

Package ‘optimalFlowData’

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Type Package

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Description

Data files used as examples and for testing of the software provided in the optimalFlow package.

License Artistic-2.0

Encoding UTF-8

LazyData true

Depends R (>= 4.0)

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Contents

buildDatabase	3
cytometry.diagnosis	3
Cytometry1	4
Cytometry10	5

Cytometry11	6
Cytometry12	7
Cytometry13	8
Cytometry14	9
Cytometry15	10
Cytometry16	11
Cytometry17	12
Cytometry18	13
Cytometry19	14
Cytometry2	15
Cytometry20	16
Cytometry21	17
Cytometry22	18
Cytometry23	19
Cytometry24	20
Cytometry25	21
Cytometry26	22
Cytometry27	23
Cytometry28	24
Cytometry29	25
Cytometry3	26
Cytometry30	27
Cytometry31	28
Cytometry32	29
Cytometry33	30
Cytometry34	31
Cytometry35	32
Cytometry36	33
Cytometry37	34
Cytometry38	35
Cytometry39	36
Cytometry4	37
Cytometry40	38
Cytometry5	39
Cytometry6	40
Cytometry7	41
Cytometry8	42
Cytometry9	43
noise.types	44

buildDatabase	<i>buildDatabase</i>
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Description

Constructs a subset of the cell types and cytometries in `optimalFlowData` in order to be used as a database.

Usage

```
buildDatabase(dataset_names, population_ids)
```

Arguments

`dataset_names` A vector of strings with the names of the cytometries, ranging in `c("Cytometry1", ..., "Cytometry40")`.
`population_ids` A vector of strings with the names of the cell types to be selected in each cytometry.

Value

A list where each element is a cytometry containing only the cell types given by `population_ids`.

Examples

```
database <- buildDatabase(
  dataset_names = paste0('Cytometry', c(2:5, 7:9, 12:17, 19, 21)),
  population_ids = c('Monocytes', 'CD4+CD8-', 'Mature SIg Kappa', 'TCRgd-'))
```

<code>cytometry.diagnosis</code>	<i>cytometry.diagnosis</i>
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Description

A list of abbreviations corresponding to the diagnosis for each cytometry in `optimalFlowData`. Diagnosis abbreviations correspond to: Healthy Diagnosis, Mantle Cell Lymphoma, Follicular Lymphoma, Lymphoplasmacytic Lymphoma, Chronic Lymphocytic Leukemia, Diffuse Large B-Cell Lymphoma and Hairy Cell Leukemia.

Usage

```
data("cytometry_diagnosis")
```

Format

A list of 40 diagnosis.

Examples

```
data(cytometry.diagnosis)
print(cytometry.diagnosis)
```

Cytometry1

Cytometry1

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry1")
```

Format

A data frame with 82810 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) an vector of cell types (strings).

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Iscar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry1)
head(Cytometry1)
```

*Cytometry10**Cytometry10*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry10")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry10)
head(Cytometry10)
```

Cytometry11

Cytometry11

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry11")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry11)
head(Cytometry11)
```

Cytometry12

Cytometry12

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry12")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry12)
head(Cytometry12)
```

Cytometry13

Cytometry13

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry13")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry13)
head(Cytometry13)
```

Cytometry14

Cytometry14

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry14")
```

Format

A data frame with 154882 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry14)
head(Cytometry14)
```

Cytometry15

Cytometry15

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry15")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry15)
head(Cytometry15)
```

Cytometry16

Cytometry16

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry16")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry16)
head(Cytometry16)
```

*Cytometry17**Cytometry17*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry17")
```

Format

A data frame with 252425 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry17)
head(Cytometry17)
```

Cytometry18

Cytometry18

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry18")
```

Format

A data frame with 200675 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry18)
head(Cytometry18)
```

*Cytometry19**Cytometry19*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry19")
```

Format

A data frame with 100600 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry19)
head(Cytometry19)
```

Cytometry2

Cytometry2

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry2")
```

Format

A data frame with 140753 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry2)
head(Cytometry2)
```

Cytometry20

Cytometry20

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry20")
```

Format

A data frame with 200925 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry20)
head(Cytometry20)
```

*Cytometry21**Cytometry21*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry21")
```

Format

A data frame with 254450 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry21)
head(Cytometry21)
```

Cytometry22

Cytometry22

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Mantle Cell Lymphoma based on data taken following Euroflow protocols.

Usage

```
data("Cytometry22")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Iscar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry22)
head(Cytometry22)
```

Cytometry23

Cytometry23

Description

A flow cytometry dataset, as a data frame, of an individual with a Mantle Cell Lymphoma taken following Euroflow protocols.

Usage

```
data("Cytometry23")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry23)
head(Cytometry23)
```

Cytometry24

Cytometry24

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Follicular Lymphoma based on data taken following Euroflow protocols.

Usage

```
data("Cytometry24")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry24)
head(Cytometry24)
```

*Cytometry25**Cytometry25*

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Mantle Cell Lymphoma based on data taken following Euroflow protocols.

Usage

```
data("Cytometry25")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry25)
head(Cytometry25)
```

*Cytometry26**Cytometry26*

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Lymphoplasmacytic Lymphoma based on data taken following Euroflow protocols.

Usage

```
data("Cytometry26")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry26)
head(Cytometry26)
```

*Cytometry27**Cytometry27*

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Chronic Lymphocytic Leukemia based on data taken following Euroflow protocols.

Usage

```
data("Cytometry27")
```

Format

A data frame with 300000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry27)
head(Cytometry27)
```

Cytometry28

Cytometry28

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Chronic Lymphocytic Leukemia based on data taken following Euroflow protocols.

Usage

```
data("Cytometry28")
```

Format

A data frame with 300000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry28)
head(Cytometry28)
```

*Cytometry29**Cytometry29*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry29")
```

Format

A data frame with 300000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry29)
head(Cytometry29)
```

Cytometry3

Cytometry3

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry3")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry3)
head(Cytometry3)
```

*Cytometry30**Cytometry30*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry30")
```

Format

A data frame with 236886 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry30)
head(Cytometry30)
```

Cytometry31

Cytometry31

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry31")
```

Format

A data frame with 229216 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry31)
head(Cytometry31)
```

Cytometry32

Cytometry32

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry32")
```

Format

A data frame with 260598 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry32)
head(Cytometry32)
```

Cytometry33

Cytometry33

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry33")
```

Format

A data frame with 135798 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry33)
head(Cytometry33)
```

*Cytometry34**Cytometry34*

Description

A simulated flow cytometry dataset, as a data frame, of an individual with Diffuse Large B-Cell Lymphoma based on data taken following Euroflow protocols.

Usage

```
data("Cytometry34")
```

Format

A data frame with 300000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Iscar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry34)
head(Cytometry34)
```

Cytometry35

Cytometry35

Description

A simulated flow cytometry dataset, as a data frame, of an individual with a Hairy Cell Leukemia based on data taken following Euroflow protocols.

Usage

```
data("Cytometry35")
```

Format

A data frame with 213720 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry35)
head(Cytometry35)
```

*Cytometry36**Cytometry36*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry36")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry36)
head(Cytometry36)
```

*Cytometry37**Cytometry37*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry37")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry37)
head(Cytometry37)
```

*Cytometry38**Cytometry38*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry38")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. arXiv:1907.08006

Examples

```
data(Cytometry38)
head(Cytometry38)
```

Cytometry39

Cytometry39

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry39")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry39)
head(Cytometry39)
```

*Cytometry4**Cytometry4*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry4")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry4)
head(Cytometry4)
```

*Cytometry40**Cytometry40*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry40")
```

Format

A data frame with 145075 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry40)
head(Cytometry40)
```

*Cytometry5**Cytometry5*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry5")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry5)
head(Cytometry5)
```

Cytometry6

Cytometry6

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry6")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry6)
head(Cytometry6)
```

*Cytometry7**Cytometry7*

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry7")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry7)
head(Cytometry7)
```

Cytometry8

Cytometry8

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry8")
```

Format

A data frame with 50000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry8)
head(Cytometry8)
```

Cytometry9

Cytometry9

Description

A simulated flow cytometry dataset, as a data frame, of a healthy individual based on data taken following Euroflow protocols.

Usage

```
data("Cytometry9")
```

Format

A data frame with 100000 observations on the following 11 variables.

CD19/TCRgd:PE Cy7-A LOGICAL an integer vector.

CD38:APC H7-A LOGICAL an integer vector.

CD3:APC-A LOGICAL an integer vector.

CD4+CD20:PB-A LOGICAL an integer vector.

CD45:PO-A LOGICAL an integer vector.

CD56+IgK:PE-A LOGICAL an integer vector.

CD5:PerCP Cy5-5-A LOGICAL an integer vector.

CD8+IgL:FITC-A LOGICAL an integer vector.

FSC-A LINEAR an integer vector.

SSC-A Exp-SSC Low an integer vector.

Population ID (name) a vector of cell types (strings)

Source

E del Barrio, H Inouzhe, JM Loubes, C Matran and A Mayo-Isar. (2019) optimalFlow: Optimal-transport approach to flow cytometry gating and population matching. [arXiv:1907.08006](https://arxiv.org/abs/1907.08006)

Examples

```
data(Cytometry9)
head(Cytometry9)
```

<code>noise.types</code>	<i>noise.types</i>
--------------------------	--------------------

Description

A list of cells that can be considered as noise (Debris and Doublets).

Usage

```
data("noise_types")
```

Format

A list 38 cell types that can be viewd as noise.

Examples

```
data(noise.types)
print(noise.types)
```

Index

buildDatabase, [3](#)

cytometry.diagnosis, [3](#)

Cytometry1, [4](#)

Cytometry10, [5](#)

Cytometry11, [6](#)

Cytometry12, [7](#)

Cytometry13, [8](#)

Cytometry14, [9](#)

Cytometry15, [10](#)

Cytometry16, [11](#)

Cytometry17, [12](#)

Cytometry18, [13](#)

Cytometry19, [14](#)

Cytometry2, [15](#)

Cytometry20, [16](#)

Cytometry21, [17](#)

Cytometry22, [18](#)

Cytometry23, [19](#)

Cytometry24, [20](#)

Cytometry25, [21](#)

Cytometry26, [22](#)

Cytometry27, [23](#)

Cytometry28, [24](#)

Cytometry29, [25](#)

Cytometry3, [26](#)

Cytometry30, [27](#)

Cytometry31, [28](#)

Cytometry32, [29](#)

Cytometry33, [30](#)

Cytometry34, [31](#)

Cytometry35, [32](#)

Cytometry36, [33](#)

Cytometry37, [34](#)

Cytometry38, [35](#)

Cytometry39, [36](#)

Cytometry4, [37](#)

Cytometry40, [38](#)

Cytometry5, [39](#)

Cytometry6, [40](#)

Cytometry7, [41](#)

Cytometry8, [42](#)

Cytometry9, [43](#)

noise.types, [44](#)