.. math:: \text{rmsqrt}(x) = \sqrt{x}

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::

sqrt([4, 9, 16]) = [2, 3, 4]

The storage type of “sqrt” output depends upon the input storage type:

- sqrt(default) = default - sqrt(row\_sparse) = row\_sparse - sqrt(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L170

**Value**

out The result mx.ndarray

---

mx.nd.square

*Returns element-wise squared value of the input.*

---

**Description**

.. math:: \text{square}(x) = x^2

**Arguments**

data                      NDAarray-or-Symbol The input array.

**Details**

Example::

square([2, 3, 4]) = [4, 9, 16]

The storage type of “square” output depends upon the input storage type:

- square(default) = default - square(row\_sparse) = row\_sparse - square(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L119

**Value**

out The result mx.ndarray

---

mx.nd.squeeze	<p><i>Remove single-dimensional entries from the shape of an array. Same behavior of defining the output tensor shape as numpy.squeeze for the most of cases. See the following note for exception. Examples:: data = [[[0], [1], [2]]] squeeze(data) = [0, 1, 2] squeeze(data, axis=0) = [[0], [1], [2]] squeeze(data, axis=2) = [[0, 1, 2]] squeeze(data, axis=(0, 2)) = [0, 1, 2] .. Note:: The output of this operator will keep at least one dimension not removed. For example, squeeze([[[4]]) = [4], while in numpy.squeeze, the output will become a scalar.</i></p>
---------------	---

---

**Description**

Remove single-dimensional entries from the shape of an array. Same behavior of defining the output tensor shape as numpy.squeeze for the most of cases. See the following note for exception. Examples:: data = [[[0], [1], [2]]] squeeze(data) = [0, 1, 2] squeeze(data, axis=0) = [[0], [1], [2]] squeeze(data, axis=2) = [[0, 1, 2]] squeeze(data, axis=(0, 2)) = [0, 1, 2] .. Note:: The output of this operator will keep at least one dimension not removed. For example, squeeze([[[4]]) = [4], while in numpy.squeeze, the output will become a scalar.

**Arguments**

data	NDArray-or-Symbol data to squeeze
axis	Shape or None, optional, default=None Selects a subset of the single-dimensional entries in the shape. If an axis is selected with shape entry greater than one, an error is raised.

**Value**

out The result mx.ndarray

---

mx.nd.stack	<p><i>Join a sequence of arrays along a new axis. The axis parameter specifies the index of the new axis in the dimensions of the result. For example, if axis=0 it will be the first dimension and if axis=-1 it will be the last dimension. Examples:: x = [1, 2] y = [3, 4] stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]</i></p>
-------------	--

---

**Description**

Join a sequence of arrays along a new axis. The axis parameter specifies the index of the new axis in the dimensions of the result. For example, if axis=0 it will be the first dimension and if axis=-1 it will be the last dimension. Examples:: x = [1, 2] y = [3, 4] stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]

**Arguments**

data	NDArray-or-Symbol[] List of arrays to stack
axis	int, optional, default='0' The axis in the result array along which the input arrays are stacked.
num.args	int, required Number of inputs to be stacked.

**Value**

out The result mx.ndarray

---

mx.nd.stop.gradient	<i>Stops gradient computation.</i>
---------------------	------------------------------------

---

**Description**

Stops the accumulated gradient of the inputs from flowing through this operator in the backward direction. In other words, this operator prevents the contribution of its inputs to be taken into account for computing gradients.

**Arguments**

data	NDArray-or-Symbol The input array.
------	------------------------------------

**Details**

Example::

```
v1 = [1, 2] v2 = [0, 1] a = Variable('a') b = Variable('b') b_stop_grad = stop_gradient(3 * b) loss =
MakeLoss(b_stop_grad + a)

executor = loss.simple_bind(ctx=cpu(), a=(1,2), b=(1,2)) executor.forward(is_train=True, a=v1, b=v2)
executor.outputs [ 1. 5.]

executor.backward() executor.grad_arrays [ 0. 0.] [ 1. 1.]

Defined in src/operator/tensor/elemwise_unary_op_basic.cc:L325
```

**Value**

out The result mx.ndarray

---

<code>mx.nd.sum</code>	<i>Computes the sum of array elements over given axes.</i>
------------------------	--

---

**Description**

.. Note::

**Arguments**

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.
<code>keepdims</code>	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
<code>exclude</code>	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Details**

'sum' and 'sum\_axis' are equivalent. For ndarray of csr storage type summation along axis 0 and axis 1 is supported. Setting keepdims or exclude to True will cause a fallback to dense operator.

Example::

```
data = [[[1, 2], [2, 3], [1, 3]], [[1, 4], [4, 3], [5, 2]], [[7, 1], [7, 2], [7, 3]]]
sum(data, axis=1) [[ 4.  8.] [ 10.  9.] [ 21.  6.]]
sum(data, axis=[1,2]) [ 12. 19. 27.]
data = [[1, 2, 0], [3, 0, 1], [4, 1, 0]]
csr = cast_storage(data, 'csr')
sum(csr, axis=0) [ 8.  3.  1.]
sum(csr, axis=1) [ 3.  4.  5.]
```

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L67

**Value**

out The result mx.ndarray

---

mx.nd.sum.axis	<i>Computes the sum of array elements over given axes.</i>
----------------	--

---

**Description**

.. Note::

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.

**Details**

'sum' and 'sum\_axis' are equivalent. For ndarray of csr storage type summation along axis 0 and axis 1 is supported. Setting keepdims or exclude to True will cause a fallback to dense operator.

Example::

```
data = [[[1, 2], [2, 3], [1, 3]], [[1, 4], [4, 3], [5, 2]], [[7, 1], [7, 2], [7, 3]]]
sum(data, axis=1) [[ 4.  8.] [ 10.  9.] [ 21.  6.]]
sum(data, axis=[1,2]) [ 12. 19. 27.]
data = [[1, 2, 0], [3, 0, 1], [4, 1, 0]]
csr = cast_storage(data, 'csr')
sum(csr, axis=0) [ 8.  3.  1.]
sum(csr, axis=1) [ 3.  4.  5.]
```

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L67

**Value**

out The result mx.ndarray

---

mx.nd.SVMOutput	<i>Computes support vector machine based transformation of the input.</i>
-----------------	---

---

### Description

This tutorial demonstrates using SVM as output layer for classification instead of softmax: <https://github.com/dmlc/mxnet/tree/master/example/python/svm>

### Arguments

data	NDArray-or-Symbol Input data for SVM transformation.
label	NDArray-or-Symbol Class label for the input data.
margin	float, optional, default=1 The loss function penalizes outputs that lie outside this margin. Default margin is 1.
regularization.coefficient	float, optional, default=1 Regularization parameter for the SVM. This balances the tradeoff between coefficient size and error.
use.linear	boolean, optional, default=0 Whether to use L1-SVM objective. L2-SVM objective is used by default.

### Value

out The result mx.ndarray

---

mx.nd.swapaxes	<i>Interchanges two axes of an array.</i>
----------------	---

---

### Description

Examples::

### Arguments

data	NDArray-or-Symbol Input array.
dim1	int, optional, default='0' the first axis to be swapped.
dim2	int, optional, default='0' the second axis to be swapped.

### Details

```
x = [[1, 2, 3]] swapaxes(x, 0, 1) = [[ 1], [ 2], [ 3]]
x = [[[ 0, 1], [ 2, 3]], [[ 4, 5], [ 6, 7]]] // (2,2,2) array
swapaxes(x, 0, 2) = [[[ 0, 4], [ 2, 6]], [[ 1, 5], [ 3, 7]]]
Defined in src/operator/swapaxis.cc:L70
```

### Value

out The result mx.ndarray



---

mx.nd.SwapAxis	<i>Interchanges two axes of an array.</i>
----------------	---

---

**Description**

Examples::

**Arguments**

- data                NDArra-or-Symbol Input array.
- dim1                int, optional, default='0' the first axis to be swapped.
- dim2                int, optional, default='0' the second axis to be swapped.

**Details**

x = [[1, 2, 3]] swapaxes(x, 0, 1) = [[ 1], [ 2], [ 3]]  
x = [[[ 0, 1], [ 2, 3]], [[ 4, 5], [ 6, 7]]] // (2,2,2) array  
swapaxes(x, 0, 2) = [[[ 0, 4], [ 2, 6]], [[ 1, 5], [ 3, 7]]]  
Defined in src/operator/swapaxis.cc:L70

**Value**

out The result mx.ndarray

---

mx.nd. take	<i>Takes elements from an input array along the given axis.</i>
-------------	---

---

**Description**

This function slices the input array along a particular axis with the provided indices.

**Arguments**

- a                    NDArra-or-Symbol The input array.
- indices              NDArra-or-Symbol The indices of the values to be extracted.
- axis                  int, optional, default='0' The axis of input array to be taken.For input tensor of rank r, it could be in the range of [-r, r-1]
- mode                  'clip', 'raise', 'wrap',optional, default='clip' Specify how out-of-bound indices bahave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around. "raise" means to raise an error when index out of range.

## Details

Given data tensor of rank  $r \geq 1$ , and indices tensor of rank  $q$ , gather entries of the axis dimension of data (by default outer-most one as  $\text{axis}=0$ ) indexed by indices, and concatenates them in an output tensor of rank  $q + (r - 1)$ .

Examples::

```
x = [4. 5. 6.]
```

```
// Trivial case, take the second element along the first axis.
```

```
take(x, [1]) = [ 5. ]
```

```
// The other trivial case, axis=-1, take the third element along the first axis
```

```
take(x, [3], axis=-1, mode='clip') = [ 6. ]
```

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// In this case we will get rows 0 and 1, then 1 and 2. Along axis 0
```

```
take(x, [[0,1],[1,2]]) = [[[ 1., 2.], [ 3., 4.]],
```

```
[[ 3., 4.], [ 5., 6.]]]
```

```
// In this case we will get rows 0 and 1, then 1 and 2 (calculated by wrapping around). // Along axis 1
```

```
take(x, [[0, 3], [-1, -2]], axis=1, mode='wrap') = [[[ 1. 2.] [ 2. 1.]]
```

```
[[ 3. 4.] [ 4. 3.]]
```

```
[[ 5. 6.] [ 6. 5.]]]
```

The storage type of “take” output depends upon the input storage type:

- take(default, default) = default - take(csr, default, axis=0) = csr

Defined in src/operator/tensor/indexing\_op.cc:L782

## Value

out The result mx.ndarray

---

mx.nd.tan

*Computes the element-wise tangent of the input array.*

---

## Description

The input should be in radians ( $2\pi$  rad equals 360 degrees).

## Arguments

data NDAarray-or-Symbol The input array.

Details

.. math:: \tan([0, \pi/4, \pi/2]) = [0, 1, -\inf]

The storage type of “tan” output depends upon the input storage type:

- tan(default) = default - tan(row\_sparse) = row\_sparse - tan(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L140

Value

out The result mx.ndarray

---

mx.nd.tanh	Returns the hyperbolic tangent of the input array, computed element-wise.
------------	---

---

Description

.. math:: \tanh(x) = \sinh(x) / \cosh(x)

Arguments

data                      NDAarray-or-Symbol The input array.

Details

The storage type of “tanh” output depends upon the input storage type:

- tanh(default) = default - tanh(row\_sparse) = row\_sparse - tanh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L451

Value

out The result mx.ndarray

---

<code>mx.nd.tile</code>	<i>Repeats the whole array multiple times. If “reps” has length *d*, and input array has dimension of *n*. There are three cases: - **n=d**.</i> <i>Repeat *i*-th dimension of the input by “reps[i]” times::</i> $x = [[1, 2], [3, 4]]$ $\text{tile}(x, \text{reps}=(2,3)) = [[1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.], [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]]$ <i>- **n&gt;d**.</i> “reps” is promoted to length *n* by pre-pending 1’s to it. Thus for an input shape “(2,3)”, “reps=(2,)” is treated as “(1,2)”: $\text{tile}(x, \text{reps}=(2,)) = [[1., 2., 1., 2.], [3., 4., 3., 4.]]$ <i>- **n&lt;d**.</i> The input is promoted to be d-dimensional by prepending new axes. So a shape “(2,2)” array is promoted to “(1,2,2)” for 3-D replication:: $\text{tile}(x, \text{reps}=(2,2,3)) = [[ [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.], [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]], [ [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.], [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]] ]$
-------------------------	--

---

## Description

Defined in `src/operator/tensor/matrix_op.cc:L796`

## Arguments

<code>data</code>	NDArray-or-Symbol Input data array
<code>reps</code>	Shape(tuple), required The number of times for repeating the tensor a. Each dim size of reps must be a positive integer. If reps has length d, the result will have dimension of max(d, a.ndim); If a.ndim < d, a is promoted to be d-dimensional by prepending new axes. If a.ndim > d, reps is promoted to a.ndim by prepending 1’s to it.

## Value

out The result `mx.ndarray`

---

<code>mx.nd.topk</code>	<i>Returns the indices of the top *k* elements in an input array along the given axis (by default). If <code>ret_type</code> is set to ‘value’ returns the value of top *k* elements (instead of indices). In case of <code>ret_type = ‘both’</code>, both value and index would be returned. The returned elements will be sorted.</i>
-------------------------	---

---

## Description

Examples::

**Arguments**

data	NDArray-or-Symbol The input array
axis	int or None, optional, default='-1' Axis along which to choose the top k indices. If not given, the flattened array is used. Default is -1.
k	int, optional, default='1' Number of top elements to select, should be always smaller than or equal to the element number in the given axis. A global sort is performed if set k < 1.
ret.typ	'both', 'indices', 'mask', 'value', optional, default='indices' The return type. "value" means to return the top k values, "indices" means to return the indices of the top k values, "mask" means to return a mask array containing 0 and 1. 1 means the top k values. "both" means to return a list of both values and indices of top k elements.
is.ascend	boolean, optional, default=0 Whether to choose k largest or k smallest elements. Top K largest elements will be chosen if set to false.
dtype	'float16', 'float32', 'float64', 'int32', 'int64', 'uint8', optional, default='float32' DType of the output indices when ret_typ is "indices" or "both". An error will be raised if the selected data type cannot precisely represent the indices.

**Details**

```

x = [[ 0.3, 0.2, 0.4], [ 0.1, 0.3, 0.2]]
// returns an index of the largest element on last axis topk(x) = [[ 2.], [ 1.]]
// returns the value of top-2 largest elements on last axis topk(x, ret_typ='value', k=2) = [[ 0.4, 0.3],
[ 0.3, 0.2]]
// returns the value of top-2 smallest elements on last axis topk(x, ret_typ='value', k=2, is_ascend=1)
= [[ 0.2 , 0.3], [ 0.1 , 0.2]]
// returns the value of top-2 largest elements on axis 0 topk(x, axis=0, ret_typ='value', k=2) = [[
0.3, 0.3, 0.4], [ 0.1, 0.2, 0.2]]
// flattens and then returns list of both values and indices topk(x, ret_typ='both', k=2) = [[[ 0.4, 0.3],
[ 0.3, 0.2]] , [[ 2., 0.], [ 1., 2.]]]
Defined in src/operator/tensor/ordering_op.cc:L68

```

**Value**

out The result mx.ndarray

---

mx.nd.transpose	<i>Permutes the dimensions of an array. Examples::</i> $x = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ $\text{transpose}(x) = \begin{bmatrix} 1. & 3. \\ 2. & 4. \end{bmatrix}$ $x = \begin{bmatrix} \begin{bmatrix} 1. & 2. \\ 3. & 4. \end{bmatrix} \\ \begin{bmatrix} 5. & 6. \\ 7. & 8. \end{bmatrix} \end{bmatrix}$ $\text{transpose}(x) = \begin{bmatrix} \begin{bmatrix} 1. & 5. \\ 3. & 7. \end{bmatrix} \\ \begin{bmatrix} 2. & 6. \\ 4. & 8. \end{bmatrix} \end{bmatrix}$ $\text{transpose}(x, \text{axes}=(1,0,2)) = \begin{bmatrix} \begin{bmatrix} 1. & 2. \\ 5. & 6. \end{bmatrix} \\ \begin{bmatrix} 3. & 4. \\ 7. & 8. \end{bmatrix} \end{bmatrix}$
-----------------	--

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L328

**Arguments**

- data                    NDArrary-or-Symbol Source input
- axes                   Shape(tuple), optional, default=[] Target axis order. By default the axes will be inverted.

**Value**

out The result mx.ndarray

---

mx.nd.trunc	<i>Return the element-wise truncated value of the input.</i>
-------------	--

---

**Description**

The truncated value of the scalar x is the nearest integer i which is closer to zero than x is. In short, the fractional part of the signed number x is discarded.

**Arguments**

- data                    NDArrary-or-Symbol The input array.

**Details**

Example::  
trunc([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-2., -1., 1., 1., 2.]  
The storage type of “trunc“ output depends upon the input storage type:  
- trunc(default) = default - trunc(row\_sparse) = row\_sparse - trunc(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L856

**Value**

out The result mx.ndarray

---

mx.nd.uniform	<i>Draw random samples from a uniform distribution.</i>
---------------	---

---

**Description**

.. note:: The existing alias “uniform“ is deprecated.

**Arguments**

low	float, optional, default=0 Lower bound of the distribution.
high	float, optional, default=1 Upper bound of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).

**Details**

Samples are uniformly distributed over the half-open interval `[low, high)` (includes `*low*`, but excludes `*high*`).

Example::

```
uniform(low=0, high=1, shape=(2,2)) = [[ 0.60276335, 0.85794562], [ 0.54488319, 0.84725171]]
```

Defined in `src/operator/random/sample_op.cc:L96`

**Value**

out The result `mx.ndarray`

---

mx.nd.unravel.index	<i>Converts an array of flat indices into a batch of index arrays. The operator follows numpy conventions so a single multi index is given by a column of the output matrix. The leading dimension may be left unspecified by using -1 as placeholder.</i>
---------------------	--

---

**Description**

Examples::

**Arguments**

data	NDArray-or-Symbol Array of flat indices
shape	Shape(tuple), optional, default=None Shape of the array into which the multi-indices apply.

Details

A = [22,41,37] unravel(A, shape=(7,6)) = [[3,6,6],[4,5,1]] unravel(A, shape=(-1,6)) = [[3,6,6],[4,5,1]]  
Defined in src/operator/tensor/ravel.cc:L68

Value

out The result mx.ndarray

---

mx.nd.UpSampling	<i>Upsamples the given input data.</i>
------------------	--

---

Description

Two algorithms (“sample\_type”) are available for upsampling:

Arguments

data	NDArray-or-Symbol[] Array of tensors to upsample. For bilinear upsampling, there should be 2 inputs - 1 data and 1 weight.
scale	int, required Up sampling scale
num.filter	int, optional, default='0' Input filter. Only used by bilinear sample_type.Since bilinear upsampling uses deconvolution, num_filters is set to the number of channels.
sample.type	'bilinear', 'nearest', required upsampling method
multi.input.mode	'concat', 'sum',optional, default='concat' How to handle multiple input. concat means concatenate upsampled images along the channel dimension. sum means add all images together, only available for nearest neighbor upsampling.
num.args	int, required Number of inputs to be upsampled. For nearest neighbor upsampling, this can be 1-N; the size of output will be(scale*h_0,scale*w_0) and all other inputs will be upsampled to thesame size. For bilinear upsampling this must be 2; 1 input and 1 weight.
workspace	long (non-negative), optional, default=512 Tmp workspace for deconvolution (MB)

Details

- Nearest Neighbor - Bilinear  
\*\*\*Nearest Neighbor Upsampling\*\*\*  
Input data is expected to be NCHW.  
Example::  
x = [[[[1. 1. 1.] [1. 1. 1.] [1. 1. 1.]]]]



```
UpSampling(x, scale=2, sample_type='nearest') = [[[[[1. 1. 1. 1. 1.] [1. 1. 1. 1. 1.] [1. 1. 1.  
1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1.] [1. 1. 1. 1. 1.]]]]]
```

### \*\*Bilinear Upsampling\*\*

Uses 'deconvolution' algorithm under the hood. You need provide both input data and the kernel.

Input data is expected to be NCHW.

'num\_filter' is expected to be same as the number of channels.

Example::

```
x = [[[[1. 1. 1.] [1. 1. 1.] [1. 1. 1.]]]]
```

$$w = [ [ [ [1. \ 1. \ 1. \ 1.] \ [1. \ 1. \ 1. \ 1.] \ [1. \ 1. \ 1. \ 1.] \ [1. \ 1. \ 1. \ 1.]] ] ] ]$$

```
UpSampling(x, w, scale=2, sample_type='bilinear', num_filter=1) = [[[[[1. 2. 2. 2. 1.] [2. 4. 4. 4. 2.] [2. 4. 4. 4. 2.] [2. 4. 4. 4. 2.] [1. 2. 2. 2. 1.]]]]]
```

Defined in src/operator/nn/upsampling.cc:L173

## Value

out The result `mx.ndarray`

<code>mx.nd.where</code>	<i>Return the elements, either from x or y, depending on the condition.</i>
--------------------------	---

## Description

Given three ndarrays, condition, x, and y, return an ndarray with the elements from x or y, depending on the elements from condition are true or false. x and y must have the same shape. If condition has the same shape as x, each element in the output array is from x if the corresponding element in the condition is true, and from y if false.

## Arguments

condition	NDAarray-or-Symbol condition array
x	NDAarray-or-Symbol
y	NDAarray-or-Symbol

## Details

If condition does not have the same shape as x, it must be a 1D array whose size is the same as x's first dimension size. Each row of the output array is from x's row if the corresponding element from condition is true, and from y's row if false.

Note that all non-zero values are interpreted as “True“ in condition.

Examples::

```
x = [[1, 2], [3, 4]] y = [[5, 6], [7, 8]] cond = [[0, 1], [-1, 0]]
```

where(cond, x, y) = [[5, 2], [3, 8]]

```
csr_cond = cast_storage(cond, 'csr')
where(csr_cond, x, y) = [[5, 2], [3, 8]]
Defined in src/operator/tensor/control_flow_op.cc:L57
```

**Value**

out The result mx.ndarray

---

<code>mx.nd.zeros</code>	<i>Generate an mx.nd.array object with zeros</i>
--------------------------	--

---

**Description**

Generate an mx.nd.array object with zeros

**Usage**

```
mx.nd.zeros(shape, ctx = NULL)
```

**Arguments**

- shape                    the dimension of the `mx.nd.array`
- ctx                     optional The context device of the array. `mx.ctx.default()` will be used in default.

**Examples**

```
mat = mx.nd.zeros(10)
as.array(mat)
mat2 = mx.nd.zeros(c(5,5))
as.array(mat)
mat3 = mx.nd.zeroses(c(3,3,3))
as.array(mat3)
```

---

<code>mx.nd.zeros.like</code>	<i>Return an array of zeros with the same shape, type and storage type as the input array.</i>
-------------------------------	--

---

**Description**

The storage type of “zeros\_like” output depends on the storage type of the input

**Arguments**

- data                    NDAarray-or-Symbol The input

**Details**

- zeros\_like(row\_sparse) = row\_sparse - zeros\_like(csr) = csr - zeros\_like(default) = default

Examples::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
zeros_like(x) = [[ 0., 0., 0.], [ 0., 0., 0.]]
```

**Value**

out The result mx.ndarray

---

mx.opt.adadelta	Create an AdaDelta optimizer with respective parameters.
-----------------	--

---

**Description**

AdaDelta optimizer as described in Zeiler, M. D. (2012). \*ADADELTA: An adaptive learning rate method.\* <http://arxiv.org/abs/1212.5701>

**Usage**

```
mx.opt.adadelta(
    rho = 0.9,
    epsilon = 1e-05,
    wd = 0,
    rescale_grad = 1,
    clip_gradient = -1
)
```

**Arguments**

rho	float, default=0.90 Decay rate for both squared gradients and delta x.
epsilon	float, default=1e-5 The constant as described in the thesis.
wd	float, default=0.0 L2 regularization coefficient add to all the weights.
rescale_grad	float, default=1 rescaling factor of gradient.
clip_gradient	float, default=-1 (no clipping if < 0) clip gradient in range [-clip_gradient, clip_gradient].

---

mx.opt.adagrad	Create an AdaGrad optimizer with respective parameters. AdaGrad optimizer of Duchi et al., 2011,
----------------	--

---

### Description

This code follows the version in <http://arxiv.org/pdf/1212.5701v1.pdf> Eq(5) by Matthew D. Zeiler, 2012. AdaGrad will help the network to converge faster in some cases.

### Usage

```
mx.opt.adagrad(
    learning.rate = 0.05,
    epsilon = 1e-08,
    wd = 0,
    rescale.grad = 1,
    clip_gradient = -1,
    lr_scheduler = NULL
)
```

### Arguments

learning.rate	float, default=0.05 Step size.
epsilon	float, default=1e-8
wd	float, default=0.0 L2 regularization coefficient add to all the weights.
rescale.grad	float, default=1.0 rescaling factor of gradient.
clip_gradient	float, default=-1.0 (no clipping if < 0) clip gradient in range [-clip_gradient, clip_gradient].
lr_scheduler	function, optional The learning rate scheduler.

---

mx.opt.adam	Create an Adam optimizer with respective parameters. Adam optimizer as described in [King2014].
-------------	---

---

### Description

[King2014] Diederik Kingma, Jimmy Ba, Adam: A Method for Stochastic Optimization, <http://arxiv.org/abs/1412.6980>

**Usage**

```
mx.opt.adam(
    learning.rate = 0.001,
    beta1 = 0.9,
    beta2 = 0.999,
    epsilon = 1e-08,
    wd = 0,
    rescale.grad = 1,
    clip_gradient = -1,
    lr_scheduler = NULL
)
```

**Arguments**

learning.rate	float, default=1e-3 The initial learning rate.
beta1	float, default=0.9 Exponential decay rate for the first moment estimates.
beta2	float, default=0.999 Exponential decay rate for the second moment estimates.
epsilon	float, default=1e-8
wd	float, default=0.0 L2 regularization coefficient add to all the weights.
rescale.grad	float, default=1.0 rescaling factor of gradient.
clip_gradient	float, optional, default=-1 (no clipping if < 0) clip gradient in range [-clip_gradient, clip_gradient].
lr_scheduler	function, optional The learning rate scheduler.

---

mx.opt.create	<i>Create an optimizer by name and parameters</i>
---------------	---

---

**Description**

Create an optimizer by name and parameters

**Usage**

```
mx.opt.create(name, ...)
```

**Arguments**

name	The name of the optimizer
...	Additional arguments

---

<code>mx.opt.get.updater</code>	<i>Get an updater closure that can take list of weight and gradient and return updated list of weight.</i>
---------------------------------	--

---

### Description

Get an updater closure that can take list of weight and gradient and return updated list of weight.

### Usage

```
mx.opt.get.updater(optimizer, weights, ctx)
```

### Arguments

<code>optimizer</code>	The optimizer
<code>weights</code>	The weights to be optimized

---

<code>mx.opt.nag</code>	<i>Create a Nesterov Accelerated SGD( NAG) optimizer.</i>
-------------------------	---

---

### Description

NAG optimizer is described in Aleksandar Botev. et al (2016). \*NAG: A Nesterov accelerated SGD.\* <https://arxiv.org/pdf/1607.01981.pdf>

### Usage

```
mx.opt.nag(
    learning.rate = 0.01,
    momentum = 0,
    wd = 0,
    rescale.grad = 1,
    clip_gradient = -1,
    lr_scheduler = NULL
)
```

### Arguments

<code>learning.rate</code>	float, default=0.01 The initial learning rate.
<code>momentum</code>	float, default=0 The momentum value
<code>wd</code>	float, default=0.0 L2 regularization coefficient added to all the weights.
<code>rescale.grad</code>	float, default=1.0 rescaling factor of gradient.
<code>clip_gradient</code>	float, optional, default=-1 (no clipping if < 0) clip gradient in range [-clip_gradient, clip_gradient].
<code>lr_scheduler</code>	function, optional The learning rate scheduler.

---

<code>mx.opt.rmsprop</code>	<i>Create an RMSProp optimizer with respective parameters. Reference: Tieleman T, Hinton G. Lecture 6.5-rmsprop: Divide the gradient by a running average of its recent magnitude[J]. COURSERA: Neural Networks for Machine Learning, 2012, 4(2). The code follows: <a href="http://arxiv.org/pdf/1308.0850v5.pdf">http://arxiv.org/pdf/1308.0850v5.pdf</a> Eq(38) - Eq(45) by Alex Graves, 2013.</i>
-----------------------------	---

---

## Description

Create an RMSProp optimizer with respective parameters. Reference: Tieleman T, Hinton G. Lecture 6.5-rmsprop: Divide the gradient by a running average of its recent magnitude[J]. COURSERA: Neural Networks for Machine Learning, 2012, 4(2). The code follows: <http://arxiv.org/pdf/1308.0850v5.pdf> Eq(38) - Eq(45) by Alex Graves, 2013.

## Usage

```
mx.opt.rmsprop(
    learning.rate = 0.002,
    centered = TRUE,
    rho = 0.95,
    momentum = 0.9,
    epsilon = 1e-04,
    wd = 0,
    rescale.grad = 1,
    clip_gradient = -1,
    lr_scheduler = NULL
)
```

## Arguments

<code>learning.rate</code>	float, default=0.002 The initial learning rate.
<code>rho</code>	float, default=0.95 decay factor of moving average for gradient, $\text{gradient}^2$ .
<code>momentum</code>	float, default=0.9 "momentum" factor.
<code>epsilon</code>	float, default=1e-4
<code>wd</code>	float, default=0.0 L2 regularization coefficient add to all the weights.
<code>rescale.grad</code>	float, default=1.0 rescaling factor of gradient.
<code>clip_gradient</code>	float, optional, default=-1 (no clipping if $< 0$ ) clip gradient in range $[-\text{clip\_gradient}, \text{clip\_gradient}]$ .
<code>lr_scheduler</code>	function, optional The learning rate scheduler.

---

<code>mx.opt.sgd</code>	<i>Create an SGD optimizer with respective parameters. Perform SGD with momentum update</i>
-------------------------	---

---

## Description

Create an SGD optimizer with respective parameters. Perform SGD with momentum update

## Usage

```
mx.opt.sgd(
    learning.rate = 0.01,
    momentum = 0,
    wd = 0,
    rescale.grad = 1,
    clip_gradient = -1,
    lr_scheduler = NULL
)
```

## Arguments

<code>learning.rate</code>	float, default=0.01 The initial learning rate.
<code>momentum</code>	float, default=0 The momentum value
<code>wd</code>	float, default=0.0 L2 regularization coefficient add to all the weights.
<code>rescale.grad</code>	float, default=1.0 rescaling factor of gradient.
<code>clip_gradient</code>	float, optional, default=-1 (no clipping if < 0) clip gradient in range [-clip_gradient, clip_gradient].
<code>lr_scheduler</code>	function, optional The learning rate scheduler.

---

<code>mx.profiler.config</code>	<i>Set up the configuration of profiler.</i>
---------------------------------	--

---

## Description

Set up the configuration of profiler.

## Usage

```
mx.profiler.config(params)
```



Arguments

flags                    list of key/value pair tuples. Indicates configuration parameters  
profile\_symbolic : boolean, whether to profile symbolic operators  
profile\_imperative : boolean, whether to profile imperative operators  
profile\_memory : boolean, whether to profile memory usage  
profile\_api : boolean, whether to profile the C API  
file\_name : string, output file for profile data  
continuous\_dump : boolean, whether to periodically dump profiling data to file  
dump\_period : float, seconds between profile data dumps

---

mx.profiler.state	Set up the profiler state to record operator.
-------------------	---

---

Description

Set up the profiler state to record operator.

Usage

```
mx.profiler.state(state = MX.PROF.STATE$STOP)
```

Arguments

state                    Indicting whether to run the profiler, can be 'MX.PROF.STATE\$RUN' or 'MX.PROF.STATE\$STOP'. Default is 'MX.PROF.STATE\$STOP'.

filename                The name of output trace file. Default is 'profile.json'

---

mx.rnorm	Generate nomal distribution with mean and sd.
----------	---

---

Description

Generate nomal distribution with mean and sd.

Usage

```
mx.rnorm(shape, mean = 0, sd = 1, ctx = NULL)
```

Arguments

shape                    Dimension, The shape(dimension) of the result.

mean                    numeric, The mean of distribution.

sd                      numeric, The standard deviations.

ctx,                    optional The context device of the array. mx.ctx.default() will be used in default.

**Examples**

```
mx.set.seed(0)
as.array(mx.runif(2))
# 0.5488135 0.5928446
mx.set.seed(0)
as.array(mx.rnorm(2))
# 2.212206 1.163079
```

---

<code>mx.runif</code>	<i>Generate uniform distribution in [low, high) with specified shape.</i>
-----------------------	---

---

**Description**

Generate uniform distribution in [low, high) with specified shape.

**Usage**

```
mx.runif(shape, min = 0, max = 1, ctx = NULL)
```

**Arguments**

<code>shape</code>	Dimension, The shape(dimension) of the result.
<code>min</code>	numeric, The lower bound of distribution.
<code>max</code>	numeric, The upper bound of distribution.
<code>ctx,</code>	optional The context device of the array. <code>mx.ctx.default()</code> will be used in default.

**Examples**

```
mx.set.seed(0)
as.array(mx.runif(2))
# 0.5488135 0.5928446
mx.set.seed(0)
as.array(mx.rnorm(2))
# 2.212206 1.163079
```

---

mx.serialize	Serialize MXNet model into RData-compatible format.
--------------	---

---

**Description**

Serialize MXNet model into RData-compatible format.

**Usage**

```
mx.serialize(model)
```

**Arguments**

model	The mxnet model
-------	-----------------

---

mx.set.seed	Set the seed used by mxnet device-specific random number generators.
-------------	--

---

**Description**

Set the seed used by mxnet device-specific random number generators.

**Usage**

```
mx.set.seed(seed)
```

**Arguments**

seed	the seed value to the device random number generators.
------	--

**Details**

We have a specific reason why `mx.set.seed` is introduced, instead of simply use `set.seed`.

The reason that is that most of mxnet random number generator can run on different devices, such as GPU. We need to use massively parallel PRNG on GPU to get fast random number generations. It can also be quite costly to seed these PRNGs. So we introduced `mx.set.seed` for mxnet specific device random numbers.

**Examples**

```
mx.set.seed(0)
as.array(mx.runif(2))
# 0.5488135 0.5928446
mx.set.seed(0)
as.array(mx.rnorm(2))
# 2.212206 1.163079
```

---

<code>mx.simple.bind</code>	<i>Simple bind the symbol to executor, with information from input shapes.</i>
-----------------------------	--

---

**Description**

Simple bind the symbol to executor, with information from input shapes.

**Usage**

```
mx.simple.bind(symbol, ctx, grad.req = "null", fixed.param = NULL, ...)
```

---

<code>mx.symbol.abs</code>	<i>abs:Returns element-wise absolute value of the input.</i>
----------------------------	--

---

**Description**

Example::

**Usage**

```
mx.symbol.abs(...)
```

**Arguments**

- |                   |  |
|-------------------|--|
| <code>data</code> | NDArray-or-Symbol The input array.             |
| <code>name</code> | string, optional Name of the resulting symbol. |

**Details**

`abs([-2, 0, 3]) = [2, 0, 3]`  
The storage type of “abs“ output depends upon the input storage type:  
- `abs(default) = default` - `abs(row_sparse) = row_sparse` - `abs(csr) = csr`  
Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L720`

**Value**

`out` The result `mx.symbol`

---

`mx.symbol.Activation`    *Activation:Applies an activation function element-wise to the input.*

---

### Description

The following activation functions are supported:

### Usage

```
mx.symbol.Activation(...)
```

### Arguments

<code>data</code>	NDArray-or-Symbol The input array.
<code>act.type</code>	'relu', 'sigmoid', 'softrelu', 'softsign', 'tanh', required Activation function to be applied.
<code>name</code>	string, optional Name of the resulting symbol.

### Details

- 'relu': Rectified Linear Unit,  $y = \max(x, 0)$  - 'sigmoid':  $y = \frac{1}{1 + \exp(-x)}$   
 - 'tanh': Hyperbolic tangent,  $y = \frac{\exp(x) - \exp(-x)}{\exp(x) + \exp(-x)}$  - 'softrelu': Soft ReLU, or SoftPlus,  $y = \log(1 + \exp(x))$  - 'softsign':  $y = \frac{x}{1 + \abs{x}}$

Defined in `src/operator/nn/activation.cc:L165`

### Value

`out` The result `mx.symbol`

---

`mx.symbol.adam_update`    *adam\_update:Update function for Adam optimizer. Adam is seen as a generalization of AdaGrad.*

---

### Description

Adam update consists of the following steps, where `g` represents gradient and `m`, `v` are 1st and 2nd order moment estimates (mean and variance).

### Usage

```
mx.symbol.adam_update(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
lr	float, required Learning rate
beta1	float, optional, default=0.8999999976 The decay rate for the 1st moment estimates.
beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.99999994e-09 A small constant for numerical stability.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and all of w, m and v have the same stype
name	string, optional Name of the resulting symbol.

**Details**

.. math::

$$g_t = \nabla J(W_{t-1}) \quad m_t = \beta_1 m_{t-1} + (1 - \beta_1) g_t \quad v_t = \beta_2 v_{t-1} + (1 - \beta_2) g_t^2 \\ W_t = W_{t-1} - \alpha \frac{m_t}{\sqrt{v_t} + \epsilon}$$

It updates the weights using::

$$m = \beta_1 * m + (1 - \beta_1) * \text{grad} \quad v = \beta_2 * v + (1 - \beta_2) * (\text{grad} ** 2) \quad w += - \text{learning\_rate} * m / (\sqrt{v} + \epsilon)$$

However, if grad's storage type is "row\_sparse", "lazy\_update" is True and the storage type of weight is the same as those of m and v, only the row slices whose indices appear in grad.indices are updated (for w, m and v)::

$$\text{for row in grad.indices: } m[\text{row}] = \beta_1 * m[\text{row}] + (1 - \beta_1) * \text{grad}[\text{row}] \quad v[\text{row}] = \beta_2 * v[\text{row}] + (1 - \beta_2) * (\text{grad}[\text{row}] ** 2) \\ w[\text{row}] += - \text{learning\_rate} * m[\text{row}] / (\sqrt{v[\text{row}]} + \epsilon)$$

Defined in src/operator/optimizer\_op.cc:L679

**Value**

out The result mx.symbol

---

mx.symbol.add_n	<i>add_n: Adds all input arguments element-wise.</i>
-----------------	--

---

**Description**

.. math:: \text{add\\_n}(a\_1, a\_2, \dots, a\_n) = a\_1 + a\_2 + \dots + a\_n

**Usage**

```
mx.symbol.add_n(...)
```

**Arguments**

args	NDArray-or-Symbol[] Positional input arguments
name	string, optional Name of the resulting symbol.

**Details**

“add\_n” is potentially more efficient than calling “add” by ‘n’ times.

The storage type of “add\_n” output depends on storage types of inputs

- add\_n(row\_sparse, row\_sparse, ..) = row\_sparse - add\_n(default, csr, default) = default - add\_n(any input combinations longer than 4 (>4) with at least one default type) = default - otherwise, “add\_n” falls all inputs back to default storage and generates default storage

Defined in src/operator/tensor/elemwise\_sum.cc:L155

**Value**

out The result mx.symbol

---

mx.symbol.all_finite	<i>all_finite: Check if all the float numbers in the array are finite (used for AMP)</i>
----------------------	--

---

**Description**

Defined in src/operator/contrib/all\_finite.cc:L101

**Usage**

```
mx.symbol.all_finite(...)
```

**Arguments**

data	NDArray Array
init.output	boolean, optional, default=1 Initialize output to 1.
name	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.amp_cast</code>	<i>amp_cast:Cast function between low precision float/FP32 used by AMP.</i>
---------------------------------	---

---

**Description**

It casts only between low precision float/FP32 and does not do anything for other types.

**Usage**

`mx.symbol.amp_cast(...)`

**Arguments**

data	NDArray-or-Symbol The input.
dtype	'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', required Output data type.
name	string, optional Name of the resulting symbol.

**Details**

Defined in `src/operator/tensor/amp_cast.cc:L121`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.amp_multicast</code>	<i>amp_multicast:Cast function used by AMP, that casts its inputs to the common widest type.</i>
--------------------------------------	--

---

**Description**

It casts only between low precision float/FP32 and does not do anything for other types.

**Usage**

`mx.symbol.amp_multicast(...)`



Arguments

data	NDArray-or-Symbol[] Weights
num.outputs	int, required Number of input/output pairs to be casted to the widest type.
cast.narrow	boolean, optional, default=0 Whether to cast to the narrowest type
name	string, optional Name of the resulting symbol.

Details

Defined in src/operator/tensor/amp\_cast.cc:L165

Value

out The result mx.symbol

---

mx.symbol.arccos	<i>arccos:Returns element-wise inverse cosine of the input array.</i>
------------------	---

---

Description

The input should be in range  $[-1, 1]$ . The output is in the closed interval  $[0, \pi]$

Usage

mx.symbol.arccos(...)

Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

Details

.. math:: \arccos([-1, -.707, 0, .707, 1]) = [\pi, 3\pi/4, \pi/2, \pi/4, 0]

The storage type of “arccos” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L233

Value

out The result mx.symbol

---

<code>mx.symbol.arccosh</code>	<i>arccosh:Returns the element-wise inverse hyperbolic cosine of the input array, \ computed element-wise.</i>
--------------------------------	--

---

**Description**

The storage type of “arccosh” output is always dense

**Usage**

```
mx.symbol.arccosh(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L535

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.arcsin</code>	<i>arcsin:Returns element-wise inverse sine of the input array.</i>
-------------------------------	---

---

**Description**

The input should be in the range ‘[-1, 1]’. The output is in the closed interval of [:math:‘-\pi/2’, :math:‘\pi/2’].

**Usage**

```
mx.symbol.arcsin(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

Details

.. math:: \arcsin([-1, -.707, 0, .707, 1]) = [-\pi/2, -\pi/4, 0, \pi/4, \pi/2]

The storage type of “arcsin“ output depends upon the input storage type:

- arcsin(default) = default - arcsin(row\_sparse) = row\_sparse - arcsin(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L187

Value

out The result mx.symbol

---

mx.symbol.arcsinh	<i>arcsinh:Returns the element-wise inverse hyperbolic sine of the input array, \ computed element-wise.</i>
-------------------	--

---

Description

The storage type of “arcsinh“ output depends upon the input storage type:

Usage

mx.symbol.arcsinh(...)

Arguments

- data               NDArray-or-Symbol The input array.
- name               string, optional Name of the resulting symbol.

Details

- arcsinh(default) = default - arcsinh(row\_sparse) = row\_sparse - arcsinh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L494

Value

out The result mx.symbol

---

<code>mx.symbol.arctan</code>	<i>arctan:Returns element-wise inverse tangent of the input array.</i>
-------------------------------	--

---

**Description**

The output is in the closed interval :math: '[-\pi/2, \pi/2]'

**Usage**

`mx.symbol.arctan(...)`

**Arguments**

- `data`                   NDArray-or-Symbol The input array.
- `name`                   string, optional Name of the resulting symbol.

**Details**

.. math:: arctan([-1, 0, 1]) = [-\pi/4, 0, \pi/4]

The storage type of “arctan“ output depends upon the input storage type:

- `arctan(default) = default` - `arctan(row_sparse) = row_sparse` - `arctan(csr) = csr`

Defined in `src/operator/tensor/elemwise_unary_op_trig.cc:L282`

**Value**

`out` The result `mx.symbol`

---

<code>mx.symbol.arctanh</code>	<i>arctanh:Returns the element-wise inverse hyperbolic tangent of the input array, \ computed element-wise.</i>
--------------------------------	---

---

**Description**

The storage type of “arctanh“ output depends upon the input storage type:

**Usage**

`mx.symbol.arctanh(...)`

**Arguments**

- `data`                   NDArray-or-Symbol The input array.
- `name`                   string, optional Name of the resulting symbol.

**Details**

- arctanh(default) = default - arctanh(row\_sparse) = row\_sparse - arctanh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L579

**Value**

out The result mx.symbol

---

mx.symbol.argmax	<i>argmax:Returns indices of the maximum values along an axis.</i>
------------------	--

---

**Description**

In the case of multiple occurrences of maximum values, the indices corresponding to the first occurrence are returned.

**Usage**

```
mx.symbol.argmax(...)
```

**Arguments**

data	NDArray-or-Symbol The input
axis	int or None, optional, default='None' The axis along which to perform the reduction. Negative values means indexing from right to left. "Requires axis to be set as int, because global reduction is not supported yet."
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axis is left in the result as dimension with size one.
name	string, optional Name of the resulting symbol.

**Details**

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
// argmax along axis 0 argmax(x, axis=0) = [ 1., 1., 1.]
```

```
// argmax along axis 1 argmax(x, axis=1) = [ 2., 2.]
```

```
// argmax along axis 1 keeping same dims as an input array argmax(x, axis=1, keepdims=True) = [[ 2.], [ 2.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L52

**Value**

out The result mx.symbol

---

```
mx.symbol.argmax_channel
```

*argmax\_channel:Returns argmax indices of each channel from the input array.*

---

### Description

The result will be an NDAarray of shape (num\_channel,).

### Usage

```
mx.symbol.argmax_channel(...)
```

### Arguments

data	NDAarray-or-Symbol The input array
name	string, optional Name of the resulting symbol.

### Details

In case of multiple occurrences of the maximum values, the indices corresponding to the first occurrence are returned.

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
argmax_channel(x) = [ 2., 2.]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L97

### Value

out The result mx.symbol

---

```
mx.symbol.argmin
```

*argmin:Returns indices of the minimum values along an axis.*

---

### Description

In the case of multiple occurrences of minimum values, the indices corresponding to the first occurrence are returned.

### Usage

```
mx.symbol.argmin(...)
```

**Arguments**

data	NDArray-or-Symbol The input
axis	int or None, optional, default='None' The axis along which to perform the reduction. Negative values means indexing from right to left. "Requires axis to be set as int, because global reduction is not supported yet."
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axis is left in the result as dimension with size one.
name	string, optional Name of the resulting symbol.

**Details**

Examples::

```
x = [[ 0., 1., 2.], [ 3., 4., 5.]]
```

```
// argmin along axis 0 argmin(x, axis=0) = [ 0., 0., 0.]
```

```
// argmin along axis 1 argmin(x, axis=1) = [ 0., 0.]
```

```
// argmin along axis 1 keeping same dims as an input array argmin(x, axis=1, keepdims=True) = [[ 0.], [ 0.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L77

**Value**

out The result mx.symbol

---

mx.symbol.argsort	<i>argsort:Returns the indices that would sort an input array along the given axis.</i>
-------------------	---

---

**Description**

This function performs sorting along the given axis and returns an array of indices having same shape as an input array that index data in sorted order.

**Usage**

```
mx.symbol.argsort(...)
```

**Arguments**

data	NDArray-or-Symbol The input array
axis	int or None, optional, default='-1' Axis along which to sort the input tensor. If not given, the flattened array is used. Default is -1.
is.ascend	boolean, optional, default=1 Whether to sort in ascending or descending order.

dtype	'float16', 'float32', 'float64', 'int32', 'int64', 'uint8', optional, default='float32' DType of the output indices. It is only valid when ret_typ is "indices" or "both". An error will be raised if the selected data type cannot precisely represent the indices.
name	string, optional Name of the resulting symbol.

**Details**

```
Examples::
x = [[ 0.3, 0.2, 0.4], [ 0.1, 0.3, 0.2]]
// sort along axis -1 argsort(x) = [[ 1., 0., 2.], [ 0., 2., 1.]]
// sort along axis 0 argsort(x, axis=0) = [[ 1., 0., 1.] [ 0., 1., 0.]]
// flatten and then sort argsort(x, axis=None) = [ 3., 1., 5., 0., 4., 2.]
Defined in src/operator/tensor/ordering_op.cc:L185
```

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.BatchNorm</code>	<i>BatchNorm:Batch normalization.</i>
----------------------------------	---------------------------------------

---

**Description**

Normalizes a data batch by mean and variance, and applies a scale “gamma” as well as offset “beta”.

**Usage**

```
mx.symbol.BatchNorm(...)
```

**Arguments**

data	NDArray-or-Symbol Input data to batch normalization
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
moving.mean	NDArray-or-Symbol running mean of input
moving.var	NDArray-or-Symbol running variance of input
eps	double, optional, default=0.0010000000474974513 Epsilon to prevent div 0. Must be no less than CUDNN_BN_MIN_EPSILON defined in cudnn.h when using cudnn (usually 1e-5)
momentum	float, optional, default=0.899999976 Momentum for moving average
fix.gamma	boolean, optional, default=1 Fix gamma while training



<code>use_global_stats</code>	boolean, optional, default=0 Whether use global moving statistics instead of local batch-norm. This will force change batch-norm into a scale shift operator.
<code>output_mean_var</code>	boolean, optional, default=0 Output the mean and inverse std
<code>axis</code>	int, optional, default='1' Specify which shape axis the channel is specified
<code>cudnn_off</code>	boolean, optional, default=0 Do not select CUDNN operator, if available
<code>min_calib_range</code>	float or None, optional, default=None The minimum scalar value in the form of float32 obtained through calibration. If present, it will be used to by quantized batch norm op to calculate primitive scale. Note: this <code>calib_range</code> is to calib bn output.
<code>max_calib_range</code>	float or None, optional, default=None The maximum scalar value in the form of float32 obtained through calibration. If present, it will be used to by quantized batch norm op to calculate primitive scale. Note: this <code>calib_range</code> is to calib bn output.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis:

```
.. math::
```

```
data\_mean[i] = mean(data[:,i,:,...]) \ data\_var[i] = var(data[:,i,:,...])
```

Then compute the normalized output, which has the same shape as input, as following:

```
.. math::
```

```
out[:,i,:,...] = \frac{data[:,i,:,...] - data\_mean[i]}{\sqrt{data\_var[i] + \epsilon}} * gamma[i] + beta[i]
```

Both `*mean*` and `*var*` returns a scalar by treating the input as a vector.

Assume the input has size `*k*` on axis 1, then both `"gamma"` and `"beta"` have shape `*(k,)*`. If `"output_mean_var"` is set to be true, then outputs both `"data_mean"` and the inverse of `"data_var"`, which are needed for the backward pass. Note that gradient of these two outputs are blocked.

Besides the inputs and the outputs, this operator accepts two auxiliary states, `"moving_mean"` and `"moving_var"`, which are `*k*`-length vectors. They are global statistics for the whole dataset, which are updated by::

```
moving_mean = moving_mean * momentum + data_mean * (1 - momentum)
moving_var = moving_var * momentum + data_var * (1 - momentum)
```

If `"use_global_stats"` is set to be true, then `"moving_mean"` and `"moving_var"` are used instead of `"data_mean"` and `"data_var"` to compute the output. It is often used during inference.

The parameter `"axis"` specifies which axis of the input shape denotes the 'channel' (separately normalized groups). The default is 1. Specifying -1 sets the channel axis to be the last item in the input shape.

Both `"gamma"` and `"beta"` are learnable parameters. But if `"fix_gamma"` is true, then set `"gamma"` to 1 and its gradient to 0.

.. Note:: When “fix\_gamma” is set to True, no sparse support is provided. If “fix\_gamma is” set to False, the sparse tensors will fallback.

Defined in src/operator/nn/batch\_norm.cc:L545

## Value

out The result mx.symbol

---

mx.symbol.BatchNorm\_v1

*BatchNorm\_v1:Batch normalization.*

---

## Description

This operator is DEPRECATED. Perform BatchNorm on the input.

## Usage

mx.symbol.BatchNorm\_v1(...)

## Arguments

data	NDArray-or-Symbol Input data to batch normalization
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
eps	float, optional, default=0.00100000005 Epsilon to prevent div 0
momentum	float, optional, default=0.899999976 Momentum for moving average
fix.gamma	boolean, optional, default=1 Fix gamma while training
use.global.stats	boolean, optional, default=0 Whether use global moving statistics instead of local batch-norm. This will force change batch-norm into a scale shift operator.
output.mean.var	boolean, optional, default=0 Output All,normal mean and var
name	string, optional Name of the resulting symbol.

## Details

Normalizes a data batch by mean and variance, and applies a scale “gamma” as well as offset “beta”.

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis:

.. math::

$data\_mean[i] = \text{mean}(data[:,i,:,...])$  \  $data\_var[i] = \text{var}(data[:,i,:,...])$

Then compute the normalized output, which has the same shape as input, as following:

.. math::

$$\text{out[:,i,:,...]} = \frac{\text{data[:,i,:,...]}}{\sqrt{\text{data\_var[i]} + \epsilon}} * \text{gamma[i]} + \text{beta[i]}$$

Both `*mean*` and `*var*` returns a scalar by treating the input as a vector.

Assume the input has size `*k*` on axis 1, then both “gamma” and “beta” have shape `*(k,)*`. If “output\_mean\_var” is set to be true, then outputs both “data\_mean” and “data\_var” as well, which are needed for the backward pass.

Besides the inputs and the outputs, this operator accepts two auxiliary states, “moving\_mean” and “moving\_var”, which are `*k*`-length vectors. They are global statistics for the whole dataset, which are updated by::

$$\begin{aligned} \text{moving\_mean} &= \text{moving\_mean} * \text{momentum} + \text{data\_mean} * (1 - \text{momentum}) \\ \text{moving\_var} &= \text{moving\_var} * \text{momentum} + \text{data\_var} * (1 - \text{momentum}) \end{aligned}$$

If “use\_global\_stats” is set to be true, then “moving\_mean” and “moving\_var” are used instead of “data\_mean” and “data\_var” to compute the output. It is often used during inference.

Both “gamma” and “beta” are learnable parameters. But if “fix\_gamma” is true, then set “gamma” to 1 and its gradient to 0.

There’s no sparse support for this operator, and it will exhibit problematic behavior if used with sparse tensors.

Defined in src/operator/batch\_norm\_v1.cc:L95

## Value

out The result mx.symbol

---

mx.symbol.batch\_dot      *batch\_dot:Batchwise dot product.*

---

## Description

“batch\_dot” is used to compute dot product of “x” and “y” when “x” and “y” are data in batch, namely N-D ( $N \geq 3$ ) arrays in shape of ‘(B0, ..., B<sub>i</sub>, :, :)’.

## Usage

```
mx.symbol.batch_dot(...)
```

## Arguments

lhs	NDArray-or-Symbol The first input
rhs	NDArray-or-Symbol The second input
transpose.a	boolean, optional, default=0 If true then transpose the first input before dot.
transpose.b	boolean, optional, default=0 If true then transpose the second input before dot.
forward.stype	None, 'csr', 'default', 'row_sparse', optional, default='None' The desired storage type of the forward output given by user, if the combination of input storage types and this hint does not match any implemented ones, the dot operator will perform fallback operation and still produce an output of the desired storage type.
name	string, optional Name of the resulting symbol.

**Details**

For example, given “x” with shape ‘(B\_0, ..., B\_i, N, M)’ and “y” with shape ‘(B\_0, ..., B\_i, M, K)’, the result array will have shape ‘(B\_0, ..., B\_i, N, K)’, which is computed by::

```
batch_dot(x,y)[b_0, ..., b_i, :, :] = dot(x[b_0, ..., b_i, :, :], y[b_0, ..., b_i, :, :])
```

Defined in src/operator/tensor/dot.cc:L127

**Value**

out The result mx.symbol

---

mx.symbol.batch\_take    *batch\_take*:Takes elements from a data batch.

---

**Description**

.. note:: ‘batch\_take’ is deprecated. Use ‘pick’ instead.

**Usage**

```
mx.symbol.batch_take(...)
```

**Arguments**

a	NDArray-or-Symbol The input array
indices	NDArray-or-Symbol The index array
name	string, optional Name of the resulting symbol.

**Details**

Given an input array of shape “(d0, d1)” and indices of shape “(i0,)”, the result will be an output array of shape “(i0,)” with::

```
output[i] = input[i, indices[i]]
```

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// takes elements with specified indices batch_take(x, [0,1,0]) = [ 1. 4. 5.]
```

Defined in src/operator/tensor/indexing\_op.cc:L841

**Value**

out The result mx.symbol

---

mx.symbol.BilinearSampler

*BilinearSampler:Applies bilinear sampling to input feature map.*


---

## Description

Bilinear Sampling is the key of [NIPS2015] \“Spatial Transformer Networks\”. The usage of the operator is very similar to remap function in OpenCV, except that the operator has the backward pass.

## Usage

```
mx.symbol.BilinearSampler(...)
```

## Arguments

data	NDArray-or-Symbol Input data to the BilinearsamplerOp.
grid	NDArray-or-Symbol Input grid to the BilinearsamplerOp.grid has two channels: x_src, y_src
cudnn.off	boolean or None, optional, default=None whether to turn cudnn off
name	string, optional Name of the resulting symbol.

## Details

Given :math:‘data’ and :math:‘grid’, then the output is computed by

```
.. math:: x\_src = grid[batch, 0, y\_dst, x\_dst] \ y\_src = grid[batch, 1, y\_dst, x\_dst] \ output[batch, channel, y\_dst, x\_dst] = G(data[batch, channel, y\_src, x\_src])
```

:math:‘x\_dst’, :math:‘y\_dst’ enumerate all spatial locations in :math:‘output’, and :math:‘G()’ denotes the bilinear interpolation kernel. The out-boundary points will be padded with zeros. The shape of the output will be (data.shape[0], data.shape[1], grid.shape[2], grid.shape[3]).

The operator assumes that :math:‘data’ has ‘NCHW’ layout and :math:‘grid’ has been normalized to [-1, 1].

BilinearSampler often cooperates with GridGenerator which generates sampling grids for BilinearSampler. GridGenerator supports two kinds of transformation: “affine” and “warp”. If users want to design a CustomOp to manipulate :math:‘grid’, please firstly refer to the code of GridGenerator.

Example 1::

```
## Zoom out data two times data = array([[[[1, 4, 3, 6], [1, 8, 8, 9], [0, 4, 1, 5], [1, 0, 1, 3]]]])
affine_matrix = array([[2, 0, 0], [0, 2, 0]])
affine_matrix = reshape(affine_matrix, shape=(1, 6))
grid = GridGenerator(data=affine_matrix, transform_type='affine', target_shape=(4, 4))
out = BilinearSampler(data, grid)
out [[[ 0, 0, 0, 0], [ 0, 3.5, 6.5, 0], [ 0, 1.25, 2.5, 0], [ 0, 0, 0, 0]]]
```

Example 2::

```
## shift data horizontally by -1 pixel
data = array([[[[1, 4, 3, 6], [1, 8, 8, 9], [0, 4, 1, 5], [1, 0, 1, 3]]]])
warp_maxtrix = array([[[[1, 1, 1, 1], [1, 1, 1, 1], [1, 1, 1, 1], [1, 1, 1, 1]], [[0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0]]]])
grid = GridGenerator(data=warp_matrix, transform_type='warp') out = BilinearSampler(data, grid)
out [[[ 4, 3, 6, 0], [ 8, 8, 9, 0], [ 4, 1, 5, 0], [ 0, 1, 3, 0]]]
Defined in src/operator/bilinear_sampler.cc:L256
```

### Value

out The result mx.symbol

---

mx.symbol.BlockGrad	<i>BlockGrad:Stops gradient computation.</i>
---------------------	--

---

### Description

Stops the accumulated gradient of the inputs from flowing through this operator in the backward direction. In other words, this operator prevents the contribution of its inputs to be taken into account for computing gradients.

### Usage

```
mx.symbol.BlockGrad(...)
```

### Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

### Details

Example::

```
v1 = [1, 2] v2 = [0, 1] a = Variable('a') b = Variable('b') b_stop_grad = stop_gradient(3 * b) loss =
MakeLoss(b_stop_grad + a)
executor = loss.simple_bind(ctx=cpu(), a=(1,2), b=(1,2)) executor.forward(is_train=True, a=v1, b=v2)
executor.outputs [ 1. 5.]
executor.backward() executor.grad_arrays [ 0. 0.] [ 1. 1.]
Defined in src/operator/tensor/elemwise_unary_op_basic.cc:L325
```

### Value

out The result mx.symbol

---

```
mx.symbol.broadcast_add
```

*broadcast\_add:Returns element-wise sum of the input arrays with broadcasting.*

---

## Description

‘broadcast\_plus’ is an alias to the function ‘broadcast\_add’.

## Usage

```
mx.symbol.broadcast_add(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_add(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

```
broadcast_plus(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_add(csr, dense(1D)) = dense broadcast_add(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L58

## Value

out The result mx.symbol

---

mx.symbol.broadcast\_axes

*broadcast\_axes: Broadcasts the input array over particular axes.*


---

## Description

Broadcasting is allowed on axes with size 1, such as from '(2,1,3,1)' to '(2,8,3,9)'. Elements will be duplicated on the broadcasted axes.

## Usage

```
mx.symbol.broadcast_axes(...)
```

## Arguments

data	NDArray-or-Symbol The input
axis	Shape(tuple), optional, default=[] The axes to perform the broadcasting.
size	Shape(tuple), optional, default=[] Target sizes of the broadcasting axes.
name	string, optional Name of the resulting symbol.

## Details

'broadcast\_axes' is an alias to the function 'broadcast\_axis'.

Example::

```
// given x of shape (1,2,1) x = [[[ 1.], [ 2.]]]
```

```
// broadcast x on on axis 2 broadcast_axis(x, axis=2, size=3) = [[[ 1., 1., 1.], [ 2., 2., 2.]]] // broadcast
x on on axes 0 and 2 broadcast_axis(x, axis=(0,2), size=(2,3)) = [[[ 1., 1., 1.], [ 2., 2., 2.]], [[ 1., 1.,
1.], [ 2., 2., 2.]]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L93

## Value

out The result mx.symbol



---

mx.symbol.broadcast\_axis

*broadcast\_axis: Broadcasts the input array over particular axes.*


---

## Description

Broadcasting is allowed on axes with size 1, such as from '(2,1,3,1)' to '(2,8,3,9)'. Elements will be duplicated on the broadcasted axes.

## Usage

```
mx.symbol.broadcast_axis(...)
```

## Arguments

data	NDArray-or-Symbol The input
axis	Shape(tuple), optional, default=[] The axes to perform the broadcasting.
size	Shape(tuple), optional, default=[] Target sizes of the broadcasting axes.
name	string, optional Name of the resulting symbol.

## Details

'broadcast\_axes' is an alias to the function 'broadcast\_axis'.

Example::

```
// given x of shape (1,2,1) x = [[[ 1.], [ 2.]]]
```

```
// broadcast x on on axis 2 broadcast_axis(x, axis=2, size=3) = [[[ 1., 1., 1.], [ 2., 2., 2.]]] // broadcast
x on on axes 0 and 2 broadcast_axis(x, axis=(0,2), size=(2,3)) = [[[ 1., 1., 1.], [ 2., 2., 2.]], [[ 1., 1.,
1.], [ 2., 2., 2.]]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L93

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_div
```

*broadcast\_div:Returns element-wise division of the input arrays with broadcasting.*

---

### Description

Example::

### Usage

```
mx.symbol.broadcast_div(...)
```

### Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

### Details

```
x = [[ 6., 6., 6.], [ 6., 6., 6.]]
```

```
y = [[ 2.], [ 3.]]
```

```
broadcast_div(x, y) = [[ 3., 3., 3.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_div(csr, dense(1D)) = csr
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L187

### Value

out The result mx.symbol

---

```
mx.symbol.broadcast_equal
```

*broadcast\_equal:Returns the result of element-wise \*\*equal to\*\* (==) comparison operation with broadcasting.*

---

### Description

Example::

### Usage

```
mx.symbol.broadcast_equal(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

x = [[ 1., 1., 1.], [ 1., 1., 1.]]

y = [[ 0.], [ 1.]]

broadcast\_equal(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L46

**Value**

out The result mx.symbol

---

mx.symbol.broadcast\_greater

*broadcast\_greater:Returns the result of element-wise \*\*greater than\*\* (>) comparison operation with broadcasting.*

---

**Description**

Example::

**Usage**

mx.symbol.broadcast\_greater(...)

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

x = [[ 1., 1., 1.], [ 1., 1., 1.]]

y = [[ 0.], [ 1.]]

broadcast\_greater(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L82

**Value**

out The result mx.symbol

---

```
mx.symbol.broadcast_greater_equal
```

*broadcast\_greater\_equal: Returns the result of element-wise **\*\*greater than or equal to\*\*** ( $\geq$ ) comparison operation with broadcasting.*

---

## Description

Example::

## Usage

```
mx.symbol.broadcast_greater_equal(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_greater_equal(x, y) = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L100

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_hypot
```

*broadcast\_hypot: Returns the hypotenuse of a right angled triangle, given its "legs" with broadcasting.*

---

## Description

It is equivalent to doing :math:\sqrt{x\_1^2 + x\_2^2}.

## Usage

```
mx.symbol.broadcast_hypot(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
x = [[ 3., 3., 3.]]
```

```
y = [[ 4.], [ 4.]]
```

```
broadcast_hypot(x, y) = [[ 5., 5., 5.], [ 5., 5., 5.]]
```

```
z = [[ 0.], [ 4.]]
```

```
broadcast_hypot(x, z) = [[ 3., 3., 3.], [ 5., 5., 5.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L158

**Value**

out The result mx.symbol

---

mx.symbol.broadcast\_lesser

*broadcast\_lesser:Returns the result of element-wise \*\*lesser than\*\* (<) comparison operation with broadcasting.*

---

**Description**

Example::

**Usage**

```
mx.symbol.broadcast_lesser(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_lesser(x, y) = [[ 0., 0., 0.], [ 0., 0., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L118

**Value**

out The result mx.symbol

---

<code>mx.symbol.broadcast_lesser_equal</code>
<i>broadcast_lesser_equal:Returns the result of element-wise **lesser than or equal to** (&lt;=) comparison operation with broadcasting.</i>

---

**Description**

Example::

**Usage**

`mx.symbol.broadcast_lesser_equal(...)`

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`  
`y = [[ 0.], [ 1.]]`  
`broadcast_lesser_equal(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]`  
Defined in `src/operator/tensor/elemwise_binary_broadcast_op_logic.cc:L136`

**Value**

out The result mx.symbol

---

mx.symbol.broadcast\_like

*broadcast\_like: Broadcasts lhs to have the same shape as rhs.*


---

## Description

Broadcasting is a mechanism that allows NDArrays to perform arithmetic operations with arrays of different shapes efficiently without creating multiple copies of arrays. Also see, 'Broadcasting <<https://docs.scipy.org/doc/numpy/user/basics.broadcasting.html>>' \_ for more explanation.

## Usage

```
mx.symbol.broadcast_like(...)
```

## Arguments

lhs	NDArry-or-Symbol First input.
rhs	NDArry-or-Symbol Second input.
lhs.axes	Shape or None, optional, default=None Axes to perform broadcast on in the first input array
rhs.axes	Shape or None, optional, default=None Axes to copy from the second input array
name	string, optional Name of the resulting symbol.

## Details

Broadcasting is allowed on axes with size 1, such as from '(2,1,3,1)' to '(2,8,3,9)'. Elements will be duplicated on the broadcasted axes.

For example::

```
broadcast_like([[1,2,3]], [[5,6,7],[7,8,9]]) = [[ 1., 2., 3.], [ 1., 2., 3.]]
```

```
broadcast_like([9], [1,2,3,4,5], lhs_axes=(0,), rhs_axes=(-1,)) = [9,9,9,9,9]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L171

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_logical_and
```

*broadcast\_logical\_and:Returns the result of element-wise \*\*logical and\*\* with broadcasting.*

---

## Description

Example::

## Usage

```
mx.symbol.broadcast_logical_and(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_logical_and(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L154

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_logical_or
```

*broadcast\_logical\_or:Returns the result of element-wise \*\*logical or\*\* with broadcasting.*

---

## Description

Example::

## Usage

```
mx.symbol.broadcast_logical_or(...)
```



**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

x = [[ 1., 1., 0.], [ 1., 1., 0.]]

y = [[ 1.], [ 0.]]

broadcast\_logical\_or(x, y) = [[ 1., 1., 1.], [ 1., 1., 0.]]

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L172

**Value**

out The result mx.symbol

---

mx.symbol.broadcast\_logical\_xor

*broadcast\_logical\_xor:Returns the result of element-wise \*\*logical xor\*\* with broadcasting.*

---

**Description**

Example::

**Usage**

mx.symbol.broadcast\_logical\_xor(...)

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

x = [[ 1., 1., 0.], [ 1., 1., 0.]]

y = [[ 1.], [ 0.]]

broadcast\_logical\_xor(x, y) = [[ 0., 0., 1.], [ 1., 1., 0.]]

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L190

**Value**

out The result mx.symbol

---

```
mx.symbol.broadcast_maximum
```

*broadcast\_maximum:Returns element-wise maximum of the input arrays with broadcasting.*

---

## Description

This function compares two input arrays and returns a new array having the element-wise maxima.

## Usage

```
mx.symbol.broadcast_maximum(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_maximum(x, y) = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L81

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_minimum
```

*broadcast\_minimum:Returns element-wise minimum of the input arrays with broadcasting.*

---

## Description

This function compares two input arrays and returns a new array having the element-wise minima.

## Usage

```
mx.symbol.broadcast_minimum(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_maximum(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_extended.cc:L117

**Value**

out The result mx.symbol

---

mx.symbol.broadcast\_minus

*broadcast\_minus:Returns element-wise difference of the input arrays with broadcasting.*

---

**Description**

‘broadcast\_minus’ is an alias to the function ‘broadcast\_sub’.

**Usage**

```
mx.symbol.broadcast_minus(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_sub(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

```
broadcast_minus(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Supported sparse operations:

`broadcast_sub/minus(csr, dense(1D)) = dense broadcast_sub/minus(dense(1D), csr) = dense`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_basic.cc:L106`

### Value

out The result `mx.symbol`

---

`mx.symbol.broadcast_mod`

*broadcast\_mod: Returns element-wise modulo of the input arrays with broadcasting.*

---

### Description

Example::

### Usage

`mx.symbol.broadcast_mod(...)`

### Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

### Details

`x = [[ 8., 8., 8.], [ 8., 8., 8.]]`

`y = [[ 2.], [ 3.]]`

`broadcast_mod(x, y) = [[ 0., 0., 0.], [ 2., 2., 2.]]`

Defined in `src/operator/tensor/elemwise_binary_broadcast_op_basic.cc:L222`

### Value

out The result `mx.symbol`

---

```
mx.symbol.broadcast_mul
```

*broadcast\_mul:Returns element-wise product of the input arrays with broadcasting.*

---

## Description

Example::

## Usage

```
mx.symbol.broadcast_mul(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_mul(x, y) = [[ 0., 0., 0.], [ 1., 1., 1.]]
```

Supported sparse operations:

```
broadcast_mul(csr, dense(1D)) = csr
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L146

## Value

out The result mx.symbol

---

```
mx.symbol.broadcast_not_equal
```

*broadcast\_not\_equal:Returns the result of element-wise **\*\*not equal to\*\*** (!=) comparison operation with broadcasting.*

---

## Description

Example::

## Usage

```
mx.symbol.broadcast_not_equal(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_not_equal(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_logic.cc:L64

**Value**

out The result mx.symbol

---

```
mx.symbol.broadcast_plus
```

*broadcast\_plus:Returns element-wise sum of the input arrays with broadcasting.*

---

**Description**

‘broadcast\_plus’ is an alias to the function ‘broadcast\_add’.

**Usage**

```
mx.symbol.broadcast_plus(...)
```

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_add(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

```
broadcast_plus(x, y) = [[ 1., 1., 1.], [ 2., 2., 2.]]
```

Supported sparse operations:

```
broadcast_add(csr, dense(1D)) = dense broadcast_add(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L58

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.broadcast_power</code>
<i>broadcast_power:Returns result of first array elements raised to powers from second array, element-wise with broadcasting.</i>

---

**Description**

Example::

**Usage**

`mx.symbol.broadcast_power(...)`

**Arguments**

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

**Details**

`x = [[ 1., 1., 1.], [ 1., 1., 1.]]`  
`y = [[ 0.], [ 1.]]`  
`broadcast_power(x, y) = [[ 2., 2., 2.], [ 4., 4., 4.]]`  
Defined in `src/operator/tensor/elemwise_binary_broadcast_op_extended.cc:L45`

**Value**

out The result `mx.symbol`

---

```
mx.symbol.broadcast_sub
```

*broadcast\_sub: Returns element-wise difference of the input arrays with broadcasting.*

---

## Description

'broadcast\_minus' is an alias to the function 'broadcast\_sub'.

## Usage

```
mx.symbol.broadcast_sub(...)
```

## Arguments

lhs	NDArray-or-Symbol First input to the function
rhs	NDArray-or-Symbol Second input to the function
name	string, optional Name of the resulting symbol.

## Details

Example::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
y = [[ 0.], [ 1.]]
```

```
broadcast_sub(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

```
broadcast_minus(x, y) = [[ 1., 1., 1.], [ 0., 0., 0.]]
```

Supported sparse operations:

```
broadcast_sub/minus(csr, dense(1D)) = dense broadcast_sub/minus(dense(1D), csr) = dense
```

Defined in src/operator/tensor/elemwise\_binary\_broadcast\_op\_basic.cc:L106

## Value

out The result mx.symbol



---

mx.symbol.broadcast\_to

*broadcast\_to: Broadcasts the input array to a new shape.*


---

## Description

Broadcasting is a mechanism that allows NDArrays to perform arithmetic operations with arrays of different shapes efficiently without creating multiple copies of arrays. Also see, ‘Broadcasting <<https://docs.scipy.org/doc/numpy/user/basics.broadcasting.html>>’\_ for more explanation.

## Usage

```
mx.symbol.broadcast_to(...)
```

## Arguments

data	NDArr-or-Symbol The input
shape	Shape(tuple), optional, default=[] The shape of the desired array. We can set the dim to zero if it’s same as the original. E.g ‘A = broadcast_to(B, shape=(10, 0, 0))’ has the same meaning as ‘A = broadcast_axis(B, axis=0, size=10)’.
name	string, optional Name of the resulting symbol.

## Details

Broadcasting is allowed on axes with size 1, such as from ‘(2,1,3,1)’ to ‘(2,8,3,9)’. Elements will be duplicated on the broadcasted axes.

For example::

```
broadcast_to([[1,2,3]], shape=(2,3)) = [[ 1., 2., 3.], [ 1., 2., 3.]]
```

The dimension which you do not want to change can also be kept as ‘0’ which means copy the original value. So with ‘shape=(2,0)’, we will obtain the same result as in the above example.

Defined in src/operator/tensor/broadcast\_reduce\_op\_value.cc:L117

## Value

out The result mx.symbol

---

mx.symbol.Cast	Cast: Casts all elements of the input to a new type.
----------------	--

---

**Description**

.. note:: “Cast“ is deprecated. Use “cast“ instead.

**Usage**

```
mx.symbol.Cast(...)
```

**Arguments**

data	NDArray-or-Symbol The input.
dtype	'bfloat16', 'bool', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', required Output data type.
name	string, optional Name of the resulting symbol.

**Details**

Example::  
cast([0.9, 1.3], dtype='int32') = [0, 1] cast([1e20, 11.1], dtype='float16') = [inf, 11.09375] cast([300, 11.1, 10.9, -1, -3], dtype='uint8') = [44, 11, 10, 255, 253]  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L664

**Value**

out The result mx.symbol

---

mx.symbol.cast	cast: Casts all elements of the input to a new type.
----------------	--

---

**Description**

.. note:: “Cast“ is deprecated. Use “cast“ instead.

**Usage**

```
mx.symbol.cast(...)
```

**Arguments**

data	NDArray-or-Symbol The input.
dtype	'bfloat16', 'bool', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', required Output data type.
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
cast([0.9, 1.3], dtype='int32') = [0, 1] cast([1e20, 11.1], dtype='float16') = [inf, 11.09375] cast([300, 11.1, 10.9, -1, -3], dtype='uint8') = [44, 11, 10, 255, 253]
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L664

**Value**

out The result mx.symbol

---

mx.symbol.cast\_storage

*cast\_storage: Casts tensor storage type to the new type.*

---

**Description**

When an NDAarray with default storage type is cast to csr or row\_sparse storage, the result is compact, which means:

**Usage**

```
mx.symbol.cast_storage(...)
```

**Arguments**

data	NDAarray-or-Symbol The input.
stype	'csr', 'default', 'row_sparse', required Output storage type.
name	string, optional Name of the resulting symbol.

**Details**

- for csr, zero values will not be retained - for row\_sparse, row slices of all zeros will not be retained

The storage type of “cast\_storage“ output depends on stype parameter:

- cast\_storage(csr, 'default') = default - cast\_storage(row\_sparse, 'default') = default - cast\_storage(default, 'csr') = csr - cast\_storage(default, 'row\_sparse') = row\_sparse - cast\_storage(csr, 'csr') = csr - cast\_storage(row\_sparse, 'row\_sparse') = row\_sparse

Example::

```
dense = [[ 0., 1., 0.], [ 2., 0., 3.], [ 0., 0., 0.], [ 0., 0., 0.]]
```

```
# cast to row_sparse storage type rsp = cast_storage(dense, 'row_sparse')
rsp.indices = [0, 1]
rsp.values = [[ 0., 1., 0.], [ 2., 0., 3.]]
```

```
# cast to csr storage type csr = cast_storage(dense, 'csr')
csr.indices = [1, 0, 2]
csr.values = [ 1., 2., 3.]
csr.indptr = [0, 1, 3, 3, 3]
```

Defined in src/operator/tensor/cast\_storage.cc:L71

**Value**

out The result mx.symbol

---

<code>mx.symbol.cbrt</code>	<i>cbrt:Returns element-wise cube-root value of the input.</i>
-----------------------------	--

---

**Description**

.. math:: \text{cbrt}(x) = \sqrt[3]{x}

**Usage**

`mx.symbol.cbrt(...)`

**Arguments**

- data                   NDArray-or-Symbol The input array.
- name                   string, optional Name of the resulting symbol.

**Details**

Example::  
`cbrt([1, 8, -125]) = [1, 2, -5]`  
The storage type of “cbrt” output depends upon the input storage type:  
- `cbrt(default) = default` - `cbrt(row_sparse) = row_sparse` - `cbrt(csr) = csr`  
Defined in `src/operator/tensor/elemwise_unary_op_pow.cc:L270`

**Value**

out The result mx.symbol

---

<code>mx.symbol.ceil</code>	<i>ceil:Returns element-wise ceiling of the input.</i>
-----------------------------	--

---

**Description**

The ceil of the scalar x is the smallest integer i, such that  $i \geq x$ .

**Usage**

`mx.symbol.ceil(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
ceil([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-2., -1., 2., 2., 3.]
```

The storage type of “ceil” output depends upon the input storage type:

- ceil(default) = default - ceil(row\_sparse) = row\_sparse - ceil(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L817

**Value**

out The result mx.symbol

---

mx.symbol.choose\_element\_0index

*choose\_element\_0index: Picks elements from an input array according to the input indices along the given axis.*

---

**Description**

Given an input array of shape “(d0, d1)” and indices of shape “(i0,)”, the result will be an output array of shape “(i0,)” with::

**Usage**

```
mx.symbol.choose_element_0index(...)
```

**Arguments**

data	NDArray-or-Symbol The input array
index	NDArray-or-Symbol The index array
axis	int or None, optional, default='-1' int or None. The axis to picking the elements. Negative values means indexing from right to left. If is 'None', the elements in the index w.r.t the flattened input will be picked.
keepdims	boolean, optional, default=0 If true, the axis where we pick the elements is left in the result as dimension with size one.
mode	'clip', 'wrap', optional, default='clip' Specify how out-of-bound indices behave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around.
name	string, optional Name of the resulting symbol.

**Details**

```
output[i] = input[i, indices[i]]
```

By default, if any index mentioned is too large, it is replaced by the index that addresses the last element along an axis (the 'clip' mode).

This function supports n-dimensional input and (n-1)-dimensional indices arrays.

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// picks elements with specified indices along axis 0 pick(x, y=[0,1], 0) = [ 1., 4.]
```

```
// picks elements with specified indices along axis 1 pick(x, y=[0,1,0], 1) = [ 1., 4., 5.]
```

```
// picks elements with specified indices along axis 1 using 'wrap' mode // to place indices that would normally be out of bounds pick(x, y=[2,-1,-2], 1, mode='wrap') = [ 1., 4., 5.]
```

```
y = [[ 1.], [ 0.], [ 2.]]
```

```
// picks elements with specified indices along axis 1 and dims are maintained pick(x, y, 1, keep-dims=True) = [[ 2.], [ 3.], [ 6.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L151

**Value**

out The result mx.symbol

---

mx.symbol.clip	<i>clip: Clips (limits) the values in an array. Given an interval, values outside the interval are clipped to the interval edges. Clipping “x” between ‘a_min’ and ‘a_max’ would be:: .. math:: clip(x, a_min, a_max) = \max(\min(x, a_max), a_min)</i> Example:: $x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]$ $clip(x, 1, 8) = [1., 1., 2., 3., 4., 5., 6., 7., 8., 8.]$ The storage type of “clip” output depends on storage types of inputs and the $a_min$ , $a_max$ parameter values: - $clip(default) = default$ - $clip(row\_sparse, a_min \leq 0, a_max \geq 0) = row\_sparse$ - $clip(csr, a_min \leq 0, a_max \geq 0) = csr$ - $clip(row\_sparse, a_min < 0, a_max < 0) = default$ - $clip(row\_sparse, a_min > 0, a_max > 0) = default$ - $clip(csr, a_min < 0, a_max < 0) = csr$ - $clip(csr, a_min > 0, a_max > 0) = csr$
----------------	--

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L677

**Usage**

```
mx.symbol.clip(...)
```

**Arguments**

data	NDArray-or-Symbol Input array.
a.min	float, required Minimum value
a.max	float, required Maximum value
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.col2im	<i>col2im: Combining the output column matrix of im2col back to image array.</i>
------------------	--

---

**Description**

Like :class: '~mxnet.ndarray.im2col', this operator is also used in the vanilla convolution implementation. Despite the name, col2im is not the reverse operation of im2col. Since there may be overlaps between neighbouring sliding blocks, the column elements cannot be directly put back into image. Instead, they are accumulated (i.e., summed) in the input image just like the gradient computation, so col2im is the gradient of im2col and vice versa.

**Usage**

```
mx.symbol.col2im(...)
```

**Arguments**

data	NDArray-or-Symbol Input array to combine sliding blocks.
output.size	Shape(tuple), required The spatial dimension of image array: (w,), (h, w) or (d, h, w).
kernel	Shape(tuple), required Sliding kernel size: (w,), (h, w) or (d, h, w).
stride	Shape(tuple), optional, default=[] The stride between adjacent sliding blocks in spatial dimension: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] The spacing between adjacent kernel points: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
pad	Shape(tuple), optional, default=[] The zero-value padding size on both sides of spatial dimension: (w,), (h, w) or (d, h, w). Defaults to no padding.
name	string, optional Name of the resulting symbol.

**Details**

Using the notation in `im2col`, given an input column array of shape  $(N, C \times \prod(\text{kernel}), W)$ , this operator accumulates the column elements into output array of shape  $(N, C, \text{output\_size}[0], \text{output\_size}[1], \dots)$ . Only 1-D, 2-D and 3-D of spatial dimension is supported in this operator.

Defined in `src/operator/nn/im2col.cc:L182`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.Concat</code>	<i>Perform an feature concat on channel dim (dim 1) over all the inputs.</i>
-------------------------------	--

---

**Description**

Perform an feature concat on channel dim (dim 1) over all the inputs.

**Usage**

`mx.symbol.Concat(data, num.args, dim = NULL, name = NULL)`

**Arguments**

- |                       |  |
|-----------------------|--|
| <code>data</code>     | list, required List of tensors to concatenate            |
| <code>num.args</code> | int, required Number of inputs to be concated.           |
| <code>dim</code>      | int, optional, default='1' the dimension to be concated. |
| <code>name</code>     | string, optional Name of the resulting symbol.           |

**Value**

out The result `mx.symbol`



---

<code>mx.symbol.concat</code>	<i>Perform an feature concat on channel dim (dim 1) over all the inputs.</i>
-------------------------------	--

---

**Description**

Perform an feature concat on channel dim (dim 1) over all the inputs.

**Usage**

`mx.symbol.concat(data, num.args, dim = NULL, name = NULL)`

**Arguments**

- |                       |  |
|-----------------------|--|
| <code>data</code>     | list, required List of tensors to concatenate            |
| <code>num.args</code> | int, required Number of inputs to be concated.           |
| <code>dim</code>      | int, optional, default='1' the dimension to be concated. |
| <code>name</code>     | string, optional Name of the resulting symbol.           |

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.Convolution</code>	<i>Convolution: Compute <math>N^*</math>-D convolution on <math>(N+2)^*</math>-D input.</i>
------------------------------------	---

---

**Description**

In the 2-D convolution, given input data with shape  $*(batch\_size, channel, height, width)*$ , the output is computed by

**Usage**

`mx.symbol.Convolution(...)`

**Arguments**

- |                     |   |
|---------------------|---|
| <code>data</code>   | NDArray-or-Symbol Input data to the ConvolutionOp.  |
| <code>weight</code> | NDArray-or-Symbol Weight matrix.  |
| <code>bias</code>   | NDArray-or-Symbol Bias parameter.   |
| <code>kernel</code> | Shape(tuple), required Convolution kernel size: (w,), (h, w) or (d, h, w)   |
| <code>stride</code> | Shape(tuple), optional, default=[] Convolution stride: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension. |
| <code>dilate</code> | Shape(tuple), optional, default=[] Convolution dilate: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension. |

pad	Shape(tuple), optional, default=[] Zero pad for convolution: (w,), (h, w) or (d, h, w). Defaults to no padding.
num.filter	int (non-negative), required Convolution filter(channel) number
num.group	int (non-negative), optional, default=1 Number of group partitions.
workspace	long (non-negative), optional, default=1024 Maximum temporary workspace allowed (MB) in convolution. This parameter has two usages. When CUDNN is not used, it determines the effective batch size of the convolution kernel. When CUDNN is used, it controls the maximum temporary storage used for tuning the best CUDNN kernel when 'limited_workspace' strategy is used.
no.bias	boolean, optional, default=0 Whether to disable bias parameter.
cudnn.tune	None, 'fastest', 'limited_workspace', 'off', optional, default='None' Whether to pick convolution algo by running performance test.
cudnn.off	boolean, optional, default=0 Turn off cudnn for this layer.
layout	None, 'NCDHW', 'NCHW', 'NCW', 'NDHWC', 'NHWC', optional, default='None' Set layout for input, output and weight. Empty for default layout: NCW for 1d, NCHW for 2d and NCDHW for 3d. NHWC and NDHWC are only supported on GPU.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$\text{out}[n,i,:,:] = \text{bias}[i] + \sum_j 0^{\text{channel}} \text{data}[n,j,:,:] \star \text{weight}[i,j,:,:]$$

where :math:\star is the 2-D cross-correlation operator.

For general 2-D convolution, the shapes are

- **data**:  $*(\text{batch\_size}, \text{channel}, \text{height}, \text{width})$  - **weight**:  $*(\text{num\_filter}, \text{channel}, \text{kernel}[0], \text{kernel}[1])$  - **bias**:  $*(\text{num\_filter})$  - **out**:  $*(\text{batch\_size}, \text{num\_filter}, \text{out\_height}, \text{out\_width})$ .

Define::

$$f(x,k,p,s,d) = \text{floor}((x+2*p-d*(k-1)-1)/s)+1$$

then we have::

$\text{out\_height} = f(\text{height}, \text{kernel}[0], \text{pad}[0], \text{stride}[0], \text{dilate}[0])$   $\text{out\_width} = f(\text{width}, \text{kernel}[1], \text{pad}[1], \text{stride}[1], \text{dilate}[1])$

If “no\_bias” is set to be true, then the “bias” term is ignored.

The default data “layout” is \*NCHW\*, namely  $*(\text{batch\_size}, \text{channel}, \text{height}, \text{width})$ . We can choose other layouts such as \*NWC\*.

If “num\_group” is larger than 1, denoted by \*g\*, then split the input “data” evenly into \*g\* parts along the channel axis, and also evenly split “weight” along the first dimension. Next compute the convolution on the \*i\*-th part of the data with the \*i\*-th weight part. The output is obtained by concatenating all the \*g\* results.

1-D convolution does not have \*height\* dimension but only \*width\* in space.

- **data**:  $*(\text{batch\_size}, \text{channel}, \text{width})$  - **weight**:  $*(\text{num\_filter}, \text{channel}, \text{kernel}[0])$  - **bias**:  $*(\text{num\_filter})$  - **out**:  $*(\text{batch\_size}, \text{num\_filter}, \text{out\_width})$ .

3-D convolution adds an additional *depth* dimension besides *height* and *width*. The shapes are

- **data**:  $(\text{batch\_size}, \text{channel}, \text{depth}, \text{height}, \text{width})$  - **weight**:  $(\text{num\_filter}, \text{channel}, \text{kernel}[0], \text{kernel}[1], \text{kernel}[2])$  - **bias**:  $(\text{num\_filter})$  - **out**:  $(\text{batch\_size}, \text{num\_filter}, \text{out\_depth}, \text{out\_height}, \text{out\_width})$ .

Both “weight” and “bias” are learnable parameters.

There are other options to tune the performance.

- **cudnn\_tune**: enable this option leads to higher startup time but may give faster speed. Options are

- **off**: no tuning - **limited\_workspace**: run test and pick the fastest algorithm that doesn't exceed workspace limit. - **fastest**: pick the fastest algorithm and ignore workspace limit. - **None** (default): the behavior is determined by environment variable “MXNET\_CUDNN\_AUTOTUNE\_DEFAULT”. 0 for off, 1 for limited workspace (default), 2 for fastest.

- **workspace**: A large number leads to more (GPU) memory usage but may improve the performance.

Defined in src/operator/nn/convolution.cc:L469

## Value

out The result mx.symbol

---

mx.symbol.Convolution\_v1

*Convolution\_v1: This operator is DEPRECATED. Apply convolution to input then add a bias.*

---

## Description

Convolution\_v1: This operator is DEPRECATED. Apply convolution to input then add a bias.

## Usage

mx.symbol.Convolution\_v1(...)

## Arguments

data	NDArray-or-Symbol Input data to the ConvolutionV1Op.
weight	NDArray-or-Symbol Weight matrix.
bias	NDArray-or-Symbol Bias parameter.
kernel	Shape(tuple), required convolution kernel size: (h, w) or (d, h, w)
stride	Shape(tuple), optional, default=[] convolution stride: (h, w) or (d, h, w)
dilate	Shape(tuple), optional, default=[] convolution dilate: (h, w) or (d, h, w)
pad	Shape(tuple), optional, default=[] pad for convolution: (h, w) or (d, h, w)

num.filter	int (non-negative), required convolution filter(channel) number
num.group	int (non-negative), optional, default=1 Number of group partitions. Equivalent to slicing input into num_group partitions, apply convolution on each, then concatenate the results
workspace	long (non-negative), optional, default=1024 Maximum temporary workspace allowed for convolution (MB).This parameter determines the effective batch size of the convolution kernel, which may be smaller than the given batch size. Also, the workspace will be automatically enlarged to make sure that we can run the kernel with batch_size=1
no.bias	boolean, optional, default=0 Whether to disable bias parameter.
cudnn.tune	None, 'fastest', 'limited_workspace', 'off', optional, default='None' Whether to pick convolution algo by running performance test. Leads to higher startup time but may give faster speed. Options are: 'off': no tuning 'limited_workspace': run test and pick the fastest algorithm that doesn't exceed workspace limit. 'fastest': pick the fastest algorithm and ignore workspace limit. If set to None (default), behavior is determined by environment variable MXNET_CUDNN_AUTOTUNE_DEFAULT: 0 for off, 1 for limited workspace (default), 2 for fastest.
cudnn.off	boolean, optional, default=0 Turn off cudnn for this layer.
layout	None, 'NCDHW', 'NCHW', 'NDHWC', 'NHWC', optional, default='None' Set layout for input, output and weight. Empty for default layout: NCHW for 2d and NCDHW for 3d.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.Correlation *Correlation:Applies correlation to inputs.*

---

**Description**

The correlation layer performs multiplicative patch comparisons between two feature maps.

**Usage**

```
mx.symbol.Correlation(...)
```

**Arguments**

data1	NDArray-or-Symbol Input data1 to the correlation.
data2	NDArray-or-Symbol Input data2 to the correlation.
kernel.size	int (non-negative), optional, default=1 kernel size for Correlation must be an odd number

<code>max.displacement</code>	int (non-negative), optional, default=1 Max displacement of Correlation
<code>stride1</code>	int (non-negative), optional, default=1 stride1 quantize data1 globally
<code>stride2</code>	int (non-negative), optional, default=1 stride2 quantize data2 within the neighborhood centered around data1
<code>pad.size</code>	int (non-negative), optional, default=0 pad for Correlation
<code>is.multiply</code>	boolean, optional, default=1 operation type is either multiplication or subtraction
<code>name</code>	string, optional Name of the resulting symbol.

## Details

Given two multi-channel feature maps  $f_1, f_2$ , with  $w$ ,  $h$ , and  $c$  being their width, height, and number of channels, the correlation layer lets the network compare each patch from  $f_1$  with each patch from  $f_2$ .

For now we consider only a single comparison of two patches. The 'correlation' of two patches centered at  $x_1$  in the first map and  $x_2$  in the second map is then defined as:

.. math::

$$c(x_1, x_2) = \sum_o \text{in } [-k, k] \text{ times } [-k, k] < f_1(x_1 + o), f_2(x_2 + o) >$$

for a square patch of size  $K=2k+1$ .

Note that the equation above is identical to one step of a convolution in neural networks, but instead of convolving data with a filter, it convolves data with other data. For this reason, it has no training weights.

Computing  $c(x_1, x_2)$  involves  $c * K^2$  multiplications. Comparing all patch combinations involves  $w^2 * h^2$  such computations.

Given a maximum displacement  $d$ , for each location  $x_1$  it computes correlations  $c(x_1, x_2)$  only in a neighborhood of size  $D=2d+1$ , by limiting the range of  $x_2$ . We use strides  $s_1, s_2$ , to quantize  $x_1$  globally and to quantize  $x_2$  within the neighborhood centered around  $x_1$ .

The final output is defined by the following expression:

$$\text{.. math:: out}[n, q, i, j] = c(x_i, j, x_q)$$

where  $i$  and  $j$  enumerate spatial locations in  $f_1$ , and  $q$  denotes the  $q^{\text{th}}$  neighborhood of  $x_{i,j}$ .

Defined in `src/operator/correlation.cc:L198`

## Value

out The result `mx.symbol`

---

mx.symbol.cos	<i>cos:Computes the element-wise cosine of the input array.</i>
---------------	---

---

**Description**

The input should be in radians (:math:‘2\pi‘ rad equals 360 degrees).

**Usage**

```
mx.symbol.cos(...)
```

**Arguments**

- data                   NDArray-or-Symbol The input array.
- name                   string, optional Name of the resulting symbol.

**Details**

.. math:: cos([0, \pi/4, \pi/2]) = [1, 0.707, 0]

The storage type of “cos” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L90

**Value**

out The result mx.symbol

---

mx.symbol.cosh	<i>cosh:Returns the hyperbolic cosine of the input array, computed element-wise.</i>
----------------	--

---

**Description**

.. math:: cosh(x) = 0.5\times(\exp(x) + \exp(-x))

**Usage**

```
mx.symbol.cosh(...)
```

**Arguments**

- data                   NDArray-or-Symbol The input array.
- name                   string, optional Name of the resulting symbol.

**Details**

The storage type of “cosh” output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L409

**Value**

out The result mx.symbol

---

mx.symbol.Crop	Crop:
----------------	-------

---

**Description**

.. note:: ‘Crop’ is deprecated. Use ‘slice’ instead.

**Usage**

mx.symbol.Crop(...)

**Arguments**

data	Symbol or Symbol[] Tensor or List of Tensors, the second input will be used as crop_like shape reference
num.args	int, required Number of inputs for crop, if equals one, then we will use the h_wfor crop height and width, else if equals two, then we will use the heightand width of the second input symbol, we name crop_like here
offset	Shape(tuple), optional, default=[0,0] crop offset coordinate: (y, x)
h.w	Shape(tuple), optional, default=[0,0] crop height and width: (h, w)
center.crop	boolean, optional, default=0 If set to true, then it will use be the center_crop,or it will crop using the shape of crop_like
name	string, optional Name of the resulting symbol.

**Details**

Crop the 2nd and 3rd dim of input data, with the corresponding size of h\_w or with width and height of the second input symbol, i.e., with one input, we need h\_w to specify the crop height and width, otherwise the second input symbol’s size will be used  
Defined in src/operator/crop.cc:L50

**Value**

out The result mx.symbol

---

mx.symbol.crop

*crop*: Slices a region of the array. .. note:: “crop” is deprecated. Use “slice” instead. This function returns a sliced array between the indices given by ‘begin’ and ‘end’ with the corresponding ‘step’. For an input array of “shape=(d\_0, d\_1, ..., d\_n-1)”, slice operation with “begin=(b\_0, b\_1...b\_m-1)”, “end=(e\_0, e\_1, ..., e\_m-1)”, and “step=(s\_0, s\_1, ..., s\_m-1)”, where  $m \leq n$ , results in an array with the shape “(l<sub>e\_0-b\_0</sub>∖s<sub>0</sub>l, ..., l<sub>e<sub>m-1</sub>-b<sub>m-1</sub></sub>∖s<sub>m-1</sub>l, d<sub>m</sub>, ..., d<sub>n-1</sub>)”. The resulting array’s *k*-th dimension contains elements from the *k*-th dimension of the input array starting from index “b<sub>k</sub>” (inclusive) with step “s<sub>k</sub>” until reaching “e<sub>k</sub>” (exclusive). If the *k*-th elements are ‘None’ in the sequence of ‘begin’, ‘end’, and ‘step’, the following rule will be used to set default values. If ‘s<sub>k</sub>’ is ‘None’, set ‘s<sub>k</sub>=1’. If ‘s<sub>k</sub> > 0’, set ‘b<sub>k</sub>=0’, ‘e<sub>k</sub>=d<sub>k</sub>’; else, set ‘b<sub>k</sub>=d<sub>k</sub>-1’, ‘e<sub>k</sub>=-1’. The storage type of “slice” output depends on storage types of inputs - slice(csr) = csr - otherwise, “slice” generates output with default storage .. note:: When input data storage type is csr, it only supports step=(), or step=(None,), or step=(1,) to generate a csr output. For other step parameter values, it falls back to slicing a dense tensor. Example:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice(x, begin=(0,1), end=(2,4)) = [[ 2., 3., 4.], [ 6., 7., 8.]] slice(x, begin=(None, 0), end=(None, 3), step=(-1, 2)) = [[9., 11.], [5., 7.], [1., 3.]]

---

## Description

Defined in src/operator/tensor/matrix\_op.cc:L482

## Usage

```
mx.symbol.crop(...)
```

## Arguments

data	NDArray-or-Symbol Source input
begin	Shape(tuple), required starting indices for the slice operation, supports negative indices.
end	Shape(tuple), required ending indices for the slice operation, supports negative indices.
step	Shape(tuple), optional, default=[] step for the slice operation, supports negative values.
name	string, optional Name of the resulting symbol.

## Value

out The result mx.symbol



---

mx.symbol.CTCLoss	<i>CTCLoss: Connectionist Temporal Classification Loss.</i>
-------------------	---

---

## Description

.. note:: The existing alias “contrib\_CTCLoss” is deprecated.

## Usage

```
mx.symbol.CTCLoss(...)
```

## Arguments

data	NDArray-or-Symbol Input ndarray
label	NDArray-or-Symbol Ground-truth labels for the loss.
data.lengths	NDArray-or-Symbol Lengths of data for each of the samples. Only required when use_data_lengths is true.
label.lengths	NDArray-or-Symbol Lengths of labels for each of the samples. Only required when use_label_lengths is true.
use.data.lengths	boolean, optional, default=0 Whether the data lengths are decided by ‘data_lengths’. If false, the lengths are equal to the max sequence length.
use.label.lengths	boolean, optional, default=0 Whether the label lengths are decided by ‘label_lengths’, or derived from ‘padding_mask’. If false, the lengths are derived from the first occurrence of the value of ‘padding_mask’. The value of ‘padding_mask’ is “0” when first CTC label is reserved for blank, and “-1” when last label is reserved for blank. See ‘blank_label’.
blank.label	‘first’, ‘last’, optional, default=‘first’ Set the label that is reserved for blank label. If “first”, 0-th label is reserved, and label values for tokens in the vocabulary are between “1” and “alphabet_size-1”, and the padding mask is “-1”. If “last”, last label value “alphabet_size-1” is reserved for blank label instead, and label values for tokens in the vocabulary are between “0” and “alphabet_size-2”, and the padding mask is “0”.
name	string, optional Name of the resulting symbol.

## Details

The shapes of the inputs and outputs:

```
- **data** : (sequence_length, batch_size, alphabet_size) - **label** : (batch_size, label_sequence_length)
- **out** : (batch_size)
```

The ‘data’ tensor consists of sequences of activation vectors (without applying softmax), with *i*-th channel in the last dimension corresponding to *i*-th label for *i* between 0 and alphabet\_size-1 (i.e always 0-indexed). Alphabet size should include one additional value reserved for blank label.

When 'blank\_label' is ""first"", the "0"-th channel is be reserved for activation of blank label, or otherwise if it is "last", "(alphabet\_size-1)"-th channel should be reserved for blank label.

"label" is an index matrix of integers. When 'blank\_label' is ""first"", the value 0 is then reserved for blank label, and should not be passed in this matrix. Otherwise, when 'blank\_label' is ""last"", the value '(alphabet\_size-1)' is reserved for blank label.

If a sequence of labels is shorter than \*label\_sequence\_length\*, use the special padding value at the end of the sequence to conform it to the correct length. The padding value is '0' when 'blank\_label' is ""first"", and '-1' otherwise.

For example, suppose the vocabulary is '[a, b, c]', and in one batch we have three sequences 'ba', 'cbb', and 'abac'. When 'blank\_label' is ""first"", we can index the labels as 'a': 1, 'b': 2, 'c': 3, and we reserve the 0-th channel for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[2, 1, 0, 0], [3, 2, 2, 0], [1, 2, 1, 3]]
```

When 'blank\_label' is ""last"", we can index the labels as 'a': 0, 'b': 1, 'c': 2, and we reserve the channel index 3 for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[1, 0, -1, -1], [2, 1, 1, -1], [0, 1, 0, 2]]
```

"out" is a list of CTC loss values, one per example in the batch.

See \*Connectionist Temporal Classification: Labelling Unsegmented Sequence Data with Recurrent Neural Networks\*, A. Graves \*et al\*., for more information on the definition and the algorithm.

Defined in src/operator/nm/ctc\_loss.cc:L100

## Value

out The result mx.symbol

---

mx.symbol.ctc_loss	<i>ctc_loss: Connectionist Temporal Classification Loss.</i>
--------------------	--

---

## Description

.. note:: The existing alias "contrib\_CTCLoss" is deprecated.

## Usage

```
mx.symbol.ctc_loss(...)
```

## Arguments

data	NDArray-or-Symbol Input ndarray
label	NDArray-or-Symbol Ground-truth labels for the loss.
data.lengths	NDArray-or-Symbol Lengths of data for each of the samples. Only required when use_data_lengths is true.
label.lengths	NDArray-or-Symbol Lengths of labels for each of the samples. Only required when use_label_lengths is true.

<code>use.data.lengths</code>	boolean, optional, default=0 Whether the data lengths are decided by 'data_lengths'. If false, the lengths are equal to the max sequence length.
<code>use.label.lengths</code>	boolean, optional, default=0 Whether the label lengths are decided by 'label_lengths', or derived from 'padding_mask'. If false, the lengths are derived from the first occurrence of the value of 'padding_mask'. The value of 'padding_mask' is "0" when first CTC label is reserved for blank, and "-1" when last label is reserved for blank. See 'blank_label'.
<code>blank.label</code>	'first', 'last', optional, default='first' Set the label that is reserved for blank label. If "first", 0-th label is reserved, and label values for tokens in the vocabulary are between "1" and "alphabet_size-1", and the padding mask is "-1". If "last", last label value "alphabet_size-1" is reserved for blank label instead, and label values for tokens in the vocabulary are between "0" and "alphabet_size-2", and the padding mask is "0".
<code>name</code>	string, optional Name of the resulting symbol.

## Details

The shapes of the inputs and outputs:

```
- **data**: (sequence_length, batch_size, alphabet_size) - **label**: (batch_size, label_sequence_length)
- **out**: (batch_size)
```

The 'data' tensor consists of sequences of activation vectors (without applying softmax), with i-th channel in the last dimension corresponding to i-th label for i between 0 and alphabet\_size-1 (i.e always 0-indexed). Alphabet size should include one additional value reserved for blank label. When 'blank\_label' is "first", the 0-th channel is reserved for activation of blank label, or otherwise if it is "last", (alphabet\_size-1)-th channel should be reserved for blank label.

'label' is an index matrix of integers. When 'blank\_label' is "first", the value 0 is then reserved for blank label, and should not be passed in this matrix. Otherwise, when 'blank\_label' is "last", the value (alphabet\_size-1) is reserved for blank label.

If a sequence of labels is shorter than \*label\_sequence\_length\*, use the special padding value at the end of the sequence to conform it to the correct length. The padding value is '0' when 'blank\_label' is "first", and '-1' otherwise.

For example, suppose the vocabulary is '[a, b, c]', and in one batch we have three sequences 'ba', 'cbb', and 'abac'. When 'blank\_label' is "first", we can index the labels as 'a': 1, 'b': 2, 'c': 3, and we reserve the 0-th channel for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[2, 1, 0, 0], [3, 2, 2, 0], [1, 2, 1, 3]]
```

When 'blank\_label' is "last", we can index the labels as 'a': 0, 'b': 1, 'c': 2, and we reserve the channel index 3 for blank label in data tensor. The resulting 'label' tensor should be padded to be::

```
[[1, 0, -1, -1], [2, 1, 1, -1], [0, 1, 0, 2]]
```

'out' is a list of CTC loss values, one per example in the batch.

See \*Connectionist Temporal Classification: Labelling Unsegmented Sequence Data with Recurrent Neural Networks\*, A. Graves et al\* for more information on the definition and the algorithm.

Defined in src/operator/nm/ctc\_loss.cc:L100

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.cumsum</code>	<i>cumsum:Return the cumulative sum of the elements along a given axis.</i>
-------------------------------	---

---

**Description**

Defined in `src/operator/numpy/np_cumsum.cc:L70`

**Usage**

`mx.symbol.cumsum(...)`

**Arguments**

<code>a</code>	NDArray-or-Symbol Input ndarray
<code>axis</code>	int or None, optional, default='None' Axis along which the cumulative sum is computed. The default (None) is to compute the cumsum over the flattened array.
<code>dtype</code>	None, 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', optional, default='None' Type of the returned array and of the accumulator in which the elements are summed. If dtype is not specified, it defaults to the dtype of a, unless a has an integer dtype with a precision less than that of the default platform integer. In that case, the default platform integer is used.
<code>name</code>	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.Custom</code>	<i>Custom:Apply a custom operator implemented in a frontend language (like Python).</i>
-------------------------------	---

---

**Description**

Custom operators should override required methods like 'forward' and 'backward'. The custom operator must be registered before it can be used. Please check the tutorial here: [https://mxnet.incubator.apache.org/api/faq/new\\_](https://mxnet.incubator.apache.org/api/faq/new_)

**Usage**

`mx.symbol.Custom(...)`

**Arguments**

data	NDArray-or-Symbol[] Input data for the custom operator.
op. type	string Name of the custom operator. This is the name that is passed to ‘mx.operator.register’ to register the operator.
name	string, optional Name of the resulting symbol.

**Details**

Defined in src/operator/custom/custom.cc:L547

**Value**

out The result mx.symbol

---

mx.symbol.Deconvolution

*Deconvolution: Computes 1D or 2D transposed convolution (aka fractionally strided convolution) of the input tensor. This operation can be seen as the gradient of Convolution operation with respect to its input. Convolution usually reduces the size of the input. Transposed convolution works the other way, going from a smaller input to a larger output while preserving the connectivity pattern.*

---

**Description**

Deconvolution: Computes 1D or 2D transposed convolution (aka fractionally strided convolution) of the input tensor. This operation can be seen as the gradient of Convolution operation with respect to its input. Convolution usually reduces the size of the input. Transposed convolution works the other way, going from a smaller input to a larger output while preserving the connectivity pattern.

**Usage**

mx.symbol.Deconvolution(...)

**Arguments**

data	NDArray-or-Symbol Input tensor to the deconvolution operation.
weight	NDArray-or-Symbol Weights representing the kernel.
bias	NDArray-or-Symbol Bias added to the result after the deconvolution operation.
kernel	Shape(tuple), required Deconvolution kernel size: (w,), (h, w) or (d, h, w). This is same as the kernel size used for the corresponding convolution
stride	Shape(tuple), optional, default=[] The stride used for the corresponding convolution: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] Dilation factor for each dimension of the input: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.

pad	Shape(tuple), optional, default=[] The amount of implicit zero padding added during convolution for each dimension of the input: (w,), (h, w) or (d, h, w). “(kernel-1)/2” is usually a good choice. If ‘target_shape’ is set, ‘pad’ will be ignored and a padding that will generate the target shape will be used. Defaults to no padding.
adj	Shape(tuple), optional, default=[] Adjustment for output shape: (w,), (h, w) or (d, h, w). If ‘target_shape’ is set, ‘adj’ will be ignored and computed accordingly.
target.shape	Shape(tuple), optional, default=[] Shape of the output tensor: (w,), (h, w) or (d, h, w).
num.filter	int (non-negative), required Number of output filters.
num.group	int (non-negative), optional, default=1 Number of groups partition.
workspace	long (non-negative), optional, default=512 Maximum temporary workspace allowed (MB) in deconvolution. This parameter has two usages. When CUDNN is not used, it determines the effective batch size of the deconvolution kernel. When CUDNN is used, it controls the maximum temporary storage used for tuning the best CUDNN kernel when ‘limited_workspace’ strategy is used.
no.bias	boolean, optional, default=1 Whether to disable bias parameter.
cudnn.tune	None, ‘fastest’, ‘limited_workspace’, ‘off’, optional, default=‘None’ Whether to pick convolution algorithm by running performance test.
cudnn.off	boolean, optional, default=0 Turn off cudnn for this layer.
layout	None, ‘NCDHW’, ‘NCHW’, ‘NCW’, ‘NDHWC’, ‘NHWC’, optional, default=‘None’ Set layout for input, output and weight. Empty for default layout, NCW for 1d, NCHW for 2d and NCDHW for 3d. NHWC and NDHWC are only supported on GPU.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.degrees	<i>degrees: Converts each element of the input array from radians to degrees.</i>
-------------------	---

---

**Description**

.. math:: \text{degrees}([0, \pi/2, \pi, 3\pi/2, 2\pi]) = [0, 90, 180, 270, 360]

**Usage**

```
mx.symbol.degrees(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “degrees” output depends upon the input storage type:

- degrees(default) = default - degrees(row\_sparse) = row\_sparse - degrees(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L332

**Value**

out The result mx.symbol

---

mx.symbol.depth\_to\_space

*depth\_to\_space:Rearranges(permutates) data from depth into blocks of spatial data. Similar to ONNX DepthToSpace operator: <https://github.com/onnx/onnx/blob/master/docs/Operators.md#DepthToSpace>. The output is a new tensor where the values from depth dimension are moved in spatial blocks to height and width dimension. The reverse of this operation is “space\_to\_depth“. ..  $\text{math}:: \backslash \text{begingather} * x \backslash \text{prime} = \text{reshape}(x, [N, \text{block\_size}, \text{block\_size}, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]) \backslash x \backslash \text{prime} \backslash \text{prime} = \text{transpose}(x \backslash \text{prime}, [0, 3, 4, 1, 5, 2]) \backslash y = \text{reshape}(x \backslash \text{prime} \backslash \text{prime}, [N, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]) \backslash \text{endgather} * \text{ where } : \text{math}:'x' \text{ is an input tensor with default layout as } : \text{math}:'[N, C, H, W]': [\text{batch, channels, height, width}] \text{ and } : \text{math}:'y' \text{ is the output tensor of layout } : \text{math}:'[N, C / (\text{block\_size}^2), H * \text{block\_size}, W * \text{block\_size}]'$*

*Example::  $x = [ [ [ [0, 1, 2], [3, 4, 5]], [ [6, 7, 8], [9, 10, 11]], [ [12, 13, 14], [15, 16, 17]], [ [18, 19, 20], [21, 22, 23]] ] ] ] \text{ depth\_to\_space}(x, 2) = [ [ [ [0, 6, 1, 7, 2, 8], [12, 18, 13, 19, 14, 20], [3, 9, 4, 10, 5, 11], [15, 21, 16, 22, 17, 23]] ] ] ]$*

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L972

**Usage**

```
mx.symbol.depth_to_space(...)
```

**Arguments**

data	NDArray-or-Symbol Input ndarray
block.size	int, required Blocks of [block_size. block_size] are moved
name	string, optional Name of the resulting symbol.

Value

out The result mx.symbol

---

mx.symbol.diag	<i>diag:Extracts a diagonal or constructs a diagonal array.</i>
----------------	---

---

Description

“diag”’s behavior depends on the input array dimensions:

Usage

mx.symbol.diag(...)

Arguments

data	NDArray-or-Symbol Input ndarray
k	int, optional, default='0' Diagonal in question. The default is 0. Use k>0 for diagonals above the main diagonal, and k<0 for diagonals below the main diagonal. If input has shape (S0 S1) k must be between -S0 and S1
axis1	int, optional, default='0' The first axis of the sub-arrays of interest. Ignored when the input is a 1-D array.
axis2	int, optional, default='1' The second axis of the sub-arrays of interest. Ignored when the input is a 1-D array.
name	string, optional Name of the resulting symbol.

Details

- 1-D arrays: constructs a 2-D array with the input as its diagonal, all other elements are zero. - N-D arrays: extracts the diagonals of the sub-arrays with axes specified by “axis1” and “axis2”. The output shape would be decided by removing the axes numbered “axis1” and “axis2” from the input shape and appending to the result a new axis with the size of the diagonals in question.

For example, when the input shape is ‘(2, 3, 4, 5)’, “axis1” and “axis2” are 0 and 2 respectively and “k” is 0, the resulting shape would be ‘(3, 5, 2)’.

Examples::

```
x = [[1, 2, 3], [4, 5, 6]]
diag(x) = [1, 5]
diag(x, k=1) = [2, 6]
diag(x, k=-1) = [4]
x = [1, 2, 3]
diag(x) = [[1, 0, 0], [0, 2, 0], [0, 0, 3]]
diag(x, k=1) = [[0, 1, 0], [0, 0, 2], [0, 0, 0]]
```



```
diag(x, k=-1) = [[0, 0, 0], [1, 0, 0], [0, 2, 0]]
x = [[[1, 2], [3, 4]],
      [[5, 6], [7, 8]]]
diag(x) = [[1, 7], [2, 8]]
diag(x, k=1) = [[3], [4]]
diag(x, axis1=-2, axis2=-1) = [[1, 4], [5, 8]]
Defined in src/operator/tensor/diag_op.cc:L87
```

Value

out The result mx.symbol

---

mx.symbol.dot	<i>dot:Dot product of two arrays.</i>
---------------	---------------------------------------

---

Description

“dot”’s behavior depends on the input array dimensions:

Usage

```
mx.symbol.dot(...)
```

Arguments

lhs	NDArray-or-Symbol The first input
rhs	NDArray-or-Symbol The second input
transpose.a	boolean, optional, default=0 If true then transpose the first input before dot.
transpose.b	boolean, optional, default=0 If true then transpose the second input before dot.
forward.stype	None, 'csr', 'default', 'row_sparse', optional, default='None' The desired storage type of the forward output given by user, if the combination of input storage types and this hint does not match any implemented ones, the dot operator will perform fallback operation and still produce an output of the desired storage type.
name	string, optional Name of the resulting symbol.

Details

- 1-D arrays: inner product of vectors - 2-D arrays: matrix multiplication - N-D arrays: a sum product over the last axis of the first input and the first axis of the second input  
For example, given 3-D “x” with shape ‘(n,m,k)’ and “y” with shape ‘(k,r,s)’, the result array will have shape ‘(n,m,r,s)’. It is computed by::  
dot(x,y)[i,j,a,b] = sum(x[i,j,:]\*y[:,a,b])  
Example::

```
x = reshape([0,1,2,3,4,5,6,7], shape=(2,2,2)) y = reshape([7,6,5,4,3,2,1,0], shape=(2,2,2)) dot(x,y)[0,0,1,1]
= 0 sum(x[0,0,:]*y[:,1,1]) = 0
```

The storage type of “dot” output depends on storage types of inputs, transpose option and forward\_type option for output storage type. Implemented sparse operations include:

- dot(default, default, transpose\_a=True/False, transpose\_b=True/False) = default - dot(csr, default, transpose\_a=True) = default - dot(csr, default, transpose\_a=True) = row\_sparse - dot(csr, default) = default - dot(csr, row\_sparse) = default - dot(default, csr) = csr (CPU only) - dot(default, csr, forward\_type='default') = default - dot(default, csr, transpose\_b=True, forward\_type='default') = default

If the combination of input storage types and forward\_type does not match any of the above patterns, “dot” will fallback and generate output with default storage.

.. Note::

If the storage type of the lhs is "csr", the storage type of gradient w.r.t rhs will be "row\_sparse". Only a subset of optimizers support sparse gradients, including SGD, AdaGrad and Adam. Note that by default lazy updates is turned on, which may perform differently from standard updates. For more details, please check the Optimization API at: <https://mxnet.incubator.apache.org/api/python/optimization/optimization.html>

Defined in src/operator/tensor/dot.cc:L77

## Value

out The result mx.symbol

---

mx.symbol.Dropout

*Dropout:Applies dropout operation to input array.*

---

## Description

- During training, each element of the input is set to zero with probability p. The whole array is rescaled by :math:'1/(1-p)' to keep the expected sum of the input unchanged.

## Usage

```
mx.symbol.Dropout(...)
```

## Arguments

data	NDArray-or-Symbol Input array to which dropout will be applied.
p	float, optional, default=0.5 Fraction of the input that gets dropped out during training time.
mode	'always', 'training', optional, default='training' Whether to only turn on dropout during training or to also turn on for inference.
axes	Shape(tuple), optional, default=[] Axes for variational dropout kernel.
cudnn.off	boolean or None, optional, default=0 Whether to turn off cudnn in dropout operator. This option is ignored if axes is specified.
name	string, optional Name of the resulting symbol.

**Details**

- During testing, this operator does not change the input if mode is 'training'. If mode is 'always', the same computation as during training will be applied.

Example::

```
random.seed(998) input_array = array([[3., 0.5, -0.5, 2., 7.], [2., -0.4, 7., 3., 0.2]]) a = symbol.Variable('a') dropout = symbol.Dropout(a, p = 0.2) executor = dropout.simple_bind(a = input_array.shape)
```

```
## If training executor.forward(is_train = True, a = input_array) executor.outputs [[ 3.75 0.625 -0.25 8.75 ] [ 2.5 -0.5 8.75 3.75 0. ]]
```

```
## If testing executor.forward(is_train = False, a = input_array) executor.outputs [[ 3. 0.5 -0.5 2. 7. ] [ 2. -0.4 7. 3. 0.2 ]]
```

Defined in src/operator/nn/dropout.cc:L96

**Value**

out The result mx.symbol

---

mx.symbol.ElementWiseSum

*ElementWiseSum: Adds all input arguments element-wise.*

---

**Description**

.. math:: \text{add\\_n}(a\_1, a\_2, \dots, a\_n) = a\_1 + a\_2 + \dots + a\_n

**Usage**

```
mx.symbol.ElementWiseSum(...)
```

**Arguments**

args	NDArray-or-Symbol[] Positional input arguments
name	string, optional Name of the resulting symbol.

**Details**

“add\_n” is potentially more efficient than calling “add” by ‘n’ times.

The storage type of “add\_n” output depends on storage types of inputs

- add\_n(row\_sparse, row\_sparse, ..) = row\_sparse - add\_n(default, csr, default) = default - add\_n(any input combinations longer than 4 (>4) with at least one default type) = default - otherwise, “add\_n” falls all inputs back to default storage and generates default storage

Defined in src/operator/tensor/elemwise\_sum.cc:L155

**Value**

out The result mx.symbol

---

<code>mx.symbol.elemwise_add</code>
<i>elemwise_add: Adds arguments element-wise.</i>

---

**Description**

The storage type of “elemwise\_add“ output depends on storage types of inputs

**Usage**

`mx.symbol.elemwise_add(...)`

**Arguments**

lhs	NDArray-or-Symbol first input
rhs	NDArray-or-Symbol second input
name	string, optional Name of the resulting symbol.

**Details**

- `elemwise_add(row_sparse, row_sparse) = row_sparse` - `elemwise_add(csr, csr) = csr` - `elemwise_add(default, csr) = default` - `elemwise_add(csr, default) = default` - `elemwise_add(default, rsp) = default` - `elemwise_add(rsp, default) = default` - otherwise, “elemwise\_add“ generates output with default storage

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.elemwise_div</code>
<i>elemwise_div: Divides arguments element-wise.</i>

---

**Description**

The storage type of “elemwise\_div“ output is always dense

**Usage**

`mx.symbol.elemwise_div(...)`

**Arguments**

lhs	NDArray-or-Symbol first input
rhs	NDArray-or-Symbol second input
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.elemwise_mul	<i>elemwise_mul:Multiplies arguments element-wise.</i>
------------------------	--

---

**Description**

The storage type of “elemwise\_mul“ output depends on storage types of inputs

**Usage**

mx.symbol.elemwise\_mul(...)

**Arguments**

lhs	NDArray-or-Symbol first input
rhs	NDArray-or-Symbol second input
name	string, optional Name of the resulting symbol.

**Details**

- elemwise\_mul(default, default) = default - elemwise\_mul(row\_sparse, row\_sparse) = row\_sparse -  
elemwise\_mul(default, row\_sparse) = row\_sparse - elemwise\_mul(row\_sparse, default) = row\_sparse  
- elemwise\_mul(csr, csr) = csr - otherwise, “elemwise\_mul“ generates output with default storage

**Value**

out The result mx.symbol

---

mx.symbol.elemwise_sub	<i>elemwise_sub:Subtracts arguments element-wise.</i>
------------------------	---

---

**Description**

The storage type of “elemwise\_sub“ output depends on storage types of inputs

**Usage**

mx.symbol.elemwise\_sub(...)

**Arguments**

lhs	NDArray-or-Symbol first input
rhs	NDArray-or-Symbol second input
name	string, optional Name of the resulting symbol.

**Details**

- `elemwise_sub(row_sparse, row_sparse) = row_sparse - elemwise_sub(csr, csr) = csr - elemwise_sub(default, csr) = default - elemwise_sub(csr, default) = default - elemwise_sub(default, rsp) = default - elemwise_sub(rsp, default) = default - otherwise, “elemwise_sub“ generates output with default storage`

**Value**

out The result mx.symbol

---

mx.symbol.Embedding	<i>Embedding:Maps integer indices to vector representations (embeddings).</i>
---------------------	---

---

**Description**

This operator maps words to real-valued vectors in a high-dimensional space, called word embeddings. These embeddings can capture semantic and syntactic properties of the words. For example, it has been noted that in the learned embedding spaces, similar words tend to be close to each other and dissimilar words far apart.

**Usage**

```
mx.symbol.Embedding(...)
```

**Arguments**

data	NDArray-or-Symbol The input array to the embedding operator.
weight	NDArray-or-Symbol The embedding weight matrix.
input.dim	int, required Vocabulary size of the input indices.
output.dim	int, required Dimension of the embedding vectors.
dtype	'bfloat16', 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', 'uint8', optional, default='float32' Data type of weight.
sparse.grad	boolean, optional, default=0 Compute row sparse gradient in the backward calculation. If set to True, the grad's storage type is row_sparse.
name	string, optional Name of the resulting symbol.

**Details**

For an input array of shape (d1, ..., dK), the shape of an output array is (d1, ..., dK, output\_dim). All the input values should be integers in the range [0, input\_dim).

If the input\_dim is ip0 and output\_dim is op0, then shape of the embedding weight matrix must be (ip0, op0).

When "sparse\_grad" is False, if any index mentioned is too large, it is replaced by the index that addresses the last vector in an embedding matrix. When "sparse\_grad" is True, an error will be raised if invalid indices are found.

Examples::

```
input_dim = 4 output_dim = 5
```

```
// Each row in weight matrix y represents a word. So, y = (w0,w1,w2,w3) y = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.], [ 10., 11., 12., 13., 14.], [ 15., 16., 17., 18., 19.]]
```

```
// Input array x represents n-grams(2-gram). So, x = ((w1,w3), (w0,w2)) x = [[ 1., 3.], [ 0., 2.]]
```

```
// Mapped input x to its vector representation y. Embedding(x, y, 4, 5) = [[[ 5., 6., 7., 8., 9.], [ 15., 16., 17., 18., 19.]],
```

```
[[ 0., 1., 2., 3., 4.], [ 10., 11., 12., 13., 14.]]]
```

The storage type of weight can be either row\_sparse or default.

.. Note::

If "sparse\_grad" is set to True, the storage type of gradient w.r.t weights will be "row\_sparse". Only a subset of optimizers support sparse gradients, including SGD, AdaGrad and Adam. Note that by default lazy updates is turned on, which may perform differently from standard updates. For more details, please check the Optimization API at: <https://mxnet.incubator.apache.org/api/python/optimization/optimization.html>

Defined in src/operator/tensor/indexing\_op.cc:L603

**Value**

out The result mx.symbol

---

mx.symbol.erf

*erf:Returns element-wise gauss error function of the input.*

---

**Description**

Example::

**Usage**

```
mx.symbol.erf(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

`erf([0, -1., 10.]) = [0., -0.8427, 1.]`  
Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L886`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.erfinv</code>	<i>erfinv:Returns element-wise inverse gauss error function of the input.</i>
-------------------------------	---

---

**Description**

Example::

**Usage**

`mx.symbol.erfinv(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input array.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

`erfinv([0, 0.5., -1.]) = [0., 0.4769, -inf]`  
Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L908`

**Value**

out The result `mx.symbol`



---

mx.symbol.exp	<i>exp:Returns element-wise exponential value of the input.</i>
---------------	---

---

## Description

.. math:: \exp(x) = e^x \approx 2.718^x

## Usage

```
mx.symbol.exp(...)
```

## Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

## Details

Example::

```
exp([0, 1, 2]) = [1., 2.71828175, 7.38905621]
```

The storage type of “exp” output is always dense

Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L64

## Value

out The result mx.symbol

---

mx.symbol.expand_dims	<i>expand_dims:Inserts a new axis of size 1 into the array shape For example, given “x” with shape “(2,3,4)”, then “expand_dims(x, axis=1)” will return a new array with shape “(2,1,3,4)”.</i>
-----------------------	---

---

## Description

Defined in src/operator/tensor/matrix\_op.cc:L395

## Usage

```
mx.symbol.expand_dims(...)
```

**Arguments**

data	NDArray-or-Symbol Source input
axis	int, required Position where new axis is to be inserted. Suppose that the input 'NDArray's dimension is 'ndim', the range of the inserted axis is '[-ndim, ndim]'
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

<code>mx.symbol.expm1</code>	<i>expm1:Returns “exp(x) - 1” computed element-wise on the input.</i>
------------------------------	---

---

**Description**

This function provides greater precision than “exp(x) - 1” for small values of “x”.

**Usage**

`mx.symbol.expm1(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “expm1” output depends upon the input storage type:  
- expm1(default) = default - expm1(row\_sparse) = row\_sparse - expm1(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L244

**Value**

out The result mx.symbol

---

mx.symbol.fill_element_0index	<i>fill_element_0index: Fill one element of each line(row for python, column for R/Julia) in lhs according to index indicated by rhs and values indicated by mhs. This function assume rhs uses 0-based index.</i>
-------------------------------	--

---

**Description**

fill\_element\_0index: Fill one element of each line(row for python, column for R/Julia) in lhs according to index indicated by rhs and values indicated by mhs. This function assume rhs uses 0-based index.

**Usage**

mx.symbol.fill\_element\_0index(...)

**Arguments**

- lhs                NDAarray Left operand to the function.
- mhs                NDAarray Middle operand to the function.
- rhs                NDAarray Right operand to the function.
- name               string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.fix	<i>fix: Returns element-wise rounded value to the nearest \ integer towards zero of the input.</i>
---------------	--

---

**Description**

Example::

**Usage**

mx.symbol.fix(...)

**Arguments**

- data                NDAarray-or-Symbol The input array.
- name                string, optional Name of the resulting symbol.

**Details**

`fix([-2.1, -1.9, 1.9, 2.1]) = [-2., -1., 1., 2.]`

The storage type of “fix” output depends upon the input storage type:

- `fix(default) = default` - `fix(row_sparse) = row_sparse` - `fix(csr) = csr`

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L874`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.Flatten</code>	<i>Flatten: Flattens the input array into a 2-D array by collapsing the higher dimensions. .. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead. For an input array with shape “(d1, d2, ..., dk)”, ‘flatten’ operation reshapes the input array into an output array of shape “(d1, d2*...*dk)”. Note that the behavior of this function is different from <code>numpy.ndarray.flatten</code>, which behaves similar to <code>mxnet.ndarray.reshape((-1,))</code>. Example:: <code>x = [[ [1,2,3], [4,5,6], [7,8,9] ], [ [1,2,3], [4,5,6], [7,8,9] ]], flatten(x) = [[ 1., 2., 3., 4., 5., 6., 7., 8., 9.], [ 1., 2., 3., 4., 5., 6., 7., 8., 9.]]</code></i>
--------------------------------	--

---

**Description**

Defined in `src/operator/tensor/matrix_op.cc:L250`

**Usage**

`mx.symbol.Flatten(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol Input array.
<code>name</code>	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`

---

mx.symbol.flatten	<i>flatten:Flattens the input array into a 2-D array by collapsing the higher dimensions. .. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead. For an input array with shape “(d1, d2, ..., dk)“, ‘flatten’ operation reshapes the input array into an output array of shape “(d1, d2*...*dk)“. Note that the behavior of this function is different from numpy.ndarray.flatten, which behaves similar to mxnet.ndarray.reshape((-1,)). Example:: x = [[ [1,2,3], [4,5,6], [7,8,9] ], [ [1,2,3], [4,5,6], [7,8,9] ]], flatten(x) = [[ 1., 2., 3., 4., 5., 6., 7., 8., 9.], [ 1., 2., 3., 4., 5., 6., 7., 8., 9.]]</i>
-------------------	--

---

### Description

Defined in src/operator/tensor/matrix\_op.cc:L250

### Usage

```
mx.symbol.flatten(...)
```

### Arguments

data	NDArray-or-Symbol Input array.
name	string, optional Name of the resulting symbol.

### Value

out The result mx.symbol

---

mx.symbol.flip	<i>flip:Reverses the order of elements along given axis while preserving array shape. Note: reverse and flip are equivalent. We use reverse in the following examples. Examples:: x = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.]] reverse(x, axis=0) = [[ 5., 6., 7., 8., 9.], [ 0., 1., 2., 3., 4.]] reverse(x, axis=1) = [[ 4., 3., 2., 1., 0.], [ 9., 8., 7., 6., 5.]]</i>
----------------	--

---

### Description

Defined in src/operator/tensor/matrix\_op.cc:L832

### Usage

```
mx.symbol.flip(...)
```

**Arguments**

data	NDArray-or-Symbol Input data array
axis	Shape(tuple), required The axis which to reverse elements.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

<code>mx.symbol.floor</code>	<i>floor:Returns element-wise floor of the input.</i>
------------------------------	---

---

**Description**

The floor of the scalar x is the largest integer i, such that  $i \leq x$ .

**Usage**

`mx.symbol.floor(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Example::

`floor([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-3., -2., 1., 1., 2.]`

The storage type of “floor“ output depends upon the input storage type:

- `floor(default) = default` - `floor(row_sparse) = row_sparse` - `floor(csr) = csr`

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L836`

**Value**

out The result mx.symbol

---

mx.symbol.ftml\_update *ftml\_update: The FTML optimizer described in \*FTML - Follow the Moving Leader in Deep Learning\*, available at <http://proceedings.mlr.press/v70/zheng17a/zheng17a.pdf>.*

---

## Description

.. math::

## Usage

```
mx.symbol.ftml_update(...)
```

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
d	NDArray-or-Symbol Internal state “d_t”
v	NDArray-or-Symbol Internal state “v_t”
z	NDArray-or-Symbol Internal state “z_t”
lr	float, required Learning rate.
beta1	float, optional, default=0.600000024 Generally close to 0.5.
beta2	float, optional, default=0.999000013 Generally close to 1.
epsilon	double, optional, default=9.9999999392252903e-09 Epsilon to prevent div 0.
t	int, required Number of update.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_grad	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
name	string, optional Name of the resulting symbol.

## Details

$$g_t = \nabla J(W_{t-1}) \quad v_t = \beta_2 v_{t-1} + (1 - \beta_2) g_t^2 \quad d_t = \frac{1 - \beta_1^t}{\sqrt{\frac{v_t}{1 - \beta_2^t} + \epsilon}} \quad \sigma_t = d_t - \beta_1 d_{t-1} \quad z_t = \beta_1 z_{t-1} + (1 - \beta_1^t) g_t - \sigma_t \quad W_t = - \frac{z_t}{d_t}$$

Defined in src/operator/optimizer\_op.cc:L631

## Value

out The result mx.symbol

---

mx.symbol.ftrl\_update *ftrl\_update: Update function for Ftrl optimizer. Referenced from \*Ad Click Prediction: a View from the Trenches\*, available at <http://dl.acm.org/citation.cfm?id=2488200>.*

---

## Description

It updates the weights using::

## Usage

```
mx.symbol.ftrl_update(...)
```

## Arguments

weight	NDAarray-or-Symbol Weight
grad	NDAarray-or-Symbol Gradient
z	NDAarray-or-Symbol z
n	NDAarray-or-Symbol Square of grad
lr	float, required Learning rate
lamda1	float, optional, default=0.00999999978 The L1 regularization coefficient.
beta	float, optional, default=1 Per-Coordinate Learning Rate beta.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
name	string, optional Name of the resulting symbol.

## Details

```
rescaled_grad = clip(grad * rescale_grad, clip_gradient)
z += rescaled_grad - (sqrt(n + rescaled_grad**2) - sqrt(n)) * weight / learning_rate
n += rescaled_grad**2
w = (sign(z) * lamda1 - z) / ((beta + sqrt(n)) / learning_rate + wd) * (abs(z) > lamda1)
```

If w, z and n are all of “row\_sparse” storage type, only the row slices whose indices appear in grad.indices are updated (for w, z and n)::

```
for row in grad.indices:
    rescaled_grad[row] = clip(grad[row] * rescale_grad, clip_gradient)
    z[row] += rescaled_grad[row] - (sqrt(n[row] + rescaled_grad[row]**2) - sqrt(n[row])) * weight[row] / learning_rate
    n[row] += rescaled_grad[row]**2
    w[row] = (sign(z[row]) * lamda1 - z[row]) / ((beta + sqrt(n[row])) / learning_rate + wd) * (abs(z[row]) > lamda1)
```

Defined in src/operator/optimizer\_op.cc:L867



**Value**

out The result mx.symbol

---

mx.symbol.FullyConnected

*FullyConnected:Applies a linear transformation: :math:'Y = XW^T + b'.*

---

**Description**

If “flatten” is set to be true, then the shapes are:

**Usage**

```
mx.symbol.FullyConnected(...)
```

**Arguments**

data	NDArray-or-Symbol Input data.
weight	NDArray-or-Symbol Weight matrix.
bias	NDArray-or-Symbol Bias parameter.
num.hidden	int, required Number of hidden nodes of the output.
no.bias	boolean, optional, default=0 Whether to disable bias parameter.
flatten	boolean, optional, default=1 Whether to collapse all but the first axis of the input data tensor.
name	string, optional Name of the resulting symbol.

**Details**

- **data**: '(batch\_size, x1, x2, ..., xn)' - **weight**: '(num\_hidden, x1 \* x2 \* ... \* xn)' - **bias**: '(num\_hidden,)' - **out**: '(batch\_size, num\_hidden)'

If “flatten” is set to be false, then the shapes are:

- **data**: '(x1, x2, ..., xn, input\_dim)' - **weight**: '(num\_hidden, input\_dim)' - **bias**: '(num\_hidden,)' - **out**: '(x1, x2, ..., xn, num\_hidden)'

The learnable parameters include both “weight” and “bias”.

If “no\_bias” is set to be true, then the “bias” term is ignored.

.. Note::

The sparse support for FullyConnected is limited to forward evaluation with ‘row\_sparse’ weight and bias, where the length of ‘weight.indices’ and ‘bias.indices’ must be equal to ‘num\_hidden’. This could be useful for model inference with ‘row\_sparse’ weights trained with importance sampling or noise contrastive estimation.

To compute linear transformation with ‘csr’ sparse data, sparse.dot is recommended instead of sparse.FullyConnected.

Defined in src/operator/nm/fully\_connected.cc:L287

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.gamma</code>	<i>gamma:Returns the gamma function (extension of the factorial function \ to the reals), computed element-wise on the input array.</i>
------------------------------	---

---

**Description**

The storage type of “gamma” output is always dense

**Usage**

`mx.symbol.gamma(...)`

**Arguments**

- |      |  |
|------|--|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.gammaln</code>	<i>gammaln:Returns element-wise log of the absolute value of the gamma function \ of the input.</i>
--------------------------------	---

---

**Description**

The storage type of “gammaln” output is always dense

**Usage**

`mx.symbol.gammaln(...)`

**Arguments**

- |      |  |
|------|--|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Value**

out The result `mx.symbol`

---

mx.symbol.gather_nd	<i>gather_nd: Gather elements or slices from 'data' and store to a tensor whose shape is defined by 'indices'.</i>
---------------------	--

---

**Description**

Given 'data' with shape '(X\_0, X\_1, ..., X\_N-1)' and indices with shape '(M, Y\_0, ..., Y\_K-1)', the output will have shape '(Y\_0, ..., Y\_K-1, X\_M, ..., X\_N-1)', where 'M <= N'. If 'M == N', output shape will simply be '(Y\_0, ..., Y\_K-1)'.

**Usage**

```
mx.symbol.gather_nd(...)
```

**Arguments**

data	NDArray-or-Symbol data
indices	NDArray-or-Symbol indices
name	string, optional Name of the resulting symbol.

**Details**

The elements in output is defined as follows::

```
output[y_0, ..., y_K-1, x_M, ..., x_N-1] = data[indices[0, y_0, ..., y_K-1], ..., indices[M-1, y_0, ..., y_K-1], x_M, ..., x_N-1]
```

Examples::

```
data = [[0, 1], [2, 3]] indices = [[1, 1, 0], [0, 1, 0]] gather_nd(data, indices) = [2, 3, 0]
```

```
data = [[[1, 2], [3, 4]], [[5, 6], [7, 8]]] indices = [[0, 1], [1, 0]] gather_nd(data, indices) = [[3, 4], [5, 6]]
```

**Value**

out The result mx.symbol

---

mx.symbol.GridGenerator	<i>GridGenerator: Generates 2D sampling grid for bilinear sampling.</i>
-------------------------	---

---

**Description**

GridGenerator: Generates 2D sampling grid for bilinear sampling.

**Usage**

`mx.symbol.GridGenerator(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol Input data to the function.
<code>transform.type</code>	'affine', 'warp', required The type of transformation. For 'affine', input data should be an affine matrix of size (batch, 6). For 'warp', input data should be an optical flow of size (batch, 2, h, w).
<code>target.shape</code>	Shape(tuple), optional, default=[0,0] Specifies the output shape (H, W). This is required if transformation type is 'affine'. If transformation type is 'warp', this parameter is ignored.
<code>name</code>	string, optional Name of the resulting symbol.

**Value**

`out` The result `mx.symbol`

---

<code>mx.symbol.Group</code>	<i>Create a symbol that groups symbols together.</i>
------------------------------	--

---

**Description**

Create a symbol that groups symbols together.

**Usage**

`mx.symbol.Group(...)`

**Arguments**

<code>kwarg</code>	Variable length of symbols or list of symbol.
--------------------	---

**Value**

The result symbol

---

mx.symbol.GroupNorm      *GroupNorm: Group normalization.*


---

## Description

The input channels are separated into “num\_groups” groups, each containing “num\_channels / num\_groups” channels. The mean and standard-deviation are calculated separately over the each group.

## Usage

```
mx.symbol.GroupNorm(...)
```

## Arguments

data	NDArray-or-Symbol Input data
gamma	NDArray-or-Symbol gamma array
beta	NDArray-or-Symbol beta array
num.groups	int, optional, default='1' Total number of groups.
eps	float, optional, default=9.9999975e-06 An ‘epsilon’ parameter to prevent division by 0.
output.mean.var	boolean, optional, default=0 Output the mean and std calculated along the given axis.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$\text{data} = \text{data.reshape}((N, \text{num\_groups}, C // \text{num\_groups}, \dots)) \quad \text{out} = \frac{\text{data} - \text{mean}(\text{data}, \text{axis})}{\sqrt{\text{var}(\text{data}, \text{axis}) + \epsilon}} * \text{gamma} + \text{beta}$$

Both “gamma” and “beta” are learnable parameters.

Defined in src/operator/nn/group\_norm.cc:L77

## Value

out The result mx.symbol

---

<code>mx.symbol.hard_sigmoid</code>	<i>hard_sigmoid: Computes hard sigmoid of x element-wise.</i>
-------------------------------------	---

---

**Description**

.. math:: y = \max(0, \min(1, \alpha \* x + \beta))

**Usage**

`mx.symbol.hard_sigmoid(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input array.
<code>alpha</code>	float, optional, default=0.200000003 Slope of hard sigmoid
<code>beta</code>	float, optional, default=0.5 Bias of hard sigmoid.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L161`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.identity</code>	<i>identity: Returns a copy of the input.</i>
---------------------------------	---

---

**Description**

From: `src/operator/tensor/elemwise_unary_op_basic.cc:244`

**Usage**

`mx.symbol.identity(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input array.
<code>name</code>	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`

---

mx.symbol.IdentityAttachKLSparseReg

*IdentityAttachKLSparseReg: Apply a sparse regularization to the output a sigmoid activation function.*

---

### Description

IdentityAttachKLSparseReg: Apply a sparse regularization to the output a sigmoid activation function.

### Usage

```
mx.symbol.IdentityAttachKLSparseReg(...)
```

### Arguments

data	NDArray-or-Symbol Input data.
sparseness.target	float, optional, default=0.100000001 The sparseness target
penalty	float, optional, default=0.00100000005 The tradeoff parameter for the sparseness penalty
momentum	float, optional, default=0.899999976 The momentum for running average
name	string, optional Name of the resulting symbol.

### Value

out The result mx.symbol

---

mx.symbol.im2col	<i>im2col: Extract sliding blocks from input array.</i>
------------------	---

---

### Description

This operator is used in vanilla convolution implementation to transform the sliding blocks on image to column matrix, then the convolution operation can be computed by matrix multiplication between column and convolution weight. Due to the close relation between im2col and convolution, the concept of **kernel**, **stride**, **dilate** and **pad** in this operator are inherited from convolution operation.

### Usage

```
mx.symbol.im2col(...)
```

**Arguments**

data	NDArray-or-Symbol Input array to extract sliding blocks.
kernel	Shape(tuple), required Sliding kernel size: (w,), (h, w) or (d, h, w).
stride	Shape(tuple), optional, default=[] The stride between adjacent sliding blocks in spatial dimension: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
dilate	Shape(tuple), optional, default=[] The spacing between adjacent kernel points: (w,), (h, w) or (d, h, w). Defaults to 1 for each dimension.
pad	Shape(tuple), optional, default=[] The zero-value padding size on both sides of spatial dimension: (w,), (h, w) or (d, h, w). Defaults to no padding.
name	string, optional Name of the resulting symbol.

**Details**

Given the input data of shape  $(N, C, *)$ , where  $N$  is the batch size,  $C$  is the channel size, and  $*$  is the arbitrary spatial dimension, the output column array is always with shape  $(N, C \times \prod(\text{kernel}), W)$ , where  $C \times \prod(\text{kernel})$  is the block size, and  $W$  is the block number which is the spatial size of the convolution output with same input parameters. Only 1-D, 2-D and 3-D of spatial dimension is supported in this operator.

Defined in src/operator/nn/im2col.cc:L100

**Value**

out The result mx.symbol

---

mx.symbol.infer.shape *Inference the shape of arguments, outputs, and auxiliary states.*

---

**Description**

Inference the shape of arguments, outputs, and auxiliary states.

**Usage**

```
mx.symbol.infer.shape(symbol, ...)
```

**Arguments**

symbol	The mx.symbol object
--------	----------------------



---

mx.symbol.InstanceNorm

*InstanceNorm: Applies instance normalization to the n-dimensional input array.*


---

## Description

This operator takes an n-dimensional input array where (n>2) and normalizes the input using the following formula:

## Usage

```
mx.symbol.InstanceNorm(...)
```

## Arguments

data	NDArray-or-Symbol An n-dimensional input array (n > 2) of the form [batch, channel, spatial_dim1, spatial_dim2, ...].
gamma	NDArray-or-Symbol A vector of length 'channel', which multiplies the normalized input.
beta	NDArray-or-Symbol A vector of length 'channel', which is added to the product of the normalized input and the weight.
eps	float, optional, default=0.00100000005 An 'epsilon' parameter to prevent division by 0.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$\text{out} = \frac{x - \text{mean}[\text{data}]}{\sqrt{\text{Var}[\text{data}] + \epsilon}} * \gamma + \beta$$

This layer is similar to batch normalization layer ('BatchNorm') with two differences: first, the normalization is carried out per example (instance), not over a batch. Second, the same normalization is applied both at test and train time. This operation is also known as 'contrast normalization'.

If the input data is of shape [batch, channel, spacial\_dim1, spacial\_dim2, ...], 'gamma' and 'beta' parameters must be vectors of shape [channel].

This implementation is based on this paper [1]

.. [1] Instance Normalization: The Missing Ingredient for Fast Stylization, D. Ulyanov, A. Vedaldi, V. Lempitsky, 2016 (arXiv:1607.08022v2).

Examples::

```
// Input of shape (2,1,2) x = [[[ 1.1, 2.2]], [[ 3.3, 4.4]]]
// gamma parameter of length 1 gamma = [1.5]
// beta parameter of length 1 beta = [0.5]
```

```
// Instance normalization is calculated with the above formula InstanceNorm(x,gamma,beta) = [[[-0.997527 , 1.99752665]], [[-0.99752653, 1.99752724]]]
```

Defined in src/operator/instance\_norm.cc:L95

### Value

out The result mx.symbol

---

mx.symbol.khatri\_rao    *khatri\_rao: Computes the Khatri-Rao product of the input matrices.*

---

### Description

Given a collection of  $n$  input matrices,

### Usage

```
mx.symbol.khatri_rao(...)
```

### Arguments

args	NDArray-or-Symbol[] Positional input matrices
name	string, optional Name of the resulting symbol.

### Details

..  $A_1 \in \mathbb{R}^{M_1 \times M}, \dots, A_n \in \mathbb{R}^{M_n \times N}$ ,

the (column-wise) Khatri-Rao product is defined as the matrix,

..  $X = A_1 \otimes \dots \otimes A_n \in \mathbb{R}^{(M_1 \dots M_n) \times N}$ ,

where the  $k$ th column is equal to the column-wise outer product  $A_{1k} \otimes \dots \otimes A_{nk}$  where  $A_{ik}$  is the  $k$ th column of the  $i$ th matrix.

Example::

```
>>> A = mx.nd.array([[1, -1], >> [2, -3]]) >> B = mx.nd.array([[1, 4], >> [2, 5], >> [3, 6]]) >> C =
mx.nd.khatri_rao(A, B) >> print(C.asnumpy()) [[ 1. -4.] [ 2. -5.] [ 3. -6.] [ 2. -12.] [ 4. -15.] [ 6.
-18.]]
```

Defined in src/operator/contrib/krprod.cc:L108

### Value

out The result mx.symbol

---

mx.symbol.L2Normalization

*L2Normalization: Normalize the input array using the L2 norm.*


---

## Description

For 1-D NDAarray, it computes::

## Usage

```
mx.symbol.L2Normalization(...)
```

## Arguments

data	NDAarray-or-Symbol Input array to normalize.
eps	float, optional, default=1.00000001e-10 A small constant for numerical stability.
mode	'channel', 'instance', 'spatial', optional, default='instance' Specify the dimension along which to compute L2 norm.
name	string, optional Name of the resulting symbol.

## Details

```
out = data / sqrt(sum(data ** 2) + eps)
```

For N-D NDAarray, if the input array has shape (N, N, ..., N),

with “mode“ = “instance“, it normalizes each instance in the multidimensional array by its L2 norm::

```
for i in 0...N out[i,:,:,...,:] = data[i,:,:,...,:] / sqrt(sum(data[i,:,:,...,:] ** 2) + eps)
```

with “mode“ = “channel“, it normalizes each channel in the array by its L2 norm::

```
for i in 0...N out[:,i,:,:,...,:] = data[:,i,:,:,...,:] / sqrt(sum(data[:,i,:,:,...,:] ** 2) + eps)
```

with “mode“ = “spatial“, it normalizes the cross channel norm for each position in the array by its L2 norm::

```
for dim in 2...N for i in 0...N out[.....,i,...] = take(out, indices=i, axis=dim) / sqrt(sum(take(out, indices=i, axis=dim) ** 2) + eps) -dim-
```

Example::

```
x = [[[1,2], [3,4]], [[2,2], [5,6]]]
```

```
L2Normalization(x, mode='instance') = [[[ 0.18257418 0.36514837] [ 0.54772252 0.73029673]] [[ 0.24077171 0.24077171] [ 0.60192931 0.72231513]]]
```

```
L2Normalization(x, mode='channel') = [[[ 0.31622776 0.44721359] [ 0.94868326 0.89442718]] [[ 0.37139067 0.31622776] [ 0.92847669 0.94868326]]]
```

```
L2Normalization(x, mode='spatial') = [[[ 0.44721359 0.89442718] [ 0.60000002 0.80000001]] [[ 0.70710677 0.70710677] [ 0.6401844 0.76822126]]]
```

Defined in src/operator/l2\_normalization.cc:L196

**Value**

out The result mx.symbol

---

mx.symbol.lamb\_update\_phase1

*lamb\_update\_phase1: Phase I of lamb update it performs the following operations and returns g:.*

---

**Description**

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

**Usage**

mx.symbol.lamb\_update\_phase1(...)

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
beta1	float, optional, default=0.899999976 The decay rate for the 1st moment estimates.
beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.99999997e-07 A small constant for numerical stability.
t	int, required Index update count.
bias.correction	boolean, optional, default=1 Whether to use bias correction.
wd	float, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip.gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
name	string, optional Name of the resulting symbol.

**Details**

```

.. math:: \begin{gather*} \text{grad} = \text{grad} * \text{rescale\_grad} \text{ if } (\text{grad} < -\text{clip\_gradient}) \text{ then } \text{grad} = -\text{clip\_gradient} \\ \text{if } (\text{grad} > \text{clip\_gradient}) \text{ then } \text{grad} = \text{clip\_gradient} \\ \text{mean} = \text{beta1} * \text{mean} + (1 - \text{beta1}) * \text{grad}; \text{variance} = \text{beta2} * \text{variance} + (1 - \text{beta2}) * \text{grad}^2; \\ \text{if } (\text{bias\_correction}) \text{ then } \text{mean\_hat} = \text{mean} / (1 - \text{beta1}^t); \text{var\_hat} = \text{var} / (1 - \text{beta2}^t); \text{g} = \text{mean\_hat} \\ / (\text{var\_hat}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight}; \text{else } \text{g} = \text{mean} / (\text{var\_data}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight}; \\ \end{gather*}

```

Defined in src/operator/optimizer\_op.cc:L944

**Value**

out The result mx.symbol

---

mx.symbol.lamb\_update\_phase2

*lamb\_update\_phase2: Phase II of lamb update it performs the following operations and updates grad.*

---

**Description**

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

**Usage**

```
mx.symbol.lamb_update_phase2(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
g	NDArray-or-Symbol Output of lamb_update_phase 1
r1	NDArray-or-Symbol r1
r2	NDArray-or-Symbol r2
lr	float, required Learning rate
lower_bound	float, optional, default=-1 Lower limit of norm of weight. If lower_bound <= 0, Lower limit is not set
upper_bound	float, optional, default=-1 Upper limit of norm of weight. If upper_bound <= 0, Upper limit is not set
name	string, optional Name of the resulting symbol.

**Details**

```

.. math:: \begin{gather*} \text{if } (\text{lower\_bound} \geq 0) \text{ then } \text{r1} = \max(\text{r1}, \text{lower\_bound}) \text{ if } (\text{upper\_bound} \geq 0) \text{ then } \text{r1} = \min(\text{r1}, \text{upper\_bound}) \\ \text{if } (\text{r1} == 0 \text{ or } \text{r2} == 0) \text{ then } \text{lr} = \text{lr} \text{ else } \text{lr} = \text{lr} * (\text{r1}/\text{r2}) \text{ weight} = \text{weight} - \text{lr} * \text{g} \end{gather*}

```

Defined in src/operator/optimizer\_op.cc:L983

**Value**

out The result mx.symbol

---

<code>mx.symbol.LayerNorm</code>	<i>LayerNorm:Layer normalization.</i>
----------------------------------	---------------------------------------

---

**Description**

Normalizes the channels of the input tensor by mean and variance, and applies a scale “gamma” as well as offset “beta”.

**Usage**

`mx.symbol.LayerNorm(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol Input data to layer normalization
<code>gamma</code>	NDArray-or-Symbol gamma array
<code>beta</code>	NDArray-or-Symbol beta array
<code>axis</code>	int, optional, default='-1' The axis to perform layer normalization. Usually, this should be be axis of the channel dimension. Negative values means indexing from right to left.
<code>eps</code>	float, optional, default=9.9999975e-06 An ‘epsilon’ parameter to prevent division by 0.
<code>output.mean.var</code>	boolean, optional, default=0 Output the mean and std calculated along the given axis.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Assume the input has more than one dimension and we normalize along axis 1. We first compute the mean and variance along this axis and then compute the normalized output, which has the same shape as input, as following:

.. math::

$$out = \frac{data - mean(data, axis)}{\sqrt{var(data, axis) + \epsilon}} * gamma + beta$$

Both “gamma” and “beta” are learnable parameters.

Unlike BatchNorm and InstanceNorm, the *\*mean\** and *\*var\** are computed along the channel dimension.

Assume the input has size *\*k\** on axis 1, then both “gamma” and “beta” have shape *\*(k,)\**. If “output\_mean\_var” is set to be true, then outputs both “data\_mean” and “data\_std”. Note that no gradient will be passed through these two outputs.

The parameter “axis” specifies which axis of the input shape denotes the ‘channel’ (separately normalized groups). The default is -1, which sets the channel axis to be the last item in the input shape.

Defined in src/operator/nn/layer\_norm.cc:L158

## Value

out The result mx.symbol

---

mx.symbol.LeakyReLU	<i>LeakyReLU:Applies Leaky rectified linear unit activation element-wise to the input.</i>
---------------------	--

---

## Description

Leaky ReLUs attempt to fix the "dying ReLU" problem by allowing a small ‘slope’ when the input is negative and has a slope of one when input is positive.

## Usage

```
mx.symbol.LeakyReLU(...)
```

## Arguments

data	NDArray-or-Symbol Input data to activation function.
gamma	NDArray-or-Symbol Input data to activation function.
act.type	‘elu’, ‘gelu’, ‘leaky’, ‘prelu’, ‘rrelu’, ‘selu’, optional, default=‘leaky’ Activation function to be applied.
slope	float, optional, default=0.25 Init slope for the activation. (For leaky and elu only)
lower_bound	float, optional, default=0.125 Lower bound of random slope. (For rrelu only)
upper_bound	float, optional, default=0.333999991 Upper bound of random slope. (For rrelu only)
name	string, optional Name of the resulting symbol.

## Details

The following modified ReLU Activation functions are supported:

- *\*elu\**: Exponential Linear Unit. ‘ $y = x > 0 ? x : \text{slope} * (\exp(x)-1)$ ’
- *\*selu\**: Scaled Exponential Linear Unit. ‘ $y = \text{lambda} * (x > 0 ? x : \alpha * (\exp(x) - 1))$ ’ where *\*lambda\** = 1.0507009873554804934193349852946\* and *\*alpha\** = 1.6732632423543772848170429916717\*.
- *\*leaky\**: Leaky ReLU. ‘ $y = x > 0 ? x : \text{slope} * x$ ’
- *\*prelu\**: Parametric ReLU. This is same as *\*leaky\** except that ‘slope’ is learnt during training.
- *\*rrelu\**: Randomized ReLU. same as *\*leaky\** but the ‘slope’ is uniformly and randomly chosen from *\*[lower\_bound, upper\_bound)\** for training, while fixed to be *\*(lower\_bound+upper\_bound)/2\** for inference.

Defined in src/operator/leaky\_relu.cc:L161

**Value**

out The result mx.symbol

---

mx.symbol.linalg_det	<i>linalg_det: Compute the determinant of a matrix. Input is a tensor *A* of dimension *n* <math>\geq 2</math>.</i>
----------------------	---

---

**Description**

If  $n \geq 2$ ,  $A$  is a square matrix. We compute:

**Usage**

```
mx.symbol.linalg_det(...)
```

**Arguments**

A	NDArray-or-Symbol Tensor of square matrix
name	string, optional Name of the resulting symbol.

**Details**

$out = det(A)$

If  $n \geq 2$ ,  $det$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only. .. note:: There is no gradient backwarded when A is non-invertible (which is equivalent to  $det(A) = 0$ ) because zero is rarely hit upon in float point computation and the Jacobi's formula on determinant gradient is not computationally efficient when A is non-invertible.

Examples::

Single matrix determinant  $A = \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix}$   $det(A) = [-5.]$

Batch matrix determinant  $A = \begin{bmatrix} \begin{bmatrix} 1. & 4. \\ 2. & 3. \end{bmatrix}, \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix} \end{bmatrix}$   $det(A) = [-5., 5.]$

Defined in src/operator/tensor/la\_op.cc:L975

**Value**

out The result mx.symbol



---

mx.symbol.linalg\_extractdiag

*linalg\_extractdiag: Extracts the diagonal entries of a square matrix.  
Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

## Description

If  $n=2$ , then  $A$  represents a single square matrix which diagonal elements get extracted as a 1-dimensional tensor.

## Usage

```
mx.symbol.linalg_extractdiag(...)
```

## Arguments

A	NDArray-or-Symbol Tensor of square matrices
offset	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
name	string, optional Name of the resulting symbol.

## Details

If  $n>2$ , then  $A$  represents a batch of square matrices on the trailing two dimensions. The extracted diagonals are returned as an  $n-1$ -dimensional tensor.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix diagonal extraction  $A = \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix}$

$\text{extractdiag}(A) = [1.0, 4.0]$

$\text{extractdiag}(A, 1) = [2.0]$

Batch matrix diagonal extraction  $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix} & \begin{bmatrix} 5.0 & 6.0 \\ 7.0 & 8.0 \end{bmatrix} \end{bmatrix}$

$\text{extractdiag}(A) = \begin{bmatrix} 1.0 & 4.0 \\ 5.0 & 8.0 \end{bmatrix}$

Defined in src/operator/tensor/la\_op.cc:L495

## Value

out The result mx.symbol

---

```
mx.symbol.linalg_extracttrian
```

*linalg\_extracttrian: Extracts a triangular sub-matrix from a square matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

### Description

If  $n=2$ , then  $A$  represents a single square matrix from which a triangular sub-matrix is extracted as a 1-dimensional tensor.

### Usage

```
mx.symbol.linalg_extracttrian(...)
```

### Arguments

<code>A</code>	NDArray-or-Symbol Tensor of square matrices
<code>offset</code>	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
<code>lower</code>	boolean, optional, default=1 Refer to the lower triangular matrix if lower=true, refer to the upper otherwise. Only relevant when offset=0
<code>name</code>	string, optional Name of the resulting symbol.

### Details

If  $n>2$ , then  $A$  represents a batch of square matrices on the trailing two dimensions. The extracted triangular sub-matrices are returned as an  $n-1$ -dimensional tensor.

The `offset` and `lower` parameters determine the triangle to be extracted:

- When `offset = 0` either the lower or upper triangle with respect to the main diagonal is extracted depending on the value of parameter `lower`.
- When `offset = k > 0` the upper triangle with respect to the  $k$ -th diagonal above the main diagonal is extracted.
- When `offset = k < 0` the lower triangle with respect to the  $k$ -th diagonal below the main diagonal is extracted.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single triangular extraction  $A = \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix}$

$\text{extracttrian}(A) = [1.0, 3.0, 4.0]$   $\text{extracttrian}(A, \text{lower}=\text{False}) = [1.0, 2.0, 4.0]$   $\text{extracttrian}(A, 1) = [2.0]$   $\text{extracttrian}(A, -1) = [3.0]$

Batch triangular extraction  $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix} & \begin{bmatrix} 5.0 & 6.0 \\ 7.0 & 8.0 \end{bmatrix} \end{bmatrix}$

$\text{extracttrian}(A) = \begin{bmatrix} [1.0, 3.0, 4.0] & [5.0, 7.0, 8.0] \end{bmatrix}$

Defined in `src/operator/tensor/la_op.cc:L605`

### Value

out The result `mx.symbol`

---

mx.symbol.linalg\_gelqf

*linalg\_gelqf: LQ factorization for general matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

## Description

If  $n=2$ , we compute the LQ factorization (LAPACK `*gelqf*`, followed by `*orglq*`). `*A*` must have shape  $(x, y)$  with  $x \leq y$ , and must have full rank  $=x$ . The LQ factorization consists of `*L*` with shape  $(x, x)$  and `*Q*` with shape  $(x, y)$ , so that:

## Usage

```
mx.symbol.linalg_gelqf(...)
```

## Arguments

A	NDArray-or-Symbol Tensor of input matrices to be factorized
name	string, optional Name of the resulting symbol.

## Details

$$*A* = *L* \backslash *Q*$$

Here, `*L*` is lower triangular (upper triangle equal to zero) with nonzero diagonal, and `*Q*` is row-orthonormal, meaning that

$$*Q* \backslash *Q* \supseteq I$$

is equal to the identity matrix of shape  $(x, x)$ .

If  $n > 2$ , `*gelqf*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single LQ factorization `A = [[1., 2., 3.], [4., 5., 6.]]` `Q, L = gelqf(A)` `Q = [[-0.26726124, -0.53452248, -0.80178373], [0.87287156, 0.21821789, -0.43643578]]` `L = [[-3.74165739, 0.], [-8.55235974, 1.96396101]]`

Batch LQ factorization `A = [[[1., 2., 3.], [4., 5., 6.]], [[7., 8., 9.], [10., 11., 12.]]]` `Q, L = gelqf(A)` `Q = [[[-0.26726124, -0.53452248, -0.80178373], [0.87287156, 0.21821789, -0.43643578]], [[-0.50257071, -0.57436653, -0.64616234], [0.7620735, 0.05862104, -0.64483142]]]` `L = [[[-3.74165739, 0.], [-8.55235974, 1.96396101]], [[-13.92838828, 0.], [-19.09768702, 0.52758934]]]`

Defined in `src/operator/tensor/la_op.cc:L798`

## Value

out The result `mx.symbol`

---

`mx.symbol.linalg_gemm` *linalg\_gemm: Performs general matrix multiplication and accumulation. Input are tensors \*A\*, \*B\*, \*C\*, each of dimension \*n\*  $\geq 2$  and having the same shape on the leading \*n-2\* dimensions.*

---

## Description

If  $n=2$ , the BLAS3 function `*gemm*` is performed:

## Usage

```
mx.symbol.linalg_gemm(...)
```

## Arguments

A	NDArray-or-Symbol Tensor of input matrices
B	NDArray-or-Symbol Tensor of input matrices
C	NDArray-or-Symbol Tensor of input matrices
transpose.a	boolean, optional, default=0 Multiply with transposed of first input (A).
transpose.b	boolean, optional, default=0 Multiply with transposed of second input (B).
alpha	double, optional, default=1 Scalar factor multiplied with A*B.
beta	double, optional, default=1 Scalar factor multiplied with C.
axis	int, optional, default='-2' Axis corresponding to the matrix rows.
name	string, optional Name of the resulting symbol.

## Details

$$*out* = *alpha* \setminus *op* \setminus (*A*) \setminus *op* \setminus (*B*) + *beta* \setminus *C*$$

Here, `*alpha*` and `*beta*` are scalar parameters, and `*op()*` is either the identity or matrix transposition (depending on `*transpose_a*`, `*transpose_b*`).

If  $n > 2$ , `*gemm*` is performed separately for a batch of matrices. The column indices of the matrices are given by the last dimensions of the tensors, the row indices by the axis specified with the `*axis*` parameter. By default, the trailing two dimensions will be used for matrix encoding.

For a non-default axis parameter, the operation performed is equivalent to a series of `swapaxes/gemm/swapaxes` calls. For example let `*A*`, `*B*`, `*C*` be 5 dimensional tensors. Then `gemm(*A*, *B*, *C*, axis=1)` is equivalent to the following without the overhead of the additional `swapaxis` operations::

```
A1 = swapaxes(A, dim1=1, dim2=3) B1 = swapaxes(B, dim1=1, dim2=3) C = swapaxes(C, dim1=1, dim2=3) C = gemm(A1, B1, C) C = swapaxis(C, dim1=1, dim2=3)
```

When the input data is of type float32 and the environment variables `MXNET_CUDA_ALLOW_TENSOR_CORE` and `MXNET_CUDA_TENSOR_OP_MATH_ALLOW_CONVERSION` are set to 1, this operator will try to use pseudo-float16 precision (float32 math with float16 I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix multiply-add A = [[1.0, 1.0], [1.0, 1.0]] B = [[1.0, 1.0], [1.0, 1.0], [1.0, 1.0]] C = [[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]] `gemm(A, B, C, transpose_b=True, alpha=2.0, beta=10.0)` = [[14.0, 14.0, 14.0], [14.0, 14.0, 14.0]]

Batch matrix multiply-add A = [[[1.0, 1.0]], [[0.1, 0.1]]] B = [[[1.0, 1.0]], [[0.1, 0.1]]] C = [[[10.0]], [[0.01]]] `gemm(A, B, C, transpose_b=True, alpha=2.0, beta=10.0)` = [[[104.0]], [[0.14]]]

Defined in `src/operator/tensor/la_op.cc:L89`

## Value

out The result `mx.symbol`

---

`mx.symbol.linalg_gemm2`

*linalg\_gemm2: Performs general matrix multiplication. Input are tensors \*A\*, \*B\*, each of dimension \*n\* >= 2\* and having the same shape on the leading \*n-2\* dimensions.*

---

## Description

If `*n=2*`, the BLAS3 function `*gemm*` is performed:

## Usage

`mx.symbol.linalg_gemm2(...)`

## Arguments

A	NDArray-or-Symbol Tensor of input matrices
B	NDArray-or-Symbol Tensor of input matrices
<code>transpose.a</code>	boolean, optional, default=0 Multiply with transposed of first input (A).
<code>transpose.b</code>	boolean, optional, default=0 Multiply with transposed of second input (B).
<code>alpha</code>	double, optional, default=1 Scalar factor multiplied with A*B.
<code>axis</code>	int, optional, default='-2' Axis corresponding to the matrix row indices.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

$$*out* = *alpha* \cdot (*op*(*A*) \cdot (*op*(*B*)))$$

Here `*alpha*` is a scalar parameter and `*op()*` is either the identity or the matrix transposition (depending on `*transpose_a*`, `*transpose_b*`).

If `*n>2*`, `*gemm*` is performed separately for a batch of matrices. The column indices of the matrices are given by the last dimensions of the tensors, the row indices by the axis specified with the `*axis*` parameter. By default, the trailing two dimensions will be used for matrix encoding.

For a non-default axis parameter, the operation performed is equivalent to a series of swapaxes/gemm/swapaxes calls. For example let *\*A\**, *\*B\** be 5 dimensional tensors. Then `gemm(*A*, *B*, axis=1)` is equivalent to the following without the overhead of the additional swapaxis operations::

```
A1 = swapaxes(A, dim1=1, dim2=3) B1 = swapaxes(B, dim1=1, dim2=3) C = gemm2(A1, B1) C
= swapaxis(C, dim1=1, dim2=3)
```

When the input data is of type float32 and the environment variables `MXNET_CUDA_ALLOW_TENSOR_CORE` and `MXNET_CUDA_TENSOR_OP_MATH_ALLOW_CONVERSION` are set to 1, this operator will try to use pseudo-float16 precision (float32 math with float16 I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

.. note:: The operator supports float32 and float64 data types only.

Examples::

```
Single matrix multiply A = [[1.0, 1.0], [1.0, 1.0]] B = [[1.0, 1.0], [1.0, 1.0], [1.0, 1.0]]
gemm2(A, B, transpose_b=True, alpha=2.0) = [[4.0, 4.0, 4.0], [4.0, 4.0, 4.0]]
```

```
Batch matrix multiply A = [[[1.0, 1.0]], [[0.1, 0.1]]] B = [[[1.0, 1.0]], [[0.1, 0.1]]]
gemm2(A, B, transpose_b=True, alpha=2.0) = [[[4.0]], [[0.04 ]]]
```

Defined in `src/operator/tensor/la_op.cc:L163`

## Value

out The result `mx.symbol`

---

`mx.symbol.linalg_inverse`

*linalg\_inverse: Compute the inverse of a matrix. Input is a tensor *\*A\** of dimension *\*n* >= 2\*.*

---

## Description

If *\*n\*=2\**, *\*A\** is a square matrix. We compute:

## Usage

```
mx.symbol.linalg_inverse(...)
```

## Arguments

A	NDArray-or-Symbol Tensor of square matrix
name	string, optional Name of the resulting symbol.

**Details**

`*out* = *A* \:sup: '-1'`

If `*n>2*`, `*inverse*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix inverse `A = [[1., 4.], [2., 3.]]` `inverse(A) = [[-0.6, 0.8], [0.4, -0.2]]`

Batch matrix inverse `A = [[[1., 4.], [2., 3.]], [[1., 3.], [2., 4.]]]` `inverse(A) = [[[[-0.6, 0.8], [0.4, -0.2]], [[-2., 1.5], [1., -0.5]]]`

Defined in `src/operator/tensor/la_op.cc:L920`

**Value**

out The result `mx.symbol`

---

`mx.symbol.linalg_makediag`

*linalg\_makediag: Constructs a square matrix with the input as diagonal. Input is a tensor `*A*` of dimension `*n >= 1*`.*

---

**Description**

If `*n=1*`, then `*A*` represents the diagonal entries of a single square matrix. This matrix will be returned as a 2-dimensional tensor. If `*n>1*`, then `*A*` represents a batch of diagonals of square matrices. The batch of diagonal matrices will be returned as an `*n+1*`-dimensional tensor.

**Usage**

`mx.symbol.linalg_makediag(...)`

**Arguments**

<code>A</code>	NDArray-or-Symbol Tensor of diagonal entries
<code>offset</code>	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single diagonal matrix construction  $A = [1.0, 2.0]$

`makediag(A) = [[1.0, 0.0], [0.0, 2.0]]`

`makediag(A, 1) = [[0.0, 1.0, 0.0], [0.0, 0.0, 2.0], [0.0, 0.0, 0.0]]`

Batch diagonal matrix construction  $A = [[1.0, 2.0], [3.0, 4.0]]$

`makediag(A) = [[[1.0, 0.0], [0.0, 2.0]], [[3.0, 0.0], [0.0, 4.0]]]`

Defined in `src/operator/tensor/la_op.cc:L547`

**Value**

out The result `mx.symbol`

---

`mx.symbol.linalg_maketrian`

*linalg\_maketrian: Constructs a square matrix with the input representing a specific triangular sub-matrix. This is basically the inverse of `*linalg.extracttrian*`. Input is a tensor `*A*` of dimension `*n`  $\geq 1$ .*

---

**Description**

If `*n=1*`, then `*A*` represents the entries of a triangular matrix which is lower triangular if `*offset<0*` or `*offset=0*`, `*lower=true*`. The resulting matrix is derived by first constructing the square matrix with the entries outside the triangle set to zero and then adding `*offset*`-times an additional diagonal with zero entries to the square matrix.

**Usage**

`mx.symbol.linalg_maketrian(...)`

**Arguments**

<code>A</code>	NDArray-or-Symbol Tensor of triangular matrices stored as vectors
<code>offset</code>	int, optional, default='0' Offset of the diagonal versus the main diagonal. 0 corresponds to the main diagonal, a negative/positive value to diagonals below/above the main diagonal.
<code>lower</code>	boolean, optional, default=1 Refer to the lower triangular matrix if <code>lower=true</code> , refer to the upper otherwise. Only relevant when <code>offset=0</code>
<code>name</code>	string, optional Name of the resulting symbol.



## Details

If  $n > 1$ , then  $A$  represents a batch of triangular sub-matrices. The batch of corresponding square matrices is returned as an  $n+1$ -dimensional tensor.

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix construction  $A = [1.0, 2.0, 3.0]$

`maketrian(A) = [[1.0, 0.0], [2.0, 3.0]]`

`maketrian(A, lower=false) = [[1.0, 2.0], [0.0, 3.0]]`

`maketrian(A, offset=1) = [[0.0, 1.0, 2.0], [0.0, 0.0, 3.0], [0.0, 0.0, 0.0]]` `maketrian(A, offset=-1) = [[0.0, 0.0, 0.0], [1.0, 0.0, 0.0], [2.0, 3.0, 0.0]]`

Batch matrix construction  $A = [[1.0, 2.0, 3.0], [4.0, 5.0, 6.0]]$

`maketrian(A) = [[[1.0, 0.0], [2.0, 3.0]], [[4.0, 0.0], [5.0, 6.0]]]`

`maketrian(A, offset=1) = [[[[0.0, 1.0, 2.0], [0.0, 0.0, 3.0], [0.0, 0.0, 0.0]], [[0.0, 4.0, 5.0], [0.0, 0.0, 6.0], [0.0, 0.0, 0.0]]]`

Defined in `src/operator/tensor/la_op.cc:L673`

## Value

out The result `mx.symbol`

---

`mx.symbol.linalg_potrf`

*linalg\_potrf: Performs Cholesky factorization of a symmetric positive-definite matrix. Input is a tensor  $A$  of dimension  $n \geq 2$ .*

---

## Description

If  $n=2$ , the Cholesky factor  $B$  of the symmetric, positive definite matrix  $A$  is computed.  $B$  is triangular (entries of upper or lower triangle are all zero), has positive diagonal entries, and:

## Usage

`mx.symbol.linalg_potrf(...)`

## Arguments

<code>A</code>	NDArray-or-Symbol Tensor of input matrices to be decomposed
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

$*A* = *B* \backslash *B* \backslash \text{sup:}^T$  if  $*lower* = *true*$   $*A* = *B* \backslash \text{sup:}^T \backslash *B*$  if  $*lower* = *false*$

If  $*n > 2*$ ,  $*potrf*$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix factorization  $A = \begin{bmatrix} 4.0 & 1.0 \\ 1.0 & 4.25 \end{bmatrix}$   $\text{potrf}(A) = \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix}$

Batch matrix factorization  $A = \begin{bmatrix} \begin{bmatrix} 4.0 & 1.0 \\ 1.0 & 4.25 \end{bmatrix} & \begin{bmatrix} 16.0 & 4.0 \\ 4.0 & 17.0 \end{bmatrix} \end{bmatrix}$   $\text{potrf}(A) = \begin{bmatrix} \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix} & \begin{bmatrix} 4.0 & 0 \\ 1.0 & 4.0 \end{bmatrix} \end{bmatrix}$

Defined in src/operator/tensor/la\_op.cc:L214

**Value**

out The result mx.symbol

---

mx.symbol.linalg\_potri

*linalg\_potri: Performs matrix inversion from a Cholesky factorization. Input is a tensor  $*A*$  of dimension  $*n \geq 2*$ .*

---

**Description**

If  $*n = 2*$ ,  $*A*$  is a triangular matrix (entries of upper or lower triangle are all zero) with positive diagonal. We compute:

**Usage**

mx.symbol.linalg\_potri(...)

**Arguments**

A	NDArray-or-Symbol Tensor of lower triangular matrices
name	string, optional Name of the resulting symbol.

**Details**

$*out* = *A* \backslash \text{sup:}^{-T} \backslash *A* \backslash \text{sup:}^{-1}$  if  $*lower* = *true*$   $*out* = *A* \backslash \text{sup:}^{-1} \backslash *A* \backslash \text{sup:}^{-T}$  if  $*lower* = *false*$

In other words, if  $*A*$  is the Cholesky factor of a symmetric positive definite matrix  $*B*$  (obtained by  $*potrf*$ ), then

$*out* = *B* \backslash \text{sup:}^{-1}$

If  $*n > 2*$ ,  $*potri*$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

.. note:: Use this operator only if you are certain you need the inverse of  $*B*$ , and cannot use the Cholesky factor  $*A*$  ( $*potrf*$ ), together with backsubstitution ( $*trsm*$ ). The latter is numerically much safer, and also cheaper.

Examples::

Single matrix inverse  $A = \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix}$   $\text{potri}(A) = \begin{bmatrix} 0.26563 & -0.0625 \\ -0.0625 & 0.25 \end{bmatrix}$

Batch matrix inverse  $A = \begin{bmatrix} \begin{bmatrix} 2.0 & 0 \\ 0.5 & 2.0 \end{bmatrix} & \begin{bmatrix} 4.0 & 0 \\ 1.0 & 4.0 \end{bmatrix} \end{bmatrix}$   $\text{potri}(A) = \begin{bmatrix} \begin{bmatrix} 0.26563 & -0.0625 \\ -0.0625 & 0.25 \end{bmatrix} & \begin{bmatrix} 0.06641 & -0.01562 \\ -0.01562 & 0.0625 \end{bmatrix} \end{bmatrix}$

Defined in `src/operator/tensor/la_op.cc:L275`

## Value

out The result mx.symbol

---

`mx.symbol.linalg_slogdet`

*linalg\_slogdet: Compute the sign and log of the determinant of a matrix. Input is a tensor  $*A*$  of dimension  $*n \geq 2*$ .*

---

## Description

If  $*n=2*$ ,  $*A*$  is a square matrix. We compute:

## Usage

`mx.symbol.linalg_slogdet(...)`

## Arguments

<code>A</code>	NDArray-or-Symbol Tensor of square matrix
<code>name</code>	string, optional Name of the resulting symbol.

## Details

$*sign* = *sign(\det(A))*$   $*logabsdet* = *log(abs(\det(A)))*$

If  $*n>2*$ ,  $*slogdet*$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only. .. note:: The gradient is not properly defined on sign, so the gradient of it is not backwarded. .. note:: No gradient is backwarded when  $A$  is non-invertible. Please see the docs of operator `det` for detail.

Examples::

Single matrix signed log determinant  $A = \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix}$   $\text{sign}, \text{logabsdet} = \text{slogdet}(A)$   $\text{sign} = [1.]$   $\text{logabsdet} = [1.609438]$

Batch matrix signed log determinant  $A = \begin{bmatrix} \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix} & \begin{bmatrix} 1. & 2. \\ 2. & 4. \end{bmatrix} & \begin{bmatrix} 1. & 2. \\ 4. & 3. \end{bmatrix} \end{bmatrix}$   $\text{sign}, \text{logabsdet} = \text{slogdet}(A)$   $\text{sign} = [1., 0., -1.]$   $\text{logabsdet} = [1.609438, -\text{inf}, 1.609438]$

Defined in `src/operator/tensor/la_op.cc:L1034`

**Value**

out The result mx.symbol

---

```
mx.symbol.linalg_sumlogdiag
```

*linalg\_sumlogdiag: Computes the sum of the logarithms of the diagonal elements of a square matrix. Input is a tensor \*A\* of dimension \*n\*  $\geq 2$ .*

---

**Description**

If  $n \geq 2$ ,  $A$  must be square with positive diagonal entries. We sum the natural logarithms of the diagonal elements, the result has shape (1,).

**Usage**

```
mx.symbol.linalg_sumlogdiag(...)
```

**Arguments**

A	NDArray-or-Symbol Tensor of square matrices
name	string, optional Name of the resulting symbol.

**Details**

If  $n \geq 2$ ,  $\text{sumlogdiag}$  is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix reduction  $A = \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 7.0 \end{bmatrix}$   $\text{sumlogdiag}(A) = [1.9459]$

Batch matrix reduction  $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 7.0 \end{bmatrix} & \begin{bmatrix} 3.0 & 0 \\ 0 & 17.0 \end{bmatrix} \end{bmatrix}$   $\text{sumlogdiag}(A) = [1.9459, 3.9318]$

Defined in src/operator/tensor/la\_op.cc:L445

**Value**

out The result mx.symbol

---

`mx.symbol.linalg_syrk` *linalg\_syrk: Multiplication of matrix with its transpose. Input is a tensor  $A$  of dimension  $n \geq 2$ .*

---

## Description

If  $n=2$ , the operator performs the BLAS3 function `syrk`:

## Usage

```
mx.symbol.linalg_syrk(...)
```

## Arguments

<code>A</code>	NDArray-or-Symbol Tensor of input matrices
<code>transpose</code>	boolean, optional, default=0 Use transpose of input matrix.
<code>alpha</code>	double, optional, default=1 Scalar factor to be applied to the result.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

$out = \alpha * A * A^T$

if `transpose=False`, or

$out = \alpha * A^T * A$

if `transpose=True`.

If  $n > 2$ , `syrk` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix multiply  $A = \begin{bmatrix} 1. & 2. & 3. \\ 4. & 5. & 6. \end{bmatrix}$  `syrk(A, alpha=1., transpose=False) =  $\begin{bmatrix} 14. & 32. \\ 32. & 77. \end{bmatrix}$`  `syrk(A, alpha=1., transpose=True) =  $\begin{bmatrix} 17. & 22. & 27. \\ 22. & 29. & 36. \\ 27. & 36. & 45. \end{bmatrix}$`

Batch matrix multiply  $A = \begin{bmatrix} 1. & 1. \\ 0.1 & 0.1 \end{bmatrix}$  `syrk(A, alpha=2., transpose=False) =  $\begin{bmatrix} 4. \\ 0.04 \end{bmatrix}$`

Defined in `src/operator/tensor/la_op.cc:L730`

## Value

`out` The result `mx.symbol`

---

`mx.symbol.linalg_trmm` *linalg\_trmm: Performs multiplication with a lower triangular matrix. Input are tensors `*A*`, `*B*`, each of dimension `*n`  $\geq 2$  and having the same shape on the leading `*n-2*` dimensions.*

---

## Description

If `*n=2*`, `*A*` must be triangular. The operator performs the BLAS3 function `*trmm*`:

## Usage

```
mx.symbol.linalg_trmm(...)
```

## Arguments

A	NDArray-or-Symbol Tensor of lower triangular matrices
B	NDArray-or-Symbol Tensor of matrices
transpose	boolean, optional, default=0 Use transposed of the triangular matrix
rightside	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
lower	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
alpha	double, optional, default=1 Scalar factor to be applied to the result.
name	string, optional Name of the resulting symbol.

## Details

`*out* = *alpha* \* *op* \ (*A*) \* *B*`

if `*rightside=False*`, or

`*out* = *alpha* \* *B* \* *op* \ (*A*)`

if `*rightside=True*`. Here, `*alpha*` is a scalar parameter, and `*op()*` is either the identity or the matrix transposition (depending on `*transpose*`).

If `*n>2*`, `*trmm*` is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single triangular matrix multiply A = [[1.0, 0], [1.0, 1.0]] B = [[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]]  
`trmm(A, B, alpha=2.0) = [[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]]`

Batch triangular matrix multiply A = [[[1.0, 0], [1.0, 1.0]], [[1.0, 0], [1.0, 1.0]]] B = [[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]], [[0.5, 0.5, 0.5], [0.5, 0.5, 0.5]]]  
`trmm(A, B, alpha=2.0) = [[[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]], [[1.0, 1.0, 1.0], [2.0, 2.0, 2.0]]]`

Defined in `src/operator/tensor/la_op.cc:L333`

**Value**

out The result mx.symbol

---

mx.symbol.linalg\_trsm *linalg\_trsm: Solves matrix equation involving a lower triangular matrix. Input are tensors \*A\*, \*B\*, each of dimension \*n\*  $\geq 2$  and having the same shape on the leading \*n-2\* dimensions.*

---

**Description**

If \*n\*=2\*, \*A\* must be triangular. The operator performs the BLAS3 function \*trsm\*, solving for \*out\* in:

**Usage**

```
mx.symbol.linalg_trsm(...)
```

**Arguments**

A	NDArray-or-Symbol Tensor of lower triangular matrices
B	NDArray-or-Symbol Tensor of matrices
transpose	boolean, optional, default=0 Use transposed of the triangular matrix
rightside	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
lower	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
alpha	double, optional, default=1 Scalar factor to be applied to the result.
name	string, optional Name of the resulting symbol.

**Details**

$$*op\backslash (*A*) \backslash *out* = *alpha* \backslash *B*$$

if \*rightside=False\*, or

$$*out* \backslash *op\backslash (*A*) = *alpha* \backslash *B*$$

if \*rightside=True\*. Here, \*alpha\* is a scalar parameter, and \*op()\* is either the identity or the matrix transposition (depending on \*transpose\*).

If \*n>2\*, \*trsm\* is performed separately on the trailing two dimensions for all inputs (batch mode).

.. note:: The operator supports float32 and float64 data types only.

Examples::

Single matrix solve A = [[1.0, 0], [1.0, 1.0]] B = [[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]] trsm(A, B, alpha=0.5) = [[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]]

Batch matrix solve A = [[[1.0, 0], [1.0, 1.0]], [[1.0, 0], [1.0, 1.0]]] B = [[[2.0, 2.0, 2.0], [4.0, 4.0, 4.0]], [[4.0, 4.0, 4.0], [8.0, 8.0, 8.0]]] trsm(A, B, alpha=0.5) = [[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0]], [[2.0, 2.0, 2.0], [2.0, 2.0, 2.0]]]

Defined in src/operator/tensor/la\_op.cc:L396

**Value**

out The result mx.symbol

---

mx.symbol.LinearRegressionOutput

*LinearRegressionOutput: Computes and optimizes for squared loss during backward propagation. Just outputs “data” during forward propagation.*

---

**Description**

If  $\hat{y}_i$  is the predicted value of the  $i$ -th sample, and  $y_i$  is the corresponding target value, then the squared loss estimated over  $n$  samples is defined as

**Usage**

mx.symbol.LinearRegressionOutput(...)

**Arguments**

data	NDArray-or-Symbol Input data to the function.
label	NDArray-or-Symbol Input label to the function.
grad_scale	float, optional, default=1 Scale the gradient by a float factor
name	string, optional Name of the resulting symbol.

**Details**

$\text{SquaredLoss}(Y, \hat{Y}) = \frac{1}{n} \sum_{i=0}^{n-1} \|\text{bfy}_i - \hat{\text{bfy}}_i\|_2^2$

.. note:: Use the LinearRegressionOutput as the final output layer of a net.

The storage type of “label” can be “default” or “csr”

- LinearRegressionOutput(default, default) = default - LinearRegressionOutput(default, csr) = default

By default, gradients of this loss function are scaled by factor  $1/m$ , where  $m$  is the number of regression outputs of a training example. The parameter ‘grad\_scale’ can be used to change this scale to ‘grad\_scale/ $m$ ’.

Defined in src/operator/regression\_output.cc:L92

**Value**

out The result mx.symbol



---

mx.symbol.load	<i>Load an mx.symbol object</i>
----------------	---------------------------------

---

### Description

Load an mx.symbol object

### Usage

```
mx.symbol.load(file.name)
```

### Arguments

filename            the filename (including the path)

### Examples

```
data = mx.symbol.Variable('data')
mx.symbol.save(data, 'temp.symbol')
data2 = mx.symbol.load('temp.symbol')
```

---

mx.symbol.load.json	<i>Load an mx.symbol object from a json string</i>
---------------------	--

---

### Description

Load an mx.symbol object from a json string

### Arguments

str                the json str represent a mx.symbol

---

<code>mx.symbol.log</code>	<i>log:Returns element-wise Natural logarithmic value of the input.</i>
----------------------------	---

---

**Description**

The natural logarithm is logarithm in base \*e\*, so that “log(exp(x)) = x”

**Usage**

`mx.symbol.log(...)`

**Arguments**

- `data` NDAarray-or-Symbol The input array.
- `name` string, optional Name of the resulting symbol.

**Details**

The storage type of “log” output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L77

**Value**

`out` The result `mx.symbol`

---

<code>mx.symbol.log10</code>	<i>log10:Returns element-wise Base-10 logarithmic value of the input.</i>
------------------------------	---

---

**Description**

“10\*log10(x) = x”

**Usage**

`mx.symbol.log10(...)`

**Arguments**

- `data` NDAarray-or-Symbol The input array.
- `name` string, optional Name of the resulting symbol.

**Details**

The storage type of “log10” output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L94

**Value**

out The result mx.symbol

---

mx.symbol.log1p	<i>log1p:Returns element-wise “log(1 + x)” value of the input.</i>
-----------------	--

---

**Description**

This function is more accurate than “log(1 + x)” for small “x” so that  $1+x \approx e^x$

**Usage**

mx.symbol.log1p(...)

**Arguments**

data                      NDAarray-or-Symbol The input array.  
name                      string, optional Name of the resulting symbol.

**Details**

The storage type of “log1p” output depends upon the input storage type:  
- log1p(default) = default - log1p(row\_sparse) = row\_sparse - log1p(csr) = csr  
Defined in src/operator/tensor/elementwise\_unary\_op\_logexp.cc:L199

**Value**

out The result mx.symbol

---

mx.symbol.log2	<i>log2:Returns element-wise Base-2 logarithmic value of the input.</i>
----------------	---

---

**Description**

$2^{\log_2(x)} = x$

**Usage**

mx.symbol.log2(...)

**Arguments**

data                      NDAarray-or-Symbol The input array.  
name                      string, optional Name of the resulting symbol.

**Details**

The storage type of “log2” output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_logexp.cc:L106

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.logical_not</code>	<i>logical_not:Returns the result of logical NOT (!) function</i>
------------------------------------	---

---

**Description**

Example: `logical_not([-2., 0., 1.]) = [0., 1., 0.]`

**Usage**

`mx.symbol.logical_not(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input array.
<code>name</code>	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.LogisticRegressionOutput</code>	<i>LogisticRegressionOutput:Applies a logistic function to the input.</i>
---	---

---

**Description**

The logistic function, also known as the sigmoid function, is computed as  $\frac{1}{1+\exp(-\text{textbf{x}})}$ .

**Usage**

`mx.symbol.LogisticRegressionOutput(...)`

**Arguments**

data	NDArray-or-Symbol Input data to the function.
label	NDArray-or-Symbol Input label to the function.
grad_scale	float, optional, default=1 Scale the gradient by a float factor
name	string, optional Name of the resulting symbol.

**Details**

Commonly, the sigmoid is used to squash the real-valued output of a linear model  $wTx+b$  into the  $[0,1]$  range so that it can be interpreted as a probability. It is suitable for binary classification or probability prediction tasks.

.. note:: Use the LogisticRegressionOutput as the final output layer of a net.

The storage type of “label“ can be “default“ or “csr“

- LogisticRegressionOutput(default, default) = default - LogisticRegressionOutput(default, csr) = default

The loss function used is the Binary Cross Entropy Loss:

$-(y\log(p) + (1 - y)\log(1 - p))$

Where ‘y’ is the ground truth probability of positive outcome for a given example, and ‘p’ the probability predicted by the model. By default, gradients of this loss function are scaled by factor ‘1/m’, where m is the number of regression outputs of a training example. The parameter ‘grad\_scale’ can be used to change this scale to ‘grad\_scale/m’.

Defined in src/operator/regression\_output.cc:L152

**Value**

out The result mx.symbol

---

mx.symbol.log\_softmax *log\_softmax: Computes the log softmax of the input. This is equivalent to computing softmax followed by log.*

---

**Description**

Examples::

**Usage**

mx.symbol.log\_softmax(...)

**Arguments**

data	NDArray-or-Symbol The input array.
axis	int, optional, default='-1' The axis along which to compute softmax.
temperature	double or None, optional, default=None Temperature parameter in softmax
dtype	None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None).
use.length	boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.
name	string, optional Name of the resulting symbol.

**Details**

```
>> x = mx.nd.array([1, 2, .1]) >> mx.nd.log_softmax(x).asnumpy() array([-1.41702998, -0.41702995, -2.31702995], dtype=float32)
>> x = mx.nd.array( [[1, 2, .1],[.1, 2, 1]] ) >> mx.nd.log_softmax(x, axis=0).asnumpy() array([[ -0.34115392, -0.69314718, -1.24115396], [-1.24115396, -0.69314718, -0.34115392]], dtype=float32)
```

**Value**

out The result mx.symbol

---

mx.symbol.LRN

*LRN:Applies local response normalization to the input.*


---

**Description**

The local response normalization layer performs "lateral inhibition" by normalizing over local input regions.

**Usage**

```
mx.symbol.LRN(...)
```

**Arguments**

data	NDArray-or-Symbol Input data to LRN
alpha	float, optional, default=9.9999975e-05 The variance scaling parameter :math: '\alpha' in the LRN expression.
beta	float, optional, default=0.75 The power parameter :math: '\beta' in the LRN expression.
knorm	float, optional, default=2 The parameter :math: 'k' in the LRN expression.
nsz	int (non-negative), required normalization window width in elements.
name	string, optional Name of the resulting symbol.

**Details**

If  $a_{x,y}^i$  is the activity of a neuron computed by applying kernel  $i$  at position  $(x, y)$  and then applying the ReLU nonlinearity, the response-normalized activity  $b_{x,y}^i$  is given by the expression:

$$b_{x,y}^i = \frac{a_{x,y}^i}{\sum_{j=\max(0, i-\frac{n}{2})}^{\min(N-1, i+\frac{n}{2})} a_{x,y}^j}^{\beta}$$

where the sum runs over  $n$  "adjacent" kernel maps at the same spatial position, and  $N$  is the total number of kernels in the layer.

Defined in `src/operator/nn/lrn.cc:L158`

**Value**

out The result `mx.symbol`

---

`mx.symbol.MAERegressionOutput`

*MAERegressionOutput: Computes mean absolute error of the input.*

---

**Description**

MAE is a risk metric corresponding to the expected value of the absolute error.

**Usage**

`mx.symbol.MAERegressionOutput(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol Input data to the function.
<code>label</code>	NDArray-or-Symbol Input label to the function.
<code>grad_scale</code>	float, optional, default=1 Scale the gradient by a float factor
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

If  $\hat{y}_i$  is the predicted value of the  $i$ -th sample, and  $y_i$  is the corresponding target value, then the mean absolute error (MAE) estimated over  $n$  samples is defined as

$$\text{MAE}(\text{bfY}, \text{hat}\text{bfY}) = \frac{1}{n} \sum_{i=0}^{n-1} |\text{bfy}_i - \text{hat}\text{bfy}_i|$$

.. note:: Use the `MAERegressionOutput` as the final output layer of a net.

The storage type of "label" can be "default" or "csr"

- `MAERegressionOutput(default, default) = default` - `MAERegressionOutput(default, csr) = default`

By default, gradients of this loss function are scaled by factor  $1/m$ , where  $m$  is the number of regression outputs of a training example. The parameter `grad_scale` can be used to change this scale to `grad_scale/m`.

Defined in `src/operator/regression_output.cc:L120`

**Value**

out The result mx.symbol

---

mx.symbol.MakeLoss	<i>MakeLoss: Make your own loss function in network construction.</i>
--------------------	---

---

**Description**

This operator accepts a customized loss function symbol as a terminal loss and the symbol should be an operator with no backward dependency. The output of this function is the gradient of loss with respect to the input data.

**Usage**

```
mx.symbol.MakeLoss(...)
```

**Arguments**

data	NDArray-or-Symbol Input array.
grad.scale	float, optional, default=1 Gradient scale as a supplement to unary and binary operators
valid.thresh	float, optional, default=0 clip each element in the array to 0 when it is less than “valid_thresh“. This is used when “normalization“ is set to “valid“.
normalization	’batch’, ’null’, ’valid’, optional, default=’null’ If this is set to null, the output gradient will not be normalized. If this is set to batch, the output gradient will be divided by the batch size. If this is set to valid, the output gradient will be divided by the number of valid input elements.
name	string, optional Name of the resulting symbol.

**Details**

For example, if you are making a cross entropy loss function. Assume “out“ is the predicted output and “label“ is the true label, then the cross entropy can be defined as::

```
cross_entropy = label * log(out) + (1 - label) * log(1 - out) loss = MakeLoss(cross_entropy)
```

We will need to use “MakeLoss“ when we are creating our own loss function or we want to combine multiple loss functions. Also we may want to stop some variables’ gradients from backpropagation. See more detail in “BlockGrad“ or “stop\_gradient“.

In addition, we can give a scale to the loss by setting “grad\_scale“, so that the gradient of the loss will be rescaled in the backpropagation.

.. note:: This operator should be used as a Symbol instead of NDArray.

Defined in src/operator/make\_loss.cc:L71

**Value**

out The result mx.symbol



---

mx.symbol.make_loss	<i>make_loss: Make your own loss function in network construction.</i>
---------------------	--

---

### Description

This operator accepts a customized loss function symbol as a terminal loss and the symbol should be an operator with no backward dependency. The output of this function is the gradient of loss with respect to the input data.

### Usage

```
mx.symbol.make_loss(...)
```

### Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

### Details

For example, if you are making a cross entropy loss function. Assume “out” is the predicted output and “label” is the true label, then the cross entropy can be defined as::

```
cross_entropy = label * log(out) + (1 - label) * log(1 - out) loss = make_loss(cross_entropy)
```

We will need to use “make\_loss” when we are creating our own loss function or we want to combine multiple loss functions. Also we may want to stop some variables’ gradients from backpropagation. See more detail in “BlockGrad” or “stop\_gradient”.

The storage type of “make\_loss” output depends upon the input storage type:

- make\_loss(default) = default - make\_loss(row\_sparse) = row\_sparse

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L358

### Value

out The result mx.symbol

---

mx.symbol.max	<i>max: Computes the max of array elements over given axes.</i>
---------------	---

---

### Description

Defined in src/operator/tensor/broadcast\_reduce\_op.h:L32

### Usage

```
mx.symbol.max(...)
```

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

<code>mx.symbol.max_axis</code>	<i>max_axis: Computes the max of array elements over given axes.</i>
---------------------------------	--

---

**Description**

Defined in src/operator/tensor/./broadcast\_reduce\_op.h:L32

**Usage**

`mx.symbol.max_axis(...)`

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead. Negative values means indexing from right to left.

keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.mean	<i>mean: Computes the mean of array elements over given axes.</i>
----------------	---

---

**Description**

Defined in src/operator/tensor/.broadcast\_reduce\_op.h:L84

**Usage**

mx.symbol.mean(...)

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction.  The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.  If 'axis' is int, a reduction is performed on a particular axis.  If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.  If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.  Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

<code>mx.symbol.moments</code>	<i>moments: Calculate the mean and variance of 'data'.</i>
--------------------------------	--

---

**Description**

The mean and variance are calculated by aggregating the contents of data across axes. If x is 1-D and axes = [0] this is just the mean and variance of a vector.

**Usage**

```
mx.symbol.moments(...)
```

**Arguments**

data	NDArray-or-Symbol Input ndarray
axes	Shape or None, optional, default=None Array of ints. Axes along which to compute mean and variance.
keepdims	boolean, optional, default=0 produce moments with the same dimensionality as the input.
name	string, optional Name of the resulting symbol.

**Details**

Example:  
x = [[1, 2, 3], [4, 5, 6]] mean, var = moments(data=x, axes=[0]) mean = [2.5, 3.5, 4.5] var = [2.25, 2.25, 2.25] mean, var = moments(data=x, axes=[1]) mean = [2.0, 5.0] var = [0.66666667, 0.66666667] mean, var = moments(data=x, axis=[0, 1]) mean = [3.5] var = [2.9166667]  
Defined in src/operator/nn/moments.cc:L54

**Value**

out The result mx.symbol

---

<code>mx.symbol.mp_lamb_update_phase1</code>	<i>mp_lamb_update_phase1: Mixed Precision version of Phase I of lamb update it performs the following operations and returns g:.</i>
--	--

---

**Description**

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

**Usage**

```
mx.symbol.mp_lamb_update_phase1(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mean	NDArray-or-Symbol Moving mean
var	NDArray-or-Symbol Moving variance
weight32	NDArray-or-Symbol Weight32
beta1	float, optional, default=0.899999976 The decay rate for the 1st moment estimates.
beta2	float, optional, default=0.999000013 The decay rate for the 2nd moment estimates.
epsilon	float, optional, default=9.99999997e-07 A small constant for numerical stability.
t	int, required Index update count.
bias.correction	boolean, optional, default=1 Whether to use bias correction.
wd	float, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
name	string, optional Name of the resulting symbol.

**Details**

.. math:: \backslash \text{begingather} \* \text{grad32} = \text{grad}(\text{float16}) \* \text{rescale\\_grad} if  $(\text{grad} < -\text{clip\_gradient})$  then  $\text{grad} = -\text{clip\_gradient}$  if  $(\text{grad} > \text{clip\_gradient})$  then  $\text{grad} = \text{clip\_gradient}$

$\text{mean} = \text{beta1} * \text{mean} + (1 - \text{beta1}) * \text{grad}$ ;  $\text{variance} = \text{beta2} * \text{variance} + (1 - \text{beta2}) * \text{grad}^2$ ;

if (bias\_correction) then  $\text{mean\_hat} = \text{mean} / (1 - \text{beta1}^t)$ ;  $\text{var\_hat} = \text{var} / (1 - \text{beta2}^t)$ ;  $g = \text{mean\_hat} / (\text{var\_hat}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight32}$ ; else  $g = \text{mean} / (\text{var\_data}^{1/2} + \text{epsilon}) + \text{wd} * \text{weight32}$ ;  $\backslash \text{endgather}$ \*

Defined in src/operator/optimizer\_op.cc:L1024

**Value**

out The result mx.symbol

---

mx.symbol.mp\_lamb\_update\_phase2

*mp\_lamb\_update\_phase2: Mixed Precision version Phase II of lamb update it performs the following operations and updates grad.*

---

## Description

Link to paper: <https://arxiv.org/pdf/1904.00962.pdf>

## Usage

mx.symbol.mp\_lamb\_update\_phase2(...)

## Arguments

weight	NDArray-or-Symbol Weight
g	NDArray-or-Symbol Output of mp_lamb_update_phase 1
r1	NDArray-or-Symbol r1
r2	NDArray-or-Symbol r2
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
lower_bound	float, optional, default=-1 Lower limit of norm of weight. If lower_bound <= 0, Lower limit is not set
upper_bound	float, optional, default=-1 Upper limit of norm of weight. If upper_bound <= 0, Upper limit is not set
name	string, optional Name of the resulting symbol.

## Details

.. math:: \begin{gather\*} \text{if } (\text{lower\\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{lower\\_bound}) \text{ if } (\text{upper\\_bound} \geq 0) \text{ then } r1 = \max(r1, \text{upper\\_bound}) \end{gather\*}

if (r1 == 0 or r2 == 0) then lr = lr else lr = lr \* (r1/r2) weight32 = weight32 - lr \* g weight(float16) = weight32 \end{gather\*}

Defined in src/operator/optimizer\_op.cc:L1066

## Value

out The result mx.symbol

---

mx.symbol.mp_nag_mom_update
<i>mp_nag_mom_update: Update function for multi-precision Nesterov Accelerated Gradient( NAG) optimizer.</i>

---

**Description**

Defined in src/operator/optimizer\_op.cc:L736

**Usage**

mx.symbol.mp\_nag\_mom\_update(...)

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

```
mx.symbol.mp_sgd_mom_update
```

*mp\_sgd\_mom\_update:Updater function for multi-precision sgd optimizer*

---

## Description

mp\_sgd\_mom\_update:Updater function for multi-precision sgd optimizer

## Usage

```
mx.symbol.mp_sgd_mom_update(...)
```

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and both weight and momentum have the same stype
name	string, optional Name of the resulting symbol.

## Value

out The result mx.symbol



---

mx.symbol.mp\_sgd\_update

*mp\_sgd\_update:Updater function for multi-precision sgd optimizer*


---

## Description

mp\_sgd\_update:Updater function for multi-precision sgd optimizer

## Usage

mx.symbol.mp\_sgd\_update(...)

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol gradient
weight32	NDArray-or-Symbol Weight32
lr	float, required Learning rate
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
lazy_update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse.
name	string, optional Name of the resulting symbol.

## Value

out The result mx.symbol

---

mx.symbol.multi\_all\_finite

*multi\_all\_finite:Check if all the float numbers in all the arrays are finite (used for AMP)*


---

## Description

Defined in src/operator/contrib/all\_finite.cc:L133

**Usage**

```
mx.symbol.multi_all_finite(...)
```

**Arguments**

data	NDArray-or-Symbol[] Arrays
num.arrays	int, optional, default='1' Number of arrays.
init.output	boolean, optional, default=1 Initialize output to 1.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.multi\_lars    *multi\_lars:Compute the LARS coefficients of multiple weights and grads from their sums of square"*

---

**Description**

Defined in src/operator/contrib/multi\_lars.cc:L37

**Usage**

```
mx.symbol.multi_lars(...)
```

**Arguments**

lrs	NDArray-or-Symbol Learning rates to scale by LARS coefficient
weights.sum.sq	NDArray-or-Symbol sum of square of weights arrays
grads.sum.sq	NDArray-or-Symbol sum of square of gradients arrays
wds	NDArray-or-Symbol weight decays
eta	float, required LARS eta
eps	float, required LARS eps
rescale.grad	float, optional, default=1 Gradient rescaling factor
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.multi\_mp\_sgd\_mom\_update

*multi\_mp\_sgd\_mom\_update: Momentum update function for multi-precision Stochastic Gradient Descent (SGD) optimizer.*


---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Usage

```
mx.symbol.multi_mp_sgd_mom_update(...)
```

## Arguments

data	NDArray-or-Symbol[] Weights
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num_weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient weight} \quad += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer\_op.cc:L463

## Value

out The result mx.symbol

---

```
mx.symbol.multi_mp_sgd_update
```

*multi\_mp\_sgd\_update: Update function for multi-precision Stochastic Gradient Descent (SDG) optimizer.*

---

## Description

It updates the weights using::

## Usage

```
mx.symbol.multi_mp_sgd_update(...)
```

## Arguments

<code>data</code>	NDArray-or-Symbol[] Weights
<code>lrs</code>	tuple of <float>, required Learning rates.
<code>wds</code>	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
<code>rescale.grad</code>	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
<code>clip.gradient</code>	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
<code>num.weights</code>	int, optional, default='1' Number of updated weights.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

$$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$$

Defined in src/operator/optimizer\_op.cc:L408

## Value

out The result mx.symbol

---

mx.symbol.multi\_sgd\_mom\_update

*multi\_sgd\_mom\_update: Momentum update function for Stochastic Gradient Descent (SGD) optimizer.*


---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Usage

```
mx.symbol.multi_sgd_mom_update(...)
```

## Arguments

data	NDArray-or-Symbol[] Weights, gradients and momentum
lrs	tuple of <float>, required Learning rates.
wds	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num_weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$v_1 = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$w = \text{momentum} * w - \text{learning\_rate} * \text{gradient weight} \quad w += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer\_op.cc:L365

## Value

out The result mx.symbol

---

```
mx.symbol.multi_sgd_update
```

*multi\_sgd\_update: Update function for Stochastic Gradient Descent (SDG) optimizer.*

---

## Description

It updates the weights using::

## Usage

```
mx.symbol.multi_sgd_update(...)
```

## Arguments

<code>data</code>	NDArray-or-Symbol[] Weights
<code>lrs</code>	tuple of <float>, required Learning rates.
<code>wds</code>	tuple of <float>, required Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
<code>rescale.grad</code>	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
<code>clip.gradient</code>	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
<code>num.weights</code>	int, optional, default='1' Number of updated weights.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

$$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$$

Defined in src/operator/optimizer\_op.cc:L320

## Value

out The result mx.symbol

---

mx.symbol.multi_sum_sq	<i>multi_sum_sq: Compute the sums of squares of multiple arrays</i>
------------------------	---

---

**Description**

Defined in src/operator/contrib/multi\_sum\_sq.cc:L36

**Usage**

mx.symbol.multi\_sum\_sq(...)

**Arguments**

- |            |  |
|------------|--|
| data       | NDArray-or-Symbol[] Arrays                     |
| num.arrays | int, required number of input arrays.          |
| name       | string, optional Name of the resulting symbol. |

**Value**

out The result mx.symbol

---

mx.symbol.nag_mom_update	<i>nag_mom_update: Update function for Nesterov Accelerated Gradient( NAG) optimizer. It updates the weights using the following formula,</i>
--------------------------	---

---

**Description**

.. math:: v\_t = \gamma v\_{t-1} + \eta \* \nabla J(W\_{t-1} - \gamma v\_{t-1}) \ W\_t = W\_{t-1} - v\_t

**Usage**

mx.symbol.nag\_mom\_update(...)

**Arguments**

- |          |  |
|----------|--|
| weight   | NDArray-or-Symbol Weight   |
| grad     | NDArray-or-Symbol Gradient   |
| mom      | NDArray-or-Symbol Momentum   |
| lr       | float, required Learning rate  |
| momentum | float, optional, default=0 The decay rate of momentum estimates at each epoch. |

<code>wd</code>	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
<code>rescale_grad</code>	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
<code>clip_gradient</code>	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Where  $\eta$  is the learning rate of the optimizer  $\gamma$  is the decay rate of the momentum estimate  $v_t$  is the update vector at time step  $t$   $W_t$  is the weight vector at time step  $t$

Defined in `src/operator/optimizer_op.cc:L717`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.nanprod</code>	<i>nanprod:Computes the product of array elements over given axes treating Not a Numbers (“NaN”) as one.</i>
--------------------------------	--

---

**Description**

`nanprod`:Computes the product of array elements over given axes treating Not a Numbers (“NaN”) as one.

**Usage**

`mx.symbol.nanprod(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, <code>axis=()</code> , will compute over all elements into a scalar array with shape <code>(1,)</code> . If <code>axis</code> is int, a reduction is performed on a particular axis. If <code>axis</code> is a tuple of ints, a reduction is performed on all the axes specified in the tuple. If <code>exclude</code> is true, reduction will be performed on the axes that are NOT in <code>axis</code> instead. Negative values means indexing from right to left.



<code>keepdims</code>	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
<code>exclude</code>	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Defined in `src/operator/tensor/broadcast_reduce_prod_value.cc:L47`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.nansum</code>	<i>nansum: Computes the sum of array elements over given axes treating Not a Numbers ("NaN") as zero.</i>
-------------------------------	---

---

**Description**

`nansum`: Computes the sum of array elements over given axes treating Not a Numbers ("NaN") as zero.

**Usage**

`mx.symbol.nansum(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	Shape or None, optional, default=None The axis or axes along which to perform the reduction.  The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.  If 'axis' is int, a reduction is performed on a particular axis.  If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.  If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.  Negative values means indexing from right to left.
<code>keepdims</code>	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
<code>exclude</code>	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L102

**Value**

out The result mx.symbol

---

<code>mx.symbol.negative</code>	<i>negative:Numerical negative of the argument, element-wise.</i>
---------------------------------	---

---

**Description**

The storage type of “negative“ output depends upon the input storage type:

**Usage**

`mx.symbol.negative(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

- negative(default) = default - negative(row\_sparse) = row\_sparse - negative(csr) = csr

**Value**

out The result mx.symbol

---

<code>mx.symbol.norm</code>	<i>norm:Computes the norm on an NDArray.</i>
-----------------------------	--

---

**Description**

This operator computes the norm on an NDArray with the specified axis, depending on the value of the ord parameter. By default, it computes the L2 norm on the entire array. Currently only ord=2 supports sparse ndarrays.

**Usage**

`mx.symbol.norm(...)`

**Arguments**

data	NDArray-or-Symbol The input
ord	int, optional, default='2' Order of the norm. Currently ord=1 and ord=2 is supported.
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction. The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'. If 'axis' is int, a reduction is performed on a particular axis. If 'axis' is a 2-tuple, it specifies the axes that hold 2-D matrices, and the matrix norms of these matrices are computed.
out.dtype	None, 'float16', 'float32', 'float64', 'int32', 'int64', 'int8', optional, default='None' The data type of the output.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axis is left in the result as dimension with size one.
name	string, optional Name of the resulting symbol.

**Details**

Examples::

```
x = [[[1, 2], [3, 4]], [[2, 2], [5, 6]]]
norm(x, ord=2, axis=1) = [[3.1622777 4.472136 ] [5.3851647 6.3245554]]
norm(x, ord=1, axis=1) = [[4., 6.], [7., 8.]]
rsp = x.cast_storage('row_sparse')
norm(rsp) = [5.47722578]
csr = x.cast_storage('csr')
norm(csr) = [5.47722578]
```

Defined in src/operator/tensor/broadcast\_reduce\_norm\_value.cc:L89

**Value**

out The result mx.symbol

---

mx.symbol.normal	<i>normal: Draw random samples from a normal (Gaussian) distribution.</i>
------------------	---

---

**Description**

.. note:: The existing alias "normal" is deprecated.

**Usage**

```
mx.symbol.normal(...)
```

**Arguments**

loc	float, optional, default=0 Mean of the distribution.
scale	float, optional, default=1 Standard deviation of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Samples are distributed according to a normal distribution parametrized by *\*loc\** (mean) and *\*scale\** (standard deviation).

Example::

```
normal(loc=0, scale=1, shape=(2,2)) = [[ 1.89171135, -1.16881478], [-1.23474145, 1.55807114]]
```

Defined in src/operator/random/sample\_op.cc:L113

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.ones_like</code>	<i>ones_like</i> :Return an array of ones with the same shape and type as the input array.
----------------------------------	--

---

**Description**

Examples::

**Usage**

```
mx.symbol.ones_like(...)
```

**Arguments**

data	NDArray-or-Symbol The input
name	string, optional Name of the resulting symbol.

**Details**

```
x = [[ 0., 0., 0.], [ 0., 0., 0.]]
ones_like(x) = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

**Value**

out The result mx.symbol

---

<code>mx.symbol.one_hot</code>	<i>one_hot:Returns a one-hot array.</i>
--------------------------------	---

---

**Description**

The locations represented by ‘indices’ take value ‘on\_value’, while all other locations take value ‘off\_value’.

**Usage**

```
mx.symbol.one_hot(...)
```

**Arguments**

<code>indices</code>	NDArray-or-Symbol array of locations where to set on_value
<code>depth</code>	int, required Depth of the one hot dimension.
<code>on.value</code>	double, optional, default=1 The value assigned to the locations represented by indices.
<code>off.value</code>	double, optional, default=0 The value assigned to the locations not represented by indices.
<code>dtype</code>	‘bfloat16’, ‘float16’, ‘float32’, ‘float64’, ‘int32’, ‘int64’, ‘int8’, ‘uint8’, optional, default=‘float32’ DType of the output
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

‘one\_hot’ operation with ‘indices’ of shape “(i0, i1)” and ‘depth’ of “d” would result in an output array of shape “(i0, i1, d)” with::

```
output[i,j,:] = off_value output[i,j,indices[i,j]] = on_value
```

Examples::

```
one_hot([1,0,2,0], 3) = [[ 0.  1.  0.] [ 1.  0.  0.] [ 0.  0.  1.] [ 1.  0.  0.]]
```

```
one_hot([1,0,2,0], 3, on_value=8, off_value=1, dtype='int32') = [[1 8 1] [8 1 1] [1 1 8] [8 1 1]]
```

```
one_hot([[1,0],[1,0],[2,0]], 3) = [[[ 0.  1.  0.] [ 1.  0.  0.]
```

```
[[ 0.  1.  0.] [ 1.  0.  0.]]
```

```
[[ 0.  0.  1.] [ 1.  0.  0.]]]
```

Defined in src/operator/tensor/indexing\_op.cc:L888

**Value**

out The result mx.symbol

---

mx.symbol.Pad

*Pad: Pads an input array with a constant or edge values of the array.*


---

## Description

.. note:: ‘Pad’ is deprecated. Use ‘pad’ instead.

## Usage

```
mx.symbol.Pad(...)
```

## Arguments

data	NDArray-or-Symbol An n-dimensional input array.
mode	‘constant’, ‘edge’, ‘reflect’, required Padding type to use. "constant" pads with ‘constant_value’ "edge" pads using the edge values of the input array "reflect" pads by reflecting values with respect to the edges.
pad.width	Shape(tuple), required Widths of the padding regions applied to the edges of each axis. It is a tuple of integer padding widths for each axis of the format “(before_1, after_1, ... , before_N, after_N)“. It should be of length “2*N“ where “N“ is the number of dimensions of the array. This is equivalent to pad_width in numpy.pad, but flattened.
constant.value	double, optional, default=0 The value used for padding when ‘mode’ is "constant".
name	string, optional Name of the resulting symbol.

## Details

.. note:: Current implementation only supports 4D and 5D input arrays with padding applied only on axes 1, 2 and 3. Expects axes 4 and 5 in ‘pad\_width’ to be zero.

This operation pads an input array with either a ‘constant\_value’ or edge values along each axis of the input array. The amount of padding is specified by ‘pad\_width’.

‘pad\_width’ is a tuple of integer padding widths for each axis of the format “(before\_1, after\_1, ... , before\_N, after\_N)“. The ‘pad\_width’ should be of length “2\*N“ where “N“ is the number of dimensions of the array.

For dimension “N“ of the input array, “before\_N“ and “after\_N“ indicates how many values to add before and after the elements of the array along dimension “N“. The widths of the higher two dimensions “before\_1“, “after\_1“, “before\_2“, “after\_2“ must be 0.

Example::

```
x = [[[[ 1. 2. 3.] [ 4. 5. 6.]]
      [[ 7. 8. 9.] [10. 11. 12.]]]
      [[[ 11. 12. 13.] [14. 15. 16.]]
      [[ 17. 18. 19.] [20. 21. 22.]]]]
```

```
pad(x,mode="edge", pad_width=(0,0,0,0,1,1,1,1)) =
[[[ [ 1. 1. 2. 3. 3.] [ 1. 1. 2. 3. 3.] [ 4. 4. 5. 6. 6.] [ 4. 4. 5. 6. 6.]]
[[ 7. 7. 8. 9. 9.] [ 7. 7. 8. 9. 9.] [ 10. 10. 11. 12. 12.] [ 10. 10. 11. 12. 12.]]]
[[[ 11. 11. 12. 13. 13.] [ 11. 11. 12. 13. 13.] [ 14. 14. 15. 16. 16.] [ 14. 14. 15. 16. 16.]]
[[ 17. 17. 18. 19. 19.] [ 17. 17. 18. 19. 19.] [ 20. 20. 21. 22. 22.] [ 20. 20. 21. 22. 22.]]]]
pad(x, mode="constant", constant_value=0, pad_width=(0,0,0,0,1,1,1,1)) =
[[[ [ 0. 0. 0. 0. 0.] [ 0. 1. 2. 3. 0.] [ 0. 4. 5. 6. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 7. 8. 9. 0.] [ 0. 10. 11. 12. 0.] [ 0. 0. 0. 0. 0.]]]
[[[ 0. 0. 0. 0. 0.] [ 0. 11. 12. 13. 0.] [ 0. 14. 15. 16. 0.] [ 0. 0. 0. 0. 0.]]
[[ 0. 0. 0. 0. 0.] [ 0. 17. 18. 19. 0.] [ 0. 20. 21. 22. 0.] [ 0. 0. 0. 0. 0.]]]]
Defined in src/operator/pad.cc:L766
```

Value

out The result mx.symbol

---

mx.symbol.pad	<i>pad: Pads an input array with a constant or edge values of the array.</i>
---------------	--

---

Description

.. note:: ‘Pad’ is deprecated. Use ‘pad’ instead.

Usage

```
mx.symbol.pad(...)
```

Arguments

data	NDArray-or-Symbol An n-dimensional input array.
mode	‘constant’, ‘edge’, ‘reflect’, required Padding type to use. "constant" pads with ‘constant_value’ "edge" pads using the edge values of the input array "reflect" pads by reflecting values with respect to the edges.
pad.width	Shape(tuple), required Widths of the padding regions applied to the edges of each axis. It is a tuple of integer padding widths for each axis of the format “(before_1, after_1, ... , before_N, after_N)“. It should be of length “2*N“ where “N“ is the number of dimensions of the array.This is equivalent to pad_width in numpy.pad, but flattened.
constant.value	double, optional, default=0 The value used for padding when ‘mode‘ is "constant".
name	string, optional Name of the resulting symbol.

## Details

.. note:: Current implementation only supports 4D and 5D input arrays with padding applied only on axes 1, 2 and 3. Expects axes 4 and 5 in 'pad\_width' to be zero.

This operation pads an input array with either a 'constant\_value' or edge values along each axis of the input array. The amount of padding is specified by 'pad\_width'.

'pad\_width' is a tuple of integer padding widths for each axis of the format "(before\_1, after\_1, ... , before\_N, after\_N)". The 'pad\_width' should be of length "2\*N" where "N" is the number of dimensions of the array.

For dimension "N" of the input array, "before\_N" and "after\_N" indicates how many values to add before and after the elements of the array along dimension "N". The widths of the higher two dimensions "before\_1", "after\_1", "before\_2", "after\_2" must be 0.

Example::

```
x = [[[ [ 1. 2. 3.] [ 4. 5. 6.]]
      [[ 7. 8. 9.] [10. 11. 12.]]]
     [[[ 11. 12. 13.] [14. 15. 16.]]
      [[ 17. 18. 19.] [20. 21. 22.]]]]

pad(x, mode="edge", pad_width=(0,0,0,0,1,1,1,1)) =
[[[[ [ 1. 1. 2. 3. 3.] [ 1. 1. 2. 3. 3.] [ 4. 4. 5. 6. 6.] [ 4. 4. 5. 6. 6.]]
  [[ 7. 7. 8. 9. 9.] [ 7. 7. 8. 9. 9.] [10. 10. 11. 12. 12.] [10. 10. 11. 12. 12.]]]
 [[ [ 11. 11. 12. 13. 13.] [11. 11. 12. 13. 13.] [14. 14. 15. 16. 16.] [14. 14. 15. 16. 16.]]
  [[ 17. 17. 18. 19. 19.] [17. 17. 18. 19. 19.] [20. 20. 21. 22. 22.] [20. 20. 21. 22. 22.]]]]

pad(x, mode="constant", constant_value=0, pad_width=(0,0,0,0,1,1,1,1)) =
[[[[ [ 0. 0. 0. 0. 0.] [ 0. 1. 2. 3. 0.] [ 0. 4. 5. 6. 0.] [ 0. 0. 0. 0. 0.]]
  [[ 0. 0. 0. 0. 0.] [ 0. 7. 8. 9. 0.] [ 0. 10. 11. 12. 0.] [ 0. 0. 0. 0. 0.]]]
 [[ [ 0. 0. 0. 0. 0.] [ 0. 11. 12. 13. 0.] [ 0. 14. 15. 16. 0.] [ 0. 0. 0. 0. 0.]]
  [[ 0. 0. 0. 0. 0.] [ 0. 17. 18. 19. 0.] [ 0. 20. 21. 22. 0.] [ 0. 0. 0. 0. 0.]]]]
```

Defined in src/operator/pad.cc:L766

## Value

out The result mx.symbol

---

mx.symbol.pick

*pick: Picks elements from an input array according to the input indices along the given axis.*

---

## Description

Given an input array of shape "(d0, d1)" and indices of shape "(i0,)", the result will be an output array of shape "(i0,)" with::



**Usage**

```
mx.symbol.pick(...)
```

**Arguments**

data	NDArray-or-Symbol The input array
index	NDArray-or-Symbol The index array
axis	int or None, optional, default='-1' int or None. The axis to picking the elements. Negative values means indexing from right to left. If is 'None', the elements in the index w.r.t the flattened input will be picked.
keepdims	boolean, optional, default=0 If true, the axis where we pick the elements is left in the result as dimension with size one.
mode	'clip', 'wrap', optional, default='clip' Specify how out-of-bound indices behave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around.
name	string, optional Name of the resulting symbol.

**Details**

```
output[i] = input[i, indices[i]]
```

By default, if any index mentioned is too large, it is replaced by the index that addresses the last element along an axis (the 'clip' mode).

This function supports n-dimensional input and (n-1)-dimensional indices arrays.

Examples::

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// picks elements with specified indices along axis 0 pick(x, y=[0,1], 0) = [ 1., 4.]
```

```
// picks elements with specified indices along axis 1 pick(x, y=[0,1,0], 1) = [ 1., 4., 5.]
```

```
// picks elements with specified indices along axis 1 using 'wrap' mode // to place indicies that would normally be out of bounds pick(x, y=[2,-1,-2], 1, mode='wrap') = [ 1., 4., 5.]
```

```
y = [[ 1.], [ 0.], [ 2.]]
```

```
// picks elements with specified indices along axis 1 and dims are maintained pick(x, y, 1, keep-dims=True) = [[ 2.], [ 3.], [ 6.]]
```

Defined in src/operator/tensor/broadcast\_reduce\_op\_index.cc:L151

**Value**

out The result mx.symbol

---

mx.symbol.Pooling	<i>Pooling: Performs pooling on the input.</i>
-------------------	--

---

## Description

The shapes for 1-D pooling are

## Usage

```
mx.symbol.Pooling(...)
```

## Arguments

data	NDArray-or-Symbol Input data to the pooling operator.
kernel	Shape(tuple), optional, default=[] Pooling kernel size: (y, x) or (d, y, x)
pool.type	'avg', 'lp', 'max', 'sum', optional, default='max' Pooling type to be applied.
global.pool	boolean, optional, default=0 Ignore kernel size, do global pooling based on current input feature map.
cudnn.off	boolean, optional, default=0 Turn off cudnn pooling and use MXNet pooling operator.
pooling.convention	'full', 'same', 'valid', optional, default='valid' Pooling convention to be applied.
stride	Shape(tuple), optional, default=[] Stride: for pooling (y, x) or (d, y, x). Defaults to 1 for each dimension.
pad	Shape(tuple), optional, default=[] Pad for pooling: (y, x) or (d, y, x). Defaults to no padding.
p.value	int or None, optional, default='None' Value of p for Lp pooling, can be 1 or 2, required for Lp Pooling.
count.include.pad	boolean or None, optional, default=None Only used for AvgPool, specify whether to count padding elements for average calculation. For example, with a 5*5 kernel on a 3*3 corner of a image, the sum of the 9 valid elements will be divided by 25 if this is set to true, or it will be divided by 9 if this is set to false. Defaults to true.
layout	None, 'NCDHW', 'NCHW', 'NCW', 'NDHWC', 'NHWC', 'NWC', optional, default='None' Set layout for input and output. Empty for default layout: NCW for 1d, NCHW for 2d and NCDHW for 3d.
name	string, optional Name of the resulting symbol.

**Details**

- **data** and **out**:  $(\text{batch\_size}, \text{channel}, \text{width})$  (NCW layout) or  $(\text{batch\_size}, \text{width}, \text{channel})$  (NWC layout),

The shapes for 2-D pooling are

- **data** and **out**:  $(\text{batch\_size}, \text{channel}, \text{height}, \text{width})$  (NCHW layout) or  $(\text{batch\_size}, \text{height}, \text{width}, \text{channel})$  (NHWC layout),

$\text{out\_height} = f(\text{height}, \text{kernel}[0], \text{pad}[0], \text{stride}[0])$   $\text{out\_width} = f(\text{width}, \text{kernel}[1], \text{pad}[1], \text{stride}[1])$

The definition of  $f$  depends on “pooling\_convention“, which has two options:

- **valid** (default)::

$f(x, k, p, s) = \text{floor}((x+2*p-k)/s)+1$

- **full**, which is compatible with Caffe::

$f(x, k, p, s) = \text{ceil}((x+2*p-k)/s)+1$

When “global\_pool“ is set to be true, then global pooling is performed. It will reset “kernel=(height, width)“ and set the appropriate padding to 0.

Three pooling options are supported by “pool\_type“:

- **avg**: average pooling - **max**: max pooling - **sum**: sum pooling - **lp**: Lp pooling

For 3-D pooling, an additional *depth* dimension is added before *height*. Namely the input data and output will have shape  $(\text{batch\_size}, \text{channel}, \text{depth}, \text{height}, \text{width})$  (NCDHW layout) or  $(\text{batch\_size}, \text{depth}, \text{height}, \text{width}, \text{channel})$  (NDHWC layout).

Notes on Lp pooling:

Lp pooling was first introduced by this paper: <https://arxiv.org/pdf/1204.3968.pdf>. L-1 pooling is simply sum pooling, while L-inf pooling is simply max pooling. We can see that Lp pooling stands between those two, in practice the most common value for p is 2.

For each window “X“, the mathematical expression for Lp pooling is:

:math: ‘ $f(X) = \sqrt[p]{\sum x^p}$ ‘

Defined in src/operator/nn/pooling.cc:L416

**Value**

out The result mx.symbol

---

mx.symbol.Pooling_v1	<i>Pooling_v1: This operator is DEPRECATED. Perform pooling on the input.</i>
----------------------	---

---

**Description**

The shapes for 2-D pooling is

**Usage**

mx.symbol.Pooling\_v1(...)

**Arguments**

<code>data</code>	NDArray-or-Symbol Input data to the pooling operator.
<code>kernel</code>	Shape(tuple), optional, default=[] pooling kernel size: (y, x) or (d, y, x)
<code>pool.type</code>	'avg', 'max', 'sum', optional, default='max' Pooling type to be applied.
<code>global.pool</code>	boolean, optional, default=0 Ignore kernel size, do global pooling based on current input feature map.
<code>pooling.convention</code>	'full', 'valid', optional, default='valid' Pooling convention to be applied.
<code>stride</code>	Shape(tuple), optional, default=[] stride: for pooling (y, x) or (d, y, x)
<code>pad</code>	Shape(tuple), optional, default=[] pad for pooling: (y, x) or (d, y, x)
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

- **data**: \*(batch\_size, channel, height, width)\* - **out**: \*(batch\_size, num\_filter, out\_height, out\_width)\*, with::

$out\_height = f(height, kernel[0], pad[0], stride[0])$   $out\_width = f(width, kernel[1], pad[1], stride[1])$

The definition of *f* depends on “pooling\_convention“, which has two options:

- **valid** (default)::

$f(x, k, p, s) = \text{floor}((x+2*p-k)/s)+1$

- **full**, which is compatible with Caffe::

$f(x, k, p, s) = \text{ceil}((x+2*p-k)/s)+1$

But “global\_pool“ is set to be true, then do a global pooling, namely reset “kernel=(height, width)“.

Three pooling options are supported by “pool\_type“:

- **avg**: average pooling - **max**: max pooling - **sum**: sum pooling

1-D pooling is special case of 2-D pooling with *weight=1* and *kernel[1]=1*.

For 3-D pooling, an additional *depth* dimension is added before *height*. Namely the input data will have shape \*(batch\_size, channel, depth, height, width)\*.

Defined in src/operator/pooling\_v1.cc:L104

**Value**

out The result mx.symbol

---

mx.symbol.preloaded\_multi\_mp\_sgd\_mom\_update

*preloaded\_multi\_mp\_sgd\_mom\_update: Momentum update function for multi-precision Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Usage

```
mx.symbol.preloaded_multi_mp_sgd_mom_update(...)
```

## Arguments

data	NDArray-or-Symbol[] Weights, gradients, momentums, learning rates and weight decays
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num_weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

## Details

.. math::

$$v_1 = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$w = \text{momentum} * w - \text{learning\_rate} * \text{gradient} \quad w_t += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L200

## Value

out The result mx.symbol

---

```
mx.symbol.preloaded_multi_mp_sgd_update
    preloaded_multi_mp_sgd_update: Update function for multi-precision
    Stochastic Gradient Descent (SDG) optimizer.
```

---

### Description

It updates the weights using::

### Usage

```
mx.symbol.preloaded_multi_mp_sgd_update(...)
```

### Arguments

data	NDArray-or-Symbol[] Weights, gradients, learning rates and weight decays
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

### Details

$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$   
 Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L140

### Value

out The result mx.symbol

---

```
mx.symbol.preloaded_multi_sgd_mom_update
    preloaded_multi_sgd_mom_update: Momentum update function for
    Stochastic Gradient Descent (SGD) optimizer.
```

---

### Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

### Usage

```
mx.symbol.preloaded_multi_sgd_mom_update(...)
```

**Arguments**

data	NDArray-or-Symbol[] Weights, gradients, momentum, learning rates and weight decays
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

**Details**

.. math::

$$v_1 = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient weight} \quad \text{weight} += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/contrib/preloaded\_multi\_sgd.cc:L91

**Value**

out The result mx.symbol

---

mx.symbol.preloaded\_multi\_sgd\_update

*preloaded\_multi\_sgd\_update: Update function for Stochastic Gradient Descent (SDG) optimizer.*

---

**Description**

It updates the weights using::

**Usage**

mx.symbol.preloaded\_multi\_sgd\_update(...)

**Arguments**

data	NDArray-or-Symbol[] Weights, gradients, learning rates and weight decays
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
num.weights	int, optional, default='1' Number of updated weights.
name	string, optional Name of the resulting symbol.

**Details**

$\text{weight} = \text{weight} - \text{learning\_rate} * (\text{gradient} + \text{wd} * \text{weight})$   
Defined in `src/operator/contrib/preloaded_multi_sgd.cc:L42`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.prod</code>	<i>prod: Computes the product of array elements over given axes.</i>
-----------------------------	--

---

**Description**

Defined in `src/operator/tensor/.broadcast_reduce_op.h:L31`

**Usage**

`mx.symbol.prod(...)`

**Arguments**

data	NDArray-or-Symbol The input
axis	Shape or None, optional, default=None The axis or axes along which to perform the reduction.  The default, 'axis=()', will compute over all elements into a scalar array with shape '(1)'.  If 'axis' is int, a reduction is performed on a particular axis.  If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.  If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.  Negative values means indexing from right to left.
keepdims	boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.
exclude	boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.
name	string, optional Name of the resulting symbol.

**Value**

out The result `mx.symbol`



---

mx.symbol.radians	<i>radians:Converts each element of the input array from degrees to radians.</i>
-------------------	--

---

**Description**

.. math:: \text{radians}([0, 90, 180, 270, 360]) = [0, \pi/2, \pi, 3\pi/2, 2\pi]

**Usage**

```
mx.symbol.radians(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “radians” output depends upon the input storage type:

- radians(default) = default - radians(row\_sparse) = row\_sparse - radians(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L351

**Value**

out The result mx.symbol

---

mx.symbol.random_exponential	<i>random_exponential:Draw random samples from an exponential distribution.</i>
------------------------------	---

---

**Description**

Samples are distributed according to an exponential distribution parametrized by  $\lambda$  (rate).

**Usage**

```
mx.symbol.random_exponential(...)
```

**Arguments**

lam	float, optional, default=1 Lambda parameter (rate) of the exponential distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Example::  
exponential(lam=4, shape=(2,2)) = [[ 0.0097189 , 0.08999364], [ 0.04146638, 0.31715935]]  
Defined in src/operator/random/sample\_op.cc:L137

**Value**

out The result mx.symbol

---

<code>mx.symbol.random_gamma</code>	<i>random_gamma:Draw random samples from a gamma distribution.</i>
-------------------------------------	--

---

**Description**

Samples are distributed according to a gamma distribution parametrized by *\*alpha\** (shape) and *\*beta\** (scale).

**Usage**

`mx.symbol.random_gamma(...)`

**Arguments**

alpha	float, optional, default=1 Alpha parameter (shape) of the gamma distribution.
beta	float, optional, default=1 Beta parameter (scale) of the gamma distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
gamma(alpha=9, beta=0.5, shape=(2,2)) = [[ 7.10486984, 3.37695289], [ 3.91697288, 3.65933681]]
```

Defined in src/operator/random/sample\_op.cc:L125

**Value**

out The result mx.symbol

---

```
mx.symbol.random_generalized_negative_binomial
```

*random\_generalized\_negative\_binomial: Draw random samples from a generalized negative binomial distribution.*

---

**Description**

Samples are distributed according to a generalized negative binomial distribution parametrized by *\*mu\** (mean) and *\*alpha\** (dispersion). *\*alpha\** is defined as *\*1/k\** where *\*k\** is the failure limit of the number of unsuccessful experiments (generalized to real numbers). Samples will always be returned as a floating point data type.

**Usage**

```
mx.symbol.random_generalized_negative_binomial(...)
```

**Arguments**

mu	float, optional, default=1 Mean of the negative binomial distribution.
alpha	float, optional, default=1 Alpha (dispersion) parameter of the negative binomial distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
generalized_negative_binomial(mu=2.0, alpha=0.3, shape=(2,2)) = [[ 2., 1.], [ 6., 4.]]
```

Defined in src/operator/random/sample\_op.cc:L179

**Value**

out The result mx.symbol

---

```
mx.symbol.random_negative_binomial
```

*random\_negative\_binomial: Draw random samples from a negative binomial distribution.*

---

## Description

Samples are distributed according to a negative binomial distribution parametrized by *\*k\** (limit of unsuccessful experiments) and *\*p\** (failure probability in each experiment). Samples will always be returned as a floating point data type.

## Usage

```
mx.symbol.random_negative_binomial(...)
```

## Arguments

<code>k</code>	int, optional, default='1' Limit of unsuccessful experiments.
<code>p</code>	float, optional, default=1 Failure probability in each experiment.
<code>shape</code>	Shape(tuple), optional, default=None Shape of the output.
<code>ctx</code>	string, optional, default="" Context of output, in format [cpu gpu cpu_pinned](n). Only used for imperative calls.
<code>dtype</code>	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
<code>name</code>	string, optional Name of the resulting symbol.

## Details

Example::

```
negative_binomial(k=3, p=0.4, shape=(2,2)) = [[ 4., 7.], [ 2., 5.]]
```

Defined in src/operator/random/sample\_op.cc:L164

## Value

out The result mx.symbol

---

```
mx.symbol.random_normal
```

*random\_normal: Draw random samples from a normal (Gaussian) distribution.*

---

## Description

.. note:: The existing alias “normal“ is deprecated.

## Usage

```
mx.symbol.random_normal(...)
```

## Arguments

loc	float, optional, default=0 Mean of the distribution.
scale	float, optional, default=1 Standard deviation of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

## Details

Samples are distributed according to a normal distribution parametrized by *\*loc\** (mean) and *\*scale\** (standard deviation).

Example::

```
normal(loc=0, scale=1, shape=(2,2)) = [[ 1.89171135, -1.16881478], [-1.23474145, 1.55807114]]
```

Defined in src/operator/random/sample\_op.cc:L113

## Value

out The result mx.symbol

---

```
mx.symbol.random_pdf_dirichlet
```

*random\_pdf\_dirichlet: Computes the value of the PDF of \*sample\* of Dirichlet distributions with parameter \*alpha\*.*

---

## Description

The shape of *alpha* must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *alpha*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the value of *alpha* at index *i*.

## Usage

```
mx.symbol.random_pdf_dirichlet(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
alpha	NDArray-or-Symbol Concentration parameters of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_dirichlet(sample=[[1,2],[2,3],[3,4]], alpha=[2.5, 2.5]) = [38.413498, 199.60245, 564.56085]
```

```
sample = [[[1, 2, 3], [10, 20, 30], [100, 200, 300]], [[0.1, 0.2, 0.3], [0.01, 0.02, 0.03], [0.001, 0.002, 0.003]]]
```

```
random_pdf_dirichlet(sample=sample, alpha=[0.1, 0.4, 0.9]) = [[2.3257459e-02, 5.8420084e-04, 1.4674458e-05], [9.2589635e-01, 3.6860607e+01, 1.4674468e+03]]
```

Defined in src/operator/random/pdf\_op.cc:L316

## Value

out The result mx.symbol

---

mx.symbol.random\_pdf\_exponential

*random\_pdf\_exponential: Computes the value of the PDF of \*sample\* of exponential distributions with parameters \*lam\* (rate).*


---

## Description

The shape of *lam* must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *lam*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the value of *lam* at index *i*.

## Usage

```
mx.symbol.random_pdf_exponential(...)
```

## Arguments

<i>sample</i>	NDArray-or-Symbol Samples from the distributions.
<i>lam</i>	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
<i>is.log</i>	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
<i>name</i>	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_exponential(sample=[[1, 2, 3]], lam=[1]) = [[0.36787945, 0.13533528, 0.04978707]]
```

```
sample = [[1,2,3], [1,2,3], [1,2,3]]
```

```
random_pdf_exponential(sample=sample, lam=[1,0.5,0.25]) = [[0.36787945, 0.13533528, 0.04978707],  
[0.30326533, 0.18393973, 0.11156508], [0.1947002, 0.15163267, 0.11809164]]
```

Defined in src/operator/random/pdf\_op.cc:L305

## Value

out The result mx.symbol

---

```
mx.symbol.random_pdf_gamma
```

*random\_pdf\_gamma: Computes the value of the PDF of \*sample\* of gamma distributions with parameters \*alpha\* (shape) and \*beta\* (rate).*

---

## Description

\*alpha\* and \*beta\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*alpha\* and \*beta\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*alpha\* and \*beta\* at index \*i\*.

## Usage

```
mx.symbol.random_pdf_gamma(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
alpha	NDArray-or-Symbol Alpha (shape) parameters of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
beta	NDArray-or-Symbol Beta (scale) parameters of the distributions.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_gamma(sample=[[1,2,3,4,5]], alpha=[5], beta=[1]) = [[0.01532831, 0.09022352, 0.16803136, 0.19536681, 0.17546739]]
```

```
sample = [[1, 2, 3, 4, 5], [2, 3, 4, 5, 6], [3, 4, 5, 6, 7]]
```

```
random_pdf_gamma(sample=sample, alpha=[5,6,7], beta=[1,1,1]) = [[0.01532831, 0.09022352, 0.16803136, 0.19536681, 0.17546739], [0.03608941, 0.10081882, 0.15629345, 0.17546739, 0.16062315], [0.05040941, 0.10419563, 0.14622283, 0.16062315, 0.14900276]]
```

Defined in src/operator/random/pdf\_op.cc:L303

## Value

out The result mx.symbol



---

```
mx.symbol.random_pdf_generalized_negative_binomial
```

*random\_pdf\_generalized\_negative\_binomial: Computes the value of the PDF of \*sample\* of generalized negative binomial distributions with parameters \*mu\* (mean) and \*alpha\* (dispersion). This can be understood as a reparameterization of the negative binomial, where  $k = 1 / \alpha$  and  $p = 1 / (\mu \backslash \alpha + 1)$ .*

---

## Description

\*mu\* and \*alpha\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*mu\* and \*alpha\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*mu\* and \*alpha\* at index \*i\*.

## Usage

```
mx.symbol.random_pdf_generalized_negative_binomial(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
mu	NDArray-or-Symbol Means of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
alpha	NDArray-or-Symbol Alpha (dispersion) parameters of the distributions.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_generalized_negative_binomial(sample=[[1, 2, 3, 4]], alpha=[1], mu=[1]) = [[0.25, 0.125, 0.0625, 0.03125]]
```

```
sample = [[1,2,3,4], [1,2,3,4]] random_pdf_generalized_negative_binomial(sample=sample, alpha=[1, 0.6666], mu=[1, 1.5]) = [[0.25, 0.125, 0.0625, 0.03125 ], [0.26517063, 0.16573331, 0.09667706, 0.05437994]]
```

Defined in src/operator/random/pdf\_op.cc:L314

## Value

out The result mx.symbol

---

```
mx.symbol.random_pdf_negative_binomial
```

*random\_pdf\_negative\_binomial: Computes the value of the PDF of samples of negative binomial distributions with parameters \*k\* (failure limit) and \*p\* (failure probability).*

---

## Description

\*k\* and \*p\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*k\* and \*p\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*k\* and \*p\* at index \*i\*.

## Usage

```
mx.symbol.random_pdf_negative_binomial(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
k	NDArray-or-Symbol Limits of unsuccessful experiments.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
p	NDArray-or-Symbol Failure probabilities in each experiment.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_negative_binomial(sample=[[1,2,3,4]], k=[1], p=a[0.5]) = [[0.25, 0.125, 0.0625, 0.03125]]
```

```
# Note that k may be real-valued sample = [[1,2,3,4], [1,2,3,4]] random_pdf_negative_binomial(sample=sample,
k=[1, 1.5], p=[0.5, 0.5]) = [[0.25, 0.125, 0.0625, 0.03125 ], [0.26516506, 0.16572815, 0.09667476,
0.05437956]]
```

Defined in src/operator/random/pdf\_op.cc:L310

## Value

out The result mx.symbol

---

```
mx.symbol.random_pdf_normal
```

*random\_pdf\_normal: Computes the value of the PDF of \*sample\* of normal distributions with parameters \*mu\* (mean) and \*sigma\* (standard deviation).*

---

## Description

\*mu\* and \*sigma\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*mu\* and \*sigma\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*mu\* and \*sigma\* at index \*i\*.

## Usage

```
mx.symbol.random_pdf_normal(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
mu	NDArray-or-Symbol Means of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
sigma	NDArray-or-Symbol Standard deviations of the distributions.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
sample = [[-2, -1, 0, 1, 2]] random_pdf_normal(sample=sample, mu=[0], sigma=[1]) = [[0.05399097, 0.24197073, 0.3989423, 0.24197073, 0.05399097]]
```

```
random_pdf_normal(sample=sample*2, mu=[0,0], sigma=[1,2]) = [[0.05399097, 0.24197073, 0.3989423, 0.24197073, 0.05399097], [0.12098537, 0.17603266, 0.19947115, 0.17603266, 0.12098537]]
```

Defined in src/operator/random/pdf\_op.cc:L300

## Value

out The result mx.symbol

---

```
mx.symbol.random_pdf_poisson
```

*random\_pdf\_poisson: Computes the value of the PDF of \*sample\* of Poisson distributions with parameters \*lam\* (rate).*

---

## Description

The shape of *lam* must match the leftmost subshape of *sample*. That is, *sample* can have the same shape as *lam*, in which case the output contains one density per distribution, or *sample* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index *i* in the output are given by the samples at index *i* in *sample* parameterized by the value of *lam* at index *i*.

## Usage

```
mx.symbol.random_pdf_poisson(...)
```

## Arguments

<code>sample</code>	NDArray-or-Symbol Samples from the distributions.
<code>lam</code>	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
<code>is.log</code>	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_poisson(sample=[[0,1,2,3]], lam=[1]) = [[0.36787945, 0.36787945, 0.18393973, 0.06131324]]
sample = [[0,1,2,3], [0,1,2,3], [0,1,2,3]]
```

```
random_pdf_poisson(sample=sample, lam=[1,2,3]) = [[0.36787945, 0.36787945, 0.18393973, 0.06131324],
[0.13533528, 0.27067056, 0.27067056, 0.18044704], [0.04978707, 0.14936121, 0.22404182, 0.22404182]]
```

Defined in src/operator/random/pdf\_op.cc:L307

## Value

out The result mx.symbol

---

mx.symbol.random\_pdf\_uniform

*random\_pdf\_uniform: Computes the value of the PDF of \*sample\* of uniform distributions on the intervals given by \*[low,high]\*.*

---

## Description

\*low\* and \*high\* must have the same shape, which must match the leftmost subshape of \*sample\*. That is, \*sample\* can have the same shape as \*low\* and \*high\*, in which case the output contains one density per distribution, or \*sample\* can be a tensor of tensors with that shape, in which case the output is a tensor of densities such that the densities at index \*i\* in the output are given by the samples at index \*i\* in \*sample\* parameterized by the values of \*low\* and \*high\* at index \*i\*.

## Usage

```
mx.symbol.random_pdf_uniform(...)
```

## Arguments

sample	NDArray-or-Symbol Samples from the distributions.
low	NDArray-or-Symbol Lower bounds of the distributions.
is.log	boolean, optional, default=0 If set, compute the density of the log-probability instead of the probability.
high	NDArray-or-Symbol Upper bounds of the distributions.
name	string, optional Name of the resulting symbol.

## Details

Examples::

```
random_pdf_uniform(sample=[[1,2,3,4]], low=[0], high=[10]) = [0.1, 0.1, 0.1, 0.1]
```

```
sample = [[[1, 2, 3], [1, 2, 3]], [[1, 2, 3], [1, 2, 3]]] low = [[0, 0], [0, 0]] high = [[ 5, 10], [15, 20]]
random_pdf_uniform(sample=sample, low=low, high=high) = [[[0.2, 0.2, 0.2 ], [0.1, 0.1, 0.1 ]], [[0.06667, 0.06667, 0.06667], [0.05, 0.05, 0.05 ]]]
```

Defined in src/operator/random/pdf\_op.cc:L298

## Value

out The result mx.symbol

---

```
mx.symbol.random_poisson
```

*random\_poisson: Draw random samples from a Poisson distribution.*

---

### Description

Samples are distributed according to a Poisson distribution parametrized by *\*lambda\** (rate). Samples will always be returned as a floating point data type.

### Usage

```
mx.symbol.random_poisson(...)
```

### Arguments

lam	float, optional, default=1 Lambda parameter (rate) of the Poisson distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

### Details

Example::

```
poisson(lam=4, shape=(2,2)) = [[ 5., 2.], [ 4., 6.]]
```

Defined in src/operator/random/sample\_op.cc:L150

### Value

out The result mx.symbol

---

```
mx.symbol.random_randint
```

*random\_randint: Draw random samples from a discrete uniform distribution.*

---

### Description

Samples are uniformly distributed over the half-open interval *\*[low, high)\** (includes *\*low\**, but excludes *\*high\**).

**Usage**

```
mx.symbol.random_randint(...)
```

**Arguments**

low	long, required Lower bound of the distribution.
high	long, required Upper bound of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'int32', 'int64', optional, default='None' DType of the output in case this can't be inferred. Defaults to int32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
randint(low=0, high=5, shape=(2,2)) = [[ 0, 2], [ 3, 1]]
```

Defined in src/operator/random/sample\_op.cc:L194

**Value**

out The result mx.symbol

---

```
mx.symbol.random_uniform
```

*random\_uniform: Draw random samples from a uniform distribution.*

---

**Description**

.. note:: The existing alias “uniform“ is deprecated.

**Usage**

```
mx.symbol.random_uniform(...)
```

**Arguments**

low	float, optional, default=0 Lower bound of the distribution.
high	float, optional, default=1 Upper bound of the distribution.
shape	Shape(tuple), optional, default=None Shape of the output.
ctx	string, optional, default="" Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

**Details**

Samples are uniformly distributed over the half-open interval `*[low, high)*` (includes `*low*`, but excludes `*high*`).

Example::

```
uniform(low=0, high=1, shape=(2,2)) = [[ 0.60276335, 0.85794562], [ 0.54488319, 0.84725171]]
```

Defined in `src/operator/random/sample_op.cc:L96`

**Value**

out The result mx.symbol

---

`mx.symbol.ravel_multi_index`

*ravel\_multi\_index: Converts a batch of index arrays into an array of flat indices. The operator follows numpy conventions so a single multi index is given by a column of the input matrix. The leading dimension may be left unspecified by using -1 as placeholder.*

---

**Description**

Examples::

```
A = [[3,6,6],[4,5,1]] ravel(A, shape=(7,6)) = [22,41,37] ravel(A, shape=(-1,6)) = [22,41,37]
```

**Usage**

```
mx.symbol.ravel_multi_index(...)
```

**Arguments**

data	NDArray-or-Symbol Batch of multi-indices
shape	Shape(tuple), optional, default=None Shape of the array into which the multi-indices apply.
name	string, optional Name of the resulting symbol.

**Details**

Defined in `src/operator/tensor/ravel.cc:L42`

**Value**

out The result mx.symbol



---

mx.symbol.rcbrt	<i>rcbrt:Returns element-wise inverse cube-root value of the input.</i>
-----------------	---

---

**Description**

.. math:: \text{rcbrt}(x) = 1/\sqrt[3]{x}

**Usage**

```
mx.symbol.rcbrt(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
rcbrt([1,8,-125]) = [1.0, 0.5, -0.2]
```

Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L323

**Value**

out The result mx.symbol

---

mx.symbol.reciprocal	<i>reciprocal:Returns the reciprocal of the argument, element-wise.</i>
----------------------	---

---

**Description**

Calculates  $1/x$ .

**Usage**

```
mx.symbol.reciprocal(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Example::  
reciprocal([-2, 1, 3, 1.6, 0.2]) = [-0.5, 1.0, 0.33333334, 0.625, 5.0]  
Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L43

**Value**

out The result mx.symbol

---

<code>mx.symbol.relu</code>	<i>relu:Computes rectified linear activation.</i>
-----------------------------	---

---

**Description**

.. math:: \max(\text{features}, 0)

**Usage**

`mx.symbol.relu(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “relu“ output depends upon the input storage type:  
- relu(default) = default - relu(row\_sparse) = row\_sparse - relu(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L85

**Value**

out The result mx.symbol

---

mx.symbol.repeat	<i>repeat:Repeats elements of an array. By default, “repeat“ flattens the input array into 1-D and then repeats the elements::</i> $x = [[1, 2], [3, 4]]$ <i>repeat</i> ( $x$ , $repeats=2$ ) = $[1., 1., 2., 2., 3., 3., 4., 4.]$ <i>The parameter “axis“ specifies the axis along which to perform repeat::</i> <i>repeat</i> ( $x$ , $repeats=2$ , $axis=1$ ) = $[[1., 1., 2., 2.], [3., 3., 4., 4.]]$ <i>repeat</i> ( $x$ , $repeats=2$ , $axis=0$ ) = $[[1., 2.], [1., 2.], [3., 4.], [3., 4.]]$ <i>repeat</i> ( $x$ , $repeats=2$ , $axis=-1$ ) = $[[1., 1., 2., 2.], [3., 3., 4., 4.]]$
------------------	--

---

## Description

Defined in src/operator/tensor/matrix\_op.cc:L744

## Usage

mx.symbol.repeat(...)

## Arguments

data	NDArray-or-Symbol Input data array
repeats	int, required The number of repetitions for each element.
axis	int or None, optional, default='None' The axis along which to repeat values. The negative numbers are interpreted counting from the backward. By default, use the flattened input array, and return a flat output array.
name	string, optional Name of the resulting symbol.

## Value

out The result mx.symbol

---

mx.symbol.reset_arrays	<i>reset_arrays:Set to zero multiple arrays</i>
------------------------	---

---

## Description

Defined in src/operator/contrib/reset\_arrays.cc:L36

## Usage

mx.symbol.reset\_arrays(...)

**Arguments**

data	NDArray-or-Symbol[] Arrays
num.arrays	int, required number of input arrays.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.Reshape

*Reshape:Reshapes the input array. .. note:: “Reshape” is deprecated, use “reshape” Given an array and a shape, this function returns a copy of the array in the new shape. The shape is a tuple of integers such as (2,3,4). The size of the new shape should be same as the size of the input array. Example:: reshape([1,2,3,4], shape=(2,2)) = [[1,2], [3,4]] Some dimensions of the shape can take special values from the set 0, -1, -2, -3, -4. The significance of each is explained below: - “0” copy this dimension from the input to the output shape. Example:: - input shape = (2,3,4), shape = (4,0,2), output shape = (4,3,2) - input shape = (2,3,4), shape = (2,0,0), output shape = (2,3,4) - “-1” infers the dimension of the output shape by using the remainder of the input dimensions keeping the size of the new array same as that of the input array. At most one dimension of shape can be -1. Example:: - input shape = (2,3,4), shape = (6,1,-1), output shape = (6,1,4) - input shape = (2,3,4), shape = (3,-1,8), output shape = (3,1,8) - input shape = (2,3,4), shape=(-1,), output shape = (24,) - “-2” copy all/remainder of the input dimensions to the output shape. Example:: - input shape = (2,3,4), shape = (-2,), output shape = (2,3,4) - input shape = (2,3,4), shape = (2,-2), output shape = (2,3,4) - input shape = (2,3,4), shape = (-2,1,1), output shape = (2,3,4,1,1) - “-3” use the product of two consecutive dimensions of the input shape as the output dimension. Example:: - input shape = (2,3,4), shape = (-3,4), output shape = (6,4) - input shape = (2,3,4,5), shape = (-3,-3), output shape = (6,20) - input shape = (2,3,4), shape = (0,-3), output shape = (2,12) - input shape = (2,3,4), shape = (-3,-2), output shape = (6,4) - “-4” split one dimension of the input into two dimensions passed subsequent to -4 in shape (can contain -1). Example:: - input shape = (2,3,4), shape = (-4,1,2,-2), output shape =(1,2,3,4) - input shape = (2,3,4), shape = (2,-4,-1,3,-2), output shape = (2,1,3,4) If the argument ‘reverse’ is set to 1, then the special values are inferred from right to left. Example:: - without reverse=1, for input shape = (10,5,4), shape = (-1,0), output shape would be (40,5) - with reverse=1, output shape will be (50,4).*

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L175

**Usage**

```
mx.symbol.Reshape(...)
```

**Arguments**

data	NDArray-or-Symbol Input data to reshape.
shape	Shape(tuple), optional, default=[] The target shape
reverse	boolean, optional, default=0 If true then the special values are inferred from right to left
target.shape	Shape(tuple), optional, default=[] (Deprecated! Use “shape“ instead.) Target new shape. One and only one dim can be 0, in which case it will be inferred from the rest of dims
keep.highest	boolean, optional, default=0 (Deprecated! Use “shape“ instead.) Whether keep the highest dim unchanged.If set to true, then the first dim in target_shape is ignored,and always fixed as input
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.reshape

*reshape: Reshapes the input array. .. note:: “Reshape” is deprecated, use “reshape”* Given an array and a shape, this function returns a copy of the array in the new shape. The shape is a tuple of integers such as (2,3,4). The size of the new shape should be same as the size of the input array. Example:: `reshape([1,2,3,4], shape=(2,2)) = [[1,2], [3,4]]` Some dimensions of the shape can take special values from the set 0, -1, -2, -3, -4. The significance of each is explained below: - “0” copy this dimension from the input to the output shape. Example:: - input shape = (2,3,4), shape = (4,0,2), output shape = (4,3,2) - input shape = (2,3,4), shape = (2,0,0), output shape = (2,3,4) - “-1” infers the dimension of the output shape by using the remainder of the input dimensions keeping the size of the new array same as that of the input array. At most one dimension of shape can be -1. Example:: - input shape = (2,3,4), shape = (6,1,-1), output shape = (6,1,4) - input shape = (2,3,4), shape = (3,-1,8), output shape = (3,1,8) - input shape = (2,3,4), shape=(-1,), output shape = (24,) - “-2” copy all/remainder of the input dimensions to the output shape. Example:: - input shape = (2,3,4), shape = (-2,), output shape = (2,3,4) - input shape = (2,3,4), shape = (2,-2), output shape = (2,3,4) - input shape = (2,3,4), shape = (-2,1,1), output shape = (2,3,4,1,1) - “-3” use the product of two consecutive dimensions of the input shape as the output dimension. Example:: - input shape = (2,3,4), shape = (-3,4), output shape = (6,4) - input shape = (2,3,4,5), shape = (-3,-3), output shape = (6,20) - input shape = (2,3,4), shape = (0,-3), output shape = (2,12) - input shape = (2,3,4), shape = (-3,-2), output shape = (6,4) - “-4” split one dimension of the input into two dimensions passed subsequent to -4 in shape (can contain -1). Example:: - input shape = (2,3,4), shape = (-4,1,2,-2), output shape = (1,2,3,4) - input shape = (2,3,4), shape = (2,-4,-1,3,-2), output shape = (2,1,3,4) If the argument ‘reverse’ is set to 1, then the special values are inferred from right to left. Example:: - without reverse=1, for input shape = (10,5,4), shape = (-1,0), output shape would be (40,5) - with reverse=1, output shape will be (50,4).

## Description

Defined in `src/operator/tensor/matrix_op.cc:L175`

## Usage

```
mx.symbol.reshape(...)
```

## Arguments

data	NDArray-or-Symbol Input data to reshape.
shape	Shape(tuple), optional, default=[] The target shape
reverse	boolean, optional, default=0 If true then the special values are inferred from right to left

target.shape	Shape(tuple), optional, default=[] (Deprecated! Use “shape“ instead.) Target new shape. One and only one dim can be 0, in which case it will be inferred from the rest of dims
keep.highest	boolean, optional, default=0 (Deprecated! Use “shape“ instead.) Whether keep the highest dim unchanged.If set to true, then the first dim in target_shape is ignored,and always fixed as input
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.reshape_like	<i>reshape_like:Reshape some or all dimensions of ‘lhs‘ to have the same shape as some or all dimensions of ‘rhs‘.</i>
------------------------	--

---

**Description**

Returns a **view** of the ‘lhs‘ array with a new shape without altering any data.

**Usage**

mx.symbol.reshape\_like(...)

**Arguments**

lhs	NDArray-or-Symbol First input.
rhs	NDArray-or-Symbol Second input.
lhs.begin	int or None, optional, default=’None’ Defaults to 0. The beginning index along which the lhs dimensions are to be reshaped. Supports negative indices.
lhs.end	int or None, optional, default=’None’ Defaults to None. The ending index along which the lhs dimensions are to be used for reshaping. Supports negative indices.
rhs.begin	int or None, optional, default=’None’ Defaults to 0. The beginning index along which the rhs dimensions are to be used for reshaping. Supports negative indices.
rhs.end	int or None, optional, default=’None’ Defaults to None. The ending index along which the rhs dimensions are to be used for reshaping. Supports negative indices.
name	string, optional Name of the resulting symbol.

Details

Example::  
x = [1, 2, 3, 4, 5, 6] y = [[0, -4], [3, 2], [2, 2]] reshape\_like(x, y) = [[1, 2], [3, 4], [5, 6]]  
More precise control over how dimensions are inherited is achieved by specifying \ slices over the 'lhs' and 'rhs' array dimensions. Only the sliced 'lhs' dimensions \ are reshaped to the 'rhs' sliced dimensions, with the non-sliced 'lhs' dimensions staying the same.  
Examples::  
- lhs shape = (30,7), rhs shape = (15,2,4), lhs\_begin=0, lhs\_end=1, rhs\_begin=0, rhs\_end=2, output shape = (15,2,7) - lhs shape = (3, 5), rhs shape = (1,15,4), lhs\_begin=0, lhs\_end=2, rhs\_begin=1, rhs\_end=2, output shape = (15)  
Negative indices are supported, and 'None' can be used for either 'lhs\_end' or 'rhs\_end' to indicate the end of the range.  
Example::  
- lhs shape = (30, 12), rhs shape = (4, 2, 2, 3), lhs\_begin=-1, lhs\_end=None, rhs\_begin=1, rhs\_end=None, output shape = (30, 2, 2, 3)  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L511

Value

out The result mx.symbol

---

mx.symbol.reverse	<i>reverse:Reverses the order of elements along given axis while preserving array shape. Note: reverse and flip are equivalent. We use reverse in the following examples. Examples:: x = [[ 0., 1., 2., 3., 4.], [ 5., 6., 7., 8., 9.]] reverse(x, axis=0) = [[ 5., 6., 7., 8., 9.], [ 0., 1., 2., 3., 4.]] reverse(x, axis=1) = [[ 4., 3., 2., 1., 0.], [ 9., 8., 7., 6., 5.]]</i>
-------------------	---

---

Description

Defined in src/operator/tensor/matrix\_op.cc:L832

Usage

mx.symbol.reverse(...)

Arguments

- data           NDArray-or-Symbol Input data array
- axis           Shape(tuple), required The axis which to reverse elements.
- name           string, optional Name of the resulting symbol.

Value

out The result mx.symbol



---

mx.symbol.rint	<i>rint:Returns element-wise rounded value to the nearest integer of the input.</i>
----------------	---

---

**Description**

.. note:: - For input “n.5” “rint” returns “n” while “round” returns “n+1”. - For input “-n.5” both “rint” and “round” returns “-n-1”.

**Usage**

```
mx.symbol.rint(...)
```

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

Example::

```
rint([-1.5, 1.5, -1.9, 1.9, 2.1]) = [-2., 1., -2., 2., 2.]
```

The storage type of “rint” output depends upon the input storage type:

- rint(default) = default - rint(row\_sparse) = row\_sparse - rint(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L798

**Value**

out The result mx.symbol

---

mx.symbol.rmspropalex_update	<i>rmspropalex_update:Update function for RMSPropAlex optimizer.</i>
------------------------------	--

---

**Description**

‘RMSPropAlex’ is non-centered version of ‘RMSProp’.

**Usage**

```
mx.symbol.rmspropalex_update(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
n	NDArray-or-Symbol n
g	NDArray-or-Symbol g
delta	NDArray-or-Symbol delta
lr	float, required Learning rate
rho	float, optional, default=0.949999988 Decay rate.
momentum	float, optional, default=0.899999976 Decay rate.
epsilon	float, optional, default=9.99999994e-09 A small constant for numerical stability.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
clip.weights	float, optional, default=-1 Clip weights to the range of $[-\text{clip\_weights}, \text{clip\_weights}]$ If $\text{clip\_weights} \leq 0$ , weight clipping is turned off. $\text{weights} = \max(\min(\text{weights}, \text{clip\_weights}), -\text{clip\_weights})$ .
name	string, optional Name of the resulting symbol.

**Details**

Define  $E[g^2]_t$  is the decaying average over past squared gradient and  $E[g]_t$  is the decaying average over past gradient.

..  $E[g^2]_t = \rho * E[g^2]_{t-1} + (1 - \rho) * g_t^2$   
 $E[g]_t = \rho * E[g]_{t-1} + (1 - \rho) * g_t$   
 $\text{momentum}_t = \gamma * \text{momentum}_{t-1} - \frac{\eta}{\sqrt{E[g^2]_t - E[g]_t^2 + \epsilon}} g_t$

The update step is

..  $\theta_{t+1} = \theta_t + \text{momentum}_t$

The RMSPropAlex code follows the version in <http://arxiv.org/pdf/1308.0850v5.pdf> Eq(38) - Eq(45) by Alex Graves, 2013.

Graves suggests the momentum term  $\rho$  to be 0.95,  $\gamma$  to be 0.9 and the learning rate  $\eta$  to be 0.0001.

Defined in src/operator/optimizer\_op.cc:L827

**Value**

out The result mx.symbol

---

mx.symbol.rmsprop\_update

*rmsprop\_update: Update function for 'RMSPProp' optimizer.*


---

## Description

'RMSPProp' is a variant of stochastic gradient descent where the gradients are divided by a cache which grows with the sum of squares of recent gradients?

## Usage

```
mx.symbol.rmsprop_update(...)
```

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
n	NDArray-or-Symbol n
lr	float, required Learning rate
rho	float, optional, default=0.949999988 The decay rate of momentum estimates.
epsilon	float, optional, default=9.99999994e-09 A small constant for numerical stability.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
clip.weights	float, optional, default=-1 Clip weights to the range of $[-\text{clip\_weights}, \text{clip\_weights}]$ . If $\text{clip\_weights} \leq 0$ , weight clipping is turned off. $\text{weights} = \max(\min(\text{weights}, \text{clip\_weights}), -\text{clip\_weights})$ .
name	string, optional Name of the resulting symbol.

## Details

'RMSPProp' is similar to 'AdaGrad', a popular variant of 'SGD' which adaptively tunes the learning rate of each parameter. 'AdaGrad' lowers the learning rate for each parameter monotonically over the course of training. While this is analytically motivated for convex optimizations, it may not be ideal for non-convex problems. 'RMSPProp' deals with this heuristically by allowing the learning rates to rebound as the denominator decays over time.

Define the Root Mean Square (RMS) error criterion of the gradient as  $\text{RMS}[g]_t = \sqrt{E[g^2]_t + \epsilon}$ , where  $g$  represents gradient and  $E[g^2]_t$  is the decaying average over past squared gradient.

The  $E[g^2]_t$  is given by:

$$E[g^2]_t = \rho * E[g^2]_{t-1} + (1-\rho) * g_t^2$$

The update step is

$$\theta_{t+1} = \theta_t - \frac{\eta}{\text{RMS}[g]_t} g_t$$

The RMSProp code follows the version in [http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture\\_slides\\_lec6.pdf](http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture_slides_lec6.pdf) Tieleman & Hinton, 2012.

Hinton suggests the momentum term  $\rho$  to be 0.9 and the learning rate  $\eta$  to be 0.001.

Defined in `src/operator/optimizer_op.cc:L788`

## Value

out The result mx.symbol

---

<code>mx.symbol.RNN</code>	<i>RNN:Applies recurrent layers to input data. Currently, vanilla RNN, LSTM and GRU are implemented, with both multi-layer and bidirectional support.</i>
----------------------------	---

---

## Description

When the input data is of type float32 and the environment variables `MXNET_CUDA_ALLOW_TENSOR_CORE` and `MXNET_CUDA_TENSOR_OP_MATH_ALLOW_CONVERSION` are set to 1, this operator will try to use pseudo-float16 precision (float32 math with float16 I/O) precision in order to use Tensor Cores on suitable NVIDIA GPUs. This can sometimes give significant speedups.

## Usage

```
mx.symbol.RNN(...)
```

## Arguments

<code>data</code>	NDArray-or-Symbol Input data to RNN
<code>parameters</code>	NDArray-or-Symbol Vector of all RNN trainable parameters concatenated
<code>state</code>	NDArray-or-Symbol initial hidden state of the RNN
<code>state.cell</code>	NDArray-or-Symbol initial cell state for LSTM networks (only for LSTM)
<code>sequence.length</code>	NDArray-or-Symbol Vector of valid sequence lengths for each element in batch. (Only used if <code>use_sequence_length</code> kwarg is True)
<code>state.size</code>	int (non-negative), required size of the state for each layer
<code>num.layers</code>	int (non-negative), required number of stacked layers
<code>bidirectional</code>	boolean, optional, default=0 whether to use bidirectional recurrent layers
<code>mode</code>	'gru', 'lstm', 'rnn_relu', 'rnn_tanh', required the type of RNN to compute

p	float, optional, default=0 drop rate of the dropout on the outputs of each RNN layer, except the last layer.
state.outputs	boolean, optional, default=0 Whether to have the states as symbol outputs.
projection.size	int or None, optional, default='None' size of project size
lstm.state.clip.min	double or None, optional, default=None Minimum clip value of LSTM states. This option must be used together with lstm_state_clip_max.
lstm.state.clip.max	double or None, optional, default=None Maximum clip value of LSTM states. This option must be used together with lstm_state_clip_min.
lstm.state.clip.nan	boolean, optional, default=0 Whether to stop NaN from propagating in state by clipping it to min/max. If clipping range is not specified, this option is ignored.
use.sequence.length	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter 'sequence_length' to specify variable length sequence
name	string, optional Name of the resulting symbol.

## Details

### \*\*Vanilla RNN\*\*

Applies a single-gate recurrent layer to input X. Two kinds of activation function are supported: ReLU and Tanh.

With ReLU activation function:

.. math:: h\_t = \text{relu}(W\_{ih} \* x\_t + b\_{ih} + W\_{hh} \* h\_{(t-1)} + b\_{hh})

With Tanh activation function:

.. math:: h\_t = \tanh(W\_{ih} \* x\_t + b\_{ih} + W\_{hh} \* h\_{(t-1)} + b\_{hh})

Reference paper: Finding structure in time - Elman, 1988. <https://crl.ucsd.edu/~elman/Papers/fsit.pdf>

### \*\*LSTM\*\*

Long Short-Term Memory - Hochreiter, 1997. <http://www.bioinf.jku.at/publications/older/2604.pdf>

.. math:: \begin{array}{l} i\_t = \text{mathrmsigmoid}(W\_{ii} x\_t + b\_{ii} + W\_{hi} h\_{(t-1)} + b\_{hi}) \\ f\_t = \text{mathrmsigmoid}(W\_{if} x\_t + b\_{if} + W\_{hf} h\_{(t-1)} + b\_{hf}) \\ g\_t = \tanh(W\_{ig} x\_t + b\_{ig} + W\_{hc} h\_{(t-1)} + b\_{hg}) \\ o\_t = \text{mathrmsigmoid}(W\_{io} x\_t + b\_{io} + W\_{ho} h\_{(t-1)} + b\_{ho}) \\ c\_t = f\_t \* c\_{(t-1)} + i\_t \* g\_t \\ h\_t = o\_t \* \tanh(c\_t) \end{array}

With the projection size being set, LSTM could use the projection feature to reduce the parameters size and give some speedups without significant damage to the accuracy.

Long Short-Term Memory Based Recurrent Neural Network Architectures for Large Vocabulary Speech Recognition - Sak et al. 2014. <https://arxiv.org/abs/1402.1128>

.. math:: \begin{array}{l} i\_t = \text{mathrmsigmoid}(W\_{ii} x\_t + b\_{ii} + W\_{ri} r\_{(t-1)} + b\_{ri}) \\ f\_t = \text{mathrmsigmoid}(W\_{if} x\_t + b\_{if} + W\_{rf} r\_{(t-1)} + b\_{rf}) \\ g\_t = \tanh(W\_{ig} x\_t + b\_{ig} + W\_{rc} r\_{(t-1)} + b\_{rg}) \\ o\_t = \text{mathrmsigmoid}(W\_{io} x\_t + b\_{io} + W\_{ro} r\_{(t-1)} + b\_{ro}) \\ c\_t = f\_t \* c\_{(t-1)} + i\_t \* g\_t \\ h\_t = o\_t \* \tanh(c\_t) \\ r\_t = W\_{hr} h\_t \end{array}

**\*\*GRU\*\***

Gated Recurrent Unit - Cho et al. 2014. <http://arxiv.org/abs/1406.1078>

The definition of GRU here is slightly different from paper but compatible with CUDNN.

$$\begin{array}{l} \text{.. math::} \\ \text{\begin{array}{l} r_t = \text{mathrmsigmoid}(W_{ir} x_t + b_{ir} + W_{hr} h_{(t-1)} + b_{hr}) \\ z_t = \text{mathrmsigmoid}(W_{iz} x_t + b_{iz} + W_{hz} h_{(t-1)} + b_{hz}) \\ n_t = \text{tanh}(W_{in} x_t + b_{in} + r_t * (W_{hn} h_{(t-1)} + b_{hn})) \\ h_t = (1 - z_t) * n_t + z_t * h_{(t-1)} \end{array}} \end{array}$$

Defined in src/operator/rnn.cc:L368

## Value

out The result mx.symbol

---

mx.symbol.ROIPooling	<i>ROIPooling: Performs region of interest(ROI) pooling on the input array.</i>
----------------------	---

---

## Description

ROI pooling is a variant of a max pooling layer, in which the output size is fixed and region of interest is a parameter. Its purpose is to perform max pooling on the inputs of non-uniform sizes to obtain fixed-size feature maps. ROI pooling is a neural-net layer mostly used in training a ‘Fast R-CNN’ network for object detection.

## Usage

```
mx.symbol.ROIPooling(...)
```

## Arguments

data	NDArray-or-Symbol The input array to the pooling operator, a 4D Feature maps
rois	NDArray-or-Symbol Bounding box coordinates, a 2D array of [[batch_index, x1, y1, x2, y2]], where (x1, y1) and (x2, y2) are top left and bottom right corners of designated region of interest. ‘batch_index’ indicates the index of corresponding image in the input array
pooled.size	Shape(tuple), required ROI pooling output shape (h,w)
spatial.scale	float, required Ratio of input feature map height (or w) to raw image height (or w). Equals the reciprocal of total stride in convolutional layers
name	string, optional Name of the resulting symbol.

## Details

This operator takes a 4D feature map as an input array and region proposals as 'rois', then it pools over sub-regions of input and produces a fixed-sized output array regardless of the ROI size.

To crop the feature map accordingly, you can resize the bounding box coordinates by changing the parameters 'rois' and 'spatial\_scale'.

The cropped feature maps are pooled by standard max pooling operation to a fixed size output indicated by a 'pooled\_size' parameter. batch\_size will change to the number of region bounding boxes after 'ROI Pooling'.

The size of each region of interest doesn't have to be perfectly divisible by the number of pooling sections('pooled\_size').

Example::

```
x = [[[ 0., 1., 2., 3., 4., 5.], [ 6., 7., 8., 9., 10., 11.], [ 12., 13., 14., 15., 16., 17.], [ 18., 19., 20., 21., 22., 23.], [ 24., 25., 26., 27., 28., 29.], [ 30., 31., 32., 33., 34., 35.], [ 36., 37., 38., 39., 40., 41.], [ 42., 43., 44., 45., 46., 47.]]]]
```

```
// region of interest i.e. bounding box coordinates. y = [[0,0,0,4,4]]
```

```
// returns array of shape (2,2) according to the given roi with max pooling. ROI Pooling(x, y, (2,2), 1.0) = [[[ 14., 16.], [ 26., 28.]]]]
```

```
// region of interest is changed due to the change in 'spacial_scale' parameter. ROI Pooling(x, y, (2,2), 0.7) = [[[ 7., 9.], [ 19., 21.]]]]
```

Defined in src/operator/roi\_pooling.cc:L225

## Value

out The result mx.symbol

---

mx.symbol.round	<i>round:Returns element-wise rounded value to the nearest integer of the input.</i>
-----------------	--

---

## Description

Example::

## Usage

```
mx.symbol.round(...)
```

## Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

`round([-1.5, 1.5, -1.9, 1.9, 2.1]) = [-2., 2., -2., 2., 2.]`

The storage type of “round” output depends upon the input storage type:

- `round(default) = default` - `round(row_sparse) = row_sparse` - `round(csr) = csr`

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L777`

**Value**

out The result `mx.symbol`

---

`mx.symbol.rsqrt`

*rsqrt: Returns element-wise inverse square-root value of the input.*

---

**Description**

.. math:: \text{rsqrt}(x) = 1/\sqrt{x}

**Usage**

`mx.symbol.rsqrt(...)`

**Arguments**

<code>data</code>	NDArray-or-Symbol The input array.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Example::

`rsqrt([4,9,16]) = [0.5, 0.33333334, 0.25]`

The storage type of “rsqrt” output is always dense

Defined in `src/operator/tensor/elemwise_unary_op_pow.cc:L221`

**Value**

out The result `mx.symbol`



---

mx.symbol.sample\_exponential

*sample\_exponential:Concurrent sampling from multiple exponential distributions with parameters lambda (rate).*


---

## Description

The parameters of the distributions are provided as an input array. Let  $[s]$  be the shape of the input array,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Usage

```
mx.symbol.sample_exponential(...)
```

## Arguments

lam	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input array,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input value at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input array.

Examples::

```
lam = [ 1.0, 8.5 ]
```

```
// Draw a single sample for each distribution sample_exponential(lam) = [ 0.51837951, 0.09994757]
```

```
// Draw a vector containing two samples for each distribution sample_exponential(lam, shape=(2))
= [[ 0.51837951, 0.19866663], [ 0.09994757, 0.50447971]]
```

Defined in src/operator/random/multisample\_op.cc:L284

## Value

out The result mx.symbol

---

```
mx.symbol.sample_gamma
```

*sample\_gamma: Concurrent sampling from multiple gamma distributions with parameters *alpha* (shape) and *beta* (scale).*

---

## Description

The parameters of the distributions are provided as input arrays. Let *[s]* be the shape of the input arrays, *n* be the dimension of *[s]*, *[t]* be the shape specified as the parameter of the operator, and *m* be the dimension of *[t]*. Then the output will be a *(n+m)*-dimensional array with shape *[s]x[t]*.

## Usage

```
mx.symbol.sample_gamma(...)
```

## Arguments

alpha	NDArray-or-Symbol Alpha (shape) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
beta	NDArray-or-Symbol Beta (scale) parameters of the distributions.
name	string, optional Name of the resulting symbol.

## Details

For any valid *n*-dimensional index *i* with respect to the input arrays, *output[i]* will be an *m*-dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index *i*. If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
alpha = [ 0.0, 2.5 ] beta = [ 1.0, 0.7 ]
```

```
// Draw a single sample for each distribution sample_gamma(alpha, beta) = [ 0. , 2.25797319]
```

```
// Draw a vector containing two samples for each distribution sample_gamma(alpha, beta, shape=(2))
= [[ 0. , 0. ], [ 2.25797319, 1.70734084]]
```

Defined in src/operator/random/multisample\_op.cc:L282

## Value

out The result mx.symbol

---

```
mx.symbol.sample_generalized_negative_binomial
```

*sample\_generalized\_negative\_binomial: Concurrent sampling from multiple generalized negative binomial distributions with parameters  $\mu$  (mean) and  $\alpha$  (dispersion).*

---

## Description

The parameters of the distributions are provided as input arrays. Let  $s$  be the shape of the input arrays,  $n$  be the dimension of  $s$ ,  $t$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $t$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $s \times t$ .

## Usage

```
mx.symbol.sample_generalized_negative_binomial(...)
```

## Arguments

<code>mu</code>	NDArray-or-Symbol Means of the distributions.
<code>shape</code>	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
<code>dtype</code>	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
<code>alpha</code>	NDArray-or-Symbol Alpha (dispersion) parameters of the distributions.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Samples will always be returned as a floating point data type.

Examples::

```
mu = [ 2.0, 2.5 ] alpha = [ 1.0, 0.1 ]
```

```
// Draw a single sample for each distribution sample_generalized_negative_binomial(mu, alpha) = [ 0., 3.]
```

```
// Draw a vector containing two samples for each distribution sample_generalized_negative_binomial(mu, alpha, shape=(2)) = [[ 0., 3.], [ 3., 1.]]
```

Defined in src/operator/random/multisample\_op.cc:L293

## Value

out The result mx.symbol

---

mx.symbol.sample\_multinomial

*sample\_multinomial: Concurrent sampling from multiple multinomial distributions.*


---

## Description

*\*data\** is an *\*n\** dimensional array whose last dimension has length *\*k\**, where *\*k\** is the number of possible outcomes of each multinomial distribution. This operator will draw *\*shape\** samples from each distribution. If shape is empty one sample will be drawn from each distribution.

## Usage

```
mx.symbol.sample_multinomial(...)
```

## Arguments

data	NDArray-or-Symbol Distribution probabilities. Must sum to one on the last axis.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
get_prob	boolean, optional, default=0 Whether to also return the log probability of sampled result. This is usually used for differentiating through stochastic variables, e.g. in reinforcement learning.
dtype	'float16', 'float32', 'float64', 'int32', 'uint8', optional, default='int32' DType of the output in case this can't be inferred.
name	string, optional Name of the resulting symbol.

## Details

If *\*get\_prob\** is true, a second array containing log likelihood of the drawn samples will also be returned. This is usually used for reinforcement learning where you can provide reward as head gradient for this array to estimate gradient.

Note that the input distribution must be normalized, i.e. *\*data\** must sum to 1 along its last axis.

Examples::

```
probs = [[0, 0.1, 0.2, 0.3, 0.4], [0.4, 0.3, 0.2, 0.1, 0]]
```

```
// Draw a single sample for each distribution sample_multinomial(probs) = [3, 0]
```

```
// Draw a vector containing two samples for each distribution sample_multinomial(probs, shape=(2))
= [[4, 2], [0, 0]]
```

```
// requests log likelihood sample_multinomial(probs, get_prob=True) = [2, 1], [0.2, 0.3]
```

## Value

out The result mx.symbol

---

mx.symbol.sample\_negative\_binomial

*sample\_negative\_binomial: Concurrent sampling from multiple negative binomial distributions with parameters \*k\* (failure limit) and \*p\* (failure probability).*

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Usage

```
mx.symbol.sample_negative_binomial(...)
```

## Arguments

k	NDArray-or-Symbol Limits of unsuccessful experiments.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
p	NDArray-or-Symbol Failure probabilities in each experiment.
name	string, optional Name of the resulting symbol.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Samples will always be returned as a floating point data type.

Examples::

```
k = [ 20, 49 ] p = [ 0.4 , 0.77 ]
```

```
// Draw a single sample for each distribution sample_negative_binomial(k, p) = [ 15., 16.]
```

```
// Draw a vector containing two samples for each distribution sample_negative_binomial(k, p,
shape=(2)) = [[ 15., 50.], [ 16., 12.]]
```

Defined in src/operator/random/multisample\_op.cc:L289

## Value

out The result mx.symbol

---

```
mx.symbol.sample_normal
```

*sample\_normal: Concurrent sampling from multiple normal distributions with parameters \*mu\* (mean) and \*sigma\* (standard deviation).*

---

## Description

The parameters of the distributions are provided as input arrays. Let  $[s]$  be the shape of the input arrays,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Usage

```
mx.symbol.sample_normal(...)
```

## Arguments

mu	NDArray-or-Symbol Means of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
sigma	NDArray-or-Symbol Standard deviations of the distributions.
name	string, optional Name of the resulting symbol.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input arrays,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
mu = [ 0.0, 2.5 ] sigma = [ 1.0, 3.7 ]
```

```
// Draw a single sample for each distribution sample_normal(mu, sigma) = [-0.56410581, 0.95934606]
```

```
// Draw a vector containing two samples for each distribution sample_normal(mu, sigma, shape=(2))
= [[-0.56410581, 0.2928229 ], [ 0.95934606, 4.48287058]]
```

Defined in src/operator/random/multisample\_op.cc:L279

## Value

out The result mx.symbol

---

mx.symbol.sample\_poisson

*sample\_poisson: Concurrent sampling from multiple Poisson distributions with parameters lambda (rate).*

---

## Description

The parameters of the distributions are provided as an input array. Let  $[s]$  be the shape of the input array,  $n$  be the dimension of  $[s]$ ,  $[t]$  be the shape specified as the parameter of the operator, and  $m$  be the dimension of  $[t]$ . Then the output will be a  $(n+m)$ -dimensional array with shape  $[s] \times [t]$ .

## Usage

```
mx.symbol.sample_poisson(...)
```

## Arguments

lam	NDArray-or-Symbol Lambda (rate) parameters of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
name	string, optional Name of the resulting symbol.

## Details

For any valid  $n$ -dimensional index  $i$  with respect to the input array,  $output[i]$  will be an  $m$ -dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input value at index  $i$ . If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input array.

Samples will always be returned as a floating point data type.

Examples::

```
lam = [ 1.0, 8.5 ]
```

```
// Draw a single sample for each distribution sample_poisson(lam) = [ 0., 13.]
```

```
// Draw a vector containing two samples for each distribution sample_poisson(lam, shape=(2)) = [[ 0., 4.], [ 13., 8.]]
```

Defined in src/operator/random/multisample\_op.cc:L286

## Value

out The result mx.symbol

---

```
mx.symbol.sample_uniform
```

*sample\_uniform: Concurrent sampling from multiple uniform distributions on the intervals given by `[low,high)`.*

---

## Description

The parameters of the distributions are provided as input arrays. Let `*[s]*` be the shape of the input arrays, `*n*` be the dimension of `*[s]*`, `*[t]*` be the shape specified as the parameter of the operator, and `*m*` be the dimension of `*[t]*`. Then the output will be a `*(n+m)*`-dimensional array with shape `*[s]x[t]*`.

## Usage

```
mx.symbol.sample_uniform(...)
```

## Arguments

low	NDArray-or-Symbol Lower bounds of the distributions.
shape	Shape(tuple), optional, default=[] Shape to be sampled from each random distribution.
dtype	'None', 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to float32 if not defined (dtype=None).
high	NDArray-or-Symbol Upper bounds of the distributions.
name	string, optional Name of the resulting symbol.

## Details

For any valid `*n*`-dimensional index `*i*` with respect to the input arrays, `*output[i]*` will be an `*m*`-dimensional array that holds randomly drawn samples from the distribution which is parameterized by the input values at index `*i*`. If the shape parameter of the operator is not set, then one sample will be drawn per distribution and the output array has the same shape as the input arrays.

Examples::

```
low = [ 0.0, 2.5 ] high = [ 1.0, 3.7 ]
```

```
// Draw a single sample for each distribution sample_uniform(low, high) = [ 0.40451524, 3.18687344]
```

```
// Draw a vector containing two samples for each distribution sample_uniform(low, high, shape=(2))
= [[ 0.40451524, 0.18017688], [ 3.18687344, 3.68352246]]
```

Defined in src/operator/random/multisample\_op.cc:L277

## Value

out The result mx.symbol



---

mx.symbol.save	Save an mx.symbol object
----------------	--------------------------

---

**Description**

Save an mx.symbol object

**Usage**

mx.symbol.save(symbol, filename)

**Arguments**

- symbol            the mx.symbol object
- filename        the filename (including the path)

**Examples**

```
data = mx.symbol.Variable('data')
mx.symbol.save(data, 'temp.symbol')
data2 = mx.symbol.load('temp.symbol')
```

---

mx.symbol.scatter_nd	<i>scatter_nd:Scatters data into a new tensor according to indices.</i>
----------------------	---

---

**Description**

Given 'data' with shape '(Y\_0, ..., Y\_K-1, X\_M, ..., X\_N-1)' and indices with shape '(M, Y\_0, ..., Y\_K-1)', the output will have shape '(X\_0, X\_1, ..., X\_N-1)', where 'M <= N'. If 'M == N', data shape should simply be '(Y\_0, ..., Y\_K-1)'.

**Usage**

mx.symbol.scatter\_nd(...)

**Arguments**

- data            NDAarray-or-Symbol data
- indices        NDAarray-or-Symbol indices
- shape          Shape(tuple), required Shape of output.
- name           string, optional Name of the resulting symbol.

**Details**

The elements in output is defined as follows::

```
output[indices[0, y_0, ..., y_K-1], ..., indices[M-1, y_0, ..., y_K-1], x_M, ..., x_N-1] = data[y_0, ..., y_K-1, x_M, ..., x_N-1]
```

all other entries in output are 0.

.. warning::

If the indices have duplicates, the result will be non-deterministic and the gradient of ‘scatter\_nd’ will not be correct!!

Examples::

```
data = [2, 3, 0] indices = [[1, 1, 0], [0, 1, 0]] shape = (2, 2) scatter_nd(data, indices, shape) = [[0, 0], [2, 3]]
```

```
data = [[[1, 2], [3, 4]], [[5, 6], [7, 8]]] indices = [[0, 1], [1, 1]] shape = (2, 2, 2, 2) scatter_nd(data, indices, shape) = [[[[0, 0], [0, 0]],
```

```
[[1, 2], [3, 4]]],
```

```
[[[0, 0], [0, 0]],
```

```
[[5, 6], [7, 8]]]]
```

**Value**

out The result mx.symbol

---

```
mx.symbol.SequenceLast
```

*SequenceLast: Takes the last element of a sequence.*

---

**Description**

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns a (n-1)-dimensional array of the form [batch\_size, other\_feature\_dims].

**Usage**

```
mx.symbol.SequenceLast(...)
```

**Arguments**

**data** NDAarray-or-Symbol n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] where n>2

**sequence.length**

NDAarray-or-Symbol vector of sequence lengths of the form [batch\_size]

**use.sequence.length**

boolean, optional, default=0 If set to true, this layer takes in an extra input parameter ‘sequence\_length’ to specify variable length sequence

axis	int, optional, default='0' The sequence axis. Only values of 0 and 1 are currently supported.
name	string, optional Name of the resulting symbol.

## Details

Parameter 'sequence\_length' is used to handle variable-length sequences. 'sequence\_length' should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set 'use\_sequence\_length' to 'True', otherwise each example in the batch is assumed to have the max sequence length.

.. note:: Alternatively, you can also use 'take' operator.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.], [ 7., 8., 9.]],
      [[ 10., 11., 12.], [ 13., 14., 15.], [ 16., 17., 18.]],
      [[ 19., 20., 21.], [ 22., 23., 24.], [ 25., 26., 27.]]]

// returns last sequence when sequence_length parameter is not used SequenceLast(x) = [[ 19., 20.,
21.], [ 22., 23., 24.], [ 25., 26., 27.]]

// sequence_length is used SequenceLast(x, sequence_length=[1,1,1], use_sequence_length=True)
= [[ 1., 2., 3.], [ 4., 5., 6.], [ 7., 8., 9.]]

// sequence_length is used SequenceLast(x, sequence_length=[1,2,3], use_sequence_length=True)
= [[ 1., 2., 3.], [ 13., 14., 15.], [ 25., 26., 27.]]

Defined in src/operator/sequence_last.cc:L106
```

## Value

out The result mx.symbol

---

mx.symbol.SequenceMask

*SequenceMask: Sets all elements outside the sequence to a constant value.*

---

## Description

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns an array of the same shape.

## Usage

```
mx.symbol.SequenceMask(...)
```

**Arguments**

<code>data</code>	NDArray-or-Symbol n-dimensional input array of the form [max_sequence_length, batch_size, other_feature_dims] where n>2
<code>sequence.length</code>	NDArray-or-Symbol vector of sequence lengths of the form [batch_size]
<code>use.sequence.length</code>	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter 'sequence_length' to specify variable length sequence
<code>value</code>	float, optional, default=0 The value to be used as a mask.
<code>axis</code>	int, optional, default='0' The sequence axis. Only values of 0 and 1 are currently supported.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

Parameter 'sequence\_length' is used to handle variable-length sequences. 'sequence\_length' should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set 'use\_sequence\_length' to 'True', otherwise each example in the batch is assumed to have the max sequence length and this operator works as the 'identity' operator.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.]],
      [[ 7., 8., 9.], [10., 11., 12.]],
      [[13., 14., 15.], [16., 17., 18.]]]
// Batch 1 B1 = [[ 1., 2., 3.], [ 7., 8., 9.], [13., 14., 15.]]
// Batch 2 B2 = [[ 4., 5., 6.], [10., 11., 12.], [16., 17., 18.]]
// works as identity operator when sequence_length parameter is not used SequenceMask(x) = [[[
1., 2., 3.], [ 4., 5., 6.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[13., 14., 15.], [16., 17., 18.]]]
// sequence_length [1,1] means 1 of each batch will be kept // and other rows are masked with
default mask value = 0 SequenceMask(x, sequence_length=[1,1], use_sequence_length=True) = [[[
1., 2., 3.], [ 4., 5., 6.]],
[[ 0., 0., 0.], [ 0., 0., 0.]],
[[ 0., 0., 0.], [ 0., 0., 0.]]]
// sequence_length [2,3] means 2 of batch B1 and 3 of batch B2 will be kept // and other rows
are masked with value = 1 SequenceMask(x, sequence_length=[2,3], use_sequence_length=True,
value=1) = [[[ 1., 2., 3.], [ 4., 5., 6.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[ 1., 1., 1.], [16., 17., 18.]]]
```

Defined in src/operator/sequence\_mask.cc:L186

**Value**

out The result mx.symbol

---

mx.symbol.SequenceReverse

*SequenceReverse:Reverses the elements of each sequence.*

---

**Description**

This function takes an n-dimensional input array of the form [max\_sequence\_length, batch\_size, other\_feature\_dims] and returns an array of the same shape.

**Usage**

```
mx.symbol.SequenceReverse(...)
```

**Arguments**

data	NDArray-or-Symbol n-dimensional input array of the form [max_sequence_length, batch_size, other dims] where n>2
sequence.length	NDArray-or-Symbol vector of sequence lengths of the form [batch_size]
use.sequence.length	boolean, optional, default=0 If set to true, this layer takes in an extra input parameter 'sequence_length' to specify variable length sequence
axis	int, optional, default='0' The sequence axis. Only 0 is currently supported.
name	string, optional Name of the resulting symbol.

**Details**

Parameter 'sequence\_length' is used to handle variable-length sequences. 'sequence\_length' should be an input array of positive ints of dimension [batch\_size]. To use this parameter, set 'use\_sequence\_length' to 'True', otherwise each example in the batch is assumed to have the max sequence length.

Example::

```
x = [[[ 1., 2., 3.], [ 4., 5., 6.]],
      [[ 7., 8., 9.], [10., 11., 12.]],
      [[13., 14., 15.], [16., 17., 18.]]]
// Batch 1 B1 = [[ 1., 2., 3.], [ 7., 8., 9.], [13., 14., 15.]]
// Batch 2 B2 = [[ 4., 5., 6.], [10., 11., 12.], [16., 17., 18.]]
// returns reverse sequence when sequence_length parameter is not used SequenceReverse(x) = [[[
13., 14., 15.], [16., 17., 18.]],
[[ 7., 8., 9.], [10., 11., 12.]],
[[ 1., 2., 3.], [ 4., 5., 6.]]]
```

```
// sequence_length [2,2] means 2 rows of // both batch B1 and B2 will be reversed. SequenceRe-
verse(x, sequence_length=[2,2], use_sequence_length=True) = [[[ 7., 8., 9.], [ 10., 11., 12.]],
[[ 1., 2., 3.], [ 4., 5., 6.]],
[[ 13., 14., 15.], [ 16., 17., 18.]]]
// sequence_length [2,3] means 2 of batch B2 and 3 of batch B3 // will be reversed. SequenceRe-
verse(x, sequence_length=[2,3], use_sequence_length=True) = [[[ 7., 8., 9.], [ 16., 17., 18.]],
[[ 1., 2., 3.], [ 10., 11., 12.]],
[[ 13., 14., 15.], [ 4., 5., 6.]]]
Defined in src/operator/sequence_reverse.cc:L122
```

## Value

out The result mx.symbol

---

mx.symbol.sgd\_mom\_update

*sgd\_mom\_update: Momentum update function for Stochastic Gradient Descent (SGD) optimizer.*

---

## Description

Momentum update has better convergence rates on neural networks. Mathematically it looks like below:

## Usage

```
mx.symbol.sgd_mom_update(...)
```

## Arguments

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale_grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip_gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
lazy_update	boolean, optional, default=1 If true, lazy updates are applied if gradient's stype is row_sparse and both weight and momentum have the same stype
name	string, optional Name of the resulting symbol.

**Details**

.. math::

$$v_1 = \alpha * \nabla J(W_0) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$v = \text{momentum} * v - \text{learning\_rate} * \text{gradient weight} \quad += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

However, if grad’s storage type is “row\_sparse“, “lazy\_update“ is True and weight’s storage type is the same as momentum’s storage type, only the row slices whose indices appear in grad.indices are updated (for both weight and momentum)::

```
for row in gradient.indices: v[row] = momentum[row] * v[row] - learning_rate * gradient[row]
weight[row] += v[row]
```

Defined in src/operator/optimizer\_op.cc:L556

**Value**

out The result mx.symbol

---

mx.symbol.sgd_update	<i>sgd_update: Update function for Stochastic Gradient Descent (SGD) optimizer.</i>
----------------------	---

---

**Description**

It updates the weights using::

**Usage**

```
mx.symbol.sgd_update(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
lr	float, required Learning rate
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to grad = rescale_grad*grad.
clip.gradient	float, optional, default=-1 Clip gradient to the range of [-clip_gradient, clip_gradient] If clip_gradient <= 0, gradient clipping is turned off. grad = max(min(grad, clip_gradient), -clip_gradient).
lazy.update	boolean, optional, default=1 If true, lazy updates are applied if gradient’s stype is row_sparse.
name	string, optional Name of the resulting symbol.

**Details**

```
weight = weight - learning_rate * (gradient + wd * weight)
```

However, if gradient is of “row\_sparse” storage type and “lazy\_update” is True, only the row slices whose indices appear in grad.indices are updated::

```
for row in gradient.indices: weight[row] = weight[row] - learning_rate * (gradient[row] + wd * weight[row])
```

Defined in src/operator/optimizer\_op.cc:L515

**Value**

out The result mx.symbol

---

`mx.symbol.shape_array` *shape\_array:Returns a 1D int64 array containing the shape of data.*

---

**Description**

Example::

**Usage**

```
mx.symbol.shape_array(...)
```

**Arguments**

data	NDArray-or-Symbol Input Array.
name	string, optional Name of the resulting symbol.

**Details**

```
shape_array([[1,2,3,4], [5,6,7,8]]) = [2,4]
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L573

**Value**

out The result mx.symbol



---

mx.symbol.shuffle	<i>shuffle: Randomly shuffle the elements.</i>
-------------------	--

---

**Description**

This shuffles the array along the first axis. The order of the elements in each subarray does not change. For example, if a 2D array is given, the order of the rows randomly changes, but the order of the elements in each row does not change.

**Usage**

mx.symbol.shuffle(...)

**Arguments**

data	NDArray-or-Symbol Data to be shuffled.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.sigmoid	<i>sigmoid: Computes sigmoid of x element-wise.</i>
-------------------	---

---

**Description**

.. math:: y = 1 / (1 + \exp(-x))

**Usage**

mx.symbol.sigmoid(...)

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “sigmoid“ output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L119

**Value**

out The result mx.symbol

---

mx.symbol.sign	<i>sign:Returns element-wise sign of the input.</i>
----------------	---

---

## Description

Example::

## Usage

```
mx.symbol.sign(...)
```

## Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

## Details

```
sign([-2, 0, 3]) = [-1, 0, 1]
```

The storage type of “sign“ output depends upon the input storage type:

- sign(default) = default - sign(row\_sparse) = row\_sparse - sign(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L758

## Value

out The result mx.symbol

---

mx.symbol.signsgd_update	<i>signsgd_update:Update function for SignSGD optimizer.</i>
--------------------------	--

---

## Description

.. math::

## Usage

```
mx.symbol.signsgd_update(...)
```

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
lr	float, required Learning rate
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
name	string, optional Name of the resulting symbol.

**Details**

$$g_t = \nabla J(W_{t-1}) \quad W_t = W_{t-1} - \eta_t \text{sign}(g_t)$$

It updates the weights using::

$$\text{weight} = \text{weight} - \text{learning\_rate} * \text{sign}(\text{gradient})$$

.. note:: - sparse ndarray not supported for this optimizer yet.

Defined in src/operator/optimizer\_op.cc:L63

**Value**

out The result mx.symbol

---

mx.symbol.signum\_update

*signum\_update: SIGN momentUM (Signum) optimizer.*

---

**Description**

.. math::

**Usage**

mx.symbol.signum\_update(...)

**Arguments**

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
mom	NDArray-or-Symbol Momentum
lr	float, required Learning rate
momentum	float, optional, default=0 The decay rate of momentum estimates at each epoch.
wd	float, optional, default=0 Weight decay augments the objective function with a regularization term that penalizes large weights. The penalty scales with the square of the magnitude of each weight.
rescale.grad	float, optional, default=1 Rescale gradient to $\text{grad} = \text{rescale\_grad} * \text{grad}$ .
clip.gradient	float, optional, default=-1 Clip gradient to the range of $[-\text{clip\_gradient}, \text{clip\_gradient}]$ . If $\text{clip\_gradient} \leq 0$ , gradient clipping is turned off. $\text{grad} = \max(\min(\text{grad}, \text{clip\_gradient}), -\text{clip\_gradient})$ .
wd.lh	float, optional, default=0 The amount of weight decay that does not go into gradient/momentum calculations otherwise do weight decay algorithmically only.
name	string, optional Name of the resulting symbol.

**Details**

$$g_t = \nabla J(W_{t-1}) \quad m_t = \beta m_{t-1} + (1 - \beta) g_t \quad W_t = W_{t-1} - \eta_t \text{sign}(m_t)$$
  
It updates the weights using::  $\text{state} = \text{momentum} * \text{state} + (1 - \text{momentum}) * \text{gradient}$   $\text{weight} = \text{weight} - \text{learning\_rate} * \text{sign}(\text{state})$   
Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.  
.. note:: - sparse ndarray not supported for this optimizer yet.  
Defined in `src/operator/optimizer_op.cc:L92`

**Value**

out The result `mx.symbol`

---

<code>mx.symbol.sin</code>	<i>sin: Computes the element-wise sine of the input array.</i>
----------------------------	--

---

**Description**

The input should be in radians (:math:‘2\pi‘ rad equals 360 degrees).

**Usage**

`mx.symbol.sin(...)`

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

.. math:: \sin([0, \pi/4, \pi/2]) = [0, 0.707, 1]

The storage type of “sin” output depends upon the input storage type:

- sin(default) = default - sin(row\_sparse) = row\_sparse - sin(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L47

**Value**

out The result mx.symbol

---

mx.symbol.sinh	<i>sinh:Returns the hyperbolic sine of the input array, computed element-wise.</i>
----------------	--

---

**Description**

.. math:: \sinh(x) = 0.5 \times (\exp(x) - \exp(-x))

**Usage**

mx.symbol.sinh(...)

**Arguments**

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

**Details**

The storage type of “sinh” output depends upon the input storage type:

- sinh(default) = default - sinh(row\_sparse) = row\_sparse - sinh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L371

**Value**

out The result mx.symbol

---

`mx.symbol.size_array`    *size\_array:Returns a 1D int64 array containing the size of data.*

---

## Description

Example::

## Usage

```
mx.symbol.size_array(...)
```

## Arguments

<code>data</code>	NDArray-or-Symbol Input Array.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

```
size_array([[1,2,3,4], [5,6,7,8]]) = [8]
```

Defined in `src/operator/tensor/elemwise_unary_op_basic.cc:L624`

## Value

out The result `mx.symbol`

---

mx.symbol.slice

*slice*: Slices a region of the array. .. note:: “crop” is deprecated. Use “slice” instead. This function returns a sliced array between the indices given by ‘begin’ and ‘end’ with the corresponding ‘step’. For an input array of “shape=(d\_0, d\_1, ..., d\_n-1)”, slice operation with “begin=(b\_0, b\_1...b\_m-1)”, “end=(e\_0, e\_1, ..., e\_m-1)”, and “step=(s\_0, s\_1, ..., s\_m-1)”, where  $m \leq n$ , results in an array with the shape “(l\_e\_0-b\_0/l\_s\_0l, ..., l\_e\_m-1-b\_m-1/l\_s\_m-1l, d\_m, ..., d\_n-1)”. The resulting array’s \*k\*-th dimension contains elements from the \*k\*-th dimension of the input array starting from index “b\_k” (inclusive) with step “s\_k” until reaching “e\_k” (exclusive). If the \*k\*-th elements are ‘None’ in the sequence of ‘begin’, ‘end’, and ‘step’, the following rule will be used to set default values. If ‘s\_k’ is ‘None’, set ‘s\_k=1’. If ‘s\_k > 0’, set ‘b\_k=0’, ‘e\_k=d\_k’; else, set ‘b\_k=d\_k-1’, ‘e\_k=-1’. The storage type of “slice” output depends on storage types of inputs - slice(csr) = csr - otherwise, “slice” generates output with default storage .. note:: When input data storage type is csr, it only supports step=(), or step=(None,), or step=(1,) to generate a csr output. For other step parameter values, it falls back to slicing a dense tensor. Example:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice(x, begin=(0,1), end=(2,4)) = [[ 2., 3., 4.], [ 6., 7., 8.]] slice(x, begin=(None, 0), end=(None, 3), step=(-1, 2)) = [[9., 11.], [5., 7.], [1., 3.]]

## Description

Defined in src/operator/tensor/matrix\_op.cc:L482

## Usage

```
mx.symbol.slice(...)
```

## Arguments

data	NDArray-or-Symbol Source input
begin	Shape(tuple), required starting indices for the slice operation, supports negative indices.
end	Shape(tuple), required ending indices for the slice operation, supports negative indices.
step	Shape(tuple), optional, default=[] step for the slice operation, supports negative values.
name	string, optional Name of the resulting symbol.

## Value

out The result mx.symbol

---

```
mx.symbol.SliceChannel
```

*SliceChannel: Splits an array along a particular axis into multiple sub-arrays.*

---

## Description

.. note:: “SliceChannel” is deprecated. Use “split” instead.

## Usage

```
mx.symbol.SliceChannel(...)
```

## Arguments

<code>data</code>	NDArray-or-Symbol The input
<code>num.outputs</code>	int, required Number of splits. Note that this should evenly divide the length of the ‘axis’.
<code>axis</code>	int, optional, default=’1’ Axis along which to split.
<code>squeeze.axis</code>	boolean, optional, default=0 If true, Removes the axis with length 1 from the shapes of the output arrays. <b>Note</b> that setting ‘squeeze_axis’ to “true” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze_axis’ can be set to “true” only if “input.shape[axis] == num_outputs”.
<code>name</code>	string, optional Name of the resulting symbol.

## Details

**Note** that ‘num\_outputs’ should evenly divide the length of the axis along which to split the array.

Example::

```
x = [[[ 1.] [ 2.]] [[ 3.] [ 4.]] [[ 5.] [ 6.]]] x.shape = (3, 2, 1)
```

```
y = split(x, axis=1, num_outputs=2) // a list of 2 arrays with shape (3, 1, 1) y = [[[ 1.]] [[ 3.]] [[ 5.]]
```

```
[[[ 2.]] [[ 4.]] [[ 6.]]]
```

```
y[0].shape = (3, 1, 1)
```

```
z = split(x, axis=0, num_outputs=3) // a list of 3 arrays with shape (1, 2, 1) z = [[[ 1.] [ 2.]]
```

```
[[[ 3.] [ 4.]]
```

```
[[[ 5.] [ 6.]]]
```

```
z[0].shape = (1, 2, 1)
```

‘squeeze\_axis=1’ removes the axis with length 1 from the shapes of the output arrays. **Note** that setting ‘squeeze\_axis’ to “1” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze\_axis’ can be set to true only if “input.shape[axis] == num\_outputs”.

Example::



```

z = split(x, axis=0, num_outputs=3, squeeze_axis=1) // a list of 3 arrays with shape (2, 1)
z = [[ 1.]
      [ 2.]]
[[ 3.] [ 4.]]
[[ 5.] [ 6.]] z[0].shape = (2,1 )
Defined in src/operator/slice_channel.cc:L107

```

**Value**

out The result mx.symbol

---

`mx.symbol.slice_axis` *slice\_axis: Slices along a given axis. Returns an array slice along a given 'axis' starting from the 'begin' index to the 'end' index. Examples:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice\_axis(x, axis=0, begin=1, end=3) = [[ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] slice\_axis(x, axis=1, begin=0, end=2) = [[ 1., 2.], [ 5., 6.], [ 9., 10.]] slice\_axis(x, axis=1, begin=-3, end=-1) = [[ 2., 3.], [ 6., 7.], [ 10., 11.]]*

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L571

**Usage**

```
mx.symbol.slice_axis(...)
```

**Arguments**

data	NDArray-or-Symbol Source input
axis	int, required Axis along which to be sliced, supports negative indexes.
begin	int, required The beginning index along the axis to be sliced, supports negative indexes.
end	int or None, required The ending index along the axis to be sliced, supports negative indexes.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.slice_like	<i>slice_like</i> :Slices a region of the array like the shape of another array. This function is similar to “slice“, however, the ‘begin‘ are always ‘0‘s and ‘end‘ of specific axes are inferred from the second input ‘shape_like‘. Given the second ‘shape_like‘ input of “shape=(d_0, d_1, ..., d_n-1)“, a “slice_like“ operator with default empty ‘axes‘, it performs the following operation: “ out = slice(input, begin=(0, 0, ..., 0), end=(d_0, d_1, ..., d_n-1))“. When ‘axes‘ is not empty, it is used to specify which axes are being sliced. Given a 4-d input data, “slice_like“ operator with “axes=(0, 2, -1)“ will perform the following operation: “ out = slice(input, begin=(0, 0, 0, 0), end=(d_0, None, d_2, d_3))“. Note that it is allowed to have first and second input with different dimensions, however, you have to make sure the ‘axes‘ are specified and not exceeding the dimension limits. For example, given ‘input_1‘ with “shape=(2,3,4,5)“ and ‘input_2‘ with “shape=(1,2,3)“, it is not allowed to use: “ out = slice_like(a, b)“ because ndim of ‘input_1‘ is 4, and ndim of ‘input_2‘ is 3. The following is allowed in this situation: “ out = slice_like(a, b, axes=(0, 2))“ Example:: x = [[ 1., 2., 3., 4.], [ 5., 6., 7., 8.], [ 9., 10., 11., 12.]] y = [[ 0., 0., 0.], [ 0., 0., 0.]] slice_like(x, y) = [[ 1., 2., 3.] [ 5., 6., 7.]] slice_like(x, y, axes=(0, 1)) = [[ 1., 2., 3.] [ 5., 6., 7.]] slice_like(x, y, axes=(0)) = [[ 1., 2., 3., 4.] [ 5., 6., 7., 8.]] slice_like(x, y, axes=(-1)) = [[ 1., 2., 3.] [ 5., 6., 7.] [ 9., 10., 11.]]
----------------------	--

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L625

**Usage**

mx.symbol.slice\_like(...)

**Arguments**

data	NDArray-or-Symbol Source input
shape_like	NDArray-or-Symbol Shape like input
axes	Shape(tuple), optional, default=[] List of axes on which input data will be sliced according to the corresponding size of the second input. By default will slice on all axes. Negative axes are supported.
name	string, optional Name of the resulting symbol.

**Value**

out The result mx.symbol

---

mx.symbol.smooth_l1	<i>smooth_l1:Calculate Smooth L1 Loss(lhs, scalar) by summing</i>
---------------------	---

---

**Description**

.. math::

**Usage**

mx.symbol.smooth\_l1(...)

**Arguments**

- |        |  |
|--------|--|
| data   | NDArray-or-Symbol source input                 |
| scalar | float scalar input                             |
| name   | string, optional Name of the resulting symbol. |

**Details**

$$f(x) = \begin{cases} (\sigma x)^2/2, & \text{if } x < 1/\sigma^2 \\ |x|-0.5/\sigma^2, & \text{otherwise} \end{cases}$$
  
where :math:`x` is an element of the tensor \*lhs\* and :math:`\sigma` is the scalar.  
Example::  
smooth\_l1([1, 2, 3, 4]) = [0.5, 1.5, 2.5, 3.5] smooth\_l1([1, 2, 3, 4], scalar=1) = [0.5, 1.5, 2.5, 3.5]  
Defined in src/operator/tensor/elemwise\_binary\_scalar\_op\_extended.cc:L108

**Value**

out The result mx.symbol

---

mx.symbol.Softmax	<i>Softmax:Computes the gradient of cross entropy loss with respect to softmax output.</i>
-------------------	--

---

**Description**

- This operator computes the gradient in two steps. The cross entropy loss does not actually need to be computed.

**Usage**

mx.symbol.Softmax(...)

**Arguments**

<code>data</code>	NDArray-or-Symbol Input array.
<code>label</code>	NDArray-or-Symbol Ground truth label.
<code>grad.scale</code>	float, optional, default=1 Scales the gradient by a float factor.
<code>ignore.label</code>	float, optional, default=-1 The instances whose 'labels' == 'ignore_label' will be ignored during backward, if 'use_ignore' is set to "true".
<code>multi.output</code>	boolean, optional, default=0 If set to "true", the softmax function will be computed along axis "1". This is applied when the shape of input array differs from the shape of label array.
<code>use.ignore</code>	boolean, optional, default=0 If set to "true", the 'ignore_label' value will not contribute to the backward gradient.
<code>preserve.shape</code>	boolean, optional, default=0 If set to "true", the softmax function will be computed along the last axis ("-1").
<code>normalization</code>	'batch', 'null', 'valid', optional, default='null' Normalizes the gradient.
<code>out.grad</code>	boolean, optional, default=0 Multiplies gradient with output gradient element-wise.
<code>smooth.alpha</code>	float, optional, default=0 Constant for computing a label smoothed version of cross-entropy for the backwards pass. This constant gets subtracted from the one-hot encoding of the gold label and distributed uniformly to all other labels.
<code>name</code>	string, optional Name of the resulting symbol.

**Details**

- Applies softmax function on the input array. - Computes and returns the gradient of cross entropy loss w.r.t. the softmax output.

- The softmax function, cross entropy loss and gradient is given by:

- Softmax Function:

$$\text{softmax}(x)_i = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$

- Cross Entropy Function:

$$\text{CE}(\text{label}, \text{output}) = - \sum_i \text{label}_i \log(\text{output}_i)$$

- The gradient of cross entropy loss w.r.t softmax output:

$$\text{gradient} = \text{output} - \text{label}$$

- During forward propagation, the softmax function is computed for each instance in the input array.

For general \*N\*-D input arrays with shape  $(d_1, d_2, \dots, d_n)$ . The size is  $s = d_1 \cdot d_2 \cdot \dots \cdot d_n$ . We can use the parameters 'preserve\_shape' and 'multi\_output' to specify the way to compute softmax:

- By default, 'preserve\_shape' is "false". This operator will reshape the input array into a 2-D array with shape  $(d_1, \frac{s}{d_1})$  and then compute the softmax function for each row in the reshaped array, and afterwards reshape it back to the original shape  $(d_1, d_2, \dots, d_n)$ .

- If 'preserve\_shape' is "true", the softmax function will be computed along the last axis ('axis' = "-1"). - If 'multi\_output' is "true", the softmax function will be computed along the second axis ('axis' = "1").

- During backward propagation, the gradient of cross-entropy loss w.r.t softmax output array is computed. The provided label can be a one-hot label array or a probability label array.
- If the parameter 'use\_ignore' is "true", 'ignore\_label' can specify input instances with a particular label to be ignored during backward propagation. \*\*This has no effect when softmax 'output' has same shape as 'label'\*\*,.

Example::

```
data = [[1,2,3,4],[2,2,2,2],[3,3,3,3],[4,4,4,4]] label = [1,0,2,3] ignore_label = 1 SoftmaxOutput(data=data,
label = label,\ multi_output=true, use_ignore=true,\ ignore_label=ignore_label) ## forward softmax
output [[ 0.0320586 0.08714432 0.23688284 0.64391428] [ 0.25 0.25 0.25 0.25 ] [ 0.25 0.25 0.25
0.25 ] [ 0.25 0.25 0.25 0.25 ]] ## backward gradient output [[ 0. 0. 0. 0. ] [-0.75 0.25 0.25 0.25] [
0.25 0.25 -0.75 0.25] [ 0.25 0.25 0.25 -0.75]] ## notice that the first row is all 0 because label[0] is
1, which is equal to ignore_label.
```

- The parameter 'grad\_scale' can be used to rescale the gradient, which is often used to give each loss function different weights.
- This operator also supports various ways to normalize the gradient by 'normalization', The 'normalization' is applied if softmax output has different shape than the labels. The 'normalization' mode can be set to the followings:
  - "null": do nothing.
  - "batch": divide the gradient by the batch size.
  - "valid": divide the gradient by the number of instances which are not ignored.

Defined in src/operator/softmax\_output.cc:L231

**Value**

out The result mx.symbol

---

mx.symbol.softmax	<i>softmax:Applies the softmax function.</i>
-------------------	--

---

**Description**

The resulting array contains elements in the range (0,1) and the elements along the given axis sum up to 1.

**Usage**

mx.symbol.softmax(...)

**Arguments**

data	NDArray-or-Symbol The input array.
length	NDArray-or-Symbol The length array.
axis	int, optional, default='-1' The axis along which to compute softmax.
temperature	double or None, optional, default=None Temperature parameter in softmax

dtype	None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None).
use.length	boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.
name	string, optional Name of the resulting symbol.

### Details

.. math:: \text{softmax}(\mathbf{z}/t)\_j = \frac{e^{z\_j/t}}{\sum\_{k=1}^K e^{z\_k/t}}

for :math:j = 1, \dots, K

t is the temperature parameter in softmax function. By default, t equals 1.0

Example::

```
x = [[ 1.  1.  1.] [ 1.  1.  1.]
```

```
softmax(x,axis=0) = [[ 0.5 0.5 0.5] [ 0.5 0.5 0.5]]
```

```
softmax(x,axis=1) = [[ 0.33333334, 0.33333334, 0.33333334], [ 0.33333334, 0.33333334, 0.33333334]]
```

Defined in src/operator/nn/softmax.cc:L134

### Value

out The result mx.symbol

---

mx.symbol.SoftmaxActivation

*SoftmaxActivation:Applies softmax activation to input. This is intended for internal layers.*

---

### Description

.. note::

### Usage

```
mx.symbol.SoftmaxActivation(...)
```

### Arguments

data	NDArray-or-Symbol The input array.
mode	'channel', 'instance', optional, default='instance' Specifies how to compute the softmax. If set to "instance", it computes softmax for each instance. If set to "channel", It computes cross channel softmax for each position of each instance.
name	string, optional Name of the resulting symbol.

## Details

This operator has been deprecated, please use ‘softmax’.

If ‘mode’ = “instance“, this operator will compute a softmax for each instance in the batch. This is the default mode.

If ‘mode’ = “channel“, this operator will compute a k-class softmax at each position of each instance, where ‘k’ = “num\_channel“. This mode can only be used when the input array has at least 3 dimensions. This can be used for ‘fully convolutional network’, ‘image segmentation’, etc.

Example::

```
>> input_array = mx.nd.array([[3., 0.5, -0.5, 2., 7.], >> [2., -.4, 7., 3., 0.2]]) >> softmax_act =
mx.nd.SoftmaxActivation(input_array) >> print softmax_act.asnumpy() [[ 1.78322066e-02 1.46375655e-
03 5.38485940e-04 6.56010211e-03 9.73605454e-01] [ 6.56221947e-03 5.95310994e-04 9.73919690e-
01 1.78379621e-02 1.08472735e-03]]
```

Defined in src/operator/nn/softmax\_activation.cc:L59

## Value

out The result mx.symbol

---

mx.symbol.SoftmaxOutput

*SoftmaxOutput: Computes the gradient of cross entropy loss with respect to softmax output.*

---

## Description

- This operator computes the gradient in two steps. The cross entropy loss does not actually need to be computed.

## Usage

```
mx.symbol.SoftmaxOutput(...)
```

## Arguments

data	NDArray-or-Symbol Input array.
label	NDArray-or-Symbol Ground truth label.
grad.scale	float, optional, default=1 Scales the gradient by a float factor.
ignore.label	float, optional, default=-1 The instances whose ‘labels’ == ‘ignore_label’ will be ignored during backward, if ‘use_ignore’ is set to “true“).
multi.output	boolean, optional, default=0 If set to “true“, the softmax function will be computed along axis “1“. This is applied when the shape of input array differs from the shape of label array.
use.ignore	boolean, optional, default=0 If set to “true“, the ‘ignore_label’ value will not contribute to the backward gradient.

preserve.shape	boolean, optional, default=0 If set to “true”, the softmax function will be computed along the last axis (“-1”).
normalization	‘batch’, ‘null’, ‘valid’, optional, default=‘null’ Normalizes the gradient.
out.grad	boolean, optional, default=0 Multiplies gradient with output gradient element-wise.
smooth.alpha	float, optional, default=0 Constant for computing a label smoothed version of cross-entropy for the backwards pass. This constant gets subtracted from the one-hot encoding of the gold label and distributed uniformly to all other labels.
name	string, optional Name of the resulting symbol.

## Details

- Applies softmax function on the input array. - Computes and returns the gradient of cross entropy loss w.r.t. the softmax output.

- The softmax function, cross entropy loss and gradient is given by:

- Softmax Function:

$$\text{softmax}(x)_i = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$

- Cross Entropy Function:

$$\text{CE}(\text{label}, \text{output}) = - \sum_i \text{label}_i \log(\text{output}_i)$$

- The gradient of cross entropy loss w.r.t softmax output:

$$\text{gradient} = \text{output} - \text{label}$$

- During forward propagation, the softmax function is computed for each instance in the input array.

For general  $N \times D$  input arrays with shape  $(d_1, d_2, \dots, d_n)$ . The size is  $s = d_1 \times d_2 \times \dots \times d_n$ . We can use the parameters ‘preserve\_shape’ and ‘multi\_output’ to specify the way to compute softmax:

- By default, ‘preserve\_shape’ is “false”. This operator will reshape the input array into a 2-D array with shape  $(d_1, \frac{s}{d_1})$  and then compute the softmax function for each row in the reshaped array, and afterwards reshape it back to the original shape  $(d_1, d_2, \dots, d_n)$ .

- If ‘preserve\_shape’ is “true”, the softmax function will be computed along the last axis (‘axis’ = “-1”). - If ‘multi\_output’ is “true”, the softmax function will be computed along the second axis (‘axis’ = “1”).

- During backward propagation, the gradient of cross-entropy loss w.r.t softmax output array is computed. The provided label can be a one-hot label array or a probability label array.

- If the parameter ‘use\_ignore’ is “true”, ‘ignore\_label’ can specify input instances with a particular label to be ignored during backward propagation. \*\*This has no effect when softmax ‘output’ has same shape as ‘label’\*\*.

Example::

```
data = [[1,2,3,4],[2,2,2,2],[3,3,3,3],[4,4,4,4]] label = [1,0,2,3] ignore_label = 1
SoftmaxOutput(data=data, label=label, multi_output=true, use_ignore=true, ignore_label=ignore_label) ## forward softmax
output [[ 0.0320586 0.08714432 0.23688284 0.64391428] [ 0.25 0.25 0.25 0.25 ] [ 0.25 0.25 0.25
0.25 ] [ 0.25 0.25 0.25 0.25 ]] ## backward gradient output [[ 0. 0. 0. 0. ] [-0.75 0.25 0.25 0.25] [
0.25 0.25 -0.75 0.25] [ 0.25 0.25 0.25 -0.75]] ## notice that the first row is all 0 because label[0] is
1, which is equal to ignore_label.
```



- The parameter 'grad\_scale' can be used to rescale the gradient, which is often used to give each loss function different weights.
  - This operator also supports various ways to normalize the gradient by 'normalization', The 'normalization' is applied if softmax output has different shape than the labels. The 'normalization' mode can be set to the followings:
    - "null": do nothing.
    - "batch": divide the gradient by the batch size.
    - "valid": divide the gradient by the number of instances which are not ignored.
- Defined in src/operator/softmax\_output.cc:L231

## Value

out The result mx.symbol

---

mx.symbol.softmax\_cross\_entropy

*softmax\_cross\_entropy: Calculate cross entropy of softmax output and one-hot label.*

---

## Description

- This operator computes the cross entropy in two steps:
  - Applies softmax function on the input array.
  - Computes and returns the cross entropy loss between the softmax output and the labels.

## Usage

mx.symbol.softmax\_cross\_entropy(...)

## Arguments

data	NDArray-or-Symbol Input data
label	NDArray-or-Symbol Input label
name	string, optional Name of the resulting symbol.

## Details

- The softmax function and cross entropy loss is given by:
  - Softmax Function:
 
$$\text{softmax}(x)_i = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$
  - Cross Entropy Function:
 
$$\text{CE}(\text{label}, \text{output}) = - \sum_i \text{label}_i \log(\text{output}_i)$$
- Example::
- ```
x = [[1, 2, 3], [11, 7, 5]]
label = [2, 0]
softmax(x) = [[0.09003057, 0.24472848, 0.66524094], [0.97962922, 0.01794253, 0.00242826]]
softmax_cross_entropy(data, label) = - log(0.66524084) - log(0.97962922) = 0.4281871
```
- Defined in src/operator/loss\_binary\_op.cc:L59

**Value**

out The result `mx.symbol`

---

|                                |                                              |
|--------------------------------|----------------------------------------------|
| <code>mx.symbol.softmax</code> | <i>softmax:Applies the softmax function.</i> |
|--------------------------------|----------------------------------------------|

---

**Description**

The resulting array contains elements in the range (0,1) and the elements along the given axis sum up to 1.

**Usage**

`mx.symbol.softmax(...)`

**Arguments**

|                          |                                                                                                                                                                                        |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>        | NDArray-or-Symbol The input array.                                                                                                                                                     |
| <code>axis</code>        | int, optional, default='-1' The axis along which to compute softmax.                                                                                                                   |
| <code>temperature</code> | double or None, optional, default=None Temperature parameter in softmax                                                                                                                |
| <code>dtype</code>       | None, 'float16', 'float32', 'float64', optional, default='None' DType of the output in case this can't be inferred. Defaults to the same as input's dtype if not defined (dtype=None). |
| <code>use.length</code>  | boolean or None, optional, default=0 Whether to use the length input as a mask over the data input.                                                                                    |
| <code>name</code>        | string, optional Name of the resulting symbol.                                                                                                                                         |

**Details**

.. math:: \text{softmax}(\mathbf{z}/t)\_j = \frac{e^{-z\_j/t}}{\sum\_{k=1}^K e^{-z\_k/t}}  
for :math:j = 1, \dots, K  
t is the temperature parameter in softmax function. By default, t equals 1.0  
Example::  
`x = [[ 1. 2. 3.] [ 3. 2. 1.]]`  
`softmax(x,axis=0) = [[ 0.88079703, 0.5, 0.11920292], [ 0.11920292, 0.5, 0.88079703]]`  
`softmax(x,axis=1) = [[ 0.66524094, 0.24472848, 0.09003057], [ 0.09003057, 0.24472848, 0.66524094]]`  
Defined in `src/operator/nn/softmax.cc:L57`

**Value**

out The result `mx.symbol`

---

|                    |                                                      |
|--------------------|------------------------------------------------------|
| mx.symbol.softsign | <i>softsign:Computes softsign of x element-wise.</i> |
|--------------------|------------------------------------------------------|

---

**Description**

.. math:: y = x / (1 + abs(x))

**Usage**

mx.symbol.softsign(...)

**Arguments**

- data                   NDArray-or-Symbol The input array.
- name                   string, optional Name of the resulting symbol.

**Details**

The storage type of “softsign“ output is always dense  
Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L191

**Value**

out The result mx.symbol

---

|                |                                                                           |
|----------------|---------------------------------------------------------------------------|
| mx.symbol.sort | <i>sort:Returns a sorted copy of an input array along the given axis.</i> |
|----------------|---------------------------------------------------------------------------|

---

**Description**

Examples::

**Usage**

mx.symbol.sort(...)

**Arguments**

- data                   NDArray-or-Symbol The input array
- axis                   int or None, optional, default='-1' Axis along which to choose sort the input tensor. If not given, the flattened array is used. Default is -1.
- is.ascend              boolean, optional, default=1 Whether to sort in ascending or descending order.
- name                   string, optional Name of the resulting symbol.

**Details**

```

x = [[ 1, 4], [ 3, 1]]
// sorts along the last axis sort(x) = [[ 1., 4.], [ 1., 3.]]
// flattens and then sorts sort(x, axis=None) = [ 1., 1., 3., 4.]
// sorts along the first axis sort(x, axis=0) = [[ 1., 1.], [ 3., 4.]]
// in a descend order sort(x, is_ascending=0) = [[ 4., 1.], [ 3., 1.]]
Defined in src/operator/tensor/ordering_op.cc:L133

```

**Value**

out The result mx.symbol

---

mx.symbol.space\_to\_depth

*space\_to\_depth: Rearranges (permutes) blocks of spatial data into depth. Similar to ONNX SpaceToDepth operator: <https://github.com/onnx/onnx/blob/master/docs/Operators.md#SpaceToDepth>. The output is a new tensor where the values from height and width dimension are moved to the depth dimension. The reverse of this operation is “depth\_to\_space”. .. math:: \begin{gather\*} x \prime = \text{reshape}(x, [N, C, H / \text{block\\_size}, \text{block\\_size}, W / \text{block\\_size}, \text{block\\_size}]) \setminus x \prime \prime = \text{transpose}(x \prime, [0, 3, 5, 1, 2, 4]) \setminus y = \text{reshape}(x \prime \prime, [N, C \* (\text{block\\_size}^2), H / \text{block\\_size}, W / \text{block\\_size}]) \end{gather\*} \text{ where } :math: 'x' \text{ is an input tensor with default layout as } :math: '[N, C, H, W]': [\text{batch}, \text{channels}, \text{height}, \text{width}] \text{ and } :math: 'y' \text{ is the output tensor of layout } :math: '[N, C \* (\text{block\\_size}^2), H / \text{block\\_size}, W / \text{block\\_size}]' \text{ Example:: } x = [[[[[0, 6, 1, 7, 2, 8], [12, 18, 13, 19, 14, 20], [3, 9, 4, 10, 5, 11], [15, 21, 16, 22, 17, 23]]]]] \text{ space\\_to\\_depth}(x, 2) = [[[[[0, 1, 2], [3, 4, 5]], [6, 7, 8], [9, 10, 11]], [[12, 13, 14], [15, 16, 17]], [[18, 19, 20], [21, 22, 23]]]]]*

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L1019

**Usage**

```
mx.symbol.space_to_depth(...)
```

**Arguments**

|            |                                                            |
|------------|------------------------------------------------------------|
| data       | NDArray-or-Symbol Input ndarray                            |
| block.size | int, required Blocks of [block_size. block_size] are moved |
| name       | string, optional Name of the resulting symbol.             |

**Value**

out The result mx.symbol

---

|                              |                                                                               |
|------------------------------|-------------------------------------------------------------------------------|
| mx.symbol.SpatialTransformer | <i>SpatialTransformer:Applies a spatial transformer to input feature map.</i> |
|------------------------------|-------------------------------------------------------------------------------|

---

**Description**

SpatialTransformer:Applies a spatial transformer to input feature map.

**Usage**

mx.symbol.SpatialTransformer(...)

**Arguments**

|                |                                                                                                                                                                  |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data           | NDArray-or-Symbol Input data to the SpatialTransformerOp.                                                                                                        |
| loc            | NDArray-or-Symbol localisation net, the output dim should be 6 when transform_type is affine. You should initialize the weight and bias with identity transform. |
| target.shape   | Shape(tuple), optional, default=[0,0] output shape(h, w) of spatial transformer: (y, x)                                                                          |
| transform.type | 'affine', required transformation type                                                                                                                           |
| sampler.type   | 'bilinear', required sampling type                                                                                                                               |
| cudnn.off      | boolean or None, optional, default=None whether to turn cudnn off                                                                                                |
| name           | string, optional Name of the resulting symbol.                                                                                                                   |

**Value**

out The result mx.symbol

---

|                 |                                                                                 |
|-----------------|---------------------------------------------------------------------------------|
| mx.symbol.split | <i>split: Splits an array along a particular axis into multiple sub-arrays.</i> |
|-----------------|---------------------------------------------------------------------------------|

---

## Description

.. note:: “SliceChannel” is deprecated. Use “split” instead.

## Usage

```
mx.symbol.split(...)
```

## Arguments

|              |                                                                                                                                                                                                                                                                                                                           |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data         | NDArray-or-Symbol The input                                                                                                                                                                                                                                                                                               |
| num.outputs  | int, required Number of splits. Note that this should evenly divide the length of the ‘axis’.                                                                                                                                                                                                                             |
| axis         | int, optional, default=’1’ Axis along which to split.                                                                                                                                                                                                                                                                     |
| squeeze.axis | boolean, optional, default=0 If true, Removes the axis with length 1 from the shapes of the output arrays. <b>**Note**</b> that setting ‘squeeze_axis’ to “true” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze_axis’ can be set to “true” only if “input.shape[axis] == num_outputs”. |
| name         | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                            |

## Details

**\*\*Note\*\*** that ‘num\_outputs’ should evenly divide the length of the axis along which to split the array.

Example::

```
x = [[[ 1.] [ 2.]] [[ 3.] [ 4.]] [[ 5.] [ 6.]]] x.shape = (3, 2, 1)
y = split(x, axis=1, num_outputs=2) // a list of 2 arrays with shape (3, 1, 1) y = [[[ 1.]] [[ 3.]] [[ 5.]]]
[[[ 2.]] [[ 4.]] [[ 6.]]]
y[0].shape = (3, 1, 1)
z = split(x, axis=0, num_outputs=3) // a list of 3 arrays with shape (1, 2, 1) z = [[[ 1.] [ 2.]]]
[[[ 3.] [ 4.]]]
[[[ 5.] [ 6.]]]
z[0].shape = (1, 2, 1)
```

‘squeeze\_axis=1’ removes the axis with length 1 from the shapes of the output arrays. **\*\*Note\*\*** that setting ‘squeeze\_axis’ to “1” removes axis with length 1 only along the ‘axis’ which it is split. Also ‘squeeze\_axis’ can be set to true only if “input.shape[axis] == num\_outputs”.

Example::

```
z = split(x, axis=0, num_outputs=3, squeeze_axis=1) // a list of 3 arrays with shape (2, 1) z = [[ 1.]
[ 2.]]
```

```
[[ 3.] [ 4.]]
[[ 5.] [ 6.]] z[0].shape = (2 ,1 )
Defined in src/operator/slice_channel.cc:L107
```

**Value**

out The result `mx.symbol`

---

|                             |                                                                  |
|-----------------------------|------------------------------------------------------------------|
| <code>mx.symbol.sqrt</code> | <i>sqrt:Returns element-wise square-root value of the input.</i> |
|-----------------------------|------------------------------------------------------------------|

---

**Description**

.. math:: \textrm{sqrt}(x) = \sqrt{x}

**Usage**

```
mx.symbol.sqrt(...)
```

**Arguments**

|      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Details**

Example::

```
sqrt([4, 9, 16]) = [2, 3, 4]
```

The storage type of “sqrt” output depends upon the input storage type:

- sqrt(default) = default
- sqrt(row\_sparse) = row\_sparse
- sqrt(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L170

**Value**

out The result `mx.symbol`

---

|                  |                                                                |
|------------------|----------------------------------------------------------------|
| mx.symbol.square | <i>square:Returns element-wise squared value of the input.</i> |
|------------------|----------------------------------------------------------------|

---

**Description**

.. math:: \text{square}(x) = x^2

**Usage**

mx.symbol.square(...)

**Arguments**

- |      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Details**

Example::  
square([2, 3, 4]) = [4, 9, 16]  
The storage type of “square” output depends upon the input storage type:  
- square(default) = default - square(row\_sparse) = row\_sparse - square(csr) = csr  
Defined in src/operator/tensor/elemwise\_unary\_op\_pow.cc:L119

**Value**

out The result mx.symbol

---

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| mx.symbol.squeeze | <i>squeeze:Remove single-dimensional entries from the shape of an array. Same behavior of defining the output tensor shape as numpy.squeeze for the most of cases. See the following note for exception. Examples:: data = [[[0], [1], [2]]] squeeze(data) = [0, 1, 2] squeeze(data, axis=0) = [[0], [1], [2]] squeeze(data, axis=2) = [[0, 1, 2]] squeeze(data, axis=(0, 2)) = [0, 1, 2] .. Note:: The output of this operator will keep at least one dimension not removed. For example, squeeze([[[4]]) = [4], while in numpy.squeeze, the output will become a scalar.</i> |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---



**Description**

squeeze:Remove single-dimensional entries from the shape of an array. Same behavior of defining the output tensor shape as numpy.squeeze for the most of cases. See the following note for exception. Examples:: data = [[[0], [1], [2]]] squeeze(data) = [0, 1, 2] squeeze(data, axis=0) = [[0], [1], [2]] squeeze(data, axis=2) = [[0, 1, 2]] squeeze(data, axis=(0, 2)) = [0, 1, 2] .. Note:: The output of this operator will keep at least one dimension not removed. For example, squeeze([[[[4]]]]) = [4], while in numpy.squeeze, the output will become a scalar.

**Usage**

```
mx.symbol.squeeze(...)
```

**Arguments**

|      |                                                                                                                                                                                      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data | NDArray-or-Symbol data to squeeze                                                                                                                                                    |
| axis | Shape or None, optional, default=None Selects a subset of the single-dimensional entries in the shape. If an axis is selected with shape entry greater than one, an error is raised. |
| name | string, optional Name of the resulting symbol.                                                                                                                                       |

**Value**

out The result mx.symbol

---

|                 |                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| mx.symbol.stack | <i>stack:Join a sequence of arrays along a new axis. The axis parameter specifies the index of the new axis in the dimensions of the result. For example, if axis=0 it will be the first dimension and if axis=-1 it will be the last dimension. Examples:: x = [1, 2] y = [3, 4] stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]</i> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---

**Description**

stack:Join a sequence of arrays along a new axis. The axis parameter specifies the index of the new axis in the dimensions of the result. For example, if axis=0 it will be the first dimension and if axis=-1 it will be the last dimension. Examples:: x = [1, 2] y = [3, 4] stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]

**Usage**

```
mx.symbol.stack(...)
```

**Arguments**

|           |                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------|
| data      | NDArray-or-Symbol[] List of arrays to stack                                                       |
| axis      | int, optional, default='0' The axis in the result array along which the input arrays are stacked. |
| num. args | int, required Number of inputs to be stacked.                                                     |
| name      | string, optional Name of the resulting symbol.                                                    |

**Value**

out The result mx.symbol

---

mx.symbol.stop\_gradient

*stop\_gradient: Stops gradient computation.*

---

**Description**

Stops the accumulated gradient of the inputs from flowing through this operator in the backward direction. In other words, this operator prevents the contribution of its inputs to be taken into account for computing gradients.

**Usage**

```
mx.symbol.stop_gradient(...)
```

**Arguments**

|      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Details**

Example::

```
v1 = [1, 2] v2 = [0, 1] a = Variable('a') b = Variable('b') b_stop_grad = stop_gradient(3 * b) loss =
MakeLoss(b_stop_grad + a)
executor = loss.simple_bind(ctx=cpu(), a=(1,2), b=(1,2)) executor.forward(is_train=True, a=v1, b=v2)
executor.outputs [ 1. 5.]
executor.backward() executor.grad_arrays [ 0. 0.] [ 1. 1.]
Defined in src/operator/tensor/elemwise_unary_op_basic.cc:L325
```

**Value**

out The result mx.symbol

---

|               |                                                                 |
|---------------|-----------------------------------------------------------------|
| mx.symbol.sum | <i>sum: Computes the sum of array elements over given axes.</i> |
|---------------|-----------------------------------------------------------------|

---

**Description**

.. Note::

**Usage**

```
mx.symbol.sum(...)
```

**Arguments**

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data     | NDArray-or-Symbol The input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| axis     | Shape or None, optional, default=None The axis or axes along which to perform the reduction.<br>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,).'<br>If 'axis' is int, a reduction is performed on a particular axis.<br>If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.<br>If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.<br>Negative values means indexing from right to left. |
| keepdims | boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.                                                                                                                                                                                                                                                                                                                                                                                               |
| exclude  | boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| name     | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Details**

'sum' and 'sum\_axis' are equivalent. For ndarray of csr storage type summation along axis 0 and axis 1 is supported. Setting keepdims or exclude to True will cause a fallback to dense operator.

Example::

```
data = [[[1, 2], [2, 3], [1, 3]], [[1, 4], [4, 3], [5, 2]], [[7, 1], [7, 2], [7, 3]]]
sum(data, axis=1) [[ 4.  8.] [ 10.  9.] [ 21.  6.]]
sum(data, axis=[1,2]) [ 12. 19. 27.]
data = [[1, 2, 0], [3, 0, 1], [4, 1, 0]]
csr = cast_storage(data, 'csr')
sum(csr, axis=0) [ 8.  3.  1.]
sum(csr, axis=1) [ 3.  4.  5.]
```

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L67

**Value**

out The result `mx.symbol`

---

|                                 |                                                                      |
|---------------------------------|----------------------------------------------------------------------|
| <code>mx.symbol.sum_axis</code> | <i>sum_axis: Computes the sum of array elements over given axes.</i> |
|---------------------------------|----------------------------------------------------------------------|

---

**Description**

.. Note::

**Usage**

```
mx.symbol.sum_axis(...)
```

**Arguments**

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data     | NDArray-or-Symbol The input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| axis     | Shape or None, optional, default=None The axis or axes along which to perform the reduction.<br>The default, 'axis=()', will compute over all elements into a scalar array with shape '(1,)'.<br>If 'axis' is int, a reduction is performed on a particular axis.<br>If 'axis' is a tuple of ints, a reduction is performed on all the axes specified in the tuple.<br>If 'exclude' is true, reduction will be performed on the axes that are NOT in axis instead.<br>Negative values means indexing from right to left. |
| keepdims | boolean, optional, default=0 If this is set to 'True', the reduced axes are left in the result as dimension with size one.                                                                                                                                                                                                                                                                                                                                                                                               |
| exclude  | boolean, optional, default=0 Whether to perform reduction on axis that are NOT in axis instead.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| name     | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Details**

'sum' and 'sum\_axis' are equivalent. For ndarray of csr storage type summation along axis 0 and axis 1 is supported. Setting keepdims or exclude to True will cause a fallback to dense operator.

Example::

```
data = [[[1, 2], [2, 3], [1, 3]], [[1, 4], [4, 3], [5, 2]], [[7, 1], [7, 2], [7, 3]]]
sum(data, axis=1) [[ 4.  8.] [ 10.  9.] [ 21.  6.]]
sum(data, axis=[1,2]) [ 12. 19. 27.]
data = [[1, 2, 0], [3, 0, 1], [4, 1, 0]]
csr = cast_storage(data, 'csr')
```

```
sum(csr, axis=0) [ 8. 3. 1.]
```

```
sum(csr, axis=1) [ 3. 4. 5.]
```

Defined in src/operator/tensor/broadcast\_reduce\_sum\_value.cc:L67

## Value

out The result mx.symbol

---

|                     |                                                                                      |
|---------------------|--------------------------------------------------------------------------------------|
| mx.symbol.SVMOutput | <i>SVMOutput: Computes support vector machine based transformation of the input.</i> |
|---------------------|--------------------------------------------------------------------------------------|

---

## Description

This tutorial demonstrates using SVM as output layer for classification instead of softmax: <https://github.com/dmlc/mxnet/tree/master/example/python/svm>

## Usage

```
mx.symbol.SVMOutput(...)
```

## Arguments

|                            |                                                                                                                                 |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| data                       | NDArray-or-Symbol Input data for SVM transformation.                                                                            |
| label                      | NDArray-or-Symbol Class label for the input data.                                                                               |
| margin                     | float, optional, default=1 The loss function penalizes outputs that lie outside this margin. Default margin is 1.               |
| regularization.coefficient | float, optional, default=1 Regularization parameter for the SVM. This balances the tradeoff between coefficient size and error. |
| use.linear                 | boolean, optional, default=0 Whether to use L1-SVM objective. L2-SVM objective is used by default.                              |
| name                       | string, optional Name of the resulting symbol.                                                                                  |

## Value

out The result mx.symbol

---

|                    |                                                    |
|--------------------|----------------------------------------------------|
| mx.symbol.swapaxes | <i>swapaxes:Interchanges two axes of an array.</i> |
|--------------------|----------------------------------------------------|

---

## Description

Examples::

## Usage

```
mx.symbol.swapaxes(...)
```

## Arguments

|      |                                                           |
|------|-----------------------------------------------------------|
| data | NDArray-or-Symbol Input array.                            |
| dim1 | int, optional, default='0' the first axis to be swapped.  |
| dim2 | int, optional, default='0' the second axis to be swapped. |
| name | string, optional Name of the resulting symbol.            |

## Details

```
x = [[1, 2, 3]] swapaxes(x, 0, 1) = [[ 1], [ 2], [ 3]]
x = [[[ 0, 1], [ 2, 3]], [[ 4, 5], [ 6, 7]]] // (2,2,2) array
swapaxes(x, 0, 2) = [[[ 0, 4], [ 2, 6]], [[ 1, 5], [ 3, 7]]]
Defined in src/operator/swapaxis.cc:L70
```

## Value

out The result mx.symbol

---

|                    |                                                    |
|--------------------|----------------------------------------------------|
| mx.symbol.SwapAxis | <i>SwapAxis:Interchanges two axes of an array.</i> |
|--------------------|----------------------------------------------------|

---

## Description

Examples::

## Usage

```
mx.symbol.SwapAxis(...)
```

**Arguments**

|      |                                                           |
|------|-----------------------------------------------------------|
| data | NDArray-or-Symbol Input array.                            |
| dim1 | int, optional, default='0' the first axis to be swapped.  |
| dim2 | int, optional, default='0' the second axis to be swapped. |
| name | string, optional Name of the resulting symbol.            |

**Details**

```
x = [[1, 2, 3]] swapaxes(x, 0, 1) = [[ 1], [ 2], [ 3]]
x = [[[ 0, 1], [ 2, 3]], [[ 4, 5], [ 6, 7]]] // (2,2,2) array
swapaxes(x, 0, 2) = [[[ 0, 4], [ 2, 6]], [[ 1, 5], [ 3, 7]]]
Defined in src/operator/swapaxis.cc:L70
```

**Value**

out The result mx.symbol

---

|                |                                                                      |
|----------------|----------------------------------------------------------------------|
| mx.symbol.take | <i>take:Takes elements from an input array along the given axis.</i> |
|----------------|----------------------------------------------------------------------|

---

**Description**

This function slices the input array along a particular axis with the provided indices.

**Usage**

```
mx.symbol.take(...)
```

**Arguments**

|         |                                                                                                                                                                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a       | NDArray-or-Symbol The input array.                                                                                                                                                                                                                                                                                                                            |
| indices | NDArray-or-Symbol The indices of the values to be extracted.                                                                                                                                                                                                                                                                                                  |
| axis    | int, optional, default='0' The axis of input array to be taken. For input tensor of rank r, it could be in the range of [-r, r-1]                                                                                                                                                                                                                             |
| mode    | 'clip', 'raise', 'wrap', optional, default='clip' Specify how out-of-bound indices behave. Default is "clip". "clip" means clip to the range. So, if all indices mentioned are too large, they are replaced by the index that addresses the last element along an axis. "wrap" means to wrap around. "raise" means to raise an error when index out of range. |
| name    | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                                                                |

**Details**

Given data tensor of rank  $r \geq 1$ , and indices tensor of rank  $q$ , gather entries of the axis dimension of data (by default outer-most one as  $\text{axis}=0$ ) indexed by indices, and concatenates them in an output tensor of rank  $q + (r - 1)$ .

Examples::

```
x = [4. 5. 6.]
```

```
// Trivial case, take the second element along the first axis.
```

```
take(x, [1]) = [ 5. ]
```

```
// The other trivial case, axis=-1, take the third element along the first axis
```

```
take(x, [3], axis=-1, mode='clip') = [ 6. ]
```

```
x = [[ 1., 2.], [ 3., 4.], [ 5., 6.]]
```

```
// In this case we will get rows 0 and 1, then 1 and 2. Along axis 0
```

```
take(x, [[0,1],[1,2]]) = [[[ 1., 2.], [ 3., 4.]],
```

```
[[ 3., 4.], [ 5., 6.]]]
```

```
// In this case we will get rows 0 and 1, then 1 and 2 (calculated by wrapping around). // Along axis 1
```

```
take(x, [[0, 3], [-1, -2]], axis=1, mode='wrap') = [[[ 1. 2.] [ 2. 1.]]
```

```
[[ 3. 4.] [ 4. 3.]]
```

```
[[ 5. 6.] [ 6. 5.]]]
```

The storage type of “take” output depends upon the input storage type:

- `take(default, default) = default` - `take(csr, default, axis=0) = csr`

Defined in `src/operator/tensor/indexing_op.cc:L782`

**Value**

out The result `mx.symbol`

---

`mx.symbol.tan`

*tan: Computes the element-wise tangent of the input array.*

---

**Description**

The input should be in radians ( $2\pi$  rad equals 360 degrees).

**Usage**

```
mx.symbol.tan(...)
```

**Arguments**

|                   |                                                |
|-------------------|------------------------------------------------|
| <code>data</code> | NDArray-or-Symbol The input array.             |
| <code>name</code> | string, optional Name of the resulting symbol. |



**Details**

.. math:: \tan([0, \pi/4, \pi/2]) = [0, 1, -\inf]

The storage type of “tan” output depends upon the input storage type:

- tan(default) = default - tan(row\_sparse) = row\_sparse - tan(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L140

**Value**

out The result mx.symbol

---

|                |                                                                                       |
|----------------|---------------------------------------------------------------------------------------|
| mx.symbol.tanh | <i>tanh:Returns the hyperbolic tangent of the input array, computed element-wise.</i> |
|----------------|---------------------------------------------------------------------------------------|

---

**Description**

.. math:: \tanh(x) = \sinh(x) / \cosh(x)

**Usage**

mx.symbol.tanh(...)

**Arguments**

|      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Details**

The storage type of “tanh” output depends upon the input storage type:

- tanh(default) = default - tanh(row\_sparse) = row\_sparse - tanh(csr) = csr

Defined in src/operator/tensor/elemwise\_unary\_op\_trig.cc:L451

**Value**

out The result mx.symbol

---

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>mx.symbol.tile</code> | <i>tile:Repeats the whole array multiple times. If “reps” has length *d*, and input array has dimension of *n*. There are three cases:</i><br><i>- **n=d**. Repeat *i*-th dimension of the input by “reps[i]” times::</i><br><i><math>x = [[1, 2], [3, 4]]</math> <math>\text{tile}(x, \text{reps}=(2,3)) = [[1, 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.], [1., 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]]</math> - **n&gt;d**.</i><br><i>“reps” is promoted to length *n* by pre-pending 1’s to it. Thus for an input shape “(2,3)”, “reps=(2,)” is treated as “(1,2)”:: <math>\text{tile}(x, \text{reps}=(2,)) = [[1, 2., 1., 2.], [3., 4., 3., 4.]]</math> - **n&lt;d**.</i><br><i>The input is promoted to be d-dimensional by prepending new axes. So a shape “(2,2)” array is promoted to “(1,2,2)” for 3-D replication:: <math>\text{tile}(x, \text{reps}=(2,2,3)) = [[[1, 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.], [1, 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]], [[1, 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]], [1, 2., 1., 2., 1., 2.], [3., 4., 3., 4., 3., 4.]]]</math></i> |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---

## Description

Defined in `src/operator/tensor/matrix_op.cc:L796`

## Usage

`mx.symbol.tile(...)`

## Arguments

|                   |                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code> | NDArray-or-Symbol Input data array                                                                                                                                                                                                                                                                                                           |
| <code>reps</code> | Shape(tuple), required The number of times for repeating the tensor a. Each dim size of reps must be a positive integer. If reps has length d, the result will have dimension of max(d, a.ndim); If a.ndim < d, a is promoted to be d-dimensional by prepending new axes. If a.ndim > d, reps is promoted to a.ndim by prepending 1’s to it. |
| <code>name</code> | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                                               |

## Value

out The result `mx.symbol`

---

|                             |                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>mx.symbol.topk</code> | <i>topk:Returns the indices of the top *k* elements in an input array along the given axis (by default). If <code>ret_type</code> is set to ‘value’ returns the value of top *k* elements (instead of indices). In case of <code>ret_type = ‘both’</code>, both value and index would be returned. The returned elements will be sorted.</i> |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---

**Description**

Examples::

**Usage**

```
mx.symbol.topk(...)
```

**Arguments**

|                        |                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>      | NDArray-or-Symbol The input array                                                                                                                                                                                                                                                                                                                   |
| <code>axis</code>      | int or None, optional, default='-1' Axis along which to choose the top k indices. If not given, the flattened array is used. Default is -1.                                                                                                                                                                                                         |
| <code>k</code>         | int, optional, default='1' Number of top elements to select, should be always smaller than or equal to the element number in the given axis. A global sort is performed if set k < 1.                                                                                                                                                               |
| <code>ret_type</code>  | 'both', 'indices', 'mask', 'value', optional, default='indices' The return type. "value" means to return the top k values, "indices" means to return the indices of the top k values, "mask" means to return a mask array containing 0 and 1. 1 means the top k values. "both" means to return a list of both values and indices of top k elements. |
| <code>is_ascend</code> | boolean, optional, default=0 Whether to choose k largest or k smallest elements. Top K largest elements will be chosen if set to false.                                                                                                                                                                                                             |
| <code>dtype</code>     | 'float16', 'float32', 'float64', 'int32', 'int64', 'uint8', optional, default='float32' DType of the output indices when ret_type is "indices" or "both". An error will be raised if the selected data type cannot precisely represent the indices.                                                                                                 |
| <code>name</code>      | string, optional Name of the resulting symbol.                                                                                                                                                                                                                                                                                                      |

**Details**

```
x = [[ 0.3, 0.2, 0.4], [ 0.1, 0.3, 0.2]]
// returns an index of the largest element on last axis topk(x) = [[ 2.], [ 1.]]
// returns the value of top-2 largest elements on last axis topk(x, ret_type='value', k=2) = [[ 0.4, 0.3],
[ 0.3, 0.2]]
// returns the value of top-2 smallest elements on last axis topk(x, ret_type='value', k=2, is_ascend=1)
= [[ 0.2 , 0.3], [ 0.1 , 0.2]]
// returns the value of top-2 largest elements on axis 0 topk(x, axis=0, ret_type='value', k=2) = [[
0.3, 0.3, 0.4], [ 0.1, 0.2, 0.2]]
// flattens and then returns list of both values and indices topk(x, ret_type='both', k=2) = [[[ 0.4, 0.3],
[ 0.3, 0.2]] , [[ 2., 0.], [ 1., 2.]]]
Defined in src/operator/tensor/ordering_op.cc:L68
```

**Value**

out The result mx.symbol

---

|                     |                                                                                                                                                                                                                                                                                                                                    |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| mx.symbol.transpose | <i>transpose:Permutates the dimensions of an array. Examples:: x = [[ 1, 2], [ 3, 4]] transpose(x) = [[ 1., 3.], [ 2., 4.]] x = [[[ 1., 2.], [ 3., 4.]], [[ 5., 6.], [ 7., 8.]]] transpose(x) = [[[ 1., 5.], [ 3., 7.]], [[ 2., 6.], [ 4., 8.]]] transpose(x, axes=(1,0,2)) = [[[ 1., 2.], [ 5., 6.]], [[ 3., 4.], [ 7., 8.]]]</i> |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---

**Description**

Defined in src/operator/tensor/matrix\_op.cc:L328

**Usage**

mx.symbol.transpose(...)

**Arguments**

- |      |                                                                                             |
|------|---------------------------------------------------------------------------------------------|
| data | NDArray-or-Symbol Source input                                                              |
| axes | Shape(tuple), optional, default=[] Target axis order. By default the axes will be inverted. |
| name | string, optional Name of the resulting symbol.                                              |

**Value**

out The result mx.symbol

---

|                 |                                                                    |
|-----------------|--------------------------------------------------------------------|
| mx.symbol.trunc | <i>trunc:Return the element-wise truncated value of the input.</i> |
|-----------------|--------------------------------------------------------------------|

---

**Description**

The truncated value of the scalar x is the nearest integer i which is closer to zero than x is. In short, the fractional part of the signed number x is discarded.

**Usage**

mx.symbol.trunc(...)

**Arguments**

- |      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input array.             |
| name | string, optional Name of the resulting symbol. |

**Details**

Example::

```
trunc([-2.1, -1.9, 1.5, 1.9, 2.1]) = [-2., -1., 1., 1., 2.]
```

The storage type of “trunc” output depends upon the input storage type:

```
- trunc(default) = default - trunc(row_sparse) = row_sparse - trunc(csr) = csr
```

Defined in src/operator/tensor/elemwise\_unary\_op\_basic.cc:L856

**Value**

out The result mx.symbol

---

|                   |                                                                 |
|-------------------|-----------------------------------------------------------------|
| mx.symbol.uniform | <i>uniform:Draw random samples from a uniform distribution.</i> |
|-------------------|-----------------------------------------------------------------|

---

**Description**

.. note:: The existing alias “uniform” is deprecated.

**Usage**

```
mx.symbol.uniform(...)
```

**Arguments**

|       |                                                                                                                                                                        |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| low   | float, optional, default=0 Lower bound of the distribution.                                                                                                            |
| high  | float, optional, default=1 Upper bound of the distribution.                                                                                                            |
| shape | Shape(tuple), optional, default=None Shape of the output.                                                                                                              |
| ctx   | string, optional, default=” Context of output, in format [cpulgpulcpu_pinned](n). Only used for imperative calls.                                                      |
| dtype | ’None’, ’float16’, ’float32’, ’float64’, optional, default=’None’ DType of the output in case this can’t be inferred. Defaults to float32 if not defined (dtype=None). |
| name  | string, optional Name of the resulting symbol.                                                                                                                         |

**Details**

Samples are uniformly distributed over the half-open interval  $[low, high)$  (includes  $low$ , but excludes  $high$ ).

Example::

```
uniform(low=0, high=1, shape=(2,2)) = [[ 0.60276335, 0.85794562], [ 0.54488319, 0.84725171]]
```

Defined in src/operator/random/sample\_op.cc:L96

**Value**

out The result mx.symbol

---

```
mx.symbol.unravel_index
```

*unravel\_index: Converts an array of flat indices into a batch of index arrays. The operator follows numpy conventions so a single multi index is given by a column of the output matrix. The leading dimension may be left unspecified by using -1 as placeholder.*

---

## Description

Examples::

## Usage

```
mx.symbol.unravel_index(...)
```

## Arguments

|       |                                                                                             |
|-------|---------------------------------------------------------------------------------------------|
| data  | NDArray-or-Symbol Array of flat indices                                                     |
| shape | Shape(tuple), optional, default=None Shape of the array into which the multi-indices apply. |
| name  | string, optional Name of the resulting symbol.                                              |

## Details

```
A = [22,41,37] unravel(A, shape=(7,6)) = [[3,6,6],[4,5,1]] unravel(A, shape=(-1,6)) = [[3,6,6],[4,5,1]]
```

Defined in src/operator/tensor/ravel.cc:L68

## Value

out The result mx.symbol

---

```
mx.symbol.UpSampling    UpSampling:Upsamples the given input data.
```

---

## Description

Two algorithms (“sample\_type”) are available for upsampling:

## Usage

```
mx.symbol.UpSampling(...)
```

**Arguments**

|                  |                                                                                                                                                                                                                                                                            |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data             | NDArray-or-Symbol[] Array of tensors to upsample. For bilinear upsampling, there should be 2 inputs - 1 data and 1 weight.                                                                                                                                                 |
| scale            | int, required Up sampling scale                                                                                                                                                                                                                                            |
| num.filter       | int, optional, default='0' Input filter. Only used by bilinear sample_type. Since bilinear upsampling uses deconvolution, num_filters is set to the number of channels.                                                                                                    |
| sample.type      | 'bilinear', 'nearest', required upsampling method                                                                                                                                                                                                                          |
| multi.input.mode | 'concat', 'sum', optional, default='concat' How to handle multiple input. concat means concatenate upsampled images along the channel dimension. sum means add all images together, only available for nearest neighbor upsampling.                                        |
| num.args         | int, required Number of inputs to be upsampled. For nearest neighbor upsampling, this can be 1-N; the size of output will be (scale*h_0, scale*w_0) and all other inputs will be upsampled to the same size. For bilinear upsampling this must be 2; 1 input and 1 weight. |
| workspace        | long (non-negative), optional, default=512 Tmp workspace for deconvolution (MB)                                                                                                                                                                                            |
| name             | string, optional Name of the resulting symbol.                                                                                                                                                                                                                             |

**Details**

- Nearest Neighbor - Bilinear

**\*\*Nearest Neighbor Upsampling\*\***

Input data is expected to be NCHW.

Example::

```
x = [[[[1. 1. 1.] [1. 1. 1.] [1. 1. 1.]]]]
```

```
UpSampling(x, scale=2, sample_type='nearest') = [[[[1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.] [1. 1. 1. 1. 1. 1.]]]]]]
```

**\*\*Bilinear Upsampling\*\***

Uses 'deconvolution' algorithm under the hood. You need provide both input data and the kernel.

Input data is expected to be NCHW.

'num\_filter' is expected to be same as the number of channels.

Example::

```
x = [[[[1. 1. 1.] [1. 1. 1.] [1. 1. 1.]]]]
```

```
w = [[[[1. 1. 1. 1.] [1. 1. 1. 1.] [1. 1. 1. 1.] [1. 1. 1. 1.]]]]]]
```

```
UpSampling(x, w, scale=2, sample_type='bilinear', num_filter=1) = [[[[1. 2. 2. 2. 2. 1.] [2. 4. 4. 4. 4. 2.] [2. 4. 4. 4. 4. 2.] [2. 4. 4. 4. 4. 2.] [1. 2. 2. 2. 2. 1.]]]]]]
```

Defined in src/operator/nn/upsampling.cc:L173

**Value**

out The result mx.symbol

---

|                                 |                                                        |
|---------------------------------|--------------------------------------------------------|
| <code>mx.symbol.Variable</code> | <i>Create a symbolic variable with specified name.</i> |
|---------------------------------|--------------------------------------------------------|

---

**Description**

Create a symbolic variable with specified name.

**Arguments**

|                   |                                       |
|-------------------|---------------------------------------|
| <code>name</code> | string The name of the result symbol. |
|-------------------|---------------------------------------|

**Value**

The result symbol

---

|                              |                                                                                   |
|------------------------------|-----------------------------------------------------------------------------------|
| <code>mx.symbol.where</code> | <i>where:Return the elements, either from x or y, depending on the condition.</i> |
|------------------------------|-----------------------------------------------------------------------------------|

---

**Description**

Given three ndarrays, condition, x, and y, return an ndarray with the elements from x or y, depending on the elements from condition are true or false. x and y must have the same shape. If condition has the same shape as x, each element in the output array is from x if the corresponding element in the condition is true, and from y if false.

**Usage**

`mx.symbol.where(...)`

**Arguments**

|                        |                                                |
|------------------------|------------------------------------------------|
| <code>condition</code> | NDArray-or-Symbol condition array              |
| <code>x</code>         | NDArray-or-Symbol                              |
| <code>y</code>         | NDArray-or-Symbol                              |
| <code>name</code>      | string, optional Name of the resulting symbol. |



**Details**

If condition does not have the same shape as x, it must be a 1D array whose size is the same as x's first dimension size. Each row of the output array is from x's row if the corresponding element from condition is true, and from y's row if false.

Note that all non-zero values are interpreted as "True" in condition.

Examples::

```
x = [[1, 2], [3, 4]] y = [[5, 6], [7, 8]] cond = [[0, 1], [-1, 0]]
```

```
where(cond, x, y) = [[5, 2], [3, 8]]
```

```
csr_cond = cast_storage(cond, 'csr')
```

```
where(csr_cond, x, y) = [[5, 2], [3, 8]]
```

Defined in src/operator/tensor/control\_flow\_op.cc:L57

**Value**

out The result mx.symbol

---

|                      |                                                                                                            |
|----------------------|------------------------------------------------------------------------------------------------------------|
| mx.symbol.zeros_like | <i>zeros_like: Return an array of zeros with the same shape, type and storage type as the input array.</i> |
|----------------------|------------------------------------------------------------------------------------------------------------|

---

**Description**

The storage type of "zeros\_like" output depends on the storage type of the input

**Usage**

```
mx.symbol.zeros_like(...)
```

**Arguments**

|      |                                                |
|------|------------------------------------------------|
| data | NDArray-or-Symbol The input                    |
| name | string, optional Name of the resulting symbol. |

**Details**

- zeros\_like(row\_sparse) = row\_sparse - zeros\_like(csr) = csr - zeros\_like(default) = default

Examples::

```
x = [[ 1., 1., 1.], [ 1., 1., 1.]]
```

```
zeros_like(x) = [[ 0., 0., 0.], [ 0., 0., 0.]]
```

**Value**

out The result mx.symbol

---

|                             |                                              |
|-----------------------------|----------------------------------------------|
| <code>mx.unserialize</code> | <i>Unserialize MXNet model from Robject.</i> |
|-----------------------------|----------------------------------------------|

---

**Description**

Unserialize MXNet model from Robject.

**Usage**

```
mx.unserialize(model)
```

**Arguments**

|                    |                                          |
|--------------------|------------------------------------------|
| <code>model</code> | The mxnet model loaded from RData files. |
|--------------------|------------------------------------------|

---

|                    |                                                                       |
|--------------------|-----------------------------------------------------------------------|
| <code>mxnet</code> | <i>MXNet: Flexible and Efficient GPU computing and Deep Learning.</i> |
|--------------------|-----------------------------------------------------------------------|

---

**Description**

MXNet is a flexible and efficient GPU computing and deep learning framework.

**Details**

It enables you to write seamless tensor/matrix computation with multiple GPUs in R.

It also enables you construct and customize the state-of-art deep learning models in R, and apply them to tasks such as image classification and data science challenges.

---

|                           |                                                                                                 |
|---------------------------|-------------------------------------------------------------------------------------------------|
| <code>mxnet.export</code> | <i>Internal function to generate mxnet_generated.R Users do not need to call this function.</i> |
|---------------------------|-------------------------------------------------------------------------------------------------|

---

**Description**

Internal function to generate mxnet\_generated.R Users do not need to call this function.

**Usage**

```
mxnet.export(path)
```

**Arguments**

|                   |                                      |
|-------------------|--------------------------------------|
| <code>path</code> | The path to the root of the package. |
|-------------------|--------------------------------------|

---

|               |                                                  |
|---------------|--------------------------------------------------|
| Ops.MXNDArray | <i>Binary operator overloading of mx.ndarray</i> |
|---------------|--------------------------------------------------|

---

**Description**

Binary operator overloading of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'  
Ops(e1, e2)
```

**Arguments**

e1                    The second operand

---

|         |                                     |
|---------|-------------------------------------|
| outputs | <i>Get the outputs of a symbol.</i> |
|---------|-------------------------------------|

---

**Description**

Get the outputs of a symbol.

**Usage**

```
outputs(x)
```

**Arguments**

x                    The input symbol

---

|                            |                                                       |
|----------------------------|-------------------------------------------------------|
| predict.MXFeedForwardModel | <i>Predict the outputs given a model and dataset.</i> |
|----------------------------|-------------------------------------------------------|

---

**Description**

Predict the outputs given a model and dataset.

**Usage**

```
## S3 method for class 'MXFeedForwardModel'
predict(
  model,
  X,
  ctx = NULL,
  array.batch.size = 128,
  array.layout = "auto",
  allow.extra.params = FALSE
)
```

**Arguments**

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| model              | The MXNet Model.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| X                  | The dataset to predict.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ctx                | mx.cpu() or mx.gpu(). The device used to generate the prediction.                                                                                                                                                                                                                                                                                                                                                                                         |
| array.batch.size   | The batch size used in batching. Only used when X is R's array.                                                                                                                                                                                                                                                                                                                                                                                           |
| array.layout       | can be "auto", "colmajor", "rowmajor", (default=auto) The layout of array. "row-major" is only supported for two dimensional array. For matrix, "rowmajor" means $\text{dim}(X) = c(\text{nexample}, \text{nfeatures})$ , "colmajor" means $\text{dim}(X) = c(\text{nfeatures}, \text{nexample})$ "auto" will auto detect the layout by match the feature size, and will report error when X is a square matrix to ask user to explicitly specify layout. |
| allow.extra.params | Whether allow extra parameters that are not needed by symbol. If this is TRUE, no error will be thrown when arg_params or aux_params contain extra parameters that is not needed by the executor.                                                                                                                                                                                                                                                         |

---

|                 |                                              |
|-----------------|----------------------------------------------|
| print.MXNDArray | <i>print operator overload of mx.ndarray</i> |
|-----------------|----------------------------------------------|

---

**Description**

print operator overload of mx.ndarray

**Usage**

```
## S3 method for class 'MXNDArray'
print(nd)
```

**Arguments**

|    |                |
|----|----------------|
| nd | The mx.ndarray |
|----|----------------|

---

rnn.graph*Generate a RNN symbolic model - requires CUDA*

---

### Description

Generate a RNN symbolic model - requires CUDA

### Usage

```
rnn.graph(  
    num_rnn_layer,  
    input_size = NULL,  
    num_embed = NULL,  
    num_hidden,  
    num_decode,  
    dropout = 0,  
    ignore_label = -1,  
    bidirectional = F,  
    loss_output = NULL,  
    config,  
    cell_type,  
    masking = F,  
    output_last_state = F,  
    rnn.state = NULL,  
    rnn.state.cell = NULL,  
    prefix = ""  
)
```

### Arguments

|               |                                                                        |
|---------------|------------------------------------------------------------------------|
| num_rnn_layer | int, number of stacked layers                                          |
| input_size    | int, number of levels in the data - only used for embedding            |
| num_embed     | int, default = NULL - no embedding. Dimension of the embedding vectors |
| num_hidden    | int, size of the state in each RNN layer                               |
| num_decode    | int, number of output variables in the decoding layer                  |
| dropout       |                                                                        |
| config        | Either seq-to-one or one-to-one                                        |
| cell_type     | Type of RNN cell: either gru or lstm                                   |

---

|                  |                                                                |
|------------------|----------------------------------------------------------------|
| rnn.graph.unroll | <i>Unroll representation of RNN running on non CUDA device</i> |
|------------------|----------------------------------------------------------------|

---

### Description

Unroll representation of RNN running on non CUDA device

### Usage

```
rnn.graph.unroll(
    num_rnn_layer,
    seq_len,
    input_size = NULL,
    num_embed = NULL,
    num_hidden,
    num_decode,
    dropout = 0,
    ignore_label = -1,
    loss_output = NULL,
    init.state = NULL,
    config,
    cell_type = "lstm",
    masking = F,
    output_last_state = F,
    prefix = "",
    data_name = "data",
    label_name = "label"
)
```

### Arguments

|               |                                                                        |
|---------------|------------------------------------------------------------------------|
| num_rnn_layer | int, number of stacked layers                                          |
| seq_len       | int, number of time steps to unroll                                    |
| input_size    | int, number of levels in the data - only used for embedding            |
| num_embed     | int, default = NULL - no embedding. Dimension of the embedding vectors |
| num_hidden    | int, size of the state in each RNN layer                               |
| num_decode    | int, number of output variables in the decoding layer                  |
| dropout       |                                                                        |
| config        | Either seq-to-one or one-to-one                                        |
| cell_type     | Type of RNN cell: either gru or lstm                                   |

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