

Package ‘kerasR’

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Type Package

Title R Interface to the Keras Deep Learning Library

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Description Provides a consistent interface to the 'Keras' Deep Learning Library directly from within R. 'Keras' provides specifications for describing dense neural networks, convolution neural networks (CNN) and recurrent neural networks (RNN) running on top of either 'TensorFlow' or 'Theano'. Type conversions between Python and R are automatically handled correctly, even when the default choices would otherwise lead to errors. Includes complete R documentation and many working examples.

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Imports reticulate (>= 0.7)

Suggests knitr, rmarkdown, testthat, covr

URL <https://github.com/statsmaths/kerasR>

BugReports <https://github.com/statsmaths/kerasR/issues>

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R topics documented:

Activation	3
ActivityRegularization	5
AdvancedActivation	6
Applications	8
AveragePooling	9
BatchNormalization	10
Constraints	11
Conv	12
Cropping	15
CSVLogger	16
Datasets	17
decode_predictions	18
Dense	19
Dropout	21
EarlyStopping	22
Embedding	24
expand_dims	25
Flatten	26
GaussianNoise	27
GlobalPooling	28
img_to_array	29
Initializers	30
kerasR	32
keras_available	32
keras_check	33
keras_compile	33
keras_fit	35
keras_init	37
LayerWrapper	37
LoadSave	38
load_img	40
LocallyConnected	41
Masking	43
MaxPooling	43
ModelCheckpoint	45
normalize	46
one_hot	47
Optimizers	48
pad_sequences	50
Permute	51
plot_model	51
Predict	52
preprocess_input	53
ReduceLROnPlateau	54
Regularizers	55
RepeatVector	56

Reshape 57
RNN 58
Sequential 60
TensorBoard 61
text_to_word_sequence 63
Tokenizer 63
to_categorical 64
UpSampling 65
ZeroPadding 65

Index 67

Activation *Applies an activation function to an output.*

Description

Applies an activation function to an output.

Usage

```
Activation(activation, input_shape = NULL)
```

Arguments

- activation name of activation function to use. See Details for possible options.
- input_shape only need when first layer of a model; sets the input shape of the data

Details

Possible activations include 'softmax', 'elu', 'softplus', 'softsign', 'relu', 'tanh', 'sigmoid', 'hard_sigmoid', 'linear'. You may also set this equal to any of the outputs from an [AdvancedActivation](#).

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()

  mod <- Sequential(
    Dense(units = 50, input_shape = ncol(X_train)),
    Dropout(rate = 0.5),
    Activation("relu"),
    Dense(units = 3),
    ActivityRegularization(l1 = 1),
    Activation("softmax")
  )
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()

```

```
mod <- Sequential(  
  Dense(units = 50, input_shape = ncol(X_train)),  
  Dropout(rate = 0.5),  
  Activation("relu"),  
  Dense(units = 3),  
  ActivityRegularization(l1 = 1),  
  Activation("softmax")  
)  
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())  
  
keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,  
  verbose = 0, validation_split = 0.2)  
  
}
```

ActivityRegularization

Layer that applies an update to the cost function based input activity.

Description

Layer that applies an update to the cost function based input activity.

Usage

```
ActivityRegularization(l1 = 0, l2 = 0, input_shape = NULL)
```

Arguments

l1	L1 regularization factor (positive float).
l2	L2 regularization factor (positive float).
input_shape	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()

  mod <- Sequential(
    Dense(units = 50, input_shape = ncol(X_train)),
    Dropout(rate = 0.5),
    Activation("relu"),
    Dense(units = 3),
    ActivityRegularization(l1 = 1),
    Activation("softmax")
  )
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}

```

AdvancedActivation *Advanced activation layers*

Description

Advanced activation layers

Usage

LeakyReLU(alpha = 0.3, input_shape = NULL)

PReLU(input_shape = NULL)

ELU(alpha = 1, input_shape = NULL)

```
ThresholdedReLU(theta = 1, input_shape = NULL)
```

Arguments

alpha	float ≥ 0 . Negative slope coefficient in LeakyReLU and scale for the negative factor in ELU .
input_shape	only need when first layer of a model; sets the input shape of the data
theta	float ≥ 0 . Threshold location of activation in ThresholdedReLU .

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(LeakyReLU(alpha = 0.4))
  mod$add(Dense(units = 50))
  mod$add(ELU(alpha = 0.5))
  mod$add(Dense(units = 50))
  mod$add(ThresholdedReLU(theta = 1.1))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5, verbose = 0)
}
```

Description

These models can be used for prediction, feature extraction, and fine-tuning. Weights are downloaded automatically when instantiating a model.

Usage

```
Xception(include_top = TRUE, weights = "imagenet", input_tensor = NULL,
         input_shape = NULL, pooling = NULL, classes = 1000)
```

```
VGG16(include_top = TRUE, weights = "imagenet", input_tensor = NULL,
       input_shape = NULL, pooling = NULL, classes = 1000)
```

```
VGG19(include_top = TRUE, weights = "imagenet", input_tensor = NULL,
       input_shape = NULL, pooling = NULL, classes = 1000)
```

```
ResNet50(include_top = TRUE, weights = "imagenet", input_tensor = NULL,
         input_shape = NULL, pooling = NULL, classes = 1000)
```

```
InceptionV3(include_top = TRUE, weights = "imagenet", input_tensor = NULL,
            input_shape = NULL, pooling = NULL, classes = 1000)
```

Arguments

<code>include_top</code>	whether to include the fully-connected layer at the top of the network.
<code>weights</code>	one of NULL (random initialization) or "imagenet" (pre-training on ImageNet).
<code>input_tensor</code>	optional Keras tensor (i.e. output of <code>layers.Input()</code>) to use as image input for the model.
<code>input_shape</code>	optional shape tuple, only to be specified if <code>include_top</code> is False
<code>pooling</code>	optional pooling mode for feature extraction when <code>include_top</code> is False. None means that the output of the model will be the 4D tensor output of the last convolutional layer. avg means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor max means that global max pooling will be applied.
<code>classes</code>	optional number of classes to classify images into, only to be specified if <code>include_top</code> is True, and if no <code>weights</code> argument is specified.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

AveragePooling	<i>Average pooling operation</i>
----------------	----------------------------------

Description

Average pooling operation

Usage

```
AveragePooling1D(pool_size = 2, strides = NULL, padding = "valid",  
input_shape = NULL)
```

```
AveragePooling2D(pool_size = c(2, 2), strides = NULL, padding = "valid",  
data_format = NULL, input_shape = NULL)
```

```
AveragePooling3D(pool_size = c(2, 2, 2), strides = NULL,  
padding = "valid", data_format = NULL, input_shape = NULL)
```

Arguments

<code>pool_size</code>	Integer or pair of integers; size(s) of the max pooling windows.
<code>strides</code>	Integer, pair of integers, or None. Factor(s) by which to downscale. E.g. 2 will halve the input. If NULL, it will default to <code>pool_size</code> .
<code>padding</code>	One of "valid" or "same" (case-insensitive).
<code>input_shape</code>	nD tensor with shape: (batch_size, ..., input_dim). The most common situation would be a 2D input with shape (batch_size, input_dim).
<code>data_format</code>	A string, one of <code>channels_last</code> (default) or <code>channels_first</code>

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

BatchNormalization *Batch normalization layer*

Description

Batch normalization layer

Usage

```
BatchNormalization(axis = -1, momentum = 0.99, epsilon = 0.001,
  center = TRUE, scale = TRUE, beta_initializer = "zeros",
  gamma_initializer = "ones", moving_mean_initializer = "zeros",
  moving_variance_initializer = "ones", beta_regularizer = NULL,
  gamma_regularizer = NULL, beta_constraint = NULL,
  gamma_constraint = NULL, input_shape = NULL)
```

Arguments

axis	Integer, the axis that should be normalized (typically the features axis).
momentum	Momentum for the moving average.
epsilon	Small float added to variance to avoid dividing by zero.
center	If True, add offset of beta to normalized tensor. If False, beta is ignored.
scale	If True, multiply by gamma. If False, gamma is not used. When the next layer is linear (also e.g. nn.relu), this can be disabled since the scaling will be done by the next layer.
beta_initializer	Initializer for the beta weight.
gamma_initializer	Initializer for the gamma weight.
moving_mean_initializer	Initializer for the moving mean.
moving_variance_initializer	Initializer for the moving variance.
beta_regularizer	Optional regularizer for the beta weight.
gamma_regularizer	Optional regularizer for the gamma weight.
beta_constraint	Optional constraint for the beta weight.
gamma_constraint	Optional constraint for the gamma weight.
input_shape	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(BatchNormalization())
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}
```

 Constraints

Apply penalties on layer parameters

Description

Regularizers allow to apply penalties on layer parameters or layer activity during optimization. These penalties are incorporated in the loss function that the network optimizes.

Usage

```
max_norm(max_value = 2, axis = 0)
```

```
non_neg()
```

```
unit_norm()
```

Arguments

`max_value` maximum value to allow for the value (`max_norm` only)
`axis` axis over which to apply constraint (`max_norm` only)

Details

The penalties are applied on a per-layer basis. The exact API will depend on the layer, but the layers `Dense`, `Conv1D`, `Conv2D` and `Conv3D` have a unified API.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

Examples

```
if(keras_available()) {  
  X_train <- matrix(rnorm(100 * 10), nrow = 100)  
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)  
  
  mod <- Sequential()  
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))  
  mod$add(Activation("relu"))  
  mod$add(Dense(units = 3, kernel_constraint = max_norm(),  
               bias_constraint = non_neg()))  
  mod$add(Dense(units = 3, kernel_constraint = unit_norm()))  
  mod$add(Activation("softmax"))  
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())  
  
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5, verbose = 0)  
}
```

Conv

Convolution layers

Description

Convolution layers

Usage

```
Conv1D(filters, kernel_size, strides = 1, padding = "valid",
       dilation_rate = 1, activation = NULL, use_bias = TRUE,
       kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
       kernel_regularizer = NULL, bias_regularizer = NULL,
       activity_regularizer = NULL, kernel_constraint = NULL,
       bias_constraint = NULL, input_shape = NULL)
```

```
Conv2D(filters, kernel_size, strides = c(1, 1), padding = "valid",
       data_format = NULL, dilation_rate = c(1, 1), activation = NULL,
       use_bias = TRUE, kernel_initializer = "glorot_uniform",
       bias_initializer = "zeros", kernel_regularizer = NULL,
       bias_regularizer = NULL, activity_regularizer = NULL,
       kernel_constraint = NULL, bias_constraint = NULL, input_shape = NULL)
```

```
SeparableConv2D(filters, kernel_size, strides = c(1, 1), padding = "valid",
                data_format = NULL, depth_multiplier = 1, dilation_rate = c(1, 1),
                activation = NULL, use_bias = TRUE,
                kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
                kernel_regularizer = NULL, bias_regularizer = NULL,
                activity_regularizer = NULL, kernel_constraint = NULL,
                bias_constraint = NULL, input_shape = NULL)
```

```
Conv2DTranspose(filters, kernel_size, strides = c(1, 1), padding = "valid",
                data_format = NULL, dilation_rate = c(1, 1), activation = NULL,
                use_bias = TRUE, kernel_initializer = "glorot_uniform",
                bias_initializer = "zeros", kernel_regularizer = NULL,
                bias_regularizer = NULL, activity_regularizer = NULL,
                kernel_constraint = NULL, bias_constraint = NULL, input_shape = NULL)
```

```
Conv3D(filters, kernel_size, strides = c(1, 1, 1), padding = "valid",
        data_format = NULL, dilation_rate = c(1, 1, 1), activation = NULL,
        use_bias = TRUE, kernel_initializer = "glorot_uniform",
        bias_initializer = "zeros", kernel_regularizer = NULL,
        bias_regularizer = NULL, activity_regularizer = NULL,
        kernel_constraint = NULL, bias_constraint = NULL, input_shape = NULL)
```

Arguments

<code>filters</code>	Integer, the dimensionality of the output space (i.e. the number output of filters in the convolution).
<code>kernel_size</code>	A pair of integers specifying the dimensions of the 2D convolution window.
<code>strides</code>	A pair of integers specifying the stride length of the convolution.
<code>padding</code>	One of "valid", "causal" or "same" (case-insensitive).
<code>dilation_rate</code>	A pair of integers specifying the dilation rate to use for dilated convolution
<code>activation</code>	Activation function to use
<code>use_bias</code>	Boolean, whether the layer uses a bias vector.

kernel_initializer	Initializer for the kernel weights matrix
bias_initializer	Initializer for the bias vector
kernel_regularizer	Regularizer function applied to the kernel weights matrix
bias_regularizer	Regularizer function applied to the bias vector
activity_regularizer	Regularizer function applied to the output of the layer (its "activation").
kernel_constraint	Constraint function applied to the kernel matrix
bias_constraint	Constraint function applied to the bias vector
input_shape	only need when first layer of a model; sets the input shape of the data
data_format	A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs.
depth_multiplier	The number of depthwise convolution output channels for each input channel. The total number of depthwise convolution output channels will be equal to filters_in * depth_multiplier.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- array(rnorm(100 * 28 * 28), dim = c(100, 28, 28, 1))
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Conv2D(filters = 2, kernel_size = c(2, 2),
                input_shape = c(28, 28, 1)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(LocallyConnected2D(filters = 2, kernel_size = c(2, 2)))
  mod$add(Activation("relu"))
}
```

```

mod$add(MaxPooling2D(pool_size=c(2, 2)))
mod$add(Dropout(0.25))

mod$add(Flatten())
mod$add(Dropout(0.5))
mod$add(Dense(3, activation='softmax'))

keras_compile(mod, loss='categorical_crossentropy', optimizer=RMSprop())
keras_fit(mod, X_train, Y_train, verbose = 0)
}

```

Cropping

Cropping layers for 1D input (e.g. temporal sequence).

Description

It crops along the time dimension (axis 1).

Usage

```
Cropping1D(cropping = c(1, 1), input_shape = NULL)
```

```
Cropping2D(cropping = 0, data_format = NULL, input_shape = NULL)
```

```
Cropping3D(cropping = 0, data_format = NULL, input_shape = NULL)
```

Arguments

cropping	integer or pair of integers. How many units should be trimmed off at the beginning and end of the cropping dimension (axis 1). If a single value is provided, the same value will be used for both.
input_shape	only need when first layer of a model; sets the input shape of the data
data_format	A string, one of channels_last (default) or channels_first.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

CSVLogger

Callback that streams epoch results to a csv file.

Description

Supports all values that can be represented as a string, including 1D iterables such as np.ndarray.

Usage

```
CSVLogger(filename, separator = ",", append = FALSE)
```

Arguments

filename	filename of the csv file, e.g. 'run/log.csv'.
separator	string used to separate elements in the csv file.
append	True: append if file exists (useful for continuing training). False: overwrite existing file,

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other callbacks: [EarlyStopping](#), [ModelCheckpoint](#), [ReduceLRonPlateau](#), [TensorBoard](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  callbacks <- list(CSVLogger(tempfile()),
                   EarlyStopping(),
                   ReduceLRonPlateau(),
                   TensorBoard(tempfile()))

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
```



```

        verbose = 0, callbacks = callbacks, validation_split = 0.2)
    }

```

 Datasets

Load datasets

Description

These functions all return a named list with elements `X_train`, `X_test`, `Y_train`, and `Y_test`. The first time calling this function will download the datasets locally; thereafter they will be loaded from the keras cache directory.

Usage

```
load_cifar10()
```

```
load_cifar100(label_mode = "fine")
```

```
load_imdb(num_words = NULL, skip_top = 0, maxlen = NULL, seed = 113,
          start_char = 1, oov_char = 2, index_from = 3)
```

```
load_reuters(num_words = NULL, skip_top = 0, maxlen = 1000,
             test_split = 0.2, seed = 113, start_char = 1, oov_char = 2,
             index_from = 3)
```

```
load_mnist()
```

```
load_boston_housing()
```

Arguments

<code>label_mode</code>	either "fine" or "coarse"; how to construct labels for load_cifar100 .
<code>num_words</code>	integer or NULL. Top most frequent words to consider. Any less frequent word will appear as 0 in the sequence data.
<code>skip_top</code>	integer. Top most frequent words to ignore (they will appear as 0s in the sequence data).
<code>maxlen</code>	integer. Maximum sequence length. Any longer sequence will be truncated.
<code>seed</code>	integer. Seed for reproducible data shuffling.
<code>start_char</code>	integer. The start of a sequence will be marked with this character. Set to 1 because 0 is usually the padding character.
<code>oov_char</code>	integer. words that were cut out because of the <code>num_words</code> or <code>skip_top</code> limit will be replaced with this character.
<code>index_from</code>	integer. Index actual words with this index and higher.
<code>test_split</code>	float. Fraction of the dataset to use for testing.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

Examples

```
if (keras_available()) {
  boston <- load_boston_housing()
  X_train <- normalize(boston$X_train, 0)
  Y_train <- boston$Y_train
  X_test <- normalize(boston$X_test, 0)
  Y_test <- boston$Y_test

  mod <- Sequential()
  mod$add(Dense(units = 200, input_shape = 13))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 200))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 1))
  keras_compile(mod, loss = 'mse', optimizer = SGD())

  keras_fit(mod, scale(X_train), Y_train,
            batch_size = 32, epochs = 20,
            verbose = 1, validation_split = 0.1)
}
```

decode_predictions *Decode predictions from pre-defined imagenet networks*

Description

These map the class integers to the actual class names in the pre-defined models.

Usage

```
decode_predictions(pred, model = c("Xception", "VGG16", "VGG19", "ResNet50",
  "InceptionV3"), top = 5)
```

Arguments

pred	the output of predictions from the specified model
model	the model you wish to preprocess to
top	integer, how many top-guesses to return.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

Dense

Regular, densely-connected NN layer.

Description

Dense implements the operation: $\text{output} = \text{activation}(\text{dot}(\text{input}, \text{kernel}) + \text{bias})$ where `activation` is the element-wise activation function passed as the `activation` argument, `kernel` is a weights matrix created by the layer, and `bias` is a bias vector created by the layer (only applicable if `use_bias` is `True`). Note: if the input to the layer has a rank greater than 2, then it is flattened prior to the initial dot product with `kernel`.

Usage

```
Dense(units, activation = "linear", use_bias = TRUE,
      kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
      kernel_regularizer = NULL, bias_regularizer = NULL,
      activity_regularizer = NULL, kernel_constraint = NULL,
      bias_constraint = NULL, input_shape = NULL)
```

Arguments

<code>units</code>	Positive integer, dimensionality of the output space.
<code>activation</code>	The activation function to use.
<code>use_bias</code>	Boolean, whether the layer uses a bias vector.
<code>kernel_initializer</code>	Initializer for the kernel weights matrix
<code>bias_initializer</code>	Initializer for the bias vector
<code>kernel_regularizer</code>	Regularizer function applied to the kernel weights matrix
<code>bias_regularizer</code>	Regularizer function applied to the bias vector
<code>activity_regularizer</code>	Regularizer function applied to the output of the layer (its "activation").
<code>kernel_constraint</code>	Constraint function applied to the
<code>bias_constraint</code>	Constraint function applied to the bias vector
<code>input_shape</code>	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()

  mod <- Sequential(
    Dense(units = 50, input_shape = ncol(X_train)),
    Dropout(rate = 0.5),
    Activation("relu"),
    Dense(units = 3),
    ActivityRegularization(l1 = 1),
    Activation("softmax")
  )
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)
```

```

mod <- Sequential()
mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
mod$add( Dropout(rate = 0.5))
mod$add(Activation("relu"))
mod$add(Dense(units = 3))
mod$add(ActivityRegularization(l1 = 1))
mod$add(Activation("softmax"))
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

# You can also add layers directly as arguments to Sequential()

mod <- Sequential(
  Dense(units = 50, input_shape = ncol(X_train)),
  Dropout(rate = 0.5),
  Activation("relu"),
  Dense(units = 3),
  ActivityRegularization(l1 = 1),
  Activation("softmax")
)
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

}

```

Dropout

Applies Dropout to the input.

Description

Applies Dropout to the input.

Usage

```
Dropout(rate, noise_shape = NULL, seed = NULL, input_shape = NULL)
```

Arguments

rate	float between 0 and 1. Fraction of the input units to drop.
noise_shape	1D integer tensor representing the shape of the the input.
seed	A Python integer to use as random seed.
input_shape	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if (keras_available()) {
  X_train <- array(rnorm(100 * 28 * 28), dim = c(100, 28, 28, 1))
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Conv2D(filters = 2, kernel_size = c(2, 2),
                input_shape = c(28, 28, 1)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(LocallyConnected2D(filters = 2, kernel_size = c(2, 2)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(Dropout(0.25))

  mod$add(Flatten())
  mod$add(Dropout(0.5))
  mod$add(Dense(3, activation='softmax'))

  keras_compile(mod, loss='categorical_crossentropy', optimizer=RMSprop())
  keras_fit(mod, X_train, Y_train, verbose = 0)
}
```

EarlyStopping

Stop training when a monitored quantity has stopped improving.

Description

Stop training when a monitored quantity has stopped improving.

Usage

```
EarlyStopping(monitor = "val_loss", min_delta = 0, patience = 0,
              verbose = 0, mode = "auto")
```

Arguments

monitor	quantity to be monitored. See keras_compile() for list of metrics
min_delta	minimum change in the monitored quantity to qualify as an improvement, i.e. an absolute change of less than min_delta, will count as no improvement.
patience	number of epochs with no improvement after which training will be stopped.
verbose	verbosity mode.
mode	one of auto, min, or max. In min mode, training will stop when the quantity monitored has stopped decreasing; in max mode it will stop when the quantity monitored has stopped increasing; in auto mode, the direction is automatically inferred from the name of the monitored quantity.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other callbacks: [CSVLogger](#), [ModelCheckpoint](#), [ReduceLRonPlateau](#), [TensorBoard](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  callbacks <- list(CSVLogger(tempfile()),
                   EarlyStopping(),
                   ReduceLRonPlateau(),
                   TensorBoard(tempfile()))

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, callbacks = callbacks, validation_split = 0.2)
}
```

Embedding

Embedding layer

Description

Turns positive integers (indexes) into dense vectors of fixed size.

Usage

```
Embedding(input_dim, output_dim, embeddings_initializer = "uniform",
          embeddings_regularizer = NULL, embeddings_constraint = NULL,
          mask_zero = FALSE, input_length = NULL, input_shape = NULL)
```

Arguments

<code>input_dim</code>	<code>int > 0</code> . Size of the vocabulary, ie. 1 + maximum integer index occurring in the input data.
<code>output_dim</code>	<code>int >= 0</code> . Dimension of the dense embedding.
<code>embeddings_initializer</code>	Initializer for the embeddings matrix
<code>embeddings_regularizer</code>	Regularizer function applied to the embeddings matrix
<code>embeddings_constraint</code>	Constraint function applied to the embeddings matrix
<code>mask_zero</code>	Whether or not the input value 0 is a special "padding" value that should be masked out.
<code>input_length</code>	Length of input sequences, when it is constant.
<code>input_shape</code>	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(sample(0:19, 100 * 100, TRUE), ncol = 100)
  Y_train <- rnorm(100)

  mod <- Sequential()
  mod$add(Embedding(input_dim = 20, output_dim = 10,
                    input_length = 100))
  mod$add(Dropout(0.5))

  mod$add(GRU(16))
  mod$add(Dense(1))
  mod$add(Activation("sigmoid"))

  keras_compile(mod, loss = "mse", optimizer = RMSprop())
  keras_fit(mod, X_train, Y_train, epochs = 3, verbose = 0)
}
```

expand_dims

Expand dimensions of an array

Description

Expand the shape of an array by inserting a new axis, corresponding to a given position in the array shape. Useful when predicting a model based on a single input.

Usage

```
expand_dims(a, axis = 0)
```

Arguments

a	array to expand
axis	position (amongst axes) where new axis is to be inserted.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other preprocessing: [Tokenizer](#), [img_to_array](#), [load_img](#), [one_hot](#), [pad_sequences](#), [text_to_word_sequence](#)

Flatten

Flattens the input. Does not affect the batch size.

Description

Flattens the input. Does not affect the batch size.

Usage

```
Flatten(input_shape = NULL)
```

Arguments

`input_shape` only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()
```

```

mod <- Sequential(
  Dense(units = 50, input_shape = ncol(X_train)),
  Dropout(rate = 0.5),
  Activation("relu"),
  Dense(units = 3),
  ActivityRegularization(l1 = 1),
  Activation("softmax")
)
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

}

if (keras_available()) {
  X_train <- array(rnorm(100 * 28 * 28), dim = c(100, 28, 28, 1))
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Conv2D(filters = 2, kernel_size = c(2, 2),
                input_shape = c(28, 28, 1)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(LocallyConnected2D(filters = 2, kernel_size = c(2, 2)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(Dropout(0.25))

  mod$add(Flatten())
  mod$add(Dropout(0.5))
  mod$add(Dense(3, activation='softmax'))

  keras_compile(mod, loss='categorical_crossentropy', optimizer=RMSprop())
  keras_fit(mod, X_train, Y_train, verbose = 0)
}

```

GaussianNoise

Apply Gaussian noise layer

Description

The function [GaussianNoise](#) applies additive noise, centered around 0 and [GaussianDropout](#) applied multiplicative noise centered around 1.

Usage

```
GaussianNoise(stddev = 1, input_shape = NULL)
```

```
GaussianDropout(rate = 0.5, input_shape = NULL)
```

Arguments

stddev	standard deviation of the random Gaussian
input_shape	only need when first layer of a model; sets the input shape of the data
rate	float, drop probability

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(GaussianNoise())
  mod$add(GaussianDropout())
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}
```

GlobalPooling

Global pooling operations

Description

Global pooling operations

Usage

```
GlobalMaxPooling1D(input_shape = NULL)
```

```
GlobalAveragePooling1D(input_shape = NULL)
```

```
GlobalMaxPooling2D(data_format = NULL, input_shape = NULL)
```

```
GlobalAveragePooling2D(data_format = NULL, input_shape = NULL)
```

Arguments

input_shape nD tensor with shape: (batch_size, ..., input_dim). The most common situation would be a 2D input with shape (batch_size, input_dim).

data_format A string, one of channels_last (default) or channels_first

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

img_to_array *Converts a PIL Image instance to a Numpy array.*

Description

Converts a PIL Image instance to a Numpy array.

Usage

```
img_to_array(img, data_format = NULL)
```

Arguments

img PIL image file; usually loaded with [load_img](#)

data_format either "channels_first" or "channels_last".

Value

A 3D numeric array.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other image: [load_img](#)

Other preprocessing: [Tokenizer](#), [expand_dims](#), [load_img](#), [one_hot](#), [pad_sequences](#), [text_to_word_sequence](#)

Initializers

Define the way to set the initial random weights of Keras layers.

Description

These functions are used to set the initial weights and biases in a keras model.

Usage

`Zeros()`

`Ones()`

`Constant(value = 0)`

`RandomNormal(mean = 0, stddev = 0.05, seed = NULL)`

`RandomUniform(minval = -0.05, maxval = 0.05, seed = NULL)`

`TruncatedNormal(mean = 0, stddev = 0.05, seed = NULL)`

`VarianceScaling(scale = 1, mode = "fan_in", distribution = "normal",
seed = NULL)`

`Orthogonal(gain = 1, seed = NULL)`

`Identity(gain = 1)`

`lecun_uniform(seed = NULL)`

`glorot_normal(seed = NULL)`

`glorot_uniform(seed = NULL)`

`he_normal(seed = NULL)`

`he_uniform(seed = NULL)`

Arguments

value	constant value to start all weights at
mean	average of the Normal distribution to sample from
stddev	standard deviation of the Normal distribution to sample from
seed	Integer. Used to seed the random generator.
minval	Lower bound of the range of random values to generate.
maxval	Upper bound of the range of random values to generate.
scale	Scaling factor (positive float).
mode	One of "fan_in", "fan_out", "fan_avg".
distribution	distribution to use. One of 'normal' or 'uniform'
gain	Multiplicative factor to apply to the orthogonal matrix

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

Examples

```

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3, kernel_initializer = Zeros(),
                bias_initializer = Ones()))
  mod$add(Dense(units = 3, kernel_initializer = Constant(),
                bias_initializer = RandomNormal()))
  mod$add(Dense(units = 3, kernel_initializer = RandomUniform(),
                bias_initializer = TruncatedNormal()))
  mod$add(Dense(units = 3, kernel_initializer = Orthogonal(),
                bias_initializer = VarianceScaling()))
  mod$add(Dense(units = 3, kernel_initializer = Identity(),
                bias_initializer = lecun_uniform()))
  mod$add(Dense(units = 3, kernel_initializer = glorot_normal(),
                bias_initializer = glorot_uniform()))
  mod$add(Dense(units = 3, kernel_initializer = he_normal(),
                bias_initializer = he_uniform()))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5, verbose = 0)
}

```

kerasR

Keras Models in R

Description

Keras is a high-level neural networks API, originally written in Python, and capable of running on top of either TensorFlow or Theano. It was developed with a focus on enabling fast experimentation. This package provides an interface to Keras from within R. All of the returned objects from functions in this package are either native R objects or raw pointers to python objects, making it possible for users to access the entire keras API. The main benefits of the package are (1) correct, manual parsing of R inputs to python, (2) R-sided documentation, and (3) examples written using the API.

Details

Most functions have associated examples showing a working example of how a layer or object may be used. These are mostly toy examples, made with small datasets with little regard to whether these are the correct models for a particular task. See the package vignettes for a more thorough explanation and several larger, more practical examples.

Author(s)

Taylor B. Arnold <taylor.arnold@acm.org>,

Maintainer: Taylor B. Arnold <taylor.arnold@acm.org>

keras_available

Tests if keras is available on the system.

Description

Returns TRUE if the python keras library is installed. If the function returns FALSE, but you believe keras is installed, then see [use_python](#) to configure the python environment, and then try running [keras_init](#) to establish the connection to keras.

Usage

```
keras_available(silent = FALSE)
```

Arguments

`silent` logical. Should warning message be displayed if the result is false.

Value

Logical

See Also[keras_init](#)

keras_check	<i>Called to check if keras is installed and loaded</i>
-------------	---

Description

Called to check if keras is installed and loaded

Usage

```
keras_check()
```

keras_compile	<i>Compile a keras model</i>
---------------	------------------------------

Description

Models must be compiled before being fit or used for prediction. This function changes to input model object itself, and does not produce a return value.

Usage

```
keras_compile(model, optimizer, loss, metrics = NULL,
              sample_weight_mode = NULL)
```

Arguments

model	a keras model object, for example created with Sequential()
optimizer	name of optimizer) or optimizer object. See Optimizers .
loss	name of a loss function. See Details for possible choices.
metrics	vector of metric names to be evaluated by the model during training and testing. See Details for possible options. See EarlyStopping() for using these in callbacks.
sample_weight_mode	if you need to do timestep-wise sample weighting (2D weights), set this to temporal. None defaults to sample-wise weights (1D).

Loss functions

Possible losses are:

- mean_squared_error
- mean_absolute_error
- mean_absolute_percentage_error
- mean_squared_logarithmic_error
- squared_hinge
- hinge
- categorical_crossentropy
- sparse_categorical_crossentropy
- binary_crossentropy
- kullback_leibler_divergence
- poisson
- cosine_proximity.

Metrics

Possible metrics are:

- binary_accuracy
- categorical_accuracy
- sparse_categorical_accuracy
- top_k_categorical_accuracy

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other model functions: [LoadSave](#), [Predict](#), [Sequential](#), [keras_fit](#)

Examples

```
if(keras_available()) {  
  X_train <- matrix(rnorm(100 * 10), nrow = 100)  
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)  
  
  mod <- Sequential()  
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))  
  mod$add( Dropout(rate = 0.5))  
}
```

```

mod$add(Activation("relu"))
mod$add(Dense(units = 3))
mod$add(ActivityRegularization(l1 = 1))
mod$add(Activation("softmax"))
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

# You can also add layers directly as arguments to Sequential()

mod <- Sequential(
  Dense(units = 50, input_shape = ncol(X_train)),
  Dropout(rate = 0.5),
  Activation("relu"),
  Dense(units = 3),
  ActivityRegularization(l1 = 1),
  Activation("softmax")
)
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

}

```

keras_fit*Fit a keras model*

Description

Learn the weight and bias values for am model given training data. Model must be compiled first. The model is modified in place.

Usage

```

keras_fit(model, x, y, batch_size = 32, epochs = 10, verbose = 1,
          callbacks = NULL, validation_split = 0, validation_data = NULL,
          shuffle = TRUE, class_weight = NULL, sample_weight = NULL,
          initial_epoch = 0)

```

Arguments

model	a keras model object, for example created with Sequential()
x	numeric matrix of input data
y	a numeric matrix or numeric vector containing labels.
batch_size	integer. Number of samples per gradient update.

epochs	integer, the number of epochs to train the model.
verbose	0 for no logging to stdout, 1 for progress bar logging, 2 for one log line per epoch.
callbacks	list of callbacks to apply during training. See EarlyStopping() or TensorBoard() for examples.
validation_split	numeric ($0 < x < 1$). Fraction of the data to use as held-out validation data.
validation_data	<code>list(x_val, y_val)</code> or <code>list(x_val, y_val, val_sample_weights)</code> to be used as held-out validation data. Will override <code>validation_split</code> .
shuffle	boolean or string (for batch). Whether to shuffle the samples at each epoch. batch is a special option for dealing with the limitations of HDF5 data; it shuffles in batch-sized chunks.
class_weight	dictionary mapping classes to a weight value, used for scaling the loss function (during training only).
sample_weight	numeric array of weights for the training samples
initial_epoch	epoch at which to start training

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

[keras_compile\(\)](#)

Other model functions: [LoadSave](#), [Predict](#), [Sequential](#), [keras_compile](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
```

```

# You can also add layers directly as arguments to Sequential()

mod <- Sequential(
  Dense(units = 50, input_shape = ncol(X_train)),
  Dropout(rate = 0.5),
  Activation("relu"),
  Dense(units = 3),
  ActivityRegularization(l1 = 1),
  Activation("softmax")
)
keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
          verbose = 0, validation_split = 0.2)

}

```

keras_init

Initialise connection to the keras python libraries.

Description

This function gets called automatically on package startup. If the python keras library is not installed, then the function displays a message, but doesn't connect to python.

Usage

```
keras_init()
```

See Also

[keras_available](#)

LayerWrapper

Layer wrappers

Description

Apply a layer to every temporal slice of an input or to bi-directional RNN.

Usage

```
TimeDistributed(layer)
```

```
Bidirectional(layer, merge_mode = "concat")
```

Arguments

layer	a layer instance (must be a recurrent layer for the bi-directional case)
merge_mode	Mode by which outputs of the forward and backward RNNs will be combined. One of 'sum', 'mul', 'concat', 'ave', None. If None, the outputs will not be combined, they will be returned as a list.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(sample(0:19, 100 * 100, TRUE), ncol = 100)
  Y_train <- rnorm(100)

  mod <- Sequential()
  mod$add(Embedding(input_dim = 20, output_dim = 10,
                    input_length = 100))
  mod$add(Dropout(0.5))

  mod$add(Bidirectional(LSTM(16)))
  mod$add(Dense(1))
  mod$add(Activation("sigmoid"))

  keras_compile(mod, loss = "mse", optimizer = RMSprop())
  keras_fit(mod, X_train, Y_train, epochs = 3, verbose = 0)
}
```

 LoadSave

Load and save keras models

Description

These functions provide methods for loading and saving a keras model. As python objects, R functions such as [readRDS](#) will not work correctly. We have [keras_save](#) and [keras_load](#) to save and load the entire object, [keras_save_weights](#) and [keras_load_weights](#) to store only the weights, and [keras_model_to_json](#) and [keras_model_from_json](#) to store only the model architecture. It is also possible to use the [get_weights](#) and [set_weights](#) methods to manually extract and set weights from R objects (returned weights can be saved as an R data file).

Usage

```
keras_save(model, path = "model.h5")

keras_load(path = "model.h5")

keras_save_weights(model, path = "model.h5")

keras_load_weights(model, path = "model.h5")

keras_model_to_json(model, path = "model.json")

keras_model_from_json(path = "model.json")
```

Arguments

model	keras model object to save; or, for keras_load_weights the the model in which to load the weights
path	local path to save or load the data from

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other model functions: [Predict](#), [Sequential](#), [keras_compile](#), [keras_fit](#)

Examples

```
if (keras_available()) {
  # X_train <- matrix(rnorm(100 * 10), nrow = 100)
  # Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)
  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = 10))
  mod$add(Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())
  # keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
  #           verbose = 0, validation_split = 0.2)

  # save/load the entire model object
  keras_save(mod, tf <- tempfile())
  mod2 <- keras_load(tf)
```

```
# save/load just the weights file
keras_save_weights(mod, tf <- tempfile())
keras_load_weights(mod, tf)

# save/load just the architecture (as human readable json)
tf <- tempfile(fileext = ".json")
keras_model_to_json(mod, tf)
cat(readLines(tf))
mod3 <- keras_model_from_json(tf)
}
```

load_img

Load image from a file as PIL object

Description

Load image from a file as PIL object

Usage

```
load_img(path, grayscale = FALSE, target_size = NULL)
```

Arguments

path	Path to image file
grayscale	Boolean, whether to load the image as grayscale.
target_size	If NULL, the default, loads the image in its native resolution. Otherwise, set this to a vector giving desired (img_height, img_width).

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other image: [img_to_array](#)

Other preprocessing: [Tokenizer](#), [expand_dims](#), [img_to_array](#), [one_hot](#), [pad_sequences](#), [text_to_word_sequence](#)

LocallyConnected *Locally-connected layer*

Description

The LocallyConnected layers works similarly to the Conv layers, except that weights are unshared, that is, a different set of filters is applied at each different patch of the input.

Usage

```
LocallyConnected1D(filters, kernel_size, strides = 1, padding = "valid",
  activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL)
```

```
LocallyConnected2D(filters, kernel_size, strides = c(1, 1),
  padding = "valid", data_format = NULL, activation = NULL,
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  bias_initializer = "zeros", kernel_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, bias_constraint = NULL, input_shape = NULL)
```

Arguments

filters	Integer, the dimensionality of the output space (i.e. the number output of filters in the convolution).
kernel_size	A pair of integers specifying the dimensions of the 2D convolution window.
strides	A pair of integers specifying the stride length of the convolution.
padding	One of "valid", "causal" or "same" (case-insensitive).
activation	Activation function to use
use_bias	Boolean, whether the layer uses a bias vector.
kernel_initializer	Initializer for the kernel weights matrix
bias_initializer	Initializer for the bias vector
kernel_regularizer	Regularizer function applied to the kernel weights matrix
bias_regularizer	Regularizer function applied to the bias vector
activity_regularizer	Regularizer function applied to the output of the layer (its "activation").
kernel_constraint	Constraint function applied to the kernel matrix

bias_constraint	Constraint function applied to the bias vector
input_shape	only need when first layer of a model; sets the input shape of the data
data_format	A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- array(rnorm(100 * 28 * 28), dim = c(100, 28, 28, 1))
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Conv2D(filters = 2, kernel_size = c(2, 2),
                input_shape = c(28, 28, 1)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(LocallyConnected2D(filters = 2, kernel_size = c(2, 2)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(Dropout(0.25))

  mod$add(Flatten())
  mod$add(Dropout(0.5))
  mod$add(Dense(3, activation='softmax'))

  keras_compile(mod, loss='categorical_crossentropy', optimizer=RMSprop())
  keras_fit(mod, X_train, Y_train, verbose = 0)
}
```

Masking

Masks a sequence by using a mask value to skip timesteps.

Description

For each timestep in the input tensor (dimension #1 in the tensor), if all values in the input tensor at that timestep are equal to `mask_value`, then the timestep will be masked (skipped) in all downstream layers (as long as they support masking). If any downstream layer does not support masking yet receives such an input mask, an exception will be raised.

Usage

```
Masking(mask_value, input_shape = NULL)
```

Arguments

<code>mask_value</code>	the value to use in the masking
<code>input_shape</code>	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

MaxPooling

Max pooling operations

Description

Max pooling operations

Usage

```
MaxPooling1D(pool_size = 2, strides = NULL, padding = "valid",
             input_shape = NULL)
```

```
MaxPooling2D(pool_size = c(2, 2), strides = NULL, padding = "valid",
             data_format = NULL, input_shape = NULL)
```

```
MaxPooling3D(pool_size = c(2, 2, 2), strides = NULL, padding = "valid",
             data_format = NULL, input_shape = NULL)
```

Arguments

pool_size	Integer or triplet of integers; size(s) of the max pooling windows.
strides	Integer, triplet of integers, or None. Factor(s) by which to downscale. E.g. 2 will halve the input. If NULL, it will default to pool_size.
padding	One of "valid" or "same" (case-insensitive).
input_shape	only need when first layer of a model; sets the input shape of the data
data_format	A string, one of channels_last (default) or channels_first

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {
  X_train <- array(rnorm(100 * 28 * 28), dim = c(100, 28, 28, 1))
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Conv2D(filters = 2, kernel_size = c(2, 2),
               input_shape = c(28, 28, 1)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(LocallyConnected2D(filters = 2, kernel_size = c(2, 2)))
  mod$add(Activation("relu"))
  mod$add(MaxPooling2D(pool_size=c(2, 2)))
  mod$add(Dropout(0.25))
}
```

```

    mod$add(Flatten())
    mod$add(Dropout(0.5))
    mod$add(Dense(3, activation='softmax'))

    keras_compile(mod, loss='categorical_crossentropy', optimizer=RMSprop())
    keras_fit(mod, X_train, Y_train, verbose = 0)
}

```

ModelCheckpoint	<i>Save the model after every epoch.</i>
-----------------	--

Description

Save the model after every epoch.

Usage

```

ModelCheckpoint(filepath, monitor = "val_loss", verbose = 0,
    save_best_only = FALSE, save_weights_only = FALSE, mode = "auto",
    period = 1)

```

Arguments

filepath	string, path to save the model file.
monitor	quantity to monitor.
verbose	verbosity mode, 0 or 1.
save_best_only	if save_best_only=True, the latest best model according to the quantity monitored will not be overwritten.
save_weights_only	if True, then only the model's weights will be saved (model.save_weights(filepath)), else the full model is saved (model.save(filepath)).
mode	one of auto, min, max. If save_best_only is True, the decision to overwrite the current save file is made based on either the maximization or the minimization of the monitored quantity. For val_acc, this should be max, for val_loss this should be min, etc. the direction is automatically inferred from the name of the monitored quantity.
period	Interval (number of epochs) between checkpoints.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other callbacks: [CSVLogger](#), [EarlyStopping](#), [ReduceLRonPlateau](#), [TensorBoard](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  callbacks <- list(CSVLogger(tempfile()),
                   EarlyStopping(),
                   ReduceLRonPlateau(),
                   TensorBoard(tempfile()))

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, callbacks = callbacks, validation_split = 0.2)
}
```

normalize

Normalize a Numpy array.

Description

It is generally very important to normalize the data matrix before fitting a neural network model in keras.

Usage

```
normalize(x, axis = -1, order = 2)
```

Arguments

x	Numpy array to normalize
axis	axis along which to normalize. (starts at 0). -1
order	Normalization order (e.g. 2 for L2 norm).

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

one_hot	<i>One-hot encode a text into a list of word indexes</i>
---------	--

Description

One-hot encode a text into a list of word indexes

Usage

```
one_hot(text, n, filters = "!\"#$%&()*+,-./:;<=>@[\\]^_`{|}~\t\n",
        lower = TRUE, split = " ")
```

Arguments

text	a string
n	integer. Size of vocabulary.
filters	vector (or concatenation) of characters to filter out, such as punctuation.
lower	boolean. Whether to set the text to lowercase.
split	string. Separator for word splitting.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other preprocessing: [Tokenizer](#), [expand_dims](#), [img_to_array](#), [load_img](#), [pad_sequences](#), [text_to_word_sequence](#)

Description

Optimization functions to use in compiling a keras model. See [keras_compile\(\)](#).

Usage

```
SGD(lr = 0.01, momentum = 0, decay = 0, nesterov = FALSE,
    clipnorm = -1, clipvalue = -1)
```

```
RMSprop(lr = 0.001, rho = 0.9, epsilon = 1e-08, decay = 0,
        clipnorm = -1, clipvalue = -1)
```

```
Adagrad(lr = 0.01, epsilon = 1e-08, decay = 0, clipnorm = -1,
        clipvalue = -1)
```

```
Adadelta(lr = 1, rho = 0.95, epsilon = 1e-08, decay = 0,
         clipnorm = -1, clipvalue = -1)
```

```
Adam(lr = 0.001, beta_1 = 0.9, beta_2 = 0.999, epsilon = 1e-08,
     decay = 0, clipnorm = -1, clipvalue = -1)
```

```
Adamax(lr = 0.002, beta_1 = 0.9, beta_2 = 0.999, epsilon = 1e-08,
       decay = 0, clipnorm = -1, clipvalue = -1)
```

```
Nadam(lr = 0.002, beta_1 = 0.9, beta_2 = 0.999, epsilon = 1e-08,
      schedule_decay = 0.004, clipnorm = -1, clipvalue = -1)
```

Arguments

lr	float ≥ 0 . Learning rate.
momentum	float ≥ 0 . Parameter updates momentum.
decay	float ≥ 0 . Learning rate decay over each update.
nesterov	boolean. Whether to apply Nesterov momentum.
clipnorm	float ≥ 0 . Gradients will be clipped when their L2 norm exceeds this value. Set to -1 to disable.
clipvalue	float ≥ 0 . Gradients will be clipped when their absolute value exceeds this value. Set to -1 to disable.
rho	float ≥ 0 to be used in RMSprop
epsilon	float ≥ 0 . Fuzz factor.
beta_1	float, $0 < \beta < 1$. Generally close to 1.
beta_2	float, $0 < \beta < 1$. Generally close to 1.
schedule_decay	float ≥ 0 . Learning rate decay over each schedule in Nadam .

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = SGD())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = Adagrad())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = Adadelta())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = Adam())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = Adamax())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = Nadam())
  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}
```

pad_sequences

Pad a linear sequence for an RNN input

Description

Transform a list of `num_samples` sequences (lists of scalars) into a 2D Numpy array of shape `(num_samples, num_timesteps)`. `num_timesteps` is either the `maxlen` argument if provided, or the length of the longest sequence otherwise. Sequences that are shorter than `num_timesteps` are padded with `value` at the end. Sequences longer than `num_timesteps` are truncated so that it fits the desired length. Position where padding or truncation happens is determined by `padding` or `truncating`, respectively.

Usage

```
pad_sequences(sequences, maxlen = NULL, dtype = "int32", padding = "pre",
              truncating = "pre", value = 0)
```

Arguments

<code>sequences</code>	vector of lists of int or float.
<code>maxlen</code>	None or int. Maximum sequence length, longer sequences are truncated and shorter sequences are padded with zeros at the end.
<code>dtype</code>	datatype of the Numpy array returned.
<code>padding</code>	'pre' or 'post', pad either before or after each sequence.
<code>truncating</code>	'pre' or 'post', remove values from sequences larger than <code>maxlen</code> either in the beginning or in the end of the sequence
<code>value</code>	float, value to pad the sequences to the desired value.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other preprocessing: [Tokenizer](#), [expand_dims](#), [img_to_array](#), [load_img](#), [one_hot](#), [text_to_word_sequence](#)

Permute	<i>Permutates the dimensions of the input according to a given pattern.</i>
---------	---

Description

Permutates the dimensions of the input according to a given pattern.

Usage

```
Permute(dims, input_shape = NULL)
```

Arguments

dims	vector of integers. Permutation pattern, does not include the samples dimension. Indexing starts at 1.
input_shape	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [RNN](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

plot_model	<i>Plot model architecture to a file</i>
------------	--

Description

This function requires that you have installed graphviz and pydot in Python.

Usage

```
plot_model(model, to_file = "model.png", show_shapes = FALSE,  
           show_layer_names = TRUE)
```

Arguments

model	model object to plot
to_file	output location of the plot)
show_shapes	controls whether output shapes are shown in the graph
show_layer_names	controls whether layer names are shown in the graph

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

Predict	<i>Predict values from a keras model</i>
---------	--

Description

Once compiled and trained, this function returns the predictions from a keras model. The function [keras_predict](#) returns raw predictions, [keras_predict_classes](#) gives class predictions, and [keras_predict_proba](#) gives class probabilities.

Usage

```
keras_predict(model, x, batch_size = 32, verbose = 1)
```

```
keras_predict_classes(model, x, batch_size = 32, verbose = 1)
```

```
keras_predict_proba(model, x, batch_size = 32, verbose = 1)
```

Arguments

model	a keras model object, for example created with Sequential()
x	input data
batch_size	integer. Number of samples per gradient update.
verbose	0 for no logging to stdout, 1 for progress bar logging, 2 for one log line per epoch.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other model functions: [LoadSave](#), [Sequential](#), [keras_compile](#), [keras_fit](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
  dim(keras_predict(mod, X_train))
  mean(keras_predict(mod, X_train) == (apply(Y_train, 1, which.max) - 1))
}
```

```
preprocess_input
```

Preprocess input for pre-defined imagenet networks

Description

These assume you have already converted images into a three channel, 224 by 224 matrix with [load_img](#) and [img_to_array](#). The processing differs based on the model so set the appropriate model that you are using.

Usage

```
preprocess_input(img, model = c("Xception", "VGG16", "VGG19", "ResNet50",
                                "InceptionV3"))
```

Arguments

<code>img</code>	the input image, as an array
<code>model</code>	the model you wish to preprocess to

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

ReduceLROnPlateau *Reduce learning rate when a metric has stopped improving.*

Description

Models often benefit from reducing the learning rate by a factor of 2-10 once learning stagnates. This callback monitors a quantity and if no improvement is seen for a 'patience' number of epochs, the learning rate is reduced.

Usage

```
ReduceLROnPlateau(monitor = "val_loss", factor = 0.1, patience = 10,  
                  verbose = 0, mode = "auto", epsilon = 1e-04, cooldown = 0,  
                  min_lr = 0)
```

Arguments

monitor	quantity to be monitored.
factor	factor by which the learning rate will be reduced. $\text{new_lr} = \text{lr} * \text{factor}$
patience	number of epochs with no improvement after which learning rate will be reduced.
verbose	int. 0: quiet, 1: update messages.
mode	one of auto, min, max. In min mode, lr will be reduced when the quantity monitored has stopped decreasing; in max mode it will be reduced when the quantity monitored has stopped increasing; in auto mode, the direction is automatically inferred from the name of the monitored quantity.
epsilon	threshold for measuring the new optimum, to only focus on significant changes.
cooldown	number of epochs to wait before resuming normal operation after lr has been reduced.
min_lr	lower bound on the learning rate.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other callbacks: [CSVLogger](#), [EarlyStopping](#), [ModelCheckpoint](#), [TensorBoard](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  callbacks <- list(CSVLogger(tempfile()),
                   EarlyStopping(),
                   ReduceLRonPlateau(),
                   TensorBoard(tempfile()))

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, callbacks = callbacks, validation_split = 0.2)
}
```

 Regularizers

Apply penalties on layer parameters

Description

Regularizers allow to apply penalties on layer parameters or layer activity during optimization. These penalties are incorporated in the loss function that the network optimizes.

Usage

```
l1(l = 0.01)
```

```
l2(l = 0.01)
```

```
l1_l2(l1 = 0.01, l2 = 0.01)
```

Arguments

l	multiplicative factor to apply to the the penalty term
l1	multiplicative factor to apply to the the l1 penalty term
l2	multiplicative factor to apply to the the l2 penalty term

Details

The penalties are applied on a per-layer basis. The exact API will depend on the layer, but the layers Dense, Conv1D, Conv2D and Conv3D have a unified API.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3, kernel_regularizer = l1(l = 0.05),
    bias_regularizer = l2(l = 0.05)))
  mod$add(Dense(units = 3, kernel_regularizer = l1_l2(l1 = 0.05, l2 = 0.1)))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5, verbose = 0)
}
```

RepeatVector

Repeats the input n times.

Description

Repeats the input n times.

Usage

```
RepeatVector(n, input_shape = NULL)
```

Arguments

n integer, repetition factor.
input_shape only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [Reshape](#), [Sequential](#)

Reshape

Reshapes an output to a certain shape.

Description

Reshapes an output to a certain shape.

Usage

```
Reshape(target_shape, input_shape = NULL)
```

Arguments

target_shape	target shape. Tuple of integers, does not include the samples dimension (batch size).
input_shape	only need when first layer of a model; sets the input shape of the data

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Sequential](#)

Description

Recurrent neural network layers

Usage

```
SimpleRNN(units, activation = "tanh", use_bias = TRUE,
  kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  kernel_regularizer = NULL, recurrent_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, recurrent_constraint = NULL,
  bias_constraint = NULL, dropout = 0, recurrent_dropout = 0,
  input_shape = NULL)
```

```
GRU(units, activation = "tanh", recurrent_activation = "hard_sigmoid",
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  kernel_regularizer = NULL, recurrent_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, recurrent_constraint = NULL,
  bias_constraint = NULL, dropout = 0, recurrent_dropout = 0,
  input_shape = NULL)
```

```
LSTM(units, activation = "tanh", recurrent_activation = "hard_sigmoid",
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  unit_forget_bias = TRUE, kernel_regularizer = NULL,
  recurrent_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  recurrent_constraint = NULL, bias_constraint = NULL, dropout = 0,
  recurrent_dropout = 0, return_sequences = FALSE, input_shape = NULL)
```

Arguments

<code>units</code>	Positive integer, dimensionality of the output space.
<code>activation</code>	Activation function to use
<code>use_bias</code>	Boolean, whether the layer uses a bias vector.
<code>kernel_initializer</code>	Initializer for the kernel weights matrix, used for the linear transformation of the inputs.
<code>recurrent_initializer</code>	Initializer for the recurrent_kernel weights matrix, used for the linear transformation of the recurrentstate.

<code>bias_initializer</code>	Initializer for the bias vector
<code>kernel_regularizer</code>	Regularizer function applied to the kernel weights matrix
<code>recurrent_regularizer</code>	Regularizer function applied to the recurrent_kernel weights matrix
<code>bias_regularizer</code>	Regularizer function applied to the bias vector
<code>activity_regularizer</code>	Regularizer function applied to the output of the layer (its "activation")
<code>kernel_constraint</code>	Constraint function applied to the kernel weights matrix
<code>recurrent_constraint</code>	Constraint function applied to the recurrent_kernel weights matrix
<code>bias_constraint</code>	Constraint function applied to the bias vector
<code>dropout</code>	Float between 0 and 1. Fraction of the units to drop for the linear transformation of the inputs.
<code>recurrent_dropout</code>	Float between 0 and 1. Fraction of the units to drop for the linear transformation of the recurrent state.
<code>input_shape</code>	only need when first layer of a model; sets the input shape of the data
<code>recurrent_activation</code>	Activation function to use for the recurrent step
<code>unit_forget_bias</code>	Boolean. If True, add 1 to the bias of the forget gate at initialization.
<code>return_sequences</code>	Boolean. Whether to return the last output in the output sequence, or the full sequence.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RepeatVector](#), [Reshape](#), [Sequential](#)

Examples

```
if(keras_available()) {  
  X_train <- matrix(sample(0:19, 100 * 100, TRUE), ncol = 100)  
  Y_train <- rnorm(100)  
  
  mod <- Sequential()  
  mod$add(Embedding(input_dim = 20, output_dim = 10,  
                    input_length = 100))  
  mod$add(Dropout(0.5))  
  
  mod$add(LSTM(16))  
  mod$add(Dense(1))  
  mod$add(Activation("sigmoid"))  
  
  keras_compile(mod, loss = "mse", optimizer = RMSprop())  
  keras_fit(mod, X_train, Y_train, epochs = 3, verbose = 0)  
}
```

Sequential

Initialize sequential model

Description

Use this function to construct an empty model to which layers will be added, or pass a list of layers directly to the function. The first layer passed to a Sequential model should have a defined input shape.

Usage

```
Sequential(...)
```

Arguments

... keras model layers to construct the model from

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other model functions: [LoadSave](#), [Predict](#), [keras_compile](#), [keras_fit](#)

Other layers: [Activation](#), [ActivityRegularization](#), [AdvancedActivation](#), [BatchNormalization](#), [Conv](#), [Dense](#), [Dropout](#), [Embedding](#), [Flatten](#), [GaussianNoise](#), [LayerWrapper](#), [LocallyConnected](#), [Masking](#), [MaxPooling](#), [Permute](#), [RNN](#), [RepeatVector](#), [Reshape](#)

Examples

```

if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add( Dropout(rate = 0.5))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(ActivityRegularization(l1 = 1))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)

  # You can also add layers directly as arguments to Sequential()

  mod <- Sequential(
    Dense(units = 50, input_shape = ncol(X_train)),
    Dropout(rate = 0.5),
    Activation("relu"),
    Dense(units = 3),
    ActivityRegularization(l1 = 1),
    Activation("softmax")
  )
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, validation_split = 0.2)
}

```

TensorBoard

Tensorboard basic visualizations.

Description

This callback writes a log for TensorBoard, which allows you to visualize dynamic graphs of your training and test metrics, as well as activation histograms for the different layers in your model.

Usage

```

TensorBoard(log_dir = "./logs", histogram_freq = 0, write_graph = TRUE,
           write_images = FALSE)

```

Arguments

<code>log_dir</code>	the path of the directory where to save the log files to be parsed by Tensorboard.
<code>histogram_freq</code>	frequency (in epochs) at which to compute activation histograms for the layers of the model. If set to 0, histograms won't be computed.
<code>write_graph</code>	whether to visualize the graph in Tensorboard. The log file can become quite large when <code>write_graph</code> is set to True.
<code>write_images</code>	whether to write model weights to visualize as image in Tensorboard.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

See Also

Other callbacks: [CSVLogger](#), [EarlyStopping](#), [ModelCheckpoint](#), [ReduceLRonPlateau](#)

Examples

```
if(keras_available()) {
  X_train <- matrix(rnorm(100 * 10), nrow = 100)
  Y_train <- to_categorical(matrix(sample(0:2, 100, TRUE), ncol = 1), 3)

  mod <- Sequential()
  mod$add(Dense(units = 50, input_shape = dim(X_train)[2]))
  mod$add(Activation("relu"))
  mod$add(Dense(units = 3))
  mod$add(Activation("softmax"))
  keras_compile(mod, loss = 'categorical_crossentropy', optimizer = RMSprop())

  callbacks <- list(CSVLogger(tempfile()),
                   EarlyStopping(),
                   ReduceLRonPlateau(),
                   TensorBoard(tempfile()))

  keras_fit(mod, X_train, Y_train, batch_size = 32, epochs = 5,
            verbose = 0, callbacks = callbacks, validation_split = 0.2)
}
```

text_to_word_sequence *Split a sentence into a list of words.*

Description

Split a sentence into a list of words.

Usage

```
text_to_word_sequence(text,
    filters = "!\"#$%&()*+,-./:;<=>@[\\]^_`{|}~\t\n", lower = TRUE,
    split = " ")
```

Arguments

text	a string
filters	vector (or concatenation) of characters to filter out, such as punctuation.
lower	boolean. Whether to set the text to lowercase.
split	string. Separator for word splitting.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other preprocessing: [Tokenizer](#), [expand_dims](#), [img_to_array](#), [load_img](#), [one_hot](#), [pad_sequences](#)

Tokenizer

Tokenizer

Description

Returns an object for vectorizing texts, or/and turning texts into sequences (=list of word indexes, where the word of rank *i* in the dataset (starting at 1) has index *i*).

Usage

```
Tokenizer(num_words = NULL,
    filters = "!\"#$%&()*+,-./:;<=>@[\\]^_`{|}~\t\n", lower = TRUE,
    split = " ")
```

Arguments

num_words	integer. None or int. Maximum number of words to work with.
filters	vector (or concatenation) of characters to filter out, such as punctuation.
lower	boolean. Whether to set the text to lowercase.
split	string. Separator for word splitting.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

See Also

Other preprocessing: [expand_dims](#), [img_to_array](#), [load_img](#), [one_hot](#), [pad_sequences](#), [text_to_word_sequence](#)

to_categorical	<i>Converts a class vector (integers) to binary class matrix.</i>
----------------	---

Description

This function takes a vector or 1 column matrix of class labels and converts it into a matrix with p columns, one for each category. This is the format most commonly used in the fitting and predicting of neural networks.

Usage

```
to_categorical(y, num_classes = NULL)
```

Arguments

y	class vector to be converted into a matrix (integers from 0 to num_classes).
num_classes	total number of classes. Set to NULL to autodetect from the input.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

UpSampling *UpSampling layers.*

Description

Repeats each temporal step size a given number of times.

Usage

UpSampling1D(size = 2, input_shape = NULL)

UpSampling2D(size = c(2, 2), data_format = NULL, input_shape = NULL)

UpSampling3D(size = c(2, 2, 2), data_format = NULL, input_shape = NULL)

Arguments

size integer. Upsampling factor.
input_shape only need when first layer of a model; sets the input shape of the data
data_format A string, one of channels_last (default) or channels_first.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow.](#)

ZeroPadding *Zero-padding layers*

Description

Zero-padding layers

Usage

ZeroPadding1D(padding = 1, input_shape = NULL)

ZeroPadding2D(padding = 1, data_format = NULL, input_shape = NULL)

ZeroPadding3D(padding = 1, data_format = NULL, input_shape = NULL)

Arguments

padding	if one integer, the same symmetric padding is applied to width and height. If two, how many to add for height and width.
input_shape	only need when first layer of a model; sets the input shape of the data
data_format	A string, one of channels_last (default) or channels_first.

Author(s)

Taylor B. Arnold, <taylor.arnold@acm.org>

References

Chollet, Francois. 2015. [Keras: Deep Learning library for Theano and TensorFlow](#).

Index

- Activation, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- ActivityRegularization, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- Adadelta (Optimizers), [48](#)
- Adagrad (Optimizers), [48](#)
- Adam (Optimizers), [48](#)
- Adamax (Optimizers), [48](#)
- AdvancedActivation, [3](#), [5](#), [6](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- Applications, [8](#)
- AveragePooling, [9](#)
- AveragePooling1D (AveragePooling), [9](#)
- AveragePooling2D (AveragePooling), [9](#)
- AveragePooling3D (AveragePooling), [9](#)
- BatchNormalization, [3](#), [5](#), [7](#), [10](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- Bidirectional (LayerWrapper), [37](#)
- Constant (Initializers), [30](#)
- Constraints, [11](#)
- Conv, [3](#), [5](#), [7](#), [11](#), [12](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- Conv1D (Conv), [12](#)
- Conv2D (Conv), [12](#)
- Conv2DTranspose (Conv), [12](#)
- Conv3D (Conv), [12](#)
- Cropping, [15](#)
- Cropping1D (Cropping), [15](#)
- Cropping2D (Cropping), [15](#)
- Cropping3D (Cropping), [15](#)
- CSVLogger, [16](#), [23](#), [46](#), [55](#), [62](#)
- Datasets, [17](#)
- decode_predictions, [18](#)
- Dense, [3](#), [5](#), [7](#), [11](#), [14](#), [19](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- Dropout, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [21](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- EarlyStopping, [16](#), [22](#), [46](#), [55](#), [62](#)
- EarlyStopping(), [33](#), [36](#)
- ELU, [7](#)
- ELU (AdvancedActivation), [6](#)
- Embedding, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- expand_dims, [25](#), [30](#), [40](#), [47](#), [50](#), [63](#), [64](#)
- Flatten, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- GaussianDropout, [27](#)
- GaussianDropout (GaussianNoise), [27](#)
- GaussianNoise, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [27](#), [27](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- GlobalAveragePooling1D (GlobalPooling), [28](#)
- GlobalAveragePooling2D (GlobalPooling), [28](#)
- GlobalMaxPooling1D (GlobalPooling), [28](#)
- GlobalMaxPooling2D (GlobalPooling), [28](#)
- GlobalPooling, [28](#)
- glorot_normal (Initializers), [30](#)
- glorot_uniform (Initializers), [30](#)
- GRU (RNN), [58](#)
- he_normal (Initializers), [30](#)
- he_uniform (Initializers), [30](#)
- Identity (Initializers), [30](#)
- img_to_array, [25](#), [29](#), [40](#), [47](#), [50](#), [53](#), [63](#), [64](#)
- InceptionV3 (Applications), [8](#)
- Initializers, [30](#)
- keras_available, [32](#), [37](#)
- keras_check, [33](#)
- keras_compile, [33](#), [36](#), [39](#), [53](#), [60](#)
- keras_compile(), [23](#), [36](#), [48](#)

- keras_fit, [34](#), [35](#), [39](#), [53](#), [60](#)
- keras_init, [32](#), [33](#), [37](#)
- keras_load, [38](#)
- keras_load (LoadSave), [38](#)
- keras_load_weights, [38](#), [39](#)
- keras_load_weights (LoadSave), [38](#)
- keras_model_from_json, [38](#)
- keras_model_from_json (LoadSave), [38](#)
- keras_model_to_json, [38](#)
- keras_model_to_json (LoadSave), [38](#)
- keras_predict, [52](#)
- keras_predict (Predict), [52](#)
- keras_predict_classes, [52](#)
- keras_predict_classes (Predict), [52](#)
- keras_predict_proba, [52](#)
- keras_predict_proba (Predict), [52](#)
- keras_save, [38](#)
- keras_save (LoadSave), [38](#)
- keras_save_weights, [38](#)
- keras_save_weights (LoadSave), [38](#)
- kerasR, [32](#)
- kerasR-package (kerasR), [32](#)

- l1 (Regularizers), [55](#)
- l1_l2 (Regularizers), [55](#)
- l2 (Regularizers), [55](#)
- LayerWrapper, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [37](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- LeakyReLU, [7](#)
- LeakyReLU (AdvancedActivation), [6](#)
- lecun_uniform (Initializers), [30](#)
- load_boston_housing (Datasets), [17](#)
- load_cifar10 (Datasets), [17](#)
- load_cifar100, [17](#)
- load_cifar100 (Datasets), [17](#)
- load_imdb (Datasets), [17](#)
- load_img, [25](#), [29](#), [30](#), [40](#), [47](#), [50](#), [53](#), [63](#), [64](#)
- load_mnist (Datasets), [17](#)
- load_reuters (Datasets), [17](#)
- LoadSave, [34](#), [36](#), [38](#), [53](#), [60](#)
- LocallyConnected, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [41](#), [43](#), [44](#), [51](#), [57](#), [59](#), [60](#)
- LocallyConnected1D (LocallyConnected), [41](#)
- LocallyConnected2D (LocallyConnected), [41](#)
- LSTM (RNN), [58](#)

- Masking, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42](#), [43](#), [44](#), [51](#), [57](#), [59](#), [60](#)
- max_norm (Constraints), [11](#)
- MaxPooling, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42](#), [43](#), [43](#), [51](#), [57](#), [59](#), [60](#)
- MaxPooling1D (MaxPooling), [43](#)
- MaxPooling2D (MaxPooling), [43](#)
- MaxPooling3D (MaxPooling), [43](#)
- ModelCheckpoint, [16](#), [23](#), [45](#), [55](#), [62](#)

- Nadam, [48](#)
- Nadam (Optimizers), [48](#)
- non_neg (Constraints), [11](#)
- normalize, [46](#)

- one_hot, [25](#), [30](#), [40](#), [47](#), [50](#), [63](#), [64](#)
- Ones (Initializers), [30](#)
- Optimizers, [33](#), [48](#)
- Orthogonal (Initializers), [30](#)

- pad_sequences, [25](#), [30](#), [40](#), [47](#), [50](#), [63](#), [64](#)
- Permute, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [59](#), [60](#)
- plot_model, [51](#)
- Predict, [34](#), [36](#), [39](#), [52](#), [60](#)
- PReLU (AdvancedActivation), [6](#)
- preprocess_input, [53](#)

- RandomNormal (Initializers), [30](#)
- RandomUniform (Initializers), [30](#)
- readRDS, [38](#)
- ReduceLROnPlateau, [16](#), [23](#), [46](#), [54](#), [62](#)
- Regularizers, [55](#)
- RepeatVector, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [56](#), [57](#), [59](#), [60](#)
- Reshape, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [57](#), [59](#), [60](#)
- ResNet50 (Applications), [8](#)
- RMSprop, [48](#)
- RMSprop (Optimizers), [48](#)
- RNN, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [38](#), [42–44](#), [51](#), [57](#), [58](#), [60](#)

- SeparableConv2D (Conv), [12](#)
- Sequential, [3](#), [5](#), [7](#), [11](#), [14](#), [20](#), [22](#), [24](#), [26](#), [28](#), [34](#), [36](#), [38](#), [39](#), [42–44](#), [51](#), [53](#), [57](#), [59](#), [60](#)
- Sequential(), [33](#), [35](#), [52](#)
- SGD (Optimizers), [48](#)

SimpleRNN (RNN), 58

TensorBoard, 16, 23, 46, 55, 61

TensorBoard(), 36

text_to_word_sequence, 25, 30, 40, 47, 50, 63, 64

ThresholdedReLU, 7

ThresholdedReLU (AdvancedActivation), 6

TimeDistributed (LayerWrapper), 37

to_categorical, 64

Tokenizer, 25, 30, 40, 47, 50, 63, 63

TruncatedNormal (Initializers), 30

unit_norm (Constraints), 11

UpSampling, 65

UpSampling1D (UpSampling), 65

UpSampling2D (UpSampling), 65

UpSampling3D (UpSampling), 65

use_python, 32

VarianceScaling (Initializers), 30

VGG16 (Applications), 8

VGG19 (Applications), 8

Xception (Applications), 8

ZeroPadding, 65

ZeroPadding1D (ZeroPadding), 65

ZeroPadding2D (ZeroPadding), 65

ZeroPadding3D (ZeroPadding), 65

Zeros (Initializers), 30