

# Package ‘mlr3tuningspaces’

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**Title** Search Spaces for 'mlr3'

**Version** 0.4.0

**Description** Collection of search spaces for hyperparameter optimization in the 'mlr3' ecosystem. It features ready-to-use search spaces for many popular machine learning algorithms. The search spaces are from scientific articles and work for a wide range of data sets.

**License** LGPL-3

**URL** <https://mlr3tuningspaces.mlr-org.com>,  
<https://github.com/mlr-org/mlr3tuningspaces>

**BugReports** <https://github.com/mlr-org/mlr3tuningspaces/issues>

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mlr3tuningspaces-package

*mlr3tuningspaces: Search Spaces for 'mlr3'*

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### Description

Collection of search spaces for hyperparameter optimization in the 'mlr3' ecosystem. It features ready-to-use search spaces for many popular machine learning algorithms. The search spaces are from scientific articles and work for a wide range of data sets.

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### See Also

Useful links:

- <https://mlr3tuningspaces.mlr-org.com>
- <https://github.com/mlr-org/mlr3tuningspaces>
- Report bugs at <https://github.com/mlr-org/mlr3tuningspaces/issues>

lts

*Syntactic Sugar for Tuning Space Construction***Description**

Function to retrieve [TuningSpace](#) objects from [mlr\\_tuning\\_spaces](#) and further, allows a [mlr3::Learner](#) to be directly configured with a search space. This function belongs to [mlr3::mlr\\_sugar](#) family.

**Usage**

```
lts(x, ...)

## S3 method for class 'missing'
lts(x, ...)

## S3 method for class 'character'
lts(x, ...)

## S3 method for class 'Learner'
lts(x, ...)

ltss(x)
```

**Arguments**

x	( <a href="#">character()</a>   <a href="#">mlr3::Learner</a> ) If <a href="#">character</a> , key passed the dictionary to retrieve the tuning space. If <a href="#">mlr3::Learner</a> , default tuning space is added to the learner.
...	(named list of <a href="#">paradox::TuneToken</a>   NULL) Pass <a href="#">paradox::TuneToken</a> to add or overwrite parameters in the tuning space. Use NULL to remove parameters (see examples).

**Value**

[TuningSpace](#) if x is [character\(\)](#). [mlr3::Learner](#) if x is [mlr3::Learner](#). Or a list of objects for the [ltss\(\)](#) function.

missing, [mlr\\_tuning\\_spaces](#) dictionary

a [character](#), [TuningSpace](#)

a [mlr3::Learner](#), [mlr3::Learner](#) with [paradox::TuneToken](#)

a [list\(\)](#), list of [TuningSpace](#) or [mlr3::Learner](#)

**Examples**

```
# load tuning space
lts("classif.rpart.default")
```

```

# load tuning space and add parameter
lts("classif.rpart.default", maxdepth = to_tune(1, 15))

# load tuning space and remove parameter
lts("classif.rpart.default", minsplit = NULL)

# load tuning space and overwrite parameter
lts("classif.rpart.default", minsplit = to_tune(32, 128))

# load learner and apply tuning space in one go
lts(lrn("classif.rpart"))

# load learner, overwrite parameter and apply tuning space
lts(lrn("classif.rpart"), minsplit = to_tune(32, 128))

# load multiple tuning spaces
ltss(c("classif.rpart.default", "classif.ranger.default"))

```

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mlr\_tuning\_spaces      *Dictionary of Tuning Spaces*

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## Description

A simple `mlr3misc::Dictionary` storing objects of class `TuningSpace`. Each tuning space has an associated help page, see `mlr_tuning_spaces_[id]`.

## Format

`R6::R6Class` object inheriting from `mlr3misc::Dictionary`.

## Methods

See `mlr3misc::Dictionary`.

## S3 methods

- `as.data.table(dict, ..., objects = FALSE)`  
`mlr3misc::Dictionary -> data.table::data.table()`  
Returns a `data.table::data.table()` with fields "key", "label", "learner", and "n\_values" as columns. If `objects` is set to `TRUE`, the constructed objects are returned in the list column named `object`.

## Examples

```

as.data.table(mlr_tuning_spaces)
mlr_tuning_spaces$get("classif.ranger.default")
lts("classif.ranger.default")

```

---

`mlr_tuning_spaces_default`*Default Tuning Spaces*

---

**Description**

Tuning spaces from the Bischl (2021) article.

**glmnet tuning space**

- `s` [ $1e - 04$ , 10000] Logscale
- `alpha` [0, 1]

**kknn tuning space**

- `k` [1, 50] Logscale
- `distance` [1, 5]
- `kernel` ["rectangular", "optimal", "epanechnikov", "biweight", "triweight", "cos", "inv", "gaussian", "rank"]

**ranger tuning space**

- `mtry.ratio` [0, 1]
- `replace` [TRUE, FALSE]
- `sample.fraction` [0.1, 1]
- `num.trees` [1, 2000]

**rpart tuning space**

- `minsplit` [2, 128] Logscale
- `minbucket` [1, 64] Logscale
- `cp` [ $1e - 04$ , 0.1] Logscale

**svm tuning space**

- `cost` [ $1e - 04$ , 10000] Logscale
- `kernel` ["polynomial", "radial", "sigmoid", "linear"]
- `degree` [2, 5]
- `gamma` [ $1e - 04$ , 10000] Logscale

**xgboost tuning space**

- eta [ $1e - 04$ , 1] Logscale
- nrounds [1, 5000]
- max\_depth [1, 20]
- colsample\_bytree [0.1, 1]
- colsample\_bylevel [0.1, 1]
- lambda [0.001, 1000] Logscale
- alpha [0.001, 1000] Logscale
- subsample [0.1, 1]

**Source**

Bischl B, Binder M, Lang M, Pielok T, Richter J, Coors S, Thomas J, Ullmann T, Becker M, Boulesteix A, Deng D, Lindauer M (2021). “Hyperparameter Optimization: Foundations, Algorithms, Best Practices and Open Challenges.” 2107.05847, <https://arxiv.org/abs/2107.05847>.

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mlr\_tuning\_spaces\_rbv1

*RandomBot Tuning Spaces*

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**Description**

Tuning spaces from the Kuehn (2018) article. The hyperparameter `respect.unordered.factors` and `min.node.size` of the ranger tuning space differ from the paper.

**glmnet tuning space**

- alpha [0, 1]
- s [ $1e - 04$ , 1000] Logscale

**kknn tuning space**

- k [1, 30]

**ranger tuning space**

- num.trees [1, 2000]
- replace [TRUE,FALSE]
- sample.fraction [0.1, 1]
- mtry.ratio [0, 1]
- respect.unordered.factors [“ignore”, “order”, “partition”]
- min.node.size [1, 100]

`mtry.power` is replaced by `mtry.ratio`.

**rpart tuning space**

- cp [0, 1]
- maxdepth [1, 30]
- minbucket [1, 60]
- minsplit [1, 60]

**svm tuning space**

- kernel [“linear”, “polynomial”, “radial”]
- cost [ $1e - 04$ , 1000] Logscale
- gamma [ $1e - 04$ , 1000] Logscale
- degree [2, 5]

**xgboost tuning space**

- nrounds [1, 5000]
- eta [ $1e - 04$ , 1] Logscale
- subsample [0, 1]
- booster [“gblinear”, “gbtree”, “dart”]
- max\_depth [1, 15]
- min\_child\_weight [1, 100] Logscale
- colsample\_bytree [0, 1]
- colsample\_bylevel [0, 1]
- lambda [ $1e - 04$ , 1000] Logscale
- alpha [ $1e - 04$ , 1000] Logscale

**Source**

Kuehn D, Probst P, Thomas J, Bischl B (2018). “Automatic Exploration of Machine Learning Experiments on OpenML.” 1806.10961, <https://arxiv.org/abs/1806.10961>.

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mlr\_tuning\_spaces\_rbv2

*RandomBot V2 Tuning Spaces*

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**Description**

Tuning spaces from the Binder (2020) article.

**glmnet tuning space**

- alpha [0, 1]
- s [ $1e - 04$ , 1000] Logscale

**kknn tuning space**

- k [1, 30]

**ranger tuning space**

- num.trees [1, 2000]
- replace [TRUE,FALSE]
- sample.fraction [0.1, 1]
- mtry.ratio [0, 1]
- respect.unordered.factors ["ignore", "order", "partition"]
- min.node.size [1, 100]
- splitrule ["gini", "extratrees"]
- num.random.splits [1, 100]

mtry.power is replaced by mtry.ratio.

**rpart tuning space**

- cp [ $1e - 04$ , 1] Logscale
- maxdepth [1, 30]
- minbucket [1, 100]
- minsplit [1, 100]

**svm tuning space**

- kernel ["linear", "polynomial", "radial"]
- cost [ $1e - 04$ , 1000] Logscale
- gamma [ $1e - 04$ , 1000] Logscale
- tolerance [ $1e - 04$ , 2] Logscale
- degree [2, 5]

**xgboost tuning space**

- booster ["gblinear", "gbtree", "dart"]
- nrounds [7, 2981] Logscale
- eta [ $1e - 04$ , 1] Logscale
- gamma [ $1e - 05$ , 7] Logscale
- lambda [ $1e - 04$ , 1000] Logscale
- alpha [ $1e - 04$ , 1000] Logscale
- subsample [0.1, 1]
- max\_depth [1, 15]
- min\_child\_weight [1, 100] Logscale



- `colsample_bytree` [0.01, 1]
- `colsample_bylevel` [0.01, 1]
- `rate_drop` [0, 1]
- `skip_drop` [0, 1]

### Source

Binder M, Pfisterer F, Bischl B (2020). "Collecting Empirical Data About Hyperparameters for Data Driven AutoML." [https://www.automl.org/wp-content/uploads/2020/07/AutoML\\_2020\\_paper\\_63.pdf](https://www.automl.org/wp-content/uploads/2020/07/AutoML_2020_paper_63.pdf).

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TuningSpace

*Tuning Spaces*

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### Description

This class defines a tuning space for hyperparameter tuning.

For tuning, it is important to create a search space that defines the range over which hyperparameters should be tuned. TuningSpace object consists of search spaces from peer-reviewed articles which work well for a wide range of data sets.

The `$values` field stores a list of `paradox::TuneToken` which define the search space. These tokens can be assigned to the `$values` slot of a learner's `paradox::ParamSet`. When the learner is tuned, the tokens are used to create the search space.

### S3 Methods

- `as.data.table.TuningSpace(x)`  
Returns a tabular view of the tuning space.  
`TuningSpace -> data.table::data.table()`
- `x (TuningSpace)`

### Public fields

`id` (`character(1)`)

Identifier of the object.

`values` (`list()`)

List of `paradox::TuneToken` that describe the tuning space and fixed parameter values.

`tags` (`character()`)

Arbitrary tags to group and filter tuning space e.g. "classification" or "regression".

`learner` (`character(1)`)

`mlr3::Learner` of the tuning space.

`package` (`character(1)`)

Packages which provide the `Learner`, e.g. `mlr3learners` for the learner `mlr3learners::LearnerClassifRanger` which interfaces the `ranger` package.

label (character(1))

Label for this object. Can be used in tables, plot and text output instead of the ID.

man (character(1))

String in the format [pkg]::[topic] pointing to a manual page for this object. The referenced help package can be opened via method \$help().

## Methods

### Public methods:

- [TuningSpace\\$new\(\)](#)
- [TuningSpace\\$get\\_learner\(\)](#)
- [TuningSpace\\$format\(\)](#)
- [TuningSpace\\$help\(\)](#)
- [TuningSpace\\$print\(\)](#)
- [TuningSpace\\$clone\(\)](#)

**Method** new(): Creates a new instance of this R6 class.

*Usage:*

```
TuningSpace$new(
  id,
  values,
  tags,
  learner,
  package = character(),
  label = NA_character_,
  man = NA_character_
)
```

*Arguments:*

id (character(1))

Identifier for the new instance.

values (list())

List of [paradox::TuneToken](#) that describe the tuning space and fixed parameter values.

tags (character())

Tags to group and filter tuning spaces e.g. "classification" or "regression".

learner (character(1))

[mlr3::Learner](#) of the tuning space.

package (character())

Packages which provide the [Learner](#), e.g. [mlr3learners](#) for the learner [mlr3learners::LearnerClassifRanger](#) which interfaces the [ranger](#) package.

label (character(1))

Label for the new instance. Can be used in tables, plot and text output instead of the ID.

man (character(1))

String in the format [pkg]::[topic] pointing to a manual page for for the new instance. The referenced help package can be opened via method \$help().

**Method** get\_learner(): Returns a learner with [TuneToken](#) set in parameter set.

*Usage:*

```
TuningSpace$get_learner(...)
```

*Arguments:*

```
... (named 'list()')
```

Passed to `mlr3::lrn()`. Named arguments passed to the constructor, to be set as parameters in the `paradox::ParamSet`, or to be set as public field. See `mlr3misc::dictionary_sugar_get()` for more details.

*Returns:* `mlr3::Learner`

**Method** `format()`: Helper for print outputs.

*Usage:*

```
TuningSpace$format(...)
```

*Arguments:*

```
... (ignored).
```

**Method** `help()`: Opens the corresponding help page referenced by field `$man`.

*Usage:*

```
TuningSpace$help()
```

**Method** `print()`: Printer.

*Usage:*

```
TuningSpace$print(...)
```

*Arguments:*

```
... (ignored).
```

**Method** `clone()`: The objects of this class are cloneable with this method.

*Usage:*

```
TuningSpace$clone(deep = FALSE)
```

*Arguments:*

`deep` Whether to make a deep clone.

**Examples**

```
library(mlr3tuning)

# get default tuning space of rpart learner
tuning_space = lts("classif.rpart.default")

# get learner and set tuning space
learner = lrn("classif.rpart")
learner$param_set$values = tuning_space$values

# tune learner
instance = tune(
  tnr("random_search"),
  task = tsk("pima"),
```

```
learner = learner,  
resampling = rsmpl("holdout"),  
measure = msr("classif.ce"),  
term_evals = 10)
```

```
instance$result
```

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