

# Package ‘umap’

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**Title** Uniform Manifold Approximation and Projection

**Version** 0.2.3.1

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**Description** Uniform manifold approximation and projection is a technique for dimension reduction. The algorithm was described by McInnes and Healy (2018) in <arXiv:1802.03426>. This package provides an interface for two implementations. One is written from scratch, including components for nearest-neighbor search and for embedding. The second implementation is a wrapper for 'python' package 'umap-learn' (requires separate installation, see vignette for more details).

**Depends** R (>= 3.1.2)

**Imports** methods, openssl, reticulate, Rcpp (>= 0.12.6), RSpectra, stats

**License** MIT + file LICENSE

**URL** <https://github.com/tkonopka/umap>

**LinkingTo** Rcpp

**LazyData** true

**Suggests** knitr, rmarkdown, testthat

**VignetteBuilder** knitr

**RoxygenNote** 6.1.1

**NeedsCompilation** yes

**Repository** CRAN

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column.seeds	<i>deterministically produce random-like integers for each column in a dataset</i>
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**Description**

deterministically produce random-like integers for each column in a dataset

**Usage**

```
column.seeds(x, key = 123)
```

**Arguments**

x	matrix, items in columns
key	numeric, a "salt" used trigger different random-like integers if needed

**Value**

vector of integers

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predict.umap	<i>project data points onto an existing umap embedding</i>
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**Description**

project data points onto an existing umap embedding

**Usage**

```
## S3 method for class 'umap'
predict(object, data, ...)
```

**Arguments**

object	trained object of class umap
data	matrix with data
...	additional arguments (not used)

**Value**

new matrix

## Examples

```
# embedd iris dataset using default settings
iris.umap = umap(iris[,1:4])

# create a dataset with structure like iris, but with perturbation
iris.perturbed = iris[,1:4] + matrix(rnorm(nrow(iris)*4, 0, 0.1), ncol=4)

# project perturbed dataset
perturbed.embedding = predict(iris.umap, iris.perturbed)

# output is a matrix with embedding coordinates
head(perturbed.embedding)
```

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umap

*Computes a manifold approximation and projection*

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## Description

Computes a manifold approximation and projection

## Usage

```
umap(d, config = umap.defaults, method = c("naive", "umap-learn"), ...)
```

## Arguments

d	matrix, input data
config	object of class umap.config
method	character, implementation. Available methods are 'naive' (an implementation written in pure R) and 'umap-learn' (requires python package 'umap-learn')
...	list of settings; overwrite default values from config

## Value

object of class umap, containing at least a component with an embedding and a component with configuration settings

## Examples

```
# embedd iris dataset using default settings
iris.umap = umap(iris[,1:4])

# display object summary
iris.umap

# display embedding coordinates
head(iris.umap$layout)
```

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`umap.defaults`*Default configuration for umap*

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**Description**

A list with parameters customizing a UMAP embedding. Each component of the list is an effective argument for `umap()`.

**Usage**`umap.defaults`**Format**

An object of class `umap.config` of length 21.

**Details**

`n_neighbors`: integer; number of nearest neighbors

`n_components`: integer; dimension of target (output) space

`metric`: character or function; determines how distances between data points are computed. When using a string, available metrics are: euclidean, manhattan. Other available generalized metrics are: cosine, pearson, pearson2. Note the triangle inequality may not be satisfied by some generalized metrics, hence knn search may not be optimal. When using `metric.function` as a function, the signature must be `function(matrix, origin, target)` and should compute a distance between the origin column and the target columns

`n_epochs`: integer; number of iterations performed during layout optimization

`input`: character, use either "data" or "dist"; determines whether the primary input argument to `umap()` is treated as a data matrix or as a distance matrix

`init`: character or matrix. The default string "spectral" computes an initial embedding using eigenvectors of the connectivity graph matrix. An alternative is the string "random", which creates an initial layout based on random coordinates. This setting can also be set to a matrix, in which case layout optimization begins from the provided coordinates.

`min_dist`: numeric; determines how close points appear in the final layout

`set_op_ratio_mix_ratio`: numeric in range [0,1]; determines who the knn-graph is used to create a fuzzy simplicial graph

`local_connectivity`: numeric; used during construction of fuzzy simplicial set

`bandwidth`: numeric; used during construction of fuzzy simplicial set

`alpha`: numeric; initial value of "learning rate" of layout optimization

`gamma`: numeric; determines, together with alpha, the learning rate of layout optimization

`negative_sample_rate`: integer; determines how many non-neighbor points are used per point and per iteration during layout optimization

a: numeric; contributes to gradient calculations during layout optimization. When left at NA, a suitable value will be estimated automatically.

b: numeric; contributes to gradient calculations during layout optimization.

spread: numeric; used during automatic estimation of a/b parameters.

random\_state: integer; seed for random number generation used during umap()

transform\_state: integer; seed for random number generation used during predict()

knn.repeat: number of times to restart knn search

verbose: logical or integer; determines whether to show progress messages

umap\_learn\_args: vector of arguments to python package umap-learn

### **Examples**

```
# display all default settings
umap.defaults

# create a new settings object with n_neighbors set to 5
custom.settings = umap.defaults
custom.settings$n_neighbors = 5
custom.settings
```

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