

Package ‘mxnet’

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Type Package

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

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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 6.1.1

Encoding UTF-8

R topics documented:

arguments	15
as.array.MXNDArray	15
as.matrix.MXNDArray	16
children	16
ctx	16
dim.MXNDArray	17
graph.viz	17
im2rec	18
internals	19
is.mx.context	19
is.mx.dataiter	19
is.mx.ndarray	20
is.mx.symbol	20
is.serialized	21
length.MXNDArray	21
mx.apply	21
mx.callback.early.stop	22
mx.callback.log.speedometer	22
mx.callback.log.train.metric	23
mx.callback.save.checkpoint	23
mx.cpu	24
mx.ctx.default	24
mx.exec.backward	24
mx.exec.forward	25
mx.exec.update.arg.arrays	25
mx.exec.update.aux.arrays	25
mx.exec.update.grad.arrays	26
mx.gpu	26
mx.infer.rnn	26
mx.infer.rnn.one	27
mx.infer.rnn.one.unroll	27
mx.init.create	28
mx.init.internal.default	28
mx.init.normal	29
mx.init.uniform	29
mx.init.Xavier	29
mx.io.arrayiter	30
mx.io.bucket.iter	30
mx.io.CSVIter	31
mx.io.extract	32
mx.io.ImageDetRecordIter	33
mx.io.ImageRecordInt8Iter	36

mx.io.ImageRecordIter	39
mx.io.ImageRecordIter_v1	42
mx.io.ImageRecordUInt8Iter	46
mx.io.ImageRecordUInt8Iter_v1	49
mx.io.LibSVMIter	52
mx.io.MNISTIter	53
mx.kv.create	54
mx.lr_scheduler.FactorScheduler	55
mx.lr_scheduler.MultiFactorScheduler	55
mx.metric.accuracy	56
mx.metric.custom	56
mx.metric.logistic_acc	56
mx.metric.logloss	57
mx.metric.mae	57
mx.metric.mse	57
mx.metric.Perplexity	58
mx.metric.rmse	58
mx.metric.rmsle	58
mx.metric.top_k_accuracy	59
mx.mlp	59
mx.model.buckets	60
mx.model.FeedForward.create	61
mx.model.init.params	62
mx.model.load	63
mx.model.save	63
mx.nd.abs	64
mx.nd.Activation	64
mx.nd.adam.update	65
mx.nd.add.n	66
mx.nd.all.finite	66
mx.nd.amp.cast	67
mx.nd.amp.multicast	67
mx.nd.arccos	68
mx.nd.arccosh	68
mx.nd.arcsin	69
mx.nd.arcsinh	69
mx.nd.arctan	70
mx.nd.arctanh	70
mx.nd.argmax	71
mx.nd.argmax.channel	71
mx.nd.argmin	72
mx.nd.argsort	73
mx.nd.array	73
mx.nd.batch.dot	74
mx.nd.batch.take	75
mx.nd.BatchNorm	75
mx.nd.BatchNorm.v1	77
mx.nd.BilinearSampler	78

mx.nd.BlockGrad	79
mx.nd.broadcast.add	80
mx.nd.broadcast.axes	81
mx.nd.broadcast.axis	81
mx.nd.broadcast.div	82
mx.nd.broadcast.equal	83
mx.nd.broadcast.greater	83
mx.nd.broadcast.greater.equal	84
mx.nd.broadcast.hypot	84
mx.nd.broadcast.lesser	85
mx.nd.broadcast.lesser.equal	86
mx.nd.broadcast.like	86
mx.nd.broadcast.logical.and	87
mx.nd.broadcast.logical.or	88
mx.nd.broadcast.logical.xor	88
mx.nd.broadcast.maximum	89
mx.nd.broadcast.minimum	89
mx.nd.broadcast.minus	90
mx.nd.broadcast.mod	91
mx.nd.broadcast.mul	91
mx.nd.broadcast.not.equal	92
mx.nd.broadcast.plus	92
mx.nd.broadcast.power	93
mx.nd.broadcast.sub	94
mx.nd.broadcast.to	94
mx.nd.Cast	95
mx.nd.cast	96
mx.nd.cast.storage	96
mx.nd.cbirt	97
mx.nd.ceil	98
mx.nd.choose.element.0index	98
mx.nd.clip	99
mx.nd.Concat	100
mx.nd.concat	101
mx.nd.Convolution	102
mx.nd.Convolution.v1	104
mx.nd.copyto	105
mx.nd.Correlation	105
mx.nd.cos	106
mx.nd.cosh	107
mx.nd.Crop	107
mx.nd.crop	108
mx.nd.ctc.loss	109
mx.nd.CTCLoss	110
mx.nd.cumsum	112
mx.nd.Custom	112
mx.nd.Deconvolution	113
mx.nd.degrees	114

<code>mx.nd.depth.to.space</code>	115
<code>mx.nd.diag</code>	116
<code>mx.nd.dot</code>	117
<code>mx.nd.Dropout</code>	118
<code>mx.nd.ElementWiseSum</code>	119
<code>mx.nd.elemwise.add</code>	119
<code>mx.nd.elemwise.div</code>	120
<code>mx.nd.elemwise.mul</code>	120
<code>mx.nd.elemwise.sub</code>	121
<code>mx.nd.Embedding</code>	121
<code>mx.nd.erf</code>	122
<code>mx.nd.erfinv</code>	123
<code>mx.nd.exp</code>	123
<code>mx.nd.expand.dims</code>	124
<code>mx.nd.expm1</code>	124
<code>mx.nd.fill.element.0index</code>	125
<code>mx.nd.fix</code>	125
<code>mx.nd.Flatten</code>	126
<code>mx.nd.flatten</code>	126
<code>mx.nd.flip</code>	127
<code>mx.nd.floor</code>	128
<code>mx.nd.ftml.update</code>	128
<code>mx.nd.ftrl.update</code>	129
<code>mx.nd.FullyConnected</code>	130
<code>mx.nd.gamma</code>	131
<code>mx.nd.gammaln</code>	131
<code>mx.nd.gather.nd</code>	132
<code>mx.nd.GridGenerator</code>	132
<code>mx.nd.GroupNorm</code>	133
<code>mx.nd.hard.sigmoid</code>	134
<code>mx.nd.identity</code>	134
<code>mx.nd.IdentityAttachKLSparseReg</code>	135
<code>mx.nd.InstanceNorm</code>	135
<code>mx.nd.khatri.rao</code>	136
<code>mx.nd.L2Normalization</code>	137
<code>mx.nd.LayerNorm</code>	138
<code>mx.nd.LeakyReLU</code>	139
<code>mx.nd.linalg.det</code>	140
<code>mx.nd.linalg.extractdiag</code>	140
<code>mx.nd.linalg.extracttrian</code>	141
<code>mx.nd.linalg.gelqf</code>	142
<code>mx.nd.linalg.gemm</code>	143
<code>mx.nd.linalg.gemm2</code>	144
<code>mx.nd.linalg.inverse</code>	145
<code>mx.nd.linalg.makediag</code>	146
<code>mx.nd.linalg.maketrian</code>	147
<code>mx.nd.linalg.potrf</code>	148
<code>mx.nd.linalg.potri</code>	148

<code>mx.nd.linalg.slogdet</code>	149
<code>mx.nd.linalg.sumlogdiag</code>	150
<code>mx.nd.linalg.syrk</code>	151
<code>mx.nd.linalg.trmm</code>	152
<code>mx.nd.linalg.trsm</code>	153
<code>mx.nd.LinearRegressionOutput</code>	154
<code>mx.nd.load</code>	154
<code>mx.nd.log</code>	155
<code>mx.nd.log.softmax</code>	155
<code>mx.nd.log10</code>	156
<code>mx.nd.log1p</code>	157
<code>mx.nd.log2</code>	157
<code>mx.nd.logical.not</code>	158
<code>mx.nd.LogisticRegressionOutput</code>	158
<code>mx.nd.LRN</code>	159
<code>mx.nd.MAERegressionOutput</code>	160
<code>mx.nd.make.loss</code>	160
<code>mx.nd.MakeLoss</code>	161
<code>mx.nd.max</code>	162
<code>mx.nd.max.axis</code>	163
<code>mx.nd.mean</code>	163
<code>mx.nd.min</code>	164
<code>mx.nd.min.axis</code>	165
<code>mx.nd.moments</code>	165
<code>mx.nd.mp.nag.mom.update</code>	166
<code>mx.nd.mp.sgd.mom.update</code>	167
<code>mx.nd.mp.sgd.update</code>	167
<code>mx.nd.multi.all.finite</code>	168
<code>mx.nd.multi.lars</code>	169
<code>mx.nd.multi.mp.sgd.mom.update</code>	169
<code>mx.nd.multi.mp.sgd.update</code>	170
<code>mx.nd.multi.sgd.mom.update</code>	171
<code>mx.nd.multi.sgd.update</code>	172
<code>mx.nd.multi.sum.sq</code>	172
<code>mx.nd.nag.mom.update</code>	173
<code>mx.nd.nanprod</code>	174
<code>mx.nd.nansum</code>	174
<code>mx.nd.negative</code>	175
<code>mx.nd.norm</code>	176
<code>mx.nd.normal</code>	177
<code>mx.nd.one.hot</code>	177
<code>mx.nd.ones</code>	178
<code>mx.nd.ones.like</code>	179
<code>mx.nd.Pad</code>	179
<code>mx.nd.pad</code>	181
<code>mx.nd.pick</code>	182
<code>mx.nd.Pooling</code>	183
<code>mx.nd.Pooling.v1</code>	185

mx.nd.preloaded.multi.mp.sgd.mom.update	186
mx.nd.preloaded.multi.mp.sgd.update	187
mx.nd.preloaded.multi.sgd.mom.update	187
mx.nd.preloaded.multi.sgd.update	188
mx.nd.prod	189
mx.nd.radians	189
mx.nd.random.exponential	190
mx.nd.random.gamma	191
mx.nd.random.generalized.negative.binomial	191
mx.nd.random.negative.binomial	192
mx.nd.random.normal	193
mx.nd.random.pdf.dirichlet	194
mx.nd.random.pdf.exponential	194
mx.nd.random.pdf.gamma	195
mx.nd.random.pdf.generalized.negative.binomial	196
mx.nd.random.pdf.negative.binomial	197
mx.nd.random.pdf.normal	198
mx.nd.random.pdf.poisson	199
mx.nd.random.pdf.uniform	199
mx.nd.random.poisson	200
mx.nd.random.randint	201
mx.nd.random.uniform	201
mx.nd.ravel.multi.index	202
mx.nd.rcbrt	203
mx.nd.reciprocal	203
mx.nd.relu	204
mx.nd.repeat	204
mx.nd.Reshape	205
mx.nd.reshape	206
mx.nd.reshape.like	208
mx.nd.reverse	209
mx.nd.rint	209
mx.nd.rmsprop.update	210
mx.nd.rmspropalex.update	211
mx.nd.RNN	212
mx.nd.ROIpooling	214
mx.nd.round	215
mx.nd.rsqrt	216
mx.nd.sample.exponential	216
mx.nd.sample.gamma	217
mx.nd.sample.generalized.negative.binomial	218
mx.nd.sample.multinomial	219
mx.nd.sample.negative.binomial	220
mx.nd.sample.normal	221
mx.nd.sample.poisson	222
mx.nd.sample.uniform	223
mx.nd.save	224
mx.nd.scatter.nd	224

<code>mx.nd.SequenceLast</code>	225
<code>mx.nd.SequenceMask</code>	226
<code>mx.nd.SequenceReverse</code>	227
<code>mx.nd.sgd.mom.update</code>	229
<code>mx.nd.sgd.update</code>	230
<code>mx.nd.shape.array</code>	231
<code>mx.nd.shuffle</code>	231
<code>mx.nd.sigmoid</code>	232
<code>mx.nd.sign</code>	232
<code>mx.nd.signsgd.update</code>	233
<code>mx.nd.signum.update</code>	233
<code>mx.nd.sin</code>	234
<code>mx.nd.sinh</code>	235
<code>mx.nd.size.array</code>	235
<code>mx.nd.slice.axis</code>	236
<code>mx.nd.slice.like</code>	237
<code>mx.nd.SliceChannel</code>	238
<code>mx.nd.smooth.l1</code>	239
<code>mx.nd.Softmax</code>	239
<code>mx.nd.softmax</code>	241
<code>mx.nd.softmax.cross.entropy</code>	242
<code>mx.nd.SoftmaxActivation</code>	243
<code>mx.nd.SoftmaxOutput</code>	244
<code>mx.nd.softmin</code>	245
<code>mx.nd.softsign</code>	246
<code>mx.nd.sort</code>	247
<code>mx.nd.space.to.depth</code>	247
<code>mx.nd.SpatialTransformer</code>	248
<code>mx.nd.split</code>	249
<code>mx.nd.sqrt</code>	250
<code>mx.nd.square</code>	250
<code>mx.nd.squeeze</code>	251
<code>mx.nd.stack</code>	251
<code>mx.nd.stop.gradient</code>	252
<code>mx.nd.sum</code>	253
<code>mx.nd.sum.axis</code>	254
<code>mx.nd.SVMOutput</code>	255
<code>mx.nd.swapaxes</code>	255
<code>mx.nd.SwapAxis</code>	256
<code>mx.nd.take</code>	256
<code>mx.nd.tan</code>	257
<code>mx.nd.tanh</code>	258
<code>mx.nd.tile</code>	259
<code>mx.nd.topk</code>	260
<code>mx.nd.transpose</code>	261
<code>mx.nd.trunc</code>	261
<code>mx.nd.uniform</code>	262
<code>mx.nd.unravel.index</code>	263

mx.nd.UpSampling	263
mx.nd.where	264
mx.nd.zeros	265
mx.nd.zeros.like	266
mx.opt.adadelta	266
mx.opt.adagrad	267
mx.opt.adam	267
mx.opt.create	268
mx.opt.get.updater	268
mx.opt.nag	269
mx.opt.rmsprop	269
mx.opt.sgd	270
mx.profiler.config	271
mx.profiler.state	271
mx.rnorm	272
mx.runif	272
mx.serialize	273
mx.set.seed	273
mx.simple.bind	274
mx.symbol.abs	274
mx.symbol.Activation	275
mx.symbol.adam_update	275
mx.symbol.add_n	277
mx.symbol.all_finite	277
mx.symbol.amp_cast	278
mx.symbol.amp_multicast	278
mx.symbol.arccos	279
mx.symbol.arccosh	280
mx.symbol.arcsin	280
mx.symbol.arcsinh	281
mx.symbol.arctan	282
mx.symbol.arctanh	282
mx.symbol.argmax	283
mx.symbol.argmax_channel	284
mx.symbol.argmin	284
mx.symbol.argsort	285
mx.symbol.BatchNorm	286
mx.symbol.BatchNorm_v1	288
mx.symbol.batch_dot	289
mx.symbol.batch_take	290
mx.symbol.BilinearSampler	291
mx.symbol.BlockGrad	292
mx.symbol.broadcast_add	293
mx.symbol.broadcast_axes	294
mx.symbol.broadcast_axis	295
mx.symbol.broadcast_div	296
mx.symbol.broadcast_equal	296
mx.symbol.broadcast_greater	297

mx.symbol.broadcast_greater_equal	298
mx.symbol.broadcast_hypot	298
mx.symbol.broadcast_lesser	299
mx.symbol.broadcast_lesser_equal	300
mx.symbol.broadcast_like	301
mx.symbol.broadcast_logical_and	302
mx.symbol.broadcast_logical_or	302
mx.symbol.broadcast_logical_xor	303
mx.symbol.broadcast_maximum	304
mx.symbol.broadcast_minimum	304
mx.symbol.broadcast_minus	305
mx.symbol.broadcast_mod	306
mx.symbol.broadcast_mul	307
mx.symbol.broadcast_not_equal	307
mx.symbol.broadcast_plus	308
mx.symbol.broadcast_power	309
mx.symbol.broadcast_sub	310
mx.symbol.broadcast_to	311
mx.symbol.Cast	312
mx.symbol.cast	312
mx.symbol.cast_storage	313
mx.symbol.cbrt	314
mx.symbol.ceil	314
mx.symbol.choose_element_0index	315
mx.symbol.clip	316
mx.symbol.Concat	317
mx.symbol.concat	318
mx.symbol.Convolution	318
mx.symbol.Convolution_v1	320
mx.symbol.Correlation	321
mx.symbol.cos	323
mx.symbol.cosh	323
mx.symbol.Crop	324
mx.symbol.crop	325
mx.symbol.CTCLoss	326
mx.symbol.ctc_loss	327
mx.symbol.cumsum	329
mx.symbol.Custom	330
mx.symbol.Deconvolution	330
mx.symbol.degrees	332
mx.symbol.depth_to_space	332
mx.symbol.diag	333
mx.symbol.dot	334
mx.symbol.Dropout	336
mx.symbol.ElementWiseSum	337
mx.symbol.elemwise_add	337
mx.symbol.elemwise_div	338
mx.symbol.elemwise_mul	339

mx.symbol.elemwise_sub	339
mx.symbol.Embedding	340
mx.symbol.erf	341
mx.symbol.erfinv	342
mx.symbol.exp	342
mx.symbol.expand_dims	343
mx.symbol.expm1	344
mx.symbol.fill_element_0index	344
mx.symbol.fix	345
mx.symbol.Flatten	346
mx.symbol.flatten	346
mx.symbol.flip	347
mx.symbol.floor	348
mx.symbol.ftml_update	348
mx.symbol.ftrl_update	349
mx.symbol.FullyConnected	350
mx.symbol.gamma	352
mx.symbol.gammaln	352
mx.symbol.gather_nd	353
mx.symbol.GridGenerator	353
mx.symbol.Group	354
mx.symbol.GroupNorm	355
mx.symbol.hard_sigmoid	356
mx.symbol.identity	356
mx.symbol.IdentityAttachKLSparseReg	357
mx.symbol.infer.shape	357
mx.symbol.InstanceNorm	358
mx.symbol.khatri_rao	359
mx.symbol.L2Normalization	360
mx.symbol.LayerNorm	361
mx.symbol.LeakyReLU	362
mx.symbol.linalg_det	363
mx.symbol.linalg_extractdiag	364
mx.symbol.linalg_extracttrian	365
mx.symbol.linalg_gelqf	366
mx.symbol.linalg_gemm	367
mx.symbol.linalg_gemm2	368
mx.symbol.linalg_inverse	369
mx.symbol.linalg_makediag	370
mx.symbol.linalg_maketrian	371
mx.symbol.linalg_potrf	372
mx.symbol.linalg_potri	373
mx.symbol.linalg_slogdet	374
mx.symbol.linalg_sumlogdiag	375
mx.symbol.linalg_syrk	376
mx.symbol.linalg_trmm	377
mx.symbol.linalg_trsm	378
mx.symbol.LinearRegressionOutput	379

mx.symbol.load	380
mx.symbol.load.json	380
mx.symbol.log	381
mx.symbol.log10	381
mx.symbol.log1p	382
mx.symbol.log2	382
mx.symbol.logical_not	383
mx.symbol.LogisticRegressionOutput	383
mx.symbol.log_softmax	384
mx.symbol.LRN	385
mx.symbol.MAERegressionOutput	386
mx.symbol.MakeLoss	387
mx.symbol.make_loss	388
mx.symbol.max	388
mx.symbol.max_axis	389
mx.symbol.mean	390
mx.symbol.moments	391
mx.symbol.mp_nag_mom_update	391
mx.symbol.mp_sgd_mom_update	392
mx.symbol.mp_sgd_update	393
mx.symbol.multi_all_finite	394
mx.symbol.multi_lars	394
mx.symbol.multi_mp_sgd_mom_update	395
mx.symbol.multi_mp_sgd_update	396
mx.symbol.multi_sgd_mom_update	397
mx.symbol.multi_sgd_update	398
mx.symbol.multi_sum_sq	399
mx.symbol.nag_mom_update	399
mx.symbol.nanprod	400
mx.symbol.nansum	401
mx.symbol.negative	402
mx.symbol.norm	402
mx.symbol.normal	403
mx.symbol.ones_like	404
mx.symbol.one_hot	405
mx.symbol.Pad	406
mx.symbol.pad	407
mx.symbol.pick	408
mx.symbol.Pooling	410
mx.symbol.Pooling_v1	411
mx.symbol.preloaded_multi_mp_sgd_mom_update	413
mx.symbol.preloaded_multi_mp_sgd_update	414
mx.symbol.preloaded_multi_sgd_mom_update	414
mx.symbol.preloaded_multi_sgd_update	415
mx.symbol.prod	416
mx.symbol.radians	417
mx.symbol.random_exponential	417
mx.symbol.random_gamma	418

mx.symbol.random_generalized_negative_binomial	419
mx.symbol.random_negative_binomial	420
mx.symbol.random_normal	421
mx.symbol.random_pdf_dirichlet	422
mx.symbol.random_pdf_exponential	423
mx.symbol.random_pdf_gamma	424
mx.symbol.random_pdf_generalized_negative_binomial	425
mx.symbol.random_pdf_negative_binomial	426
mx.symbol.random_pdf_normal	427
mx.symbol.random_pdf_poisson	428
mx.symbol.random_pdf_uniform	429
mx.symbol.random_poisson	430
mx.symbol.random_randint	430
mx.symbol.random_uniform	431
mx.symbol.ravel_multi_index	432
mx.symbol.rcbrt	433
mx.symbol.reciprocal	433
mx.symbol.relu	434
mx.symbol.repeat	435
mx.symbol.Reshape	436
mx.symbol.reshape	437
mx.symbol.reshape_like	439
mx.symbol.reverse	440
mx.symbol rint	441
mx.symbol.rmspropalex_update	442
mx.symbol.rmsprop_update	443
mx.symbol.RNN	444
mx.symbol.ROIPooling	446
mx.symbol.round	447
mx.symbol.rsqrt	448
mx.symbol.sample_exponential	449
mx.symbol.sample_gamma	450
mx.symbol.sample_generalized_negative_binomial	451
mx.symbol.sample_multinomial	452
mx.symbol.sample_negative_binomial	453
mx.symbol.sample_normal	454
mx.symbol.sample_poisson	455
mx.symbol.sample_uniform	456
mx.symbol.save	457
mx.symbol.scatter_nd	457
mx.symbol.SequenceLast	458
mx.symbol.SequenceMask	459
mx.symbol.SequenceReverse	461
mx.symbol.sgd_mom_update	462
mx.symbol.sgd_update	463
mx.symbol.shape_array	464
mx.symbol.shuffle	465
mx.symbol.sigmoid	465

<code>mx.symbol.sign</code>	466
<code>mx.symbol.signsgd_update</code>	466
<code>mx.symbol.signum_update</code>	467
<code>mx.symbol.sin</code>	468
<code>mx.symbol.sinh</code>	469
<code>mx.symbol.size_array</code>	470
<code>mx.symbol.slice</code>	470
<code>mx.symbol.SliceChannel</code>	471
<code>mx.symbol.slice_axis</code>	473
<code>mx.symbol.slice_like</code>	474
<code>mx.symbol.smooth_l1</code>	475
<code>mx.symbol.Softmax</code>	476
<code>mx.symbol.softmax</code>	478
<code>mx.symbol.SoftmaxActivation</code>	479
<code>mx.symbol.SoftmaxOutput</code>	480
<code>mx.symbol.softmax_cross_entropy</code>	482
<code>mx.symbol.softmin</code>	483
<code>mx.symbol.softsign</code>	484
<code>mx.symbol.sort</code>	484
<code>mx.symbol.space_to_depth</code>	485
<code>mx.symbol.SpatialTransformer</code>	486
<code>mx.symbol.split</code>	487
<code>mx.symbol.sqrt</code>	488
<code>mx.symbol.square</code>	489
<code>mx.symbol.squeeze</code>	489
<code>mx.symbol.stack</code>	490
<code>mx.symbol.stop_gradient</code>	491
<code>mx.symbol.sum</code>	491
<code>mx.symbol.sum_axis</code>	493
<code>mx.symbol.SVMOutput</code>	494
<code>mx.symbol.swapaxes</code>	494
<code>mx.symbol.SwapAxis</code>	495
<code>mx.symbol.take</code>	496
<code>mx.symbol.tan</code>	497
<code>mx.symbol.tanh</code>	498
<code>mx.symbol.tile</code>	498
<code>mx.symbol.topk</code>	499
<code>mx.symbol.transpose</code>	500
<code>mx.symbol.trunc</code>	501
<code>mx.symbol.uniform</code>	502
<code>mx.symbol.unravel_index</code>	503
<code>mx.symbol.UpSampling</code>	503
<code>mx.symbol.Variable</code>	505
<code>mx.symbol.where</code>	505
<code>mx.symbol.zeros_like</code>	506
<code>mx.unserialize</code>	507
<code>mxnet</code>	507
<code>mxnet.export</code>	507

arguments15

Ops.MXNDArray508

outputs508

predict.MXFeedForwardModel509

print.MXNDArray509

rnn.graph510

rnn.graph.unroll510

Index512

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

Convert images into image recordio format

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	<i>Get a symbol that contains all the internals</i>
-----------	---

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

Description

Judge if an object is mx.symbol

Usage

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

Value

Logical indicator

is.serialized	<i>Check if the model has been serialized into RData-compatible format.</i>
---------------	---

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, ...)
```

mx.exec.forward	<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)
```

mx.exec.update.arg.arrays	<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)
```

mx.exec.update.aux.arrays	<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)
```

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

<code>mx.gpu</code>	<i>Create a mxnet GPU context.</i>
---------------------	------------------------------------

Description

Create a mxnet GPU context.

Arguments

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

Value

The GPU context.

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

Description

Inference of RNN model

Usage

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

Arguments

`infer.data` Datalter
`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	

<code>mx.init.create</code>	<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

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

<code>mx.init.internal.default</code>	<i>Internal default value initialization scheme.</i>
---------------------------------------	--

Description

Internal default value initialization scheme.

Usage

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

Arguments

<code>name</code>	the name of the variable.
<code>shape</code>	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	Xavier initializer
----------------	--------------------

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

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

<code>mx.io.arrayiter</code>	<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

<code>data</code>	The data array.
<code>label</code>	The label array.
<code>batch.size</code>	The batch size used to pack the array.
<code>shuffle</code>	Whether shuffle the data

<code>mx.io.bucket.iter</code>	<i>Create Bucket Iter</i>
--------------------------------	---------------------------

Description

Create Bucket Iter

Usage

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

Arguments

<code>buckets</code>	The data array.
<code>batch.size</code>	The batch size used to pack the array.
<code>data.mask.element</code>	The element to mask
<code>shuffle</code>	Whether shuffle the data
<code>seed</code>	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

data.csv	string, required The input CSV file or a directory path.
data.shape	Shape(tuple), required The shape of one example.
label.csv	string, optional, default='NULL' The input CSV file or a directory path. If NULL, all labels will be returned as 0.
label.shape	Shape(tuple), optional, default=[1] The shape of one label.
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, '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

Extract a certain field from DataIter.

Description

Extract a certain field from DataIter.

Usage

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

mx.io.ImageDetRecordIter

Create iterator for image detection dataset packed in recordio.

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.
data.shape	Shape(tuple), required Dataset Param: Shape of each instance generated by the DataIter.
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, '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 DataIter.
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.
data.shape	Shape(tuple), required The shape of one output image in (channels, height, width) format.

```

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, '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]"

```

<code>max.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>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 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.
<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 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:L941

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.
data.shape	Shape(tuple), required The shape of one output image in (channels, height, width) format.
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, '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.affloat, 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.affloat, 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:L904

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 augments names to represent sequence of augmenters to be applied, separated by comma. Additional keyword parameters will be seen by these augmenters.
label.width	int, optional, default='1' The number of labels per image.
data.shape	Shape(tuple), required The shape of one output image in (channels, height, width) format.
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, '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]"

<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 <code>[1 - max_aspect_ratio, 1 + max_aspect_ratio]</code> , else it is in <code>"[min_aspect_ratio, 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, max_aspect_ratio]"</code>
<code>max.shear.ratio</code>	float, optional, default=0 Apply a shear transformation (namely <code>"(x,y)->(x+my,y)"</code>) with <code>"m"</code> randomly chose from <code>"[-max_shear_ratio, max_shear_ratio]"</code>
<code>max.crop.size</code>	int, optional, default=-1 Crop both width and height into a random size in <code>"[min_crop_size, 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, max_crop_size]"</code> . Ignored if <code>"random_resized_crop"</code> is True.
<code>max.random.scale</code>	float, optional, default=1 Resize into <code>"[width*s, height*s]"</code> with <code>"s"</code> randomly chosen from <code>"[min_random_scale, max_random_scale]"</code> . Ignored if <code>"random_resized_crop"</code> is True.
<code>min.random.scale</code>	float, optional, default=1 Resize into <code>"[width*s, height*s]"</code> with <code>"s"</code> randomly chosen from <code>"[min_random_scale, 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, 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, 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 <code>"[-brightness, brightness]"</code> to the brightness of image.
<code>contrast</code>	float, optional, default=0 Add a random value in <code>"[-contrast, contrast]"</code> to the contrast of image.
<code>saturation</code>	float, optional, default=0 Add a random value in <code>"[-saturation, saturation]"</code> 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 <code>"[-random_h, random_h]"</code> to the H channel in HSL color space.
<code>random.s</code>	int, optional, default=0 Add a random value in <code>"[-random_s, random_s]"</code> 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
	.. 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

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 augments names to represent sequence of augments to be applied, seperated by comma. Additional keyword parameters will be seen by these augments.
label.width	int, optional, default='1' The number of labels per image.
data.shape	Shape(tuple), required The shape of one output image in (channels, height, width) format.
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, '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 “uint8“ as the data type instead of “float“.

Defined in src/io/iter_image_recordio_2.cc:L923

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.
data.shape	Shape(tuple), required The shape of one output image in (channels, height, width) format.
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, '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 is 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

“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

<code>mx.io.LibSVMIter</code>	<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/>>' _

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, '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, '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

mx.kv.create

Create a mxnet KVStore.

Description

Create a mxnet KVStore.

Arguments

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

Value

The kvstore.

`mx.lr_scheduler.FactorScheduler`*Learning rate scheduler. Reduction based on a factor value.*

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

<code>step</code>	(integer) Schedule learning rate after n updates
<code>factor</code>	(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

<code>step</code>	(array of integer) Schedule learning rate after n updates
<code>factor</code>	(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 mx.io.DataIter 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 mx.model.FeedForward.create/
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

Train RNN with bucket support

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

symbol	The symbolic configuration of the neural network.
X	mx.io.DataIter or R array/matrix The training data.
y	R array, optional label of the data This is only used when X is R array.
ctx	mx.context or list of mx.context, optional The devices used to perform training.
begin.round	integer (default=1) The initial iteration over the training data to train the model.
num.round	integer (default=10) The number of iterations over training data to train the model.
optimizer	string, default="sgd" The optimization method.
initializer,	initializer object. default=mx.init.uniform(0.01) The initialization scheme for parameters.
eval.data	mx.io.DataIter or list(data=R.array, label=R.array), optional The validation set used for validation evaluation during the progress
eval.metric	function, optional The evaluation function on the results.
epoch.end.callback	function, optional The callback when iteration ends.
batch.end.callback	function, optional The callback when one mini-batch iteration ends.
array.batch.size	integer (default=128) The batch size used for R array training.

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.
kvstore	string (default="local") The parameter synchronization scheme in multiple devices.
verbose	logical (default=TRUE) Specifies whether to print information on the iterations during training.
arg.params	list, optional Model parameter, list of name to NDAarray of net's weights.
aux.params	list, optional Model parameter, list of name to NDAarray of net's auxiliary states.
input.names	optional The names of the input symbols.
output.names	optional The names of the output symbols.
fixed.param	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.
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.

Value

model A trained mxnet model.

mx.model.init.params *Parameter initialization*

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.

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

Description

Load model checkpoint from file.

Usage

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

Arguments

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

<code>mx.model.save</code>	<i>Save model checkpoint into file.</i>
----------------------------	---

Description

Save model checkpoint into file.

Usage

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

Arguments

<code>model</code>	The feedforward model to be saved.
<code>prefix</code>	string prefix of the model name
<code>iteration</code>	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	Applies an activation function element-wise to the input.
------------------	---

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': $y = \frac{1}{1 + \exp(-x)}$

Defined in `src/operator/nn/activation.cc:L168`

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	NDAarray-or-Symbol Weight
grad	NDAarray-or-Symbol Gradient
mean	NDAarray-or-Symbol Moving mean
var	NDAarray-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=9.9999994e-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::

$$g_t = \nabla J(W_{t-1}) \quad m_t = \beta_1 m_{t-1} + (1 - \beta_1) g_t \quad v_t = \beta_2 v_{t-1} + (1 - \beta_2) g_t^2 \\ W_t = W_{t-1} - \alpha \frac{m_t}{\sqrt{v_t} + \epsilon}$$

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):

```
for row in grad.indices: m[row] = beta1*m[row] + (1-beta1)*grad[row] v[row] = beta2*v[row] +
(1-beta2)*(grad[row]**2) w[row] += - learning_rate * m[row] / (sqrt(v[row]) + epsilon)
Defined in src/operator/optimizer_op.cc:L686
```

Value

out The result mx.ndarray

mx.nd.add.n	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/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 NDAarray Array
init.output boolean, optional, default=1 Initialize output to 1.

Value

out The result mx.ndarray

mx.nd.amp.cast	<i>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.

Arguments

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

Details

Defined in src/operator/tensor/amp_cast.cc:L37

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.

Details

Defined in src/operator/tensor/amp_cast.cc:L71

Value

out The result mx.ndarray

<code>mx.nd.arccos</code>	<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` NDAarray-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:L206`

Value

`out` The result `mx.ndarray`

<code>mx.nd.arccosh</code>	<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/elemwise_unary_op_trig.cc:L474`

Value

`out` The result `mx.ndarray`

mx.nd.arcsin	Returns element-wise inverse sine of the input array.
--------------	---

Description

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

Arguments

data	NDArray-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/elemwise_unary_op_trig.cc:L187

Value

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

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

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:L436

Value

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

mx.nd.arctan

Returns element-wise inverse tangent of the input array.

Description

The output is in the closed interval $[-\pi/2, \pi/2]$.

Arguments

data NDAarray-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:L227

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/elemwise_unary_op_trig.cc:L515

Value

out The result mx.ndarray

mx.nd.argmax	<i>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.

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.]]
```

```
// 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	<i>Returns argmax indices of each channel from the input array.</i>
----------------------	---

Description

The result will be an NDArray of shape (num_channel,).

Arguments

data	NDArray-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

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.

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	Returns the indices that would sort an input array along the given axis.
---------------	--

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:L178
```

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 3D arrays in shape of ‘(batch_size, :, :)’.

Arguments

lhs NDAarray-or-Symbol The first input
 rhs NDAarray-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 ‘(batch_size, n, m)’ and “y” with shape ‘(batch_size, m, k)’, the result array will have shape ‘(batch_size, n, k)’, which is computed by::

```
batch_dot(x,y)[i,:,:] = dot(x[i,:,:], y[i,:,:])
```

Defined in src/operator/tensor/dot.cc:L126

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:L769

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)

<code>momentum</code>	float, optional, default=0.899999976 Momentum for moving average
<code>fix.gamma</code>	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.

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:L571

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 data and grid , then the output is computed by

$$\text{output}[\text{batch}, \text{channel}, \text{y_dst}, \text{x_dst}] = G(\text{data}[\text{batch}, \text{channel}, \text{y_src}, \text{x_src}])$$

y_dst , y_src enumerate all spatial locations in 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:L327
```

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:L58

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:L58

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/elementwise_binary_broadcast_op_logic.cc:L47`

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/elementwise_binary_broadcast_op_logic.cc:L85`

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:L104

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:L123

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:L142

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:L135

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:L160

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:L178

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:L196

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:L66

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:L82

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	'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	'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:L216

Value

out The result mx.ndarray

mx.nd.ceil

Returns element-wise ceiling of the input.

Description

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

Arguments

data NDAarray-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/elementwise_unary_op_basic.cc:L817`

Value

out The result mx.ndarray

mx.nd.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::

Arguments

data	NDAarray-or-Symbol The input array
index	NDAarray-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.]

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

// 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:L155
```

Value

out The result mx.ndarray

mx.nd.clip	<i>Clips (limits) the values in an array.</i>
------------	---

Description

Given an interval, values outside the interval are clipped to the interval edges. Clipping “x” between ‘a_min’ and ‘a_max’ would be::

Arguments

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

Details

.. math::

$\text{clip}(x, a_{\min}, a_{\max}) = \max(\min(x, a_{\max}), a_{\min})$

Example::

$x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]$

$\text{clip}(x, 1, 8) = [1., 1., 2., 3., 4., 5., 6., 7., 8., 8.]$

The storage type of “clip” output depends on storage types of inputs and the a_{\min} , a_{\max} \ parameter values:

- $\text{clip}(\text{default}) = \text{default}$ - $\text{clip}(\text{row_sparse}, a_{\min} \leq 0, a_{\max} \geq 0) = \text{row_sparse}$ - $\text{clip}(\text{csr}, a_{\min} \leq 0, a_{\max} \geq 0) = \text{csr}$ - $\text{clip}(\text{row_sparse}, a_{\min} < 0, a_{\max} < 0) = \text{default}$ - $\text{clip}(\text{row_sparse}, a_{\min} > 0, a_{\max} > 0) = \text{default}$ - $\text{clip}(\text{csr}, a_{\min} < 0, a_{\max} < 0) = \text{csr}$ - $\text{clip}(\text{csr}, a_{\min} > 0, a_{\max} > 0) = \text{csr}$

Defined in `src/operator/tensor/matrix_op.cc:L735`

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

<code>data</code>	NDArray-or-Symbol[] List of arrays 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.

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

- $\text{concat}(\text{csr}, \text{csr}, \dots, \text{csr}, \text{dim}=0) = \text{csr}$ - otherwise, “concat” generates output with default storage

Example::

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

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

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:L383

Value

out The result mx.ndarray

mx.nd.concat	<i>Joins input arrays along a given axis.</i>
--------------	---

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:L383

Value

out The result mx.ndarray

mx.nd.Convolution	Compute N^* -D convolution on $(N+2)^*$ -D input.
-------------------	---

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::

$$out[n,i,:,:] = bias[i] + \sum_j 0^{channel} data[n,j,:,:] \star weight[i,j,:,:]$$

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:L473

Value

out The result mx.ndarray

mx.nd.Convolution.v1 *This operator is DEPRECATED. Apply convolution to input then add a bias.*

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	<i>Generate an mx.ndarray object on ctx, with data copied from src</i>
--------------	--

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^{th} neighborhood of x_i, j .

Defined in src/operator/correlation.cc:L198

Value

out The result mx.ndarray

mx.nd.cos

Computes the element-wise cosine of the input array.

Description

The input should be in radians (2π 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	Returns the hyperbolic cosine of the input array, computed element-wise.
------------	--

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:L351

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_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

Details

Defined in src/operator/crop.cc:L50

Value

out The result mx.ndarray

mx.nd.crop	<i>Slices a region of the array.</i>
------------	--------------------------------------

Description

.. note:: “crop” is deprecated. Use “slice” instead.

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.

Details

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 ≤ n, results in an array with the shape “(le_0-b_0/s_0, ..., le_m-1-b_m-1/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.]]
```

Defined in src/operator/tensor/matrix_op.cc:L511

Value

out The result mx.ndarray

mx.nd.ctc.loss	<i>Connectionist Temporal Classification Loss.</i>
----------------	--

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/nv/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

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.cumsum

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

Description

Defined in src/operator/numpy/np_cumsum.cc:L67

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_

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:L546

Value

out The result mx.ndarray

mx.nd.Deconvolution	<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

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.

<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:L274`

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”.*

Description

.. math::

Arguments

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

Details

$$\text{\backslash begingather* } x \text{\backslash prime} = \text{reshape}(x, [N, \text{block_size}, \text{block_size}, C / (\text{block_size}^2), H * \text{block_size}, W * \text{block_size}]) \text{\backslash } x \text{\backslash prime} \text{\backslash prime} = \text{transpose}(x \text{\backslash prime}, [0, 3, 4, 1, 5, 2]) \text{\backslash } y = \text{reshape}(x \text{\backslash prime} \text{\backslash prime}, [N, C / (\text{block_size}^2), H * \text{block_size}, W * \text{block_size}]) \text{\backslash endgather*}$$

where x is an input tensor with default layout as $[N, C, H, W]$: [batch, channels, height, width] and y is the output tensor of layout $[N, C / (\text{block_size}^2), H * \text{block_size}, W * \text{block_size}]$

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]]]]
```

```
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]]]]
```

Defined in `src/operator/tensor/matrix_op.cc:L1065`

Value

out The result mx.ndarray

mx.nd.diag

*Extracts a diagonal or constructs a diagonal array.***Description**

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

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.

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

<code>mx.nd.dot</code>	<i>Dot product of two arrays.</i>
------------------------	-----------------------------------

Description

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

Arguments

<code>lhs</code>	NDArray-or-Symbol The first input
<code>rhs</code>	NDArray-or-Symbol The second input
<code>transpose.a</code>	boolean, optional, default=0 If true then transpose the first input before dot.
<code>transpose.b</code>	boolean, optional, default=0 If true then transpose the second input before dot.
<code>forward.stype</code>	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	<i>Applies dropout operation to input array.</i>
---------------	--

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	'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:L534

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:L885

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:L906

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:L63

Value

out The result mx.ndarray

<code>mx.nd.expand_dims</code>	<i>Inserts a new axis of size 1 into the array shape</i>
--------------------------------	--

Description

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)”.

Arguments

<code>data</code>	NDArray-or-Symbol Source input
<code>axis</code>	int, required Position where new axis is to be inserted. Suppose that the input ‘NDArray’'s dimension is ‘ <code>ndim</code> ’, the range of the inserted axis is ‘ <code>[-ndim, ndim]</code> ’

Details

Defined in `src/operator/tensor/matrix_op.cc:L421`

Value

out The result `mx.ndarray`

<code>mx.nd.expm1</code>	<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

<code>data</code>	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:L224`

Value

out The result `mx.ndarray`

mx.nd.fill.element.0index	<i>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 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	<i>Returns element-wise rounded value to the nearest \ integer towards zero of the input.</i>
-----------	---

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.</i>
---------------	---

Description

.. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead.

Arguments

data NDAarray-or-Symbol Input array.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L292`

Value

out The result mx.ndarray

mx.nd.flatten	<i>Flattens the input array into a 2-D array by collapsing the higher dimensions.</i>
---------------	---

Description

.. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead.

Arguments

data NDAarray-or-Symbol Input array.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L292`

Value

out The result mx.ndarray

<code>mx.nd.flip</code>	<i>Reverses the order of elements along given axis while preserving array shape.</i>
-------------------------	--

Description

Note: reverse and flip are equivalent. We use reverse in the following examples.

Arguments

<code>data</code>	NDArray-or-Symbol Input data array
<code>axis</code>	Shape(tuple), required The axis which to reverse elements.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L913`

Value

out The result mx.ndarray

mx.nd.floor	Returns element-wise floor of the input.
-------------	--

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/elementwise_unary_op_basic.cc:L836`

Value

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

mx.nd.ftml.update	The FTML optimizer described in <i>*FTML - Follow the Moving Leader in Deep Learning*</i> , available at http://proceedings.mlr.press/v70/zheng17a/zheng17a.pdf .
-------------------	--

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 $\text{grad} = \text{rescale_grad} * \text{grad}$.
clip_grad	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

$$\mathbf{g}_t = \nabla J(\mathbf{W}_{t-1})$$

$$\mathbf{v}_t = \beta_2 \mathbf{v}_{t-1} + (1 - \beta_2) \mathbf{g}_t^2$$

$$\mathbf{d}_t = \frac{1 - \beta_1^t}{\sqrt{1 - \beta_2^t + \epsilon}} \mathbf{v}_t$$

$$\mathbf{z}_t = \beta_1 \mathbf{d}_{t-1}$$

$$\mathbf{W}_t = -\frac{\mathbf{z}_t}{\mathbf{d}_t}$$

Defined in src/operator/optimizer_op.cc:L638

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 http://dl.acm.org/citation.cfm?id=2488200.</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:L874

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:L288

Value

out The result mx.ndarray

mx.nd.gamma	Returns the gamma function (extension of the factorial function \ 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 \ 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:246

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.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:

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::

$$\text{out} = \frac{x - \text{mean}[\text{data}]}{\sqrt{\text{Var}[\text{data}] + \epsilon}} * \gamma + \beta$$

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 paper:

.. [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 :math:'n' input matrices,

Arguments

args NDAarray-or-Symbol[] Positional input matrices

Details

.. math:: 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,

.. math:: X = A_1 \otimes \dots \otimes A_n \in \mathbb{R}^{(M_1 \dots M_n) \times N},

where the :math:'k' th column is equal to the column-wise outer product :math:'A_1_k \otimes \dots \otimes A_n_k' where :math:'A_i_k' is the kth column of the ith 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=1.0000001e-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.LayerNorm	<i>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”.

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=9.9999975e-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

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::

$$\text{out} = \frac{\text{data} - \text{mean}(\text{data}, \text{axis})}{\sqrt{\text{var}(\text{data}, \text{axis}) + \epsilon}} * \text{gamma} + \text{beta}$$

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:L156

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. $y = x > 0 ? x : \text{slope} * (\exp(x)-1)$ - *selu*: Scaled Exponential Linear Unit. $y = \text{lambda} * (x > 0 ? x : \alpha * (\exp(x) - 1))$ where $\text{lambda} = 1.0507009873554804934193349852946$ 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 $[\text{lower_bound}, \text{upper_bound}]$ for training, while fixed to be $(\text{lower_bound} + \text{upper_bound})/2$ 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* ≥ 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:L970

Value

out The result mx.ndarray

mx.nd.linalg.extractdiag	<i>Extracts the diagonal entries of a square matrix. Input is a tensor *A* of dimension *n* ≥ 2.</i>
--------------------------	--

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 $A = [[1.0, 2.0], [3.0, 4.0]]$

`extractdiag(A) = [1.0, 4.0]`

`extractdiag(A, 1) = [2.0]`

Batch matrix diagonal extraction $A = [[[1.0, 2.0], [3.0, 4.0]], [[5.0, 6.0], [7.0, 8.0]]]$

`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]]`

`extracttrian(A) = [1.0, 3.0, 4.0]` `extracttrian(A, lower=False) = [1.0, 2.0, 4.0]` `extracttrian(A, 1) = [2.0]` `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]]]`

`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`

<code>mx.nd.linalg.gelqf</code>	<i>LQ factorization for general matrix. Input is a tensor <code>*A*</code> of dimension <code>*n >= 2*</code>.</i>
---------------------------------	---

Description

If `*n=2*`, we compute the LQ factorization (LAPACK `*gelqf*`, followed by `*orglq*`). `*A*` must have shape `*(x, y)*` with `*x <= 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

$*Q* \setminus *Q* \supset 'T'$

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 $A = \begin{bmatrix} [1., 2., 3.], [4., 5., 6.], [7., 8., 9.], [10., 11., 12.] \end{bmatrix}$ $Q, L = \text{gelqf}(A)$
 $Q = \begin{bmatrix} [-0.26726124, -0.53452248, -0.80178373], [0.87287156, 0.21821789, -0.43643578], [-0.50257071, -0.57436653, -0.64616234], [0.7620735, 0.05862104, -0.64483142] \end{bmatrix}$ $L = \begin{bmatrix} [-3.74165739, 0.], [-8.55235974, 1.96396101], [-13.92838828, 0.], [-19.09768702, 0.52758934] \end{bmatrix}$

Defined in `src/operator/tensor/la_op.cc:L798`

Value

out The result `mx.ndarray`

<code>mx.nd.linalg.gemm</code>	<i>Performs general matrix multiplication and accumulation. Input are tensors <code>*A*</code>, <code>*B*</code>, <code>*C*</code>, each of dimension <code>*n</code> ≥ 2 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

<code>A</code>	NDArray-or-Symbol Tensor of input matrices
<code>B</code>	NDArray-or-Symbol Tensor of input matrices
<code>C</code>	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>beta</code>	double, optional, default=1 Scalar factor multiplied with <code>C</code> .
<code>axis</code>	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 >= 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).
alpha	double, optional, default=1 Scalar factor multiplied with <code>A*B</code> .
axis	int, optional, default='-2' Axis corresponding to the matrix row indices.

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.ndarray

mx.nd.linalg.inverse	<i>Compute the inverse of a matrix. Input is a tensor *A* of dimension *n* >= 2*.</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 = [[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:L917`

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

A	NDArray-or-Symbol Tensor of diagonal entries
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

.. 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]`

`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.ndarray`

mx.nd.linalg.potrf	<i>Performs Cholesky factorization of a symmetric positive-definite matrix. Input is a tensor *A* of dimension *n* ≥ 2.</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

$A = B \begin{cases} \text{if } \text{lower} = \text{true} \\ \text{if } \text{lower} = \text{false} \end{cases} B^T$

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 *A* of dimension *n* ≥ 2.</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	NDArray-or-Symbol Tensor of lower triangular matrices
---	---

Details

$\text{*out*} = \text{*A*}^{\text{'-T'}}$ if $\text{*lower*} = \text{*true*}$ $\text{*out*} = \text{*A*}^{\text{'-1'}}$ if $\text{*lower*} = \text{*false*}$

In other words, if *A* is the Cholesky factor of a symmetric positive definite matrix *B* (obtained by *potrf*), then

$\text{*out*} = \text{*B*}^{\text{'-1'}}$

If $\text{*n} > 2$, *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	<i>Compute the sign and log of the determinant of a matrix. Input is a tensor *A* of dimension *n* >= 2.</i>
----------------------	---

Description

If $\text{*n} = 2$, *A* is a square matrix. We compute:

Arguments

A NDAarray-or-Symbol Tensor of square matrix

Details

$\text{*sign*} = \text{*sign}(\det(A))$ $\text{*logabsdet*} = \text{*log}(\text{abs}(\det(A)))$

If $\text{*n} > 2$, *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 $A = \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix}$ sign, logabsdet = slogdet(A) sign = [1.] logabsdet = [1.609438]

Batch matrix signed log determinant $A = \begin{bmatrix} \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix}, \begin{bmatrix} 1. & 2. \\ 2. & 4. \end{bmatrix}, \begin{bmatrix} 1. & 2. \\ 4. & 3. \end{bmatrix} \end{bmatrix}$ sign, logabsdet = slogdet(A) sign = [1., 0., -1.] logabsdet = [1.609438, -inf, 1.609438]

Defined in src/operator/tensor/la_op.cc:L1027

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* ≥ 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,).

Arguments

A NDAarray-or-Symbol Tensor of square matrices

Details

If $n \geq 2$, *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 $A = \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 7.0 \end{bmatrix}$ sumlogdiag(A) = [1.9459]

Batch matrix reduction $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 1.0 \\ 1.0 & 7.0 \end{bmatrix}, \begin{bmatrix} 3.0 & 0. \\ 0. & 17.0 \end{bmatrix} \end{bmatrix}$ 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	<i>Multiplication of matrix with its transpose. Input is a tensor *A* of dimension *n* ≥ 2.</i>
-------------------	---

Description

If $n=2$, the operator performs the BLAS3 function `*syrk*`:

Arguments

A	NDArray-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

$$*out* = *alpha* \cdot *A* \cdot *A*^T$$

if `*transpose=False*`, or

$$*out* = *alpha* \cdot *A*^T \cdot *A*$$

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.ndarray`

mx.nd.linalg.trmm	<i>Performs multiplication with a lower triangular matrix. Input are tensors <code>*A*</code>, <code>*B*</code>, each of dimension <code>*n >= 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	<i>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.</i>
-------------------	--

Description

If $n=2$, A^* must be triangular. The operator performs the BLAS3 function `*trsm*`, solving for out^* in:

Arguments

<code>A</code>	NDArray-or-Symbol Tensor of lower triangular matrices
<code>B</code>	NDArray-or-Symbol Tensor of matrices
<code>transpose</code>	boolean, optional, default=0 Use transposed of the triangular matrix
<code>rightside</code>	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
<code>lower</code>	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
<code>alpha</code>	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 $A = \begin{bmatrix} 1.0 & 0 \\ 1.0 & 1.0 \end{bmatrix}$ $B = \begin{bmatrix} 2.0 & 2.0 & 2.0 \\ 4.0 & 4.0 & 4.0 \end{bmatrix}$ `trsm(A, B, alpha=0.5)` $= \begin{bmatrix} 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 \end{bmatrix}$

Batch matrix solve $A = \begin{bmatrix} \begin{bmatrix} 1.0 & 0 \\ 1.0 & 1.0 \end{bmatrix}, \begin{bmatrix} 1.0 & 0 \\ 1.0 & 1.0 \end{bmatrix} \end{bmatrix}$ $B = \begin{bmatrix} \begin{bmatrix} 2.0 & 2.0 & 2.0 \\ 4.0 & 4.0 & 4.0 \end{bmatrix}, \begin{bmatrix} 4.0 & 4.0 & 4.0 \\ 8.0 & 8.0 & 8.0 \end{bmatrix} \end{bmatrix}$ `trsm(A, B, alpha=0.5)` $= \begin{bmatrix} \begin{bmatrix} 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 \end{bmatrix}, \begin{bmatrix} 2.0 & 2.0 & 2.0 \\ 2.0 & 2.0 & 2.0 \end{bmatrix} \end{bmatrix}$

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 \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

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

$$\text{SquaredLoss}(\textbf{Y}, \hat{\textbf{Y}}) = \frac{1}{n} \sum_{i=0}^{n-1} \|\textbf{y}_i - \hat{\textbf{y}}_i\|^2$$

.. 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
```

Load an mx.nd.array object on disk

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	Returns element-wise Natural logarithmic value of the input.
-----------	--

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:L76

Value

out The result mx.ndarray

mx.nd.log.softmax	Computes the log softmax of the input. This is equivalent to computing softmax followed by log.
-------------------	---

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	<i>Returns element-wise Base-10 logarithmic value of the input.</i>
-------------	---

Description

“ $10^{\log_{10}(x)} = x$ ”

Arguments

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

Details

The storage type of “log10” output is always dense
 Defined in src/operator/tensor/elemwise_unary_op_logexp.cc:L93

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 $1+x \approx 1$

Arguments

data	NDArray-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/elemwise_unary_op_logexp.cc:L206

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	NDArray-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:L105

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	NDArray-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 $\frac{1}{1 + \exp(-\text{textbf{f}x})}$.

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 α in the LRN expression.
beta	float, optional, default=0.75 The power parameter β in the LRN expression.
knorm	float, optional, default=2 The parameter k in the LRN expression.
nsize	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:L164

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

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 The input array.
------	------------------------------------

Details

For example, if you are a 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:L360

Value

out The result mx.ndarray

mx.nd.MakeLoss	<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 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 a 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 NDAarray.

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	NDAarray-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	<i>Computes the max of array elements over given axes.</i>
----------------	--

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	<i>Computes the mean of array elements over given axes.</i>
------------	---

Description

Defined in src/operator/tensor/./broadcast_reduce_op.h:L83

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

Computes the min of array elements over given axes.

Description

Defined in src/operator/tensor/./broadcast_reduce_op.h:L46

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.axis	<i>Computes the min of array elements over given axes.</i>
----------------	--

Description

Defined in src/operator/tensor/.broadcast_reduce_op.h:L46

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.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.nag.mom.update

Update function for multi-precision Nesterov Accelerated Gradient(NAG) optimizer.

Description

Defined in src/operator/optimizer_op.cc:L743

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	<i>Compute the LARS coefficients of multiple weights and grads from their sums of square"</i>
------------------	---

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	<i>Momentum update function for multi-precision Stochastic Gradient Descent (SGD) optimizer.</i>
-------------------------------	--

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::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_t) \quad W_t = W_{t-1} + v_t$$

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:L470

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 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

$$\text{weight} = \text{weight} - \text{learning_rate} * (\text{gradient} + \text{wd} * \text{weight})$$

Defined in src/operator/optimizer_op.cc:L415

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::

$$w = \text{momentum} * w - \text{learning_rate} * \text{gradient} \quad w += v$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer_op.cc:L372

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 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

weight = weight - learning_rate * (gradient + wd * weight)

Defined in src/operator/optimizer_op.cc:L327

Value

out The result mx.ndarray

 mx.nd.multi.sum.sq

Compute the sums of squares of multiple arrays

Description

Defined in src/operator/contrib/multi_sum_sq.cc:L36

Arguments

data	NDArray-or-Symbol[] Arrays
num.arrays	int, required number of input arrays.

Value

out The result mx.ndarray

mx.nd.nag.mom.update *Update function for Nesterov Accelerated Gradient(NAG) optimizer.
It updates the weights using the following formula,*

Description

.. $v_t = \gamma v_{t-1} + \eta * \nabla J(W_{t-1} - \gamma v_{t-1})$ $W_t = W_{t-1} - v_t$

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 $grad = rescale_grad * grad$.
clip_gradient	float, optional, default=-1 Clip gradient to the range of $[-clip_gradient, clip_gradient]$ If $clip_gradient \leq 0$, gradient clipping is turned off. $grad = \max(\min(grad, clip_gradient), -clip_gradient)$.

Details

Where η is the learning rate of the optimizer γ 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:L724

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:L46

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:L100

Value

out The result mx.ndarray

mx.nd.negative	<i>Numerical negative of the argument, element-wise.</i>
----------------	--

Description

The storage type of “negative“ output depends upon the input storage type:

Arguments

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

Details

- negative(default) = default - negative(row_sparse) = row_sparse - negative(csr) = csr

Value

out The result mx.ndarray

mx.nd.norm

*Computes the norm on an NDArry.***Description**

This operator computes the norm on an NDArry 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	NDArry-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

<code>mx.nd.normal</code>	<i>Draw random samples from a normal (Gaussian) distribution.</i>
---------------------------	---

Description

.. note:: The existing alias “normal” is deprecated.

Arguments

<code>loc</code>	float, optional, default=0 Mean of the distribution.
<code>scale</code>	float, optional, default=1 Standard deviation 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 [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).

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:L115

Value

out The result mx.ndarray

<code>mx.nd.one_hot</code>	<i>Returns a one-hot array.</i>
----------------------------	---------------------------------

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	'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:L816

Value

out The result mx.ndarray

<code>mx.nd.ones</code>	<i>Generate an mx.ndarray object with ones</i>
-------------------------	--

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	<i>Return an array of ones with the same shape and type as the input array.</i>
-----------------	---

Description

Examples::

Arguments

data NDArry-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	<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 NDArry-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

*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.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.]
y = [[ 1.], [ 0.], [ 2.]]
// 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:L155
```

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.
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.

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:L417

Value

out The result mx.ndarray

mx.nd.Pooling.v1

*This operator is DEPRECATED. Perform pooling on the input.***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::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_t) \quad W_t = W_{t-1} + v_t$$

It updates the weights using::

$$w = \text{momentum} * w - \text{learning_rate} * \text{gradient} \quad w += v$$

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::

$$w = \text{momentum} * w - \text{learning_rate} * \text{gradient} \quad w += v$$

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

$$\text{weight} = \text{weight} - \text{learning_rate} * (\text{gradient} + \text{wd} * \text{weight})$$

Defined in src/operator/contrib/preloaded_multi_sgd.cc:L42

Value

out The result mx.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:L293

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:L139

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:L127

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:L181

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:L166

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:L115

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:L152
```

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:L196`

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:L97`

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:L269

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:L42

Value

out The result mx.ndarray

<code>mx.nd.relu</code>	<i>Computes rectified linear activation.</i>
-------------------------	--

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

<code>mx.nd.repeat</code>	<i>Repeats elements of an array.</i>
---------------------------	--------------------------------------

Description

By default, “repeat” flattens the input array into 1-D and then repeats the elements::

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.

Details

x = [[1, 2], [3, 4]]
repeat(x, repeats=2) = [1., 1., 2., 2., 3., 3., 4., 4.]
The parameter “axis” specifies the axis along which to perform repeat::
repeat(x, repeats=2, axis=1) = [[1., 1., 2., 2.], [3., 3., 4., 4.]]
repeat(x, repeats=2, axis=0) = [[1., 2.], [1., 2.], [3., 4.], [3., 4.]]
repeat(x, repeats=2, axis=-1) = [[1., 1., 2., 2.], [3., 3., 4., 4.]]
Defined in src/operator/tensor/matrix_op.cc:L810

Value

out The result mx.ndarray

mx.nd.Reshape	<i>Reshapes the input array.</i>
---------------	----------------------------------

Description

.. note:: “Reshape” is deprecated, use “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

Details

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).

Defined in src/operator/tensor/matrix_op.cc:L202

Value

out The result mx.ndarray

mx.nd.reshape	<i>Reshapes the input array.</i>
---------------	----------------------------------

Description

.. note:: “Reshape” is deprecated, use “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

Details

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).

Defined in src/operator/tensor/matrix_op.cc:L202

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:L513

Value

out The result mx.ndarray

mx.nd.reverse	<i>Reverses the order of elements along given axis while preserving array shape.</i>
---------------	--

Description

Note: reverse and flip are equivalent. We use reverse in the following examples.

Arguments

data NDArray-or-Symbol Input data array
axis Shape(tuple), required The axis which to reverse elements.

Details

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.]]
Defined in src/operator/tensor/matrix_op.cc:L913

Value

out The result mx.ndarray

mx.nd rint	<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 NDArray-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

mx.nd.rmsprop.update	<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

weight	NDArray-or-Symbol Weight
grad	NDArray-or-Symbol Gradient
n	NDArray-or-Symbol n
lr	float, required Learning rate
gamma1	float, optional, default=0.949999988 The decay rate of momentum estimates.
epsilon	float, optional, default=9.9999994e-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 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).
clip.weights	float, optional, default=-1 Clip weights to the range of [-clip_weights, clip_weights] If clip_weights <= 0, weight clipping is turned off. weights = max(min(weights, clip_weights), -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:

$$E[g^2]_t = \gamma E[g^2]_{t-1} + (1-\gamma) g_t^2$$

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 Tieleman & Hinton, 2012.

Hinton suggests the momentum term γ to be 0.9 and the learning rate η to be 0.001.

Defined in src/operator/optimizer_op.cc:L795

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
gamma1	float, optional, default=0.949999988 Decay rate.
gamma2	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.

..
$$\begin{aligned} E[g^2]_t &= \gamma_1 * E[g^2]_{t-1} + (1 - \gamma_1) * g_t^2 \\ E[g]_t &= \gamma_1 * E[g]_{t-1} + (1 - \gamma_1) * g_t \\ \Delta_t &= \gamma_2 * \Delta_{t-1} - \frac{\eta}{\sqrt{E[g^2]_t}} * E[g]_t^2 + \epsilon * g_t \end{aligned}$$

The update step is

..
$$\theta_{t+1} = \theta_t + \Delta_t$$

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 γ_1 to be 0.95, γ_2 to be 0.9 and the learning rate η to be 0.0001.

Defined in `src/operator/optimizer_op.cc:L834`

Value

out The result `mx.nd.array`

`mx.nd.RNN`

Applies recurrent layers to input data. Currently, vanilla RNN, LSTM and GRU are implemented, with both multi-layer and bidirectional support.

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

<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
<code>p</code>	float, optional, default=0 drop rate of the dropout on the outputs of each RNN layer, except the last layer.
<code>state.outputs</code>	boolean, optional, default=0 Whether to have the states as symbol outputs.
<code>projection.size</code>	int or None, optional, default='None' size of project size
<code>lstm.state.clip.min</code>	double or None, optional, default=None Minimum clip value of LSTM states. This option must be used together with <code>lstm_state_clip_max</code> .
<code>lstm.state.clip.max</code>	double or None, optional, default=None Maximum clip value of LSTM states. This option must be used together with <code>lstm_state_clip_min</code> .
<code>lstm.state.clip.nan</code>	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.
<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

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}) \setminus f_t = \text{math-} \\ \text{rmsigmoid}(W_{if} x_t + b_{if} + W_{hf} h_{(t-1)} + b_{hf}) \setminus g_t = \tanh(W_{ig} x_t + b_{ig} + W_{hc} h_{(t-1)} \\ + b_{hg}) \setminus o_t = \text{mathrmsigmoid}(W_{io} x_t + b_{io} + W_{ho} h_{(t-1)} + b_{ho}) \setminus c_t = f_t * c_{(t-1)} + i_t \\ * g_t \setminus h_t = o_t * \tanh(c_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.

```

.. math:: \begin{array}{l} r_t = \text{mathrmsigmoid}(W_{ir} x_t + b_{ir} + W_{hr} h_{(t-1)} + b_{hr}) \setminus z_t = \\ \text{mathrmsigmoid}(W_{iz} x_t + b_{iz} + W_{hz} h_{(t-1)} + b_{hz}) \setminus n_t = \tanh(W_{in} x_t + b_{in} + r_t * \\ (W_{hn} h_{(t-1)} + b_{hn})) \setminus h_t = (1 - z_t) * n_t + z_t * h_{(t-1)} \end{array}

```

Defined in src/operator/rnn.cc:L707

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 '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.ndarray

mx.nd.round	Returns element-wise rounded value to the nearest integer of the input.
-------------	---

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 NDArry-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:L193

Value

out The result mx.ndarray

<code>mx.nd.sample.exponential</code>	<i>Concurrent sampling from multiple exponential 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]x[t]*.

Arguments

lam NDArry-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 α (shape) and β (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 μ (mean) and α (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

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.

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 μ (mean) and σ (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 *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 $[s] \times [t]$.

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

<code>mx.nd.save</code>	<i>Save an <code>mx.nd.array</code> object</i>
-------------------------	--

Description

Save an `mx.nd.array` object

Usage

`mx.nd.save(ndarray, filename)`

Arguments

- | | |
|-----------------------|-------------------------------------|
| <code>ndarray</code> | the <code>mx.nd.array</code> object |
| <code>filename</code> | 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]])
```

<code>mx.nd.scatter.nd</code>	<i>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)’.

Arguments

- | | |
|----------------------|---|
| <code>data</code> | NDArray-or-Symbol data |
| <code>indices</code> | NDArray-or-Symbol indices |
| <code>shape</code> | 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:L563

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:L522

Value

out The result mx.ndarray

mx.nd.shape.array	Returns a 1D int64 array containing the shape of data.
-------------------	--

Description

Example::

Arguments

data	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:L574

Value

out The result mx.ndarray

mx.nd.shuffle	Randomly shuffle the elements.
---------------	--------------------------------

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

data	NDArray-or-Symbol Data to be shuffled.
------	--

Value

out The result mx.ndarray

<code>mx.nd.sigmoid</code>	<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

<code>mx.nd.sign</code>	<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

mx.nd.signsgd.update	<i>Update function for SignSGD optimizer.</i>
----------------------	---

Description

.. math::

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).

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:L61

Value

out The result mx.ndarray

mx.nd.signum.update	<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:L90`

Value

out The result `mx.ndarray`

<code>mx.nd.sin</code>	<i>Computes the element-wise sine of the input array.</i>
------------------------	---

Description

The input should be in radians (2π 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/elementwise_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/elementwise_unary_op_trig.cc:L313

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:L625

Value

out The result mx.ndarray

<code>mx.nd.slice.axis</code>	<i>Slices along a given axis.</i>
-------------------------------	-----------------------------------

Description

Returns an array slice along a given ‘axis‘ starting from the ‘begin‘ index to the ‘end‘ index.

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.

Details

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.]]
```

Defined in src/operator/tensor/matrix_op.cc:L605

Value

out The result mx.ndarray

mx.nd.slice.like	<i>Slices a region of the array like the shape of another array.</i>
------------------	--

Description

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‘.

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.

Details

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.]]

Defined in src/operator/tensor/matrix_op.cc:L674

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. Note 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.smooth.l1	Calculate Smooth L1 Loss(lhs, scalar) by summing
-----------------	--

Description

.. math::

Arguments

data NDAarray-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/elementwise_binary_scalar_op_extended.cc:L108

Value

out The result mx.ndarray

mx.nd.Softmax	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.

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:L230

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.
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:L103

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 $(d_1, \frac{s}{d_1})$ 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:L230

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:L128
```

Value

out The result mx.ndarray

mx.nd.space.to.depth	Rearranges(permutates) blocks of spatial data into depth. Similar to ONNX SpaceToDepth operator: https://github.com/onnx/onnx/blob/master/docs/Operators.md#SpaceToDepth
----------------------	---

Description

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”.

Arguments

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

Details

.. math::

$$\begin{gathered} x' = \text{reshape}(x, [N, C, H / \text{block_size}, \text{block_size}, W / \text{block_size}, \text{block_size}]) \\ x' \prime = \text{transpose}(x', [0, 3, 5, 1, 2, 4]) \quad y = \text{reshape}(x' \prime, [N, C * (\text{block_size}^2), H / \text{block_size}, W / \text{block_size}]) \end{gathered}$$

where x is an input tensor with default layout as $[N, C, H, W]$: [batch, channels, height, width] and y is the output tensor of layout $[N, C * (\text{block_size}^2), H / \text{block_size}, W / \text{block_size}]$

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]]]
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]]]
```

Defined in src/operator/tensor/matrix_op.cc:L1119

Value

out The result mx.ndarray

mx.nd.SpatialTransformer

Applies a spatial transformer to input feature map.

Description

Applies a spatial transformer to input feature map.

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

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. Note 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.sqrt</code>	<i>Returns element-wise square-root value of the input.</i>
-------------------------	---

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:L142`

Value

out The result mx.ndarray

<code>mx.nd.square</code>	<i>Returns element-wise squared value of the input.</i>
---------------------------	---

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:L118`

Value

out The result mx.ndarray

mx.nd.squeeze	<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.</i>
---------------	--

Description

Examples::

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.

Details

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.

Value

out The result mx.ndarray

mx.nd.stack	<i>Join a sequence of arrays along a new axis.</i>
-------------	--

Description

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.

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.

Details

Examples::

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

```
stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]
```

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:L327

Value

out The result mx.ndarray

mx.nd.sum	<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

<code>mx.nd.sum.axis</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.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

<code>mx.nd.SwapAxis</code>	<i>Interchanges two axes of an array.</i>
-----------------------------	---

Description

Examples::

Arguments

- `data` NDAarray-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

<code>mx.nd.take</code>	<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` NDAarray-or-Symbol The input array.
- `indices` NDAarray-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:L711

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 (2π 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

<code>mx.nd.tanh</code>	<i>Returns the hyperbolic tangent of the input array, computed element-wise.</i>
-------------------------	--

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:L393

Value

out The result mx.ndarray

mx.nd.tile	<i>Repeats the whole array multiple times.</i>
------------	--

Description

If “reps” has length d , and input array has dimension of n . There are three cases:

Arguments

data	NDArray-or-Symbol Input data array
reps	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 $\max(d, a.\text{ndim})$; If $a.\text{ndim} < d$, a is promoted to be d -dimensional by prepending new axes. If $a.\text{ndim} > d$, reps is promoted to $a.\text{ndim}$ by prepending 1’s to it.

Details

- $n=d$. Repeat i -th dimension of the input by “reps[i]” times::

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

```
tile(x, 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.]]
```

- $n>d$. “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)”::

```
tile(x, reps=(2,)) = [[ 1., 2., 1., 2.], [ 3., 4., 3., 4.]]
```

- $n<d$. 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::

```
tile(x, 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.]]]
```

Defined in src/operator/tensor/matrix_op.cc:L872

Value

out The result mx.ndarray

<code>mx.nd.topk</code>	<i>Returns the top $*k*$ elements in an input array along the given axis. The returned elements will be sorted.</i>
-------------------------	--

Description

Examples::

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.typ</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 <code>ret_typ</code> 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:L65
```

Value

out The result mx.ndarray

mx.nd.transpose	<i>Permutates the dimensions of an array.</i>
-----------------	---

Description

Examples::

Arguments

data	NDArray-or-Symbol Source input
axes	Shape(tuple), optional, default=[] Target axis order. By default the axes will be inverted.

Details

```
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.]]]
Defined in src/operator/tensor/matrix_op.cc:L379
```

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	NDArray-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:L97

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:L67

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 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)

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.]]]]
```

****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.] [2. 4. 4. 4. 2.] [1. 2. 2. 2. 1.]]]]
```

Defined in src/operator/nn/upsampling.cc:L173

Value

out The result mx.ndarray

mx.nd.where

Return the elements, either from x or y, depending on the condition.

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	NDArray-or-Symbol condition array
x	NDArray-or-Symbol
y	NDArray-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

mx.nd.zeros	Generate an mx.nd.array object with zeros
-------------	---

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.zeros(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

<code>data</code>	NDArray-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`

<code>mx.opt.adadelta</code>	<i>Create an AdaDelta optimizer with respective parameters.</i>
------------------------------	---

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

<code>rho</code>	float, default=0.90 Decay rate for both squared gradients and delta x.
<code>epsilon</code>	float, default=1e-5 The constant as described in the thesis.
<code>wd</code>	float, default=0.0 L2 regularization coefficient add to all the weights.
<code>rescale_grad</code>	float, default=1 rescaling factor of gradient.
<code>clip_gradient</code>	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

mx.opt.get.updater	<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

optimizer	The optimizer
weights	The weights to be optimized

mx.opt.nag

*Create a Nesterov Accelerated SGD(NAG) optimizer.***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

learning.rate	float, default=0.01 The initial learning rate.
momentum	float, default=0 The momentum value
wd	float, default=0.0 L2 regularization coefficient added 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.rmsprop

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.

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, gamma1 = 0.95,
               gamma2 = 0.9, epsilon = 1e-04, wd = 0, rescale.grad = 1,
               clip_gradient = -1, lr_scheduler = NULL)
```

Arguments

learning.rate	float, default=0.002 The initial learning rate.
gamma1	float, default=0.95 decay factor of moving average for gradient, gradient^2 .
gamma2	float, default=0.9 "momentum" factor.
epsilon	float, default=1e-4
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.sgd	<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

learning.rate	float, default=0.01 The initial learning rate.
momentum	float, default=0 The momentum value
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.profiler.config	<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	<i>Set up the profiler state to record operator.</i>
-------------------	--

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	<i>Generate normal distribution with mean and sd.</i>
----------	---

Description

Generate normal 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
```

mx.runif	<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

shape	Dimension, The shape(dimension) of the result.
min	numeric, The lower bound of distribution.
max	numeric, The upper bound of distribution.
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
```

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
```

mx.simple.bind	<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, ...)
```

mx.symbol.abs	<i>abs:Returns element-wise absolute value of the input.</i>
---------------	--

Description

Example::

Usage

```
mx.symbol.abs(...)
```

Arguments

data	NDArray-or-Symbol The input array.
name	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

data	NDArray-or-Symbol The input array.
act.type	'relu', 'sigmoid', 'softrelu', 'softsign', 'tanh', required Activation function to be applied.
name	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': $y = \frac{x}{1 + \exp(-x)}$

Defined in src/operator/nn/activation.cc:L168

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:L686

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	'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:L37`

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.
name	string, optional Name of the resulting symbol.

Details

Defined in src/operator/tensor/amp_cast.cc:L71

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:L206

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:L474`

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:L436

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:L227`

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

- $\text{arctanh}(\text{default}) = \text{default} - \text{arctanh}(\text{row_sparse}) = \text{row_sparse} - \text{arctanh}(\text{csr}) = \text{csr}$

Defined in src/operator/tensor/elemwise_unary_op_trig.cc:L515

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:L178
```

Value

out The result mx.symbol

mx.symbol.BatchNorm	<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:L571

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	<i>batch_dot: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 3D arrays in shape of ‘(batch_size, :, :)’.

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 ‘(batch_size, n, m)’ and “y” with shape ‘(batch_size, m, k)’, the result array will have shape ‘(batch_size, n, k)’, which is computed by::

```
batch_dot(x,y)[i,:,:] = dot(x[i,:,:], y[i,:,:])
```

Defined in src/operator/tensor/dot.cc:L126

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:L769

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:L327
```

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:L58

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:L58

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:L47

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:L85

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:L104

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:L123

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** (<=) 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:L142

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:L135

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:L160

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:L178

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:L196

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/elementwise_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/elementwise_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:L66

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

mx.symbol.broadcast_power	<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:L82

Value

out The result mx.symbol

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

Description

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

Usage

```
mx.symbol.Cast(...)
```

Arguments

data	NDArray-or-Symbol The input.
dtype	'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`

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

Description

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

Usage

```
mx.symbol.cast(...)
```

Arguments

data	NDArray-or-Symbol The input.
dtype	'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` NDAarray-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:L216`

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 >= 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.]
```

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

```
// 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:L155

Value

out The result mx.symbol

mx.symbol.clip

clip:Clips (limits) the values in an array.

Description

Given an interval, values outside the interval are clipped to the interval edges. Clipping “x” between ‘a_min’ and ‘a_max’ would be::

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.

Details

.. 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
Defined in src/operator/tensor/matrix_op.cc:L735

Value

out The result mx.symbol

mx.symbol.Concat	Perform an feature concat on channel dim (dim 1) over all the inputs.
------------------	---

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

- data list, required List of tensors to concatenate
- num.args int, required Number of inputs to be concated.
- dim int, optional, default='1' the dimension to be concated.
- name 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 N^*-D convolution on $(N+2)^*$-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**: *(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:L473

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^{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:L351

Value

out The result mx.symbol

<code>mx.symbol.Crop</code>	<i>Crop:</i>
-----------------------------	--------------

Description

.. note:: ‘Crop’ is deprecated. Use ‘slice’ instead.

Usage

`mx.symbol.Crop(...)`

Arguments

<code>data</code>	Symbol or Symbol[] Tensor or List of Tensors, the second input will be used as crop_like shape reference
<code>num.args</code>	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
<code>offset</code>	Shape(tuple), optional, default=[0,0] crop offset coordinate: (y, x)
<code>h.w</code>	Shape(tuple), optional, default=[0,0] crop height and width: (h, w)
<code>center.crop</code>	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
<code>name</code>	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	<i>crop: Slices a region of the array.</i>
----------------	--

Description

.. note:: “crop” is deprecated. Use “slice” instead.

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.

Details

This function returns a sliced array between the indices given by ‘begin’ and ‘end’ with the corresponding ‘step’.

For an input array of “shape=(d₀, d₁, ..., d_{n-1})”, slice operation with “begin=(b₀, b₁...b_{m-1})”, “end=(e₀, e₁, ..., e_{m-1})”, and “step=(s₀, s₁, ..., s_{m-1})”, where m ≤ n, results in an array with the shape “(le₀-b₀/s₀, ..., le_{m-1}-b_{m-1}/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.]]
```

Defined in src/operator/tensor/matrix_op.cc:L511

Value

out The result `mx.symbol`

<code>mx.symbol.CTCLoss</code>	<i>CTCLoss: Connectionist Temporal Classification Loss.</i>
--------------------------------	---

Description

.. note:: The existing alias “`contrib_CTCLoss`” is deprecated.

Usage

`mx.symbol.CTCLoss(...)`

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 “0” when first CTC label is reserved for blank, and “-1” when last label is reserved for blank. See ‘ <code>blank_label</code> ’.
<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 “ <code>alphabet_size-1</code> ”, and the padding mask is “-1”. If “last”, last label value “ <code>alphabet_size-1</code> ” is reserved for blank label instead, and label values for tokens in the vocabulary are between “0” and “ <code>alphabet_size-2</code> ”, 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 $\text{alphabet_size}-1$ (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 $\text{label_sequence_length}$, 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/nnet/ctc_loss.cc:L100`

Value

out The result `mx.symbol`

<code>mx.symbol.ctc_loss</code>	<code>ctc_loss</code> : Connectionist Temporal Classification Loss.
---------------------------------	---

Description

.. note:: The existing alias “contrib_CTCLoss” is deprecated.

Usage

```
mx.symbol.ctc_loss(...)
```

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 "0" when first CTC label is reserved for blank, and "-1" when last label is reserved for blank. See ' <code>blank_label</code> '.
<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

mx.symbol.cumsum	<i>cumsum:Return the cumulative sum of the elements along a given axis.</i>
------------------	---

Description

Defined in src/operator/numpy/np_cumsum.cc:L67

Usage

```
mx.symbol.cumsum(...)
```

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.
name	string, optional Name of the resulting symbol.

Value

out The result mx.symbol

mx.symbol.Custom	<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_

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:L546

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

<code>mx.symbol.degrees</code>	<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` NDAarray-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:L274`

Value

`out` The result `mx.symbol`

<code>mx.symbol.depth_to_space</code>	<i>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“.</i>
---------------------------------------	--

Description

.. math::

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.

Details

$\backslash \text{begingather} * x \backslash \text{prime} = \text{reshape}(x, [N, \text{block_size}, \text{block_size}, C / (\text{block_size}^2), H * \text{block_size}, W * \text{block_size}]) \backslash x \backslash \text{prime} \backslash \text{prime} = \text{transpose}(x \backslash \text{prime}, [0, 3, 4, 1, 5, 2]) \backslash y = \text{reshape}(x \backslash \text{prime} \backslash \text{prime}, [N, C / (\text{block_size}^2), H * \text{block_size}, W * \text{block_size}]) \backslash \text{endgather} *$

where :math:'x' is an input tensor with default layout as :math:'[N, C, H, W]': [batch, channels, height, width] and :math:'y' is the output tensor of layout :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]]]]
```

```
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]]]]]
```

Defined in src/operator/tensor/matrix_op.cc:L1065

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

dot:Dot product of two arrays.

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_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.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 $\frac{1}{1-p}$ 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

mx.symbol.elemwise_add

elemwise_add: Adds arguments element-wise.

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

mx.symbol.elemwise_div

elemwise_div:Divides arguments element-wise.

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

elemwise_mul: Multiplies arguments element-wise.

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

elemwise_sub: Subtracts arguments element-wise.

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	'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:L534

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:L885

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

- `data` NDAarray-or-Symbol The input array.
- `name` 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:L906`

Value

out The result `mx.symbol`

<code>mx.symbol.exp</code>	<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` NDAarray-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:L63

Value

out The result mx.symbol

mx.symbol.expand_dims *expand_dims: Inserts a new axis of size 1 into the array shape*

Description

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)”.

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.

Details

Defined in src/operator/tensor/matrix_op.cc:L421

Value

out The result mx.symbol

mx.symbol.expm1	<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:L224

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	NDArray Left operand to the function.
mhs	NDArray Middle operand to the function.
rhs	NDArray 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	NDArray-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

mx.symbol.Flatten	<i>Flatten:Flattens the input array into a 2-D array by collapsing the higher dimensions.</i>
-------------------	---

Description

.. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead.

Usage

```
mx.symbol.Flatten(...)
```

Arguments

data	NDArray-or-Symbol Input array.
name	string, optional Name of the resulting symbol.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L292`

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.</i>
-------------------	---

Description

.. note:: ‘Flatten’ is deprecated. Use ‘flatten’ instead.

Usage

```
mx.symbol.flatten(...)
```

Arguments

data NDAarray-or-Symbol Input array.
 name string, optional Name of the resulting symbol.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L292`

Value

out The result mx.symbol

<code>mx.symbol.flip</code>	<i>flip:Reverses the order of elements along given axis while preserving array shape.</i>
-----------------------------	---

Description

Note: reverse and flip are equivalent. We use reverse in the following examples.

Usage

```
mx.symbol.flip(...)
```

Arguments

data NDAarray-or-Symbol Input data array
 axis Shape(tuple), required The axis which to reverse elements.
 name string, optional Name of the resulting symbol.

Details

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.]]
```

Defined in `src/operator/tensor/matrix_op.cc:L913`

Value

out The result mx.symbol

mx.symbol.floor	<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 NDAarray-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	<i>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.</i>
-----------------------	--

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=9.999999392252903e-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 $\text{grad} = \text{rescale_grad} * \text{grad}$.
clip_grad	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

$$\begin{aligned} g_t &= \nabla J(W_{t-1}) \\ v_t &= \beta_2 v_{t-1} + (1 - \beta_2) g_t^2 \\ d_t &= \frac{1 - \beta_1^t}{\sqrt{\frac{v_t}{1 - \beta_2^t} + \epsilon}} \sigma_t = d_t - \beta_1 d_{t-1} \\ z_t &= \beta_1 z_{t-1} + (1 - \beta_1^t) g_t - \sigma_t \\ W_t &= -\frac{z_t}{d_t} \end{aligned}$$

Defined in src/operator/optimizer_op.cc:L638

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	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. $\text{grad} = \max(\min(\text{grad}, \text{clip_gradient}), -\text{clip_gradient})$.
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:L874

Value

out The result mx.symbol

mx.symbol.FullyConnected

FullyConnected:Applies a linear transformation: $Y = XW^T + b$.

Description

If “flatten” is set to be true, then the shapes are:

Usage

```
mx.symbol.FullyConnected(...)
```

Arguments

<code>data</code>	NDArray-or-Symbol Input data.
<code>weight</code>	NDArray-or-Symbol Weight matrix.
<code>bias</code>	NDArray-or-Symbol Bias parameter.
<code>num_hidden</code>	int, required Number of hidden nodes of the output.
<code>no_bias</code>	boolean, optional, default=0 Whether to disable bias parameter.
<code>flatten</code>	boolean, optional, default=1 Whether to collapse all but the first axis of the input data tensor.
<code>name</code>	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/nn/fully_connected.cc:L288`

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

- | | |
|-------------------|--|
| <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.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

- | | |
|-------------------|--|
| <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.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

mx.symbol.hard_sigmoid	<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

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.
name	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

mx.symbol.identity	<i>identity: Returns a copy of the input.</i>
--------------------	---

Description

From:src/operator/tensor/elemwise_unary_op_basic.cc:246

Usage

mx.symbol.identity(...)

Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

Value

out The result mx.symbol

mx.symbol.IdentityAttachKLSparseReg	<i>IdentityAttachKLSparseReg: Apply a sparse regularization to the output a sigmoid activation function.</i>
-------------------------------------	--

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.infer.shape	<i>Inference the shape of arguments, outputs, and auxiliary states.</i>
-----------------------	---

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::

$$\text{out} = \frac{\text{data} - \text{mean}[\text{data}]}{\sqrt{\text{Var}[\text{data}] + \epsilon}} * \text{gamma} + \text{beta}$$

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 paper:

.. [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 $A_{1,k} \otimes \dots \otimes A_{n,k}$ 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.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.LayerNorm	<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

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=9.9999975e-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

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::

$$\text{out} = \frac{\text{data} - \text{mean}(\text{data}, \text{axis})}{\sqrt{\text{var}(\text{data}, \text{axis}) + \epsilon}} * \text{gamma} + \text{beta}$$

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:L156

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. ‘ $y = \text{lambda} * (x > 0 ? x : \text{alpha} * (\exp(x) - 1))$ ’ 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* ≥ 2.</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:L970

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* ≥ 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 $A = \begin{bmatrix} 1.0 & 2.0 \\ 3.0 & 4.0 \end{bmatrix}$

```
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.symbol

mx.symbol.linalg_extracttrian

*linalg_extracttrian: Extracts a triangular sub-matrix from a square matrix. Input is a tensor *A* of dimension *n* ≥ 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

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
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 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* ≥ 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

$A = L * Q$

Here, `*L*` is lower triangular (upper triangle equal to zero) with nonzero diagonal, and `*Q*` is row-orthonormal, meaning that

$Q^T Q = I$

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 $A = \begin{bmatrix} 1. & 2. & 3. \\ 4. & 5. & 6. \end{bmatrix}$ $Q, L = \text{gelqf}(A)$ $Q = \begin{bmatrix} -0.26726124, -0.53452248, -0.80178373 \\ 0.87287156, 0.21821789, -0.43643578 \end{bmatrix}$ $L = \begin{bmatrix} -3.74165739, 0. \\ -8.55235974, 1.96396101 \end{bmatrix}$

Batch LQ factorization $A = \begin{bmatrix} \begin{bmatrix} 1. & 2. & 3. \\ 4. & 5. & 6. \end{bmatrix}, \begin{bmatrix} 7. & 8. & 9. \\ 10. & 11. & 12. \end{bmatrix} \end{bmatrix}$ $Q, L = \text{gelqf}(A)$ $Q = \begin{bmatrix} \begin{bmatrix} -0.26726124, -0.53452248, -0.80178373 \\ 0.87287156, 0.21821789, -0.43643578 \end{bmatrix}, \begin{bmatrix} -0.50257071, -0.57436653, -0.64616234 \\ 0.7620735, 0.05862104, -0.64483142 \end{bmatrix} \end{bmatrix}$ $L = \begin{bmatrix} \begin{bmatrix} -3.74165739, 0. \\ -8.55235974, 1.96396101 \end{bmatrix}, \begin{bmatrix} -13.92838828, 0. \\ -19.09768702, 0.52758934 \end{bmatrix} \end{bmatrix}$

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* ≥ 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

<code>A</code>	NDArray-or-Symbol Tensor of input matrices
<code>B</code>	NDArray-or-Symbol Tensor of input matrices
<code>C</code>	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>beta</code>	double, optional, default=1 Scalar factor multiplied with C .
<code>axis</code>	int, optional, default='-2' Axis corresponding to the matrix rows.
<code>name</code>	string, optional Name of the resulting symbol.

Details

$$*out* = *alpha* \backslash *op* \backslash (*A*) \backslash *op* \backslash (*B*) + *beta* \backslash *C*$$

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* * *op* (*A*) * *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:L917`

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* \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.

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 >= 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 $A = \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix}$ $sign, logabsdet = slogdet(A)$ $sign = [1.]$ $logabsdet = [1.609438]$

Batch matrix signed log determinant $A = \begin{bmatrix} \begin{bmatrix} 2. & 3. \\ 1. & 4. \end{bmatrix} & \begin{bmatrix} 1. & 2. \\ 2. & 4. \end{bmatrix} & \begin{bmatrix} 1. & 2. \\ 4. & 3. \end{bmatrix} \end{bmatrix}$ $sign, logabsdet = slogdet(A)$ $sign = [1., 0., -1.]$ $logabsdet = [1.609438, -inf, 1.609438]$

Defined in `src/operator/tensor/la_op.cc:L1027`

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* ≥ 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 $n \geq 2$, 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* ≥ 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

$\text{*out*} = \text{*alpha*} \backslash \text{*A*} \backslash \text{*A*}^{\text{sup: 'T'}}$

if *transpose=False* , or

$\text{*out*} = \text{*alpha*} \backslash \text{*A*}^{\text{sup: 'T' }} \backslash \text{*A*}$

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` ≥ 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

<code>A</code>	NDArray-or-Symbol Tensor of lower triangular matrices
<code>B</code>	NDArray-or-Symbol Tensor of matrices
<code>transpose</code>	boolean, optional, default=0 Use transposed of the triangular matrix
<code>rightside</code>	boolean, optional, default=0 Multiply triangular matrix from the right to non-triangular one.
<code>lower</code>	boolean, optional, default=1 True if the triangular matrix is lower triangular, false if it is upper triangular.
<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* * *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* ≥ 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

$\text{SquaredLoss}(Y, \hat{Y}) = \frac{1}{n} \sum_{i=0}^{n-1} \|\textbf{y}_i - \hat{\textbf{y}}_i\|_2^2$

.. 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.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
-----	------------------------------------

mx.symbol.log	<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	NDArray-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:L76

Value

out The result mx.symbol

mx.symbol.log10	<i>log10:Returns element-wise Base-10 logarithmic value of the input.</i>
-----------------	---

Description

“10*log10(x) = x”

Usage

```
mx.symbol.log10(...)
```

Arguments

data	NDArray-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:L93

Value

out The result mx.symbol

<code>mx.symbol.log1p</code>	<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 $1+x \approx 1^x$

Usage

`mx.symbol.log1p(...)`

Arguments

data NDArray-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/elemwise_unary_op_logexp.cc:L206

Value

out The result mx.symbol

<code>mx.symbol.log2</code>	<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 NDArray-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:L105

Value

out The result mx.symbol

mx.symbol.logical_not *logical_not:Returns the result of logical NOT (!) function*

Description

Example: `logical_not([-2., 0., 1.]) = [0., 1., 0.]`

Usage

`mx.symbol.logical_not(...)`

Arguments

data	NDArray-or-Symbol The input array.
name	string, optional Name of the resulting symbol.

Value

out The result mx.symbol

mx.symbol.LogisticRegressionOutput
LogisticRegressionOutput:Applies a logistic function to the input.

Description

The logistic function, also known as the sigmoid function, is computed as $\frac{1}{1+\exp(-\text{textbf{x}})}$.

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 :math:'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:

:math:'-(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=9.99999975e-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:L164`

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

$$\text{MAE}(\hat{Y}, Y) = \frac{1}{n} \sum_{i=0}^{n-1} |\hat{y}_i - y_i|$$

.. 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.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:L360

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

mx.symbol.max_axis	<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

<code>mx.symbol.mean</code>	<i>mean: Computes the mean of array elements over given axes.</i>
-----------------------------	---

Description

Defined in src/operator/tensor/.broadcast_reduce_op.h:L83

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

mx.symbol.moments	<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

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:L743

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 $\text{grad} = \text{rescale_grad} * \text{grad}$.
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.

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 $\text{grad} = \text{rescale_grad} * \text{grad}$.
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.
name	string, optional Name of the resulting symbol.

Value

out The result `mx.symbol`

<code>mx.symbol.multi_all_finite</code>	<i>multi_all_finite: Check if all the float numbers in all the arrays are finite (used for AMP)</i>
---	---

Description

Defined in `src/operator/contrib/all_finite.cc:L133`

Usage

`mx.symbol.multi_all_finite(...)`

Arguments

<code>data</code>	NDArray-or-Symbol[] Arrays
<code>num.arrays</code>	int, optional, default='1' Number of arrays.
<code>init.output</code>	boolean, optional, default=1 Initialize output to 1.
<code>name</code>	string, optional Name of the resulting symbol.

Value

out The result `mx.symbol`

<code>mx.symbol.multi_lars</code>	<i>multi_lars: Compute the LARS coefficients of multiple weights and grads from their sums of square"</i>
-----------------------------------	---

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::

$$w = \text{momentum} * w - \text{learning_rate} * \text{gradient} \quad w += w$$

Where the parameter “momentum” is the decay rate of momentum estimates at each epoch.

Defined in src/operator/optimizer_op.cc:L470

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

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 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.
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/optimizer_op.cc:L415

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::

$$v_t = \alpha * \nabla J(W_t) \quad v_t = \gamma v_{t-1} - \alpha * \nabla J(W_{t-1}) \quad W_t = W_{t-1} + v_t$$

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:L372

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

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.
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/optimizer_op.cc:L327

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.

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

Where η is the learning rate of the optimizer γ 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:L724`

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

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, <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 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.

Details

Defined in src/operator/tensor/broadcast_reduce_prod_value.cc:L46

Value

out The result mx.symbol

mx.symbol.nansum	<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

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.

Details

Defined in src/operator/tensor/broadcast_reduce_sum_value.cc:L100

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:L115

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>	‘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:L816

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.]
```

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

```
// 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:L155

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:L417

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::

$$w = \text{momentum} * w - \text{learning_rate} * \text{gradient} \quad w += v$$

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

$weight = weight - learning_rate * (gradient + wd * weight)$
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:L293

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 λ (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:L139

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:L127

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 μ (mean) and α (dispersion). α 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:L181

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

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 [cpu gpu cpu_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::

```
negative_binomial(k=3, p=0.4, shape=(2,2)) = [[ 4., 7.], [ 2., 5.]]
```

Defined in src/operator/random/sample_op.cc:L166

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:L115

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 $p = 1 / (\mu \alpha + 1)$.*

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:L152

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:L196

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:L97`

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

<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.
<code>name</code>	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:L269

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:L42

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

<code>mx.symbol.repeat</code>	<i>repeat:Repeats elements of an array.</i>
-------------------------------	---

Description

By default, “repeat“ flattens the input array into 1-D and then repeats the elements::

Usage

`mx.symbol.repeat(...)`

Arguments

<code>data</code>	NDArray-or-Symbol Input data array
<code>repeats</code>	int, required The number of repetitions for each element.
<code>axis</code>	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.
<code>name</code>	string, optional Name of the resulting symbol.

Details

`x = [[1, 2], [3, 4]]`
`repeat(x, repeats=2) = [1., 1., 2., 2., 3., 3., 4., 4.]`
The parameter “axis“ specifies the axis along which to perform repeat::
`repeat(x, repeats=2, axis=1) = [[1., 1., 2., 2.], [3., 3., 4., 4.]]`
`repeat(x, repeats=2, axis=0) = [[1., 2.], [1., 2.], [3., 4.], [3., 4.]]`
`repeat(x, repeats=2, axis=-1) = [[1., 1., 2., 2.], [3., 3., 4., 4.]]`
Defined in `src/operator/tensor/matrix_op.cc:L810`

Value

`out` The result `mx.symbol`

mx.symbol.Reshape	<i>Reshape:Reshapes the input array.</i>
-------------------	--

Description

.. note:: “Reshape“ is deprecated, use “reshape“

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.

Details

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).

Defined in src/operator/tensor/matrix_op.cc:L202

Value

out The result mx.symbol

mx.symbol.reshape	<i>reshape:Reshapes the input array.</i>
-------------------	--

Description

.. note:: “Reshape” is deprecated, use “reshape”

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.

Details

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).

Defined in src/operator/tensor/matrix_op.cc:L202

Value

out The result mx.symbol

mx.symbol.reshape_like

reshape_like: Reshape some or all dimensions of ‘lhs’ to have the same shape as some or all dimensions of ‘rhs’.

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:L513

Value

out The result mx.symbol

<code>mx.symbol.reverse</code>	<i>reverse:Reverses the order of elements along given axis while preserving array shape.</i>
--------------------------------	--

Description

Note: reverse and flip are equivalent. We use reverse in the following examples.

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.

Details

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.]]
Defined in src/operator/tensor/matrix_op.cc:L913

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

rmspropalex_update: Update function for RMSPropAlex optimizer.

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
gamma1	float, optional, default=0.949999988 Decay rate.
gamma2	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.

.. $\text{math:: } E[g^2]_t = \gamma_1 * E[g^2]_{t-1} + (1 - \gamma_1) * g_t^2$
 $E[g]_t = \gamma_1 * E[g]_{t-1} + (1 - \gamma_1) * g_t$
 $\Delta_t = \gamma_2 * \Delta_{t-1} - \frac{\eta}{\sqrt{E[g^2]_t} + \epsilon} g_t$

The update step is

.. $\theta_{t+1} = \theta_t + \Delta_t$

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 γ_1 to be 0.95, γ_2 to be 0.9 and the learning rate η to be 0.0001.

Defined in src/operator/optimizer_op.cc:L834

Value

out The result mx.symbol

mx.symbol.rmsprop_update

rmsprop_update: Update function for 'RMSProp' optimizer.

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?

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
gamma1	float, optional, default=0.949999988 The decay rate of momentum estimates.
epsilon	float, optional, default=9.9999994e-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

‘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:

$$E[g^2]_t = \gamma * E[g^2]_{t-1} + (1-\gamma) * g_t^2$$

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 Tieleman & Hinton, 2012.

Hinton suggests the momentum term γ to be 0.9 and the learning rate η to be 0.001.

Defined in src/operator/optimizer_op.cc:L795

Value

out The result mx.symbol

mx.symbol.RNN

RNN:Applies recurrent layers to input data. Currently, vanilla RNN, LSTM and GRU are implemented, with both multi-layer and bidirectional support.

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
<code>p</code>	float, optional, default=0 drop rate of the dropout on the outputs of each RNN layer, except the last layer.
<code>state.outputs</code>	boolean, optional, default=0 Whether to have the states as symbol outputs.
<code>projection.size</code>	int or None, optional, default='None' size of project size
<code>lstm.state.clip.min</code>	double or None, optional, default=None Minimum clip value of LSTM states. This option must be used together with <code>lstm_state_clip_max</code> .
<code>lstm.state.clip.max</code>	double or None, optional, default=None Maximum clip value of LSTM states. This option must be used together with <code>lstm_state_clip_min</code> .
<code>lstm.state.clip.nan</code>	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.
<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>name</code>	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}) \setminus f_t = \text{math-} \\ \text{rmsigmoid}(W_{if} x_t + b_{if} + W_{hf} h_{(t-1)} + b_{hf}) \setminus g_t = \tanh(W_{ig} x_t + b_{ig} + W_{hc} h_{(t-1)} \\ + b_{hg}) \setminus o_t = \text{mathrmsigmoid}(W_{io} x_t + b_{io} + W_{ho} h_{(t-1)} + b_{ho}) \setminus c_t = f_t * c_{(t-1)} + i_t \\ * g_t \setminus h_t = o_t * \tanh(c_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.

```
.. math:: \begin{array}{l} r_t = \text{mathrmsigmoid}(W_{ir} x_t + b_{ir} + W_{hr} h_{(t-1)} + b_{hr}) \setminus z_t = \\ \text{mathrmsigmoid}(W_{iz} x_t + b_{iz} + W_{hz} h_{(t-1)} + b_{hz}) \setminus n_t = \tanh(W_{in} x_t + b_{in} + r_t * \\ (W_{hn} h_{(t-1)} + b_{hn})) \setminus h_t = (1 - z_t) * n_t + z_t * h_{(t-1)} \end{array}
```

Defined in src/operator/rnn.cc:L707

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:L193`

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 μ (mean) and α (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

<code>mx.symbol.save</code>	<i>Save an mx.symbol object</i>
-----------------------------	---------------------------------

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')
```

<code>mx.symbol.scatter_nd</code>	<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-
reverse(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-
reverse(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:L563

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:L522

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:L574

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:L61

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 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).
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:: state = momentum * state + (1-momentum) * gradient weight = weight - learning_rate * sign(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:L90

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:L313

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:L625`

Value

out The result `mx.symbol`

`mx.symbol.slice` *slice:Slices a region of the array.*

Description

.. note:: “crop” is deprecated. Use “slice” instead.

Usage

```
mx.symbol.slice(...)
```

Arguments

<code>data</code>	NDArray-or-Symbol Source input
<code>begin</code>	Shape(tuple), required starting indices for the slice operation, supports negative indices.
<code>end</code>	Shape(tuple), required ending indices for the slice operation, supports negative indices.
<code>step</code>	Shape(tuple), optional, default=[] step for the slice operation, supports negative values.
<code>name</code>	string, optional Name of the resulting symbol.

Details

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 “(le_0-b_0//s_0, ..., le_m-1-b_m-1//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.]]
```

Defined in src/operator/tensor/matrix_op.cc:L511

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

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. **Note** 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

mx.symbol.slice_axis	<i>slice_axis:Slices along a given axis.</i>
----------------------	--

Description

Returns an array slice along a given ‘axis’ starting from the ‘begin’ index to the ‘end’ index.

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.

Details

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.]]

Defined in src/operator/tensor/matrix_op.cc:L605

Value

out The result mx.symbol

mx.symbol.slice_like *slice_like: Slices a region of the array like the shape of another array.*

Description

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‘.

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.

Details

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.]]
```

Defined in src/operator/tensor/matrix_op.cc:L674

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 x is an element of the tensor *lhs* and σ 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/elementwise_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

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:

.. math:: \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:L230

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}(\frac{\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:L103

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 -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:L230

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:

.. 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.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.
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.  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_ascend=0) = [[ 4., 1.], [ 3., 1.]]
Defined in src/operator/tensor/ordering_op.cc:L128

```

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>

Description

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”.

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.

Details

```

.. math::
\begin{gather*}
x' = \text{reshape}(x, [N, C, H / \text{block\_size}, \text{block\_size}, W / \text{block\_size}, \text{block\_size}]) \\
x' = \text{transpose}(x', [0, 3, 5, 1, 2, 4]) \\
y = \text{reshape}(x', [N, C * (\text{block\_size}^2), H / \text{block\_size}, W / \text{block\_size}])
\end{gather*}

```

where ‘x’ is an input tensor with default layout as ‘[N, C, H, W]’: [batch, channels, height, width] and ‘y’ is the output tensor of layout ‘[N, C * (block_size ^ 2), H / block_size, W / block_size]’

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]]]]
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]]]]
```

Defined in src/operator/tensor/matrix_op.cc:L1119

Value

out The result mx.symbol

mx.symbol.SpatialTransformer

SpatialTransformer:Applies a spatial transformer to input feature map.

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. Note 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:L142

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:L118

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.</i>
-------------------	--

Description

Examples::

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.

Details

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.

Value

out The result mx.symbol

<code>mx.symbol.stack</code>	<i>stack:Join a sequence of arrays along a new axis.</i>
------------------------------	--

Description

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.

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.

Details

Examples::
x = [1, 2] y = [3, 4]
stack(x, y) = [[1, 2], [3, 4]] stack(x, y, axis=1) = [[1, 3], [2, 4]]

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:L327
```

Value

out The result mx.symbol

mx.symbol.sum

sum:Computes the sum of array elements over given axes.

Description

.. Note::

Usage

```
mx.symbol.sum(...)
```

Arguments

<code>data</code>	NDArray-or-Symbol The input
<code>axis</code>	<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>
<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

'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.sum_axis	<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. 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.

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:L711

Value

out The result mx.symbol

mx.symbol.tan	<i>tan: Computes the element-wise tangent of the input array.</i>
---------------	---

Description

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

Usage

```
mx.symbol.tan(...)
```

Arguments

data	NDArray-or-Symbol The input array.
name	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

<code>mx.symbol.tanh</code>	<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

- | | |
|-------------------|--|
| <code>data</code> | NDArray-or-Symbol The input array. |
| <code>name</code> | 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:L393`

Value

`out` The result `mx.symbol`

<code>mx.symbol.tile</code>	<i>tile:Repeats the whole array multiple times.</i>
-----------------------------	---

Description

If “reps“ has length `*d*`, and input array has dimension of `*n*`. There are three cases:

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 <code>d</code> , the result will have dimension of <code>max(d, a.ndim)</code> ; If <code>a.ndim < d</code> , <code>a</code> is promoted to be <code>d</code> -dimensional by prepending new axes. If <code>a.ndim > d</code> , <code>reps</code> is promoted to <code>a.ndim</code> by prepending 1’s to it. |
| <code>name</code> | string, optional Name of the resulting symbol. |

Details

- ****n=d****. Repeat *i*-th dimension of the input by “reps[i]” times::

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

```
tile(x, 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.]]
```

- ****n>d****. “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)”::

```
tile(x, reps=(2,)) = [[ 1., 2., 1., 2.], [ 3., 4., 3., 4.]]
```

- ****n<d****. 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::

```
tile(x, 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.]]]
```

Defined in src/operator/tensor/matrix_op.cc:L872

Value

out The result mx.symbol

mx.symbol.topk	<i>topk:Returns the top *k* elements in an input array along the given axis. The returned elements will be sorted.</i>
----------------	--

Description

Examples::

Usage

```
mx.symbol.topk(...)
```

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.
name	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_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:L65
```

Value

out The result `mx.symbol`

<code>mx.symbol.transpose</code>	<i>transpose:Permutes the dimensions of an array.</i>
----------------------------------	---

Description

Examples::

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.

Details

```
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.]]]
Defined in src/operator/tensor/matrix_op.cc:L379
```

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

<code>mx.symbol.uniform</code>	<i>uniform:Draw random samples from a uniform distribution.</i>
--------------------------------	---

Description

.. note:: The existing alias “uniform“ is deprecated.

Usage

`mx.symbol.uniform(...)`

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 [cpulgpulcpu_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

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:L97`

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:L67

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

mx.symbol.Variable	Create a symbolic variable with specified name.
--------------------	---

Description

Create a symbolic variable with specified name.

Arguments

name string The name of the result symbol.

Value

The result symbol

mx.symbol.where	<i>where:</i> Return the elements, either from x or y, depending on the condition.
-----------------	--

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

condition NDArray-or-Symbol condition array
x NDArray-or-Symbol
y NDArray-or-Symbol
name 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

<code>mx.symbol.zeros_like</code>	<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

mx.unserialize	<i>Unserialize MXNet model from Robject.</i>
----------------	--

Description

Unserialize MXNet model from Robject.

Usage

```
mx.unserialize(model)
```

Arguments

model	The mxnet model loaded from RData files.
-------	--

mxnet	<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.

mxnet.export	<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

path	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 first operand
- e2 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

Predict the outputs given a model and dataset.

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 <code>arg_params</code> or <code>aux_params</code> contain extra parameters that is not needed by the executor.

print.MXNDArray

print operator overload of mx.ndarray

Description

print operator overload of mx.ndarray

Usage

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

Arguments

nd	The mx.ndarray
<hr/>	
rnn.graph	Generate a RNN symbolic model - requires CUDA
<hr/>	

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	Unroll representation of RNN running on non CUDA device
------------------	---

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

<code>num_rnn_layer</code>	int, number of stacked layers
<code>seq_len</code>	int, number of time steps to unroll
<code>input_size</code>	int, number of levels in the data - only used for embedding
<code>num_embed</code>	int, default = NULL - no embedding. Dimension of the embedding vectors
<code>num_hidden</code>	int, size of the state in each RNN layer
<code>num_decode</code>	int, number of output variables in the decoding layer
<code>dropout</code>	
<code>config</code>	Either seq-to-one or one-to-one
<code>cell_type</code>	Type of RNN cell: either gru or lstm

Index

*Topic **datasets**

- `mx.metric.accuracy`, [56](#)
- `mx.metric.logistic_acc`, [56](#)
- `mx.metric.logloss`, [57](#)
- `mx.metric.mae`, [57](#)
- `mx.metric.mse`, [57](#)
- `mx.metric.Perplexity`, [58](#)
- `mx.metric.rmse`, [58](#)
- `mx.metric.rmsle`, [58](#)
- `mx.metric.top_k_accuracy`, [59](#)

`arguments`, [15](#)

`as.array.MXNDArray`, [15](#)

`as.matrix.MXNDArray`, [16](#)

`children`, [16](#)

`ctx`, [16](#)

`dim.MXNDArray`, [17](#)

`graph.viz`, [17](#)

`im2rec`, [18](#)

`internals`, [19](#)

`is.mx.context`, [19](#)

`is.mx.dataiter`, [19](#)

`is.mx.ndarray`, [20](#)

`is.mx.symbol`, [20](#)

`is.serialized`, [21](#)

`length.MXNDArray`, [21](#)

`mx.apply`, [21](#)

`mx.callback.early.stop`, [22](#)

`mx.callback.log.speedometer`, [22](#)

`mx.callback.log.train.metric`, [23](#)

`mx.callback.save.checkpoint`, [23](#)

`mx.cpu`, [24](#)

`mx.ctx.default`, [24](#)

`mx.exec.backward`, [24](#)

`mx.exec.forward`, [25](#)

`mx.exec.update.arg.arrays`, [25](#)

`mx.exec.update.aux.arrays`, [25](#)

`mx.exec.update.grad.arrays`, [26](#)

`mx.gpu`, [26](#)

`mx.infer.rnn`, [26](#)

`mx.infer.rnn.one`, [27](#)

`mx.infer.rnn.one.unroll`, [27](#)

`mx.init.create`, [28](#)

`mx.init.internal.default`, [28](#)

`mx.init.normal`, [29](#)

`mx.init.uniform`, [29](#)

`mx.init.Xavier`, [29](#)

`mx.io.arrayiter`, [30](#)

`mx.io.bucket.iter`, [30](#)

`mx.io.CSVIter`, [31](#)

`mx.io.extract`, [32](#)

`mx.io.ImageDetRecordIter`, [33](#)

`mx.io.ImageRecordInt8Iter`, [36](#)

`mx.io.ImageRecordIter`, [39](#)

`mx.io.ImageRecordIter_v1`, [42](#)

`mx.io.ImageRecordUInt8Iter`, [46](#)

`mx.io.ImageRecordUInt8Iter_v1`, [49](#)

`mx.io.LibSVMIter`, [52](#)

`mx.io.MNISTIter`, [53](#)

`mx.kv.create`, [54](#)

`mx.lr_scheduler.FactorScheduler`, [55](#)

`mx.lr_scheduler.MultiFactorScheduler`, [55](#)

`mx.metric.accuracy`, [56](#)

`mx.metric.custom`, [56](#)

`mx.metric.logistic_acc`, [56](#)

`mx.metric.logloss`, [57](#)

`mx.metric.mae`, [57](#)

`mx.metric.mse`, [57](#)

`mx.metric.Perplexity`, [58](#)

`mx.metric.rmse`, [58](#)

`mx.metric.rmsle`, [58](#)

`mx.metric.top_k_accuracy`, [59](#)

`mx.mlp`, [59](#)

mx.model.buckets, 60
mx.model.FeedForward.create, 61
mx.model.init.params, 62
mx.model.load, 63
mx.model.save, 63
mx.nd.abs, 64
mx.nd.Activation, 64
mx.nd.adam.update, 65
mx.nd.add.n, 66
mx.nd.all.finite, 66
mx.nd.amp.cast, 67
mx.nd.amp.multicast, 67
mx.nd.arccos, 68
mx.nd.arccosh, 68
mx.nd.arcsin, 69
mx.nd.arcsinh, 69
mx.nd.arctan, 70
mx.nd.arctanh, 70
mx.nd.argmax, 71
mx.nd.argmax.channel, 71
mx.nd.argmin, 72
mx.nd.argsort, 73
mx.nd.array, 73
mx.nd.batch.dot, 74
mx.nd.batch.take, 75
mx.nd.BatchNorm, 75
mx.nd.BatchNorm.v1, 77
mx.nd.BilinearSampler, 78
mx.nd.BlockGrad, 79
mx.nd.broadcast.add, 80
mx.nd.broadcast.axes, 81
mx.nd.broadcast.axis, 81
mx.nd.broadcast.div, 82
mx.nd.broadcast.equal, 83
mx.nd.broadcast.greater, 83
mx.nd.broadcast.greater.equal, 84
mx.nd.broadcast.hypot, 84
mx.nd.broadcast.less, 85
mx.nd.broadcast.less.equal, 86
mx.nd.broadcast.like, 86
mx.nd.broadcast.logical.and, 87
mx.nd.broadcast.logical.or, 88
mx.nd.broadcast.logical.xor, 88
mx.nd.broadcast.maximum, 89
mx.nd.broadcast.minimum, 89
mx.nd.broadcast.minus, 90
mx.nd.broadcast.mod, 91
mx.nd.broadcast.mul, 91
mx.nd.broadcast.not.equal, 92
mx.nd.broadcast.plus, 92
mx.nd.broadcast.power, 93
mx.nd.broadcast.sub, 94
mx.nd.broadcast.to, 94
mx.nd.Cast, 95
mx.nd.cast, 96
mx.nd.cast.storage, 96
mx.nd.cbrt, 97
mx.nd.ceil, 98
mx.nd.choose.element.0index, 98
mx.nd.clip, 99
mx.nd.Concat, 100
mx.nd.concat, 101
mx.nd.Convolution, 102
mx.nd.Convolution.v1, 104
mx.nd.copyto, 105
mx.nd.Correlation, 105
mx.nd.cos, 106
mx.nd.cosh, 107
mx.nd.Crop, 107
mx.nd.crop, 108
mx.nd.ctc.loss, 109
mx.nd.CTCLoss, 110
mx.nd.cumsum, 112
mx.nd.Custom, 112
mx.nd.Deconvolution, 113
mx.nd.degrees, 114
mx.nd.depth.to.space, 115
mx.nd.diag, 116
mx.nd.dot, 117
mx.nd.Dropout, 118
mx.nd.ElementWiseSum, 119
mx.nd.elemwise.add, 119
mx.nd.elemwise.div, 120
mx.nd.elemwise.mul, 120
mx.nd.elemwise.sub, 121
mx.nd.Embedding, 121
mx.nd.erf, 122
mx.nd.erfinv, 123
mx.nd.exp, 123
mx.nd.expand.dims, 124
mx.nd.expm1, 124
mx.nd.fill.element.0index, 125
mx.nd.fix, 125
mx.nd.Flatten, 126
mx.nd.flatten, 126
mx.nd.flip, 127

- mx.nd.floor, 128
- mx.nd.ftml.update, 128
- mx.nd.ftrl.update, 129
- mx.nd.FullyConnected, 130
- mx.nd.gamma, 131
- mx.nd.gammaln, 131
- mx.nd.gather.nd, 132
- mx.nd.GridGenerator, 132
- mx.nd.GroupNorm, 133
- mx.nd.hard.sigmoid, 134
- mx.nd.identity, 134
- mx.nd.IdentityAttachKLSparseReg, 135
- mx.nd.InstanceNorm, 135
- mx.nd.khatri.rao, 136
- mx.nd.L2Normalization, 137
- mx.nd.LayerNorm, 138
- mx.nd.LeakyReLU, 139
- mx.nd.linalg.det, 140
- mx.nd.linalg.extractdiag, 140
- mx.nd.linalg.extracttrian, 141
- mx.nd.linalg.gelqf, 142
- mx.nd.linalg.gemm, 143
- mx.nd.linalg.gemm2, 144
- mx.nd.linalg.inverse, 145
- mx.nd.linalg.makediag, 146
- mx.nd.linalg.maketrian, 147
- mx.nd.linalg.potrf, 148
- mx.nd.linalg.potri, 148
- mx.nd.linalg.slogdet, 149
- mx.nd.linalg.sumlogdiag, 150
- mx.nd.linalg.syrk, 151
- mx.nd.linalg.trmm, 152
- mx.nd.linalg.trsm, 153
- mx.nd.LinearRegressionOutput, 154
- mx.nd.load, 154
- mx.nd.log, 155
- mx.nd.log.softmax, 155
- mx.nd.log10, 156
- mx.nd.log1p, 157
- mx.nd.log2, 157
- mx.nd.logical.not, 158
- mx.nd.LogisticRegressionOutput, 158
- mx.nd.LRN, 159
- mx.nd.MAERegressionOutput, 160
- mx.nd.make.loss, 160
- mx.nd.MakeLoss, 161
- mx.nd.max, 162
- mx.nd.max.axis, 163
- mx.nd.mean, 163
- mx.nd.min, 164
- mx.nd.min.axis, 165
- mx.nd.moments, 165
- mx.nd.mp.nag.mom.update, 166
- mx.nd.mp.sgd.mom.update, 167
- mx.nd.mp.sgd.update, 167
- mx.nd.multi.all.finite, 168
- mx.nd.multi.lars, 169
- mx.nd.multi.mp.sgd.mom.update, 169
- mx.nd.multi.mp.sgd.update, 170
- mx.nd.multi.sgd.mom.update, 171
- mx.nd.multi.sgd.update, 172
- mx.nd.multi.sum.sq, 172
- mx.nd.nag.mom.update, 173
- mx.nd.nanprod, 174
- mx.nd.nansum, 174
- mx.nd.negative, 175
- mx.nd.norm, 176
- mx.nd.normal, 177
- mx.nd.one.hot, 177
- mx.nd.ones, 178
- mx.nd.ones.like, 179
- mx.nd.Pad, 179
- mx.nd.pad, 181
- mx.nd.pick, 182
- mx.nd.Pooling, 183
- mx.nd.Pooling.v1, 185
- mx.nd.preloaded.multi.mp.sgd.mom.update, 186
- mx.nd.preloaded.multi.mp.sgd.update, 187
- mx.nd.preloaded.multi.sgd.mom.update, 187
- mx.nd.preloaded.multi.sgd.update, 188
- mx.nd.prod, 189
- mx.nd.radians, 189
- mx.nd.random.exponential, 190
- mx.nd.random.gamma, 191
- mx.nd.random.generalized.negative.binomial, 191
- mx.nd.random.negative.binomial, 192
- mx.nd.random.normal, 193
- mx.nd.random.pdf.dirichlet, 194
- mx.nd.random.pdf.exponential, 194
- mx.nd.random.pdf.gamma, 195
- mx.nd.random.pdf.generalized.negative.binomial, 196

- `mx.nd.random.pdf.negative.binomial`, 197
- `mx.nd.random.pdf.normal`, 198
- `mx.nd.random.pdf.poisson`, 199
- `mx.nd.random.pdf.uniform`, 199
- `mx.nd.random.poisson`, 200
- `mx.nd.random.randint`, 201
- `mx.nd.random.uniform`, 201
- `mx.nd.ravel.multi.index`, 202
- `mx.nd.rcbrt`, 203
- `mx.nd.reciprocal`, 203
- `mx.nd.relu`, 204
- `mx.nd.repeat`, 204
- `mx.nd.Reshape`, 205
- `mx.nd.reshape`, 206
- `mx.nd.reshape.like`, 208
- `mx.nd.reverse`, 209
- `mx.nd rint`, 209
- `mx.nd.rmsprop.update`, 210
- `mx.nd.rmspropalex.update`, 211
- `mx.nd.RNN`, 212
- `mx.nd.ROIPooling`, 214
- `mx.nd.round`, 215
- `mx.nd.rsqrt`, 216
- `mx.nd.sample.exponential`, 216
- `mx.nd.sample.gamma`, 217
- `mx.nd.sample.generalized.negative.binomial`, 218
- `mx.nd.sample.multinomial`, 219
- `mx.nd.sample.negative.binomial`, 220
- `mx.nd.sample.normal`, 221
- `mx.nd.sample.poisson`, 222
- `mx.nd.sample.uniform`, 223
- `mx.nd.save`, 224
- `mx.nd.scatter.nd`, 224
- `mx.nd.SequenceLast`, 225
- `mx.nd.SequenceMask`, 226
- `mx.nd.SequenceReverse`, 227
- `mx.nd.sgd.mom.update`, 229
- `mx.nd.sgd.update`, 230
- `mx.nd.shape.array`, 231
- `mx.nd.shuffle`, 231
- `mx.nd.sigmoid`, 232
- `mx.nd.sign`, 232
- `mx.nd.signsgd.update`, 233
- `mx.nd.signum.update`, 233
- `mx.nd.sin`, 234
- `mx.nd.sinh`, 235
- `mx.nd.size.array`, 235
- `mx.nd.slice.axis`, 236
- `mx.nd.slice.like`, 237
- `mx.nd.SliceChannel`, 238
- `mx.nd.smooth.l1`, 239
- `mx.nd.Softmax`, 239
- `mx.nd.softmax`, 241
- `mx.nd.softmax.cross.entropy`, 242
- `mx.nd.SoftmaxActivation`, 243
- `mx.nd.SoftmaxOutput`, 244
- `mx.nd.softmin`, 245
- `mx.nd.softsign`, 246
- `mx.nd.sort`, 247
- `mx.nd.space.to.depth`, 247
- `mx.nd.SpatialTransformer`, 248
- `mx.nd.split`, 249
- `mx.nd.sqrt`, 250
- `mx.nd.square`, 250
- `mx.nd.squeeze`, 251
- `mx.nd.stack`, 251
- `mx.nd.stop.gradient`, 252
- `mx.nd.sum`, 253
- `mx.nd.sum.axis`, 254
- `mx.nd.SVMOutput`, 255
- `mx.nd.swapaxes`, 255
- `mx.nd.SwapAxis`, 256
- `mx.nd.take`, 256
- `mx.nd.tan`, 257
- `mx.nd.tanh`, 258
- `mx.nd.tile`, 259
- `mx.nd.topk`, 260
- `mx.nd.transpose`, 261
- `mx.nd.trunc`, 261
- `mx.nd.uniform`, 262
- `mx.nd.unravel.index`, 263
- `mx.nd.UpSampling`, 263
- `mx.nd.where`, 264
- `mx.nd.zeros`, 265
- `mx.nd.zeros.like`, 266
- `mx.opt.adadelat`, 266
- `mx.opt.adagrad`, 267
- `mx.opt.adam`, 267
- `mx.opt.create`, 268
- `mx.opt.get.updater`, 268
- `mx.opt.nag`, 269
- `mx.opt.rmsprop`, 269
- `mx.opt.sgd`, 270
- `mx.profiler.config`, 271

mx.profiler.state, 271
mx.rnorm, 272
mx.runif, 272
mx.serialize, 273
mx.set.seed, 273
mx.simple.bind, 274
mx.symbol.abs, 274
mx.symbol.Activation, 275
mx.symbol.adam_update, 275
mx.symbol.add_n, 277
mx.symbol.all_finite, 277
mx.symbol.amp_cast, 278
mx.symbol.amp_multicast, 278
mx.symbol.arccos, 279
mx.symbol.arccosh, 280
mx.symbol.arcsin, 280
mx.symbol.arcsinh, 281
mx.symbol.arctan, 282
mx.symbol.arctanh, 282
mx.symbol.argmax, 283
mx.symbol.argmax_channel, 284
mx.symbol.argmin, 284
mx.symbol.argsort, 285
mx.symbol.batch_dot, 289
mx.symbol.batch_take, 290
mx.symbol.BatchNorm, 286
mx.symbol.BatchNorm_v1, 288
mx.symbol.BilinearSampler, 291
mx.symbol.BlockGrad, 292
mx.symbol.broadcast_add, 293
mx.symbol.broadcast_axes, 294
mx.symbol.broadcast_axis, 295
mx.symbol.broadcast_div, 296
mx.symbol.broadcast_equal, 296
mx.symbol.broadcast_greater, 297
mx.symbol.broadcast_greater_equal, 298
mx.symbol.broadcast_hypot, 298
mx.symbol.broadcast_lesser, 299
mx.symbol.broadcast_lesser_equal, 300
mx.symbol.broadcast_like, 301
mx.symbol.broadcast_logical_and, 302
mx.symbol.broadcast_logical_or, 302
mx.symbol.broadcast_logical_xor, 303
mx.symbol.broadcast_maximum, 304
mx.symbol.broadcast_minimum, 304
mx.symbol.broadcast_minus, 305
mx.symbol.broadcast_mod, 306
mx.symbol.broadcast_mul, 307
mx.symbol.broadcast_not_equal, 307
mx.symbol.broadcast_plus, 308
mx.symbol.broadcast_power, 309
mx.symbol.broadcast_sub, 310
mx.symbol.broadcast_to, 311
mx.symbol.Cast, 312
mx.symbol.cast, 312
mx.symbol.cast_storage, 313
mx.symbol.cbrt, 314
mx.symbol.ceil, 314
mx.symbol.choose_element_0index, 315
mx.symbol.clip, 316
mx.symbol.Concat, 317
mx.symbol.concat, 318
mx.symbol.Convolution, 318
mx.symbol.Convolution_v1, 320
mx.symbol.Correlation, 321
mx.symbol.cos, 323
mx.symbol.cosh, 323
mx.symbol.Crop, 324
mx.symbol.crop, 325
mx.symbol.ctc_loss, 327
mx.symbol.CTCLoss, 326
mx.symbol.cumsum, 329
mx.symbol.Custom, 330
mx.symbol.Deconvolution, 330
mx.symbol.degrees, 332
mx.symbol.depth_to_space, 332
mx.symbol.diag, 333
mx.symbol.dot, 334
mx.symbol.Dropout, 336
mx.symbol.ElementWiseSum, 337
mx.symbol.elemwise_add, 337
mx.symbol.elemwise_div, 338
mx.symbol.elemwise_mul, 339
mx.symbol.elemwise_sub, 339
mx.symbol.Embedding, 340
mx.symbol.erf, 341
mx.symbol.erfinv, 342
mx.symbol.exp, 342
mx.symbol.expand_dims, 343
mx.symbol.expm1, 344
mx.symbol.fill_element_0index, 344
mx.symbol.fix, 345
mx.symbol.Flatten, 346
mx.symbol.flatten, 346
mx.symbol.flip, 347
mx.symbol.floor, 348

`mx.symbol.ftml_update`, 348
`mx.symbol.ftrl_update`, 349
`mx.symbol.FullyConnected`, 350
`mx.symbol.gamma`, 352
`mx.symbol.gammaln`, 352
`mx.symbol.gather_nd`, 353
`mx.symbol.GridGenerator`, 353
`mx.symbol.Group`, 354
`mx.symbol.GroupNorm`, 355
`mx.symbol.hard_sigmoid`, 356
`mx.symbol.identity`, 356
`mx.symbol.IdentityAttachKLSparseReg`, 357
`mx.symbol.infer.shape`, 357
`mx.symbol.InstanceNorm`, 358
`mx.symbol.khatri_rao`, 359
`mx.symbol.L2Normalization`, 360
`mx.symbol.LayerNorm`, 361
`mx.symbol.LeakyReLU`, 362
`mx.symbol.linalg_det`, 363
`mx.symbol.linalg_extractdiag`, 364
`mx.symbol.linalg_extracttrian`, 365
`mx.symbol.linalg_gelqf`, 366
`mx.symbol.linalg_gemm`, 367
`mx.symbol.linalg_gemm2`, 368
`mx.symbol.linalg_inverse`, 369
`mx.symbol.linalg_makediag`, 370
`mx.symbol.linalg_maketrian`, 371
`mx.symbol.linalg_potrf`, 372
`mx.symbol.linalg_potri`, 373
`mx.symbol.linalg_slogdet`, 374
`mx.symbol.linalg_sumlogdiag`, 375
`mx.symbol.linalg_syrk`, 376
`mx.symbol.linalg_trmm`, 377
`mx.symbol.linalg_trsm`, 378
`mx.symbol.LinearRegressionOutput`, 379
`mx.symbol.load`, 380
`mx.symbol.load.json`, 380
`mx.symbol.log`, 381
`mx.symbol.log10`, 381
`mx.symbol.log1p`, 382
`mx.symbol.log2`, 382
`mx.symbol.log_softmax`, 384
`mx.symbol.logical_not`, 383
`mx.symbol.LogisticRegressionOutput`, 383
`mx.symbol.LRN`, 385
`mx.symbol.MAERegressionOutput`, 386
`mx.symbol.make_loss`, 388
`mx.symbol.MakeLoss`, 387
`mx.symbol.max`, 388
`mx.symbol.max_axis`, 389
`mx.symbol.mean`, 390
`mx.symbol.moments`, 391
`mx.symbol.mp_nag_mom_update`, 391
`mx.symbol.mp_sgd_mom_update`, 392
`mx.symbol.mp_sgd_update`, 393
`mx.symbol.multi_all_finite`, 394
`mx.symbol.multi_lars`, 394
`mx.symbol.multi_mp_sgd_mom_update`, 395
`mx.symbol.multi_mp_sgd_update`, 396
`mx.symbol.multi_sgd_mom_update`, 397
`mx.symbol.multi_sgd_update`, 398
`mx.symbol.multi_sum_sq`, 399
`mx.symbol.nag_mom_update`, 399
`mx.symbol.nanprod`, 400
`mx.symbol.nansum`, 401
`mx.symbol.negative`, 402
`mx.symbol.norm`, 402
`mx.symbol.normal`, 403
`mx.symbol.one_hot`, 405
`mx.symbol.ones_like`, 404
`mx.symbol.Pad`, 406
`mx.symbol.pad`, 407
`mx.symbol.pick`, 408
`mx.symbol.Pooling`, 410
`mx.symbol.Pooling_v1`, 411
`mx.symbol.preloaded_multi_mp_sgd_mom_update`, 413
`mx.symbol.preloaded_multi_mp_sgd_update`, 414
`mx.symbol.preloaded_multi_sgd_mom_update`, 414
`mx.symbol.preloaded_multi_sgd_update`, 415
`mx.symbol.prod`, 416
`mx.symbol.radians`, 417
`mx.symbol.random_exponential`, 417
`mx.symbol.random_gamma`, 418
`mx.symbol.random_generalized_negative_binomial`, 419
`mx.symbol.random_negative_binomial`, 420
`mx.symbol.random_normal`, 421
`mx.symbol.random_pdf_dirichlet`, 422
`mx.symbol.random_pdf_exponential`, 423

mx.symbol.random_pdf_gamma, 424
 mx.symbol.random_pdf_generalized_negative_binomial, 425
 mx.symbol.random_pdf_negative_binomial, 426
 mx.symbol.random_pdf_normal, 427
 mx.symbol.random_pdf_poisson, 428
 mx.symbol.random_pdf_uniform, 429
 mx.symbol.random_poisson, 430
 mx.symbol.random_randint, 430
 mx.symbol.random_uniform, 431
 mx.symbol.ravel_multi_index, 432
 mx.symbol.rcbrt, 433
 mx.symbol.reciprocal, 433
 mx.symbol.relu, 434
 mx.symbol.repeat, 435
 mx.symbol.Reshape, 436
 mx.symbol.reshape, 437
 mx.symbol.reshape_like, 439
 mx.symbol.reverse, 440
 mx.symbol rint, 441
 mx.symbol.rmsprop_update, 443
 mx.symbol.rmspropalex_update, 442
 mx.symbol.RNN, 444
 mx.symbol.ROIPooling, 446
 mx.symbol.round, 447
 mx.symbol.rsqrt, 448
 mx.symbol.sample_exponential, 449
 mx.symbol.sample_gamma, 450
 mx.symbol.sample_generalized_negative_binomial, 451
 mx.symbol.sample_multinomial, 452
 mx.symbol.sample_negative_binomial, 453
 mx.symbol.sample_normal, 454
 mx.symbol.sample_poisson, 455
 mx.symbol.sample_uniform, 456
 mx.symbol.save, 457
 mx.symbol.scatter_nd, 457
 mx.symbol.SequenceLast, 458
 mx.symbol.SequenceMask, 459
 mx.symbol.SequenceReverse, 461
 mx.symbol.sgd_mom_update, 462
 mx.symbol.sgd_update, 463
 mx.symbol.shape_array, 464
 mx.symbol.shuffle, 465
 mx.symbol.sigmoid, 465
 mx.symbol.sign, 466
 mx.symbol.signsgd_update, 466
 mx.symbol.signum_update, 467
 mx.symbol.sin, 468
 mx.symbol.sinh, 469
 mx.symbol.size_array, 470
 mx.symbol.slice, 470
 mx.symbol.slice_axis, 473
 mx.symbol.slice_like, 474
 mx.symbol.SliceChannel, 471
 mx.symbol.smooth_l1, 475
 mx.symbol.Softmax, 476
 mx.symbol.softmax, 478
 mx.symbol.softmax_cross_entropy, 482
 mx.symbol.SoftmaxActivation, 479
 mx.symbol.SoftmaxOutput, 480
 mx.symbol.softmin, 483
 mx.symbol.softsign, 484
 mx.symbol.sort, 484
 mx.symbol.space_to_depth, 485
 mx.symbol.SpatialTransformer, 486
 mx.symbol.split, 487
 mx.symbol.sqrt, 488
 mx.symbol.square, 489
 mx.symbol.squeeze, 489
 mx.symbol.stack, 490
 mx.symbol.stop_gradient, 491
 mx.symbol.sum, 491
 mx.symbol.sum_axis, 493
 mx.symbol.SVMOutput, 494
 mx.symbol.swapaxes, 494
 mx.symbol.SwapAxis, 495
 mx.symbol.take, 496
 mx.symbol.tan, 497
 mx.symbol.tanh, 498
 mx.symbol.tile, 498
 mx.symbol.topk, 499
 mx.symbol.transpose, 500
 mx.symbol.trunc, 501
 mx.symbol.uniform, 502
 mx.symbol.unravel_index, 503
 mx.symbol.UpSampling, 503
 mx.symbol.Variable, 505
 mx.symbol.where, 505
 mx.symbol.zeros_like, 506
 mx.unserialize, 507
 mxnet, 507
 mxnet-package (mxnet), 507
 mxnet.export, 507

Ops.MXNDArray, [508](#)
outputs, [508](#)

predict.MXFeedForwardModel, [509](#)
print.MXNDArray, [509](#)

rnn.graph, [510](#)
rnn.graph.unroll, [510](#)