

Package ‘rwig’

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Type Package

Title Wasserstein Index Generation (WIG) Model

Version 0.2.0

Description Efficient implementation of several Optimal Transport algorithms in Fangzhou Xie (2025) <[doi:10.48550/arXiv.2504.08722](https://doi.org/10.48550/arXiv.2504.08722)> and the Wasserstein Index Generation (WIG) model in Fangzhou Xie (2020) <[doi:10.1016/j.econlet.2019.108874](https://doi.org/10.1016/j.econlet.2019.108874)>.

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Encoding UTF-8

LazyData true

RoxygenNote 8.0.0

URL <https://github.com/fangzhou-xie/rwig>,
<https://fangzhou-xie.github.io/rwig/>

BugReports <https://github.com/fangzhou-xie/rwig/issues>

Imports utils, stats, rlang, cli, word2vec, tokenizers, stopwords

SystemRequirements autoconf, CUDA (> 13.0, only for Linux, optional)

Suggests RhpcBLASctl, knitr, rmarkdown, tinytest

Depends R (>= 4.2)

VignetteBuilder knitr

NeedsCompilation yes

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Contents

barycenter	2
check_cuda	4
headlines	4
sinkhorn	5
tsvd	7
wdl	8
wdl_specs	9
wig	11
Index	13

barycenter	<i>Barycenter algorithm</i>
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Description

Barycenter algorithm to solve for entropy-regularized Optimal Transport Barycenter problems. For a more detailed explanation, please refer to vignette("barycenter").

Usage

```
barycenter(
  A,
  C,
  w,
  b_ext = NULL,
  barycenter_control = list(reg = 0.1, with_grad = FALSE, use_cuda = TRUE, n_threads = 0,
    method = "auto", threshold = 0.1, max_iter = 1000, zero_tol = 1e-06, verbose = 0)
)
```

Arguments

A	numeric matrix, source discrete densities (M * S)
C	numeric matrix, cost matrix between source and target (M * N)
w	numeric vector, weight vector (S)
b_ext	numeric vector, only used to calculate quadratic loss against the computed barycenter (default = NULL)
barycenter_control	list, control parameters for the computation • reg: double, regularization parameter (default = .1) • with_grad: bool, whether to calculate the gradient w.r.t. A • n_threads: int, number of threads (only used for method = "log", ignored by method = "parallel", default = 0) • threshold: double, threshold value below which "auto" method will default to method = "log" for stablized computation in log-domain (default = .1)

- `max_iter`: int, maximum iteration of `barycenter` algorithm (default = 1000)
- `zero_tol`: double, determine convergence (default = 1e-6)
- `verbose`: int, print out debug info for the algorithm for every verbose iteration (default to 0, i.e. not printing anything)

Details

This is the general function to solve OT Barycenter problem, and it will use either parallel (method = "parallel") or log-stabilized Barycenter algorithm (method = "log") for solving the problem.

Value

list of results

- `b`: numeric vector, computed barycenter
- `grad_A`: gradient w.r.t. `A` (only with `with_grad = TRUE`)
- `grad_w`: gradient w.r.t. `w` (only with `with_grad = TRUE`)
- `loss`: double, quadratic loss between `b` and `b_ext` (only with `with_grad = TRUE`)
- `U`, `V`: scaling variables for the Sinkhorn algorithm (only with method = "parallel")
- `F`, `G`: scaling variables for the Sinkhorn algorithm (only with method = "log")
- `iter`: iterations of the algorithm
- `err`: condition for convergence
- `return_status`: 0 (convergence), 1 (max iteration reached), 2 (other)

References

Peyré, G., & Cuturi, M. (2019). Computational Optimal Transport: With Applications to Data Science. *Foundations and Trends® in Machine Learning*, 11(5–6), 355–607. <https://doi.org/10.1561/22000000073>

Xie, F. (2025). Deriving the Gradients of Some Popular Optimal Transport Algorithms (No. arXiv:2504.08722). *arXiv*. <https://doi.org/10.48550/arXiv.2504.08722>

See Also

`vignette("gradient")`, `vignette("threading")`

Examples

```
A <- rbind(c(.3, .2), c(.2, .1), c(.1, .2), c(.1, .1), c(.3, .4))
C <- rbind(
  c(.1, .2, .3, .4, .5),
  c(.2, .3, .4, .3, .2),
  c(.4, .3, .2, .1, .2),
  c(.3, .2, .1, .2, .5),
  c(.5, .5, .4, .0, .2)
)
w <- c(.4, .6)
b <- c(.2, .2, .2, .2, .2)
reg <- .1
```

```
# simple barycenter example
sol <- barycenter(A, C, w, barycenter_control = list(reg = reg))

# you can also supply arguments to control the computation
# for example, including the loss and gradient w.r.t. `A`
sol <- barycenter(A, C, w, b, barycenter_control = list(reg = reg, with_grad = TRUE))
```

check_cuda	<i>Check if CUDA is available</i>
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Description

Check if CUDA is available for GPU computations.

Usage

```
check_cuda()
```

Value

logical, TRUE if CUDA is available, FALSE otherwise

Examples

```
if (check_cuda()) {
  cat("CUDA is available for GPU computations.\n")
} else {
  cat("CUDA is not available.\n")
}
```

headlines	<i>NYT headlines by economic policy uncertainty</i>
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Description

NYT headlines by economic policy uncertainty

Usage

```
headlines
```

Format**headlines:**

A data frame with 18,507 rows and 2 columns:

headline Headline of the NYT News

ref_date Date of the News

Source

www.nytimes.com

References

Xie, F. (2020). Wasserstein index generation model: Automatic generation of time-series index with application to economic policy uncertainty. *Economics Letters*, 186, 108874. <https://doi.org/10.1016/j.econlet.2019.108874>

sinkhorn

Sinkhorn algorithm

Description

Sinkhorn algorithm to solve entropy-regularized Optimal Transport problems. For a more detailed explanation, please refer to vignette("sinkhorn").

Usage

```
sinkhorn(
  a,
  b,
  C,
  sinkhorn_control = list(reg = 0.1, with_grad = FALSE, use_cuda = TRUE, n_threads = 0,
    method = "auto", threshold = 0.1, max_iter = 1000L, zero_tol = 1e-06, verbose = 0L)
)
```

Arguments

a	numeric vector, source discrete density (probability vector)
b	numeric vector, target discrete density (probability vector)
C	numeric matrix, cost matrix between source and target
sinkhorn_control	list, control parameters for the computation • reg double, regularization parameter (default = .1) • with_grad: bool, whether to calculate the gradient w.r.t. a • n_threads: int, number of threads (only used for method = "log", ignored by the method = "vanilla", default = 0)

- `method`: character, which method to use: "auto", "vanilla", "log" "auto" with try to calculate minimum value of the Gibbs kernel K and switch to `method = "log"` if the minimum value is less than `threshold` (default = "auto")
- `threshold`: double, threshold value below which "auto" method will default to `method = "log"` for stablized computation in log-domain (default = .1)
- `max_iter`: int, maximum iteration of [sinkhorn](#) algorithm (default = 1000)
- `zero_tol`: double, determine convergence (default = 1e-6)
- `verbose`: int, print out debug info for the algorithm for every verbose iteration (default to 0, i.e. not printing anything)

Details

This is the general function to solve the OT problem, and it will use either vanilla (`method = "vanilla"`) or log-stabilized Sinkhorn algorithm (`method = "log"`) for solving the problem.

Value

list of results

- `P`: optimal coupling matrix
- `grad_a`: gradient of loss w.r.t. `a` (only with `with_grad = TRUE`)
- `u`, `v`: scaling vectors
- `loss`: regularized loss
- `iter`: iterations of the algorithm
- `err`: condition for convergence
- `return_status`: 0 (convergence), 1 (max iteration reached), 2 (other)

References

Peyré, G., & Cuturi, M. (2019). Computational Optimal Transport: With Applications to Data Science. *Foundations and Trends® in Machine Learning*, 11(5–6), 355–607. <https://doi.org/10.1561/22000000073>

Xie, F. (2025). Deriving the Gradients of Some Popular Optimal Transport Algorithms (No. arXiv:2504.08722). *arXiv*. <https://doi.org/10.48550/arXiv.2504.08722>

See Also

`vignette("gradient")`, `vignette("threading")`

Examples

```
# simple sinkhorn example
a <- c(.3, .4, .1, .1, .1)
b <- c(.4, .5, .1)
C <- rbind(
  c(.1, .2, .3),
  c(.2, .3, .4),
  c(.4, .3, .2),
```

```

      c(.3, .2, .1),
      c(.5, .5, .4)
    )
    reg <- .1
    sol <- sinkhorn(a, b, C, sinkhorn_control = list(reg = reg, verbose = 0))

    # you can also supply arguments to control the computation
    # for example, calculate the gradient w.r.t. a
    sol <- sinkhorn(a, b, C,
      sinkhorn_control = list(reg = reg, with_grad = TRUE, verbose = 0))

```

tsvd

*Truncated SVD***Description**

Truncated Singular Value Decomposition algorithm

Usage

```
tsvd(M, k = 1, flip_sign = c("auto", "sklearn", "none"))
```

Arguments

M	matrix, data to be analyzed
k	int, number of columns/features to be kept
flip_sign	character, one of the following: "auto", "sklearn", "none"

Details

Compute the truncated SVD for dimension reduction. Note that SVD suffers from "sign indeterminacy," which means that the signs of the output vectors could depend on the algorithm and random state. Two variants of "sign flipping methods" are implemented here, one following the sklearn implementation on Truncated SVD, another by Bro et al. (2008).

Value

matrix after dimension reduction

References

<https://scikit-learn.org/stable/modules/generated/sklearn.decomposition.TruncatedSVD.html>
 Bro, R., Acar, E., & Kolda, T. G. (2008). Resolving the sign ambiguity in the singular value decomposition. *Journal of Chemometrics*, 22(2), 135–140. <https://doi.org/10.1002/cem.1122>

See Also

Truncated SVD (sklearn) `vignette("tsvd")`

Examples

```
A <- rbind(c(1,3), c(2,4))
tsvd(A)
```

wdl

*Wasserstein Dictionary Learning model***Description**

Wasserstein Dictionary Learning (WDL) model for topic modeling

Usage

```
wdl(docs, ...)

## S3 method for class 'character'
wdl(docs, specs = wdl_specs(), verbose = TRUE, ...)

## S3 method for class 'wdl'
print(x, topic = 0, token_per_topic = 10, ...)

## S3 method for class 'wdl'
summary(object, topic = 1, token_per_topic = 10, ...)
```

Arguments

docs	character vector, sentences to be analyzed
...	only for compatibility
specs	list, model specification for the WDL see wdl_specs for reference
verbose	bool, whether to print useful info
x	WDL model
topic	int, number of topic to be printed
token_per_topic	int, number of tokens to be printed
object	WDL model

Details

This is the re-implementation of WDL model from ground up, and it calls the [barycenter](#) under the hood (to be precise directly calling the underlying C++ routine for [barycenter](#))

Value

topics and weights computed from the WDL given the input data

References

- Peyré, G., & Cuturi, M. (2019). Computational Optimal Transport: With Applications to Data Science. *Foundations and Trends® in Machine Learning*, 11(5–6), 355–607. <https://doi.org/10.1561/22000000073>
- Schmitz, M. A., Heitz, M., Bonneel, N., Ngolè, F., Coeurjolly, D., Cuturi, M., Peyré, G., & Starck, J.-L. (2018). Wasserstein dictionary learning: Optimal transport-based unsupervised nonlinear dictionary learning. *SIAM Journal on Imaging Sciences*, 11(1), 643–678. <https://doi.org/10.1137/17M1140431>
- Xie, F. (2025). Deriving the Gradients of Some Popular Optimal Transport Algorithms (No. arXiv:2504.08722). *arXiv*. <https://doi.org/10.48550/arXiv.2504.08722>

See Also

`vignette("wdl-model")`

Examples

```
# simple WDL example
sentences <- c("this is a sentence", "this is another one")
wdl_fit <- wdl(
  sentences,
  specs = wdl_specs(wdl_control = list(num_topics = 2), word2vec_control = list(min_count = 1)),
  verbose = TRUE)
```

wdl_specs

Model Specs for WDL and WIG models

Description

Control the parameters of WDL and WIG models

Usage

```
wdl_specs(
  wdl_control = list(num_topics = 4, batch_size = 64, epochs = 2, shuffle = TRUE, seed =
    42L),
  tokenizer_control = list(stopwords = stopwords::stopwords()),
  word2vec_control = list(type = "cbow", dim = 10, min_count = 3),
  barycenter_control = list(reg = 0.1, with_grad = TRUE, use_cuda = TRUE, n_threads = 0,
    method = "auto", threshold = 0.1, max_iter = 20, zero_tol = 1e-06),
  optimizer_control = list(optimizer = "adamw", lr = 0.005, decay = 0.01, beta1 = 0.9,
    beta2 = 0.999, eps = 1e-08)
)

wig_specs(
  wig_control = list(group_unit = "month", svd_method = "topics", standardize = TRUE),
  wdl_control = list(num_topics = 4, batch_size = 64, epochs = 2, shuffle = TRUE, seed =
    42L),
```

```

tokenizer_control = list(stopwords = stopwords::stopwords()),
word2vec_control = list(type = "cbow", dim = 10, min_count = 1),
barycenter_control = list(reg = 0.1, with_grad = TRUE, use_cuda = TRUE, n_threads = 0,
  method = "auto", threshold = 0.1, max_iter = 20, zero_tol = 1e-06),
optimizer_control = list(optimizer = "adamw", lr = 0.005, decay = 0.01, beta1 = 0.9,
  beta2 = 0.999, eps = 1e-08)
)

```

Arguments

wdl_control list, parameters for WDL
tokenizer_control list, parameters for `tokenizers::tokenize_words()`
word2vec_control list, parameters for `word2vec::word2vec()`
barycenter_control list, parameters for `barycenter()`
optimizer_control list, parameters for the optimizer (SGD, Adam, AdamW)
wig_control list, parameters for WIG model

Details

See `vignette("specs")` for details on the parameters. Entries left out of a control list take the defaults shown in the usage section. In `barycenter_control`, `with_grad` is always `TRUE` (the gradients are what WDL trains on) and `max_iter` is the fixed number of barycenter iterations per training step, so keep it small: the batched training keeps a history of `max_iter` iterations for every document in a batch.

Value

list of the control lists

References

- Peyré, G., & Cuturi, M. (2019). Computational Optimal Transport: With Applications to Data Science. *Foundations and Trends® in Machine Learning*, 11(5–6), 355–607. <https://doi.org/10.1561/22000000073>
- Schmitz, M. A., Heitz, M., Bonneel, N., Ngolè, F., Coeurjolly, D., Cuturi, M., Peyré, G., & Starck, J.-L. (2018). Wasserstein dictionary learning: Optimal transport-based unsupervised nonlinear dictionary learning. *SIAM Journal on Imaging Sciences*, 11(1), 643–678. <https://doi.org/10.1137/17M1140431>
- Kingma, D. P., & Ba, J. (2015). Adam: A method for stochastic optimization. *International Conference on Learning Representations (ICLR)*.
- Loshchilov, I., & Hutter, F. (2019). Decoupled Weight Decay Regularization (No. arXiv:1711.05101). *arXiv*. <https://doi.org/10.48550/arXiv.1711.05101>
- Xie, F. (2020). Wasserstein index generation model: Automatic generation of time-series index with application to economic policy uncertainty. *Economics Letters*, 186, 108874. <https://doi.org/10.1016/j.econlet.2019.108874>
- Xie, F. (2025). Deriving the Gradients of Some Popular Optimal Transport Algorithms (No. arXiv:2504.08722). *arXiv*. <https://doi.org/10.48550/arXiv.2504.08722>

See Also

[wig_specs\(\)](#), [barycenter\(\)](#), [word2vec::word2vec\(\)](#), [tokenizers::tokenize_words\(\)](#), [vignette\("specs"\)](#)

 wig

Wasserstein Index Generation model

Description

Wasserstein Index Generation (WIG) model for time-series sentiment index autogeneration

Usage

```
wig(.data, date_col, docs_col, ...)

## S3 method for class 'data.frame'
wig(.data, date_col, docs_col, specs = wig_specs(), verbose = TRUE, ...)

## S3 method for class 'wig'
print(x, topic = 1, token_per_topic = 10, ...)

## S3 method for class 'wig'
summary(object, topic = 1, token_per_topic = 10, ...)
```

Arguments

<code>.data</code>	a dataframe containing the dates/datetimees and documents
<code>date_col</code>	name of the column for dates (Date) or datetimees (POSIXct); documents are grouped by the <code>group_unit</code> of <code>wig_control</code> (see wig_specs()), any breaks accepted by cut.Date() such as "day", "week", "month", "quarter", "year" or "2 months"
<code>docs_col</code>	name of the column for the texts/documents
<code>...</code>	only for compatibility
<code>specs</code>	list, model specification for WIG see wig_specs for reference
<code>verbose</code>	bool, whether to print useful info
<code>x</code>	WIG model
<code>topic</code>	int, number of topic to be printed
<code>token_per_topic</code>	int, number of tokens to be printed
<code>object</code>	WIG model

Details

This is the re-implementation of WIG model from scratch in R.

Value

"wig" class, i.e. list of the index and the WDL model

References

Xie, F. (2020). Wasserstein index generation model: Automatic generation of time-series index with application to economic policy uncertainty. *Economics Letters*, 186, 108874. <https://doi.org/10.1016/j.econlet.2019.108874>

See Also

`vignette("wdl-model")`

Examples

```
# create a small dataset
wigdf <- data.frame(
  ref_date = as.Date(c("2012-01-01", "2012-02-01")),
  docs = c("this is a sentence", "this is another sentence"))

wigfit <- wig(wigdf, ref_date, docs,
  specs = wig_specs(wdl_control = list(num_topics = 2), word2vec_control = list(min_count = 1)),
  verbose = FALSE)
```

Index

- * **Barycenter algorithms**

- barycenter, [2](#)

- * **Sinkhorn algorithms**

- sinkhorn, [5](#)

- * **datasets**

- headlines, [4](#)

barycenter, [2](#), [3](#), [8](#)

barycenter(), [10](#), [11](#)

check_cuda, [4](#)

cut.Date(), [11](#)

headlines, [4](#)

print.wdl (wdl), [8](#)

print.wig (wig), [11](#)

sinkhorn, [5](#), [6](#)

summary.wdl (wdl), [8](#)

summary.wig (wig), [11](#)

tokenizers::tokenize_words(), [10](#), [11](#)

tsvd, [7](#)

wdl, [8](#)

wdl_specs, [8](#), [9](#)

wig, [11](#)

wig_specs, [11](#)

wig_specs (wdl_specs), [9](#)

wig_specs(), [11](#)

word2vec::word2vec(), [10](#), [11](#)