Package 'causalimages'

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Title causalimages: R Package for Causal Inference with Earth Observation, Bio-
medical, and Social Science Images

Version 0.1

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Description R Package for causal inference with earth observation, bio-
medical, and social science images and image sequences (i.e., videos)

Depends R (>= 3.3.3)

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Imports tensorflow, latex2exp, keras

RoxygenNote 7.2.3

R topics documented:

```
AnalyzeImageConfounding
```
Perform causal estimation under image confounding

Description

Perform causal estimation under image confounding

Usage

```
AnalyzeImageConfounding(obsW, obsY, imageKeysOfUnits, acquireImageFxn, ...)
```

Arguments

obsW	A numeric vector where 0's correspond to control units and 1's to treated units.
obsY	A numeric vector containing observed outcomes.
X	(optional) A numeric matrix containing tabular information used if orthogonalize = T. X is normalized internally and salience maps with respect to X are transformed back to the original scale.
file	(default = NULL) Path to a tfrecord file generated by WriteTfRecord.
imageKeysOfUnits	
	(default = 1:length(obsY)) A vector of length length(obsY) specifying the unique image ID associated with each unit. Samples of imageKeysOfUnits are fed into acquireImageFxn to call images into memory.
doConvLowerDimProj	
	(default = T) Should we project the nFilters convolutional feature dimensions down to nDimLowerDimConv to reduce the number of required parameters.
nDimLowerDimConv	
	(default = 3L) If doConvLowerDimProj = T, then, in each convolutional layer, we project the nFilters feature dimensions down to nDimLowerDimConv to reduce the number of parameters needed.
nFilters	(default = 50L) Integer specifying the number of convolutional filters used.
modelClass	(default = "cnn") Either "cnn" or "embeddings".
nBoot	(default = 100L) Number of bootstrap iterations for uncertainty estimation.
typeBoot	(default = SamplingOnly) Bootstrap type. typeBoot = 'SamplingOnly' captures sampling uncertainty only. typeBoot = 'EstimationAndSampling' captures both estimation and sampling uncertainty.
nEmbedDim	(default = 96L) Integer specifying the image/image sequence embedding dimension. Used if modelClass = "embeddings".
acquireImageFxn	
	A function specifying how to load images representations associated with imageKeysOfUnits into memory. For example, if observation 3 has a value of "a34f" in imageKeysOfUnits, acquireImageFxn should extract the image associated with the unique key "a34f". First argument should be image key values and second argument have be training (in case different behavior in training/inference mode).

transportabilityMat

(optional) A matrix with a column named imageKeysOfUnits specifying keys to be used by acquireImageFxn for generating treatment effect predictions for out-of-sample points.

long, lat   (optional) Vectors specifying longitude and latitude coordinates for units. Used only for describing highest and lowest probability neighorhood units if specified.

conda_env   (default = NULL) A string specifying a conda environment wherein tensorflow, tensorflow_probability, and gc are installed.

conda_env_required

(default = F) A Boolean stating whether use of the specified conda environment is required.

figuresTag   (default = "") A string specifying an identifier that is appended to all figure names.

figuresPath   (default = "./") A string specifying file path for saved figures made in the analysis.

tagInFigures   (default = F) A Boolean specifying whether to visually include the tag in the figures.

plotBands   (default = 1L) An integer or vector specifying which band position (from the acquired image representation) should be plotted in the visual results. If a vector, plotBands should have 3 (and only 3) dimensions (corresponding to the 3 dimensions to be used in RBG plotting).

simMode   (default = F) Should the analysis be performed in comparison with ground truth from simulation?

plotResults   (default = T) Should analysis results be plotted?

nDepthHidden_conv

(default = 3L) Hidden depth of convolutional layer.

nDepthHidden_dense

(default = 0L) Hidden depth of dense layers. Default of 0L means a single projection layer is performed after the convolutional layer (i.e., no hidden layers are used).

maxPoolSize   (default = 2L) Integer specifying the max pooling size used in the convolutional layers.

strides   (default = 2L) Integer specifying the strides used in the convolutional layers.

dropoutRate   (default = 0.1) Droppout rate used in training used to prevent overfitting (dropoutRate = 0 corresponds to no dropout).

batchSize   (default = 50L) Batch size used in SGD optimization.

kernelSize   (default = 5L) Dimensions used in convolution kernels.

nSGD   (default = 400L) Number of stochastic gradient descent (SGD) iterations.

testFrac   (default = 0.01) Fraction of observations held out as a test set to evaluate out-of-sample loss values.

nDenseWidth   (default = 32L) Width of dense projection layers post-convolutions.

channelNormalize

(default = T) Should channelwise image feature normalization be attempted? Default is T, as this improves training.

TfRecords_BufferScaler

(default = 4L) The buffer size used in tfrecords mode is batchSize*TfRecords_BufferScaler. Lower TfRecords_BufferScaler towards 1 if out-of-memory problems.

tf_seed   (default = NULL) Specification for the tensorflow seed.

quiet   (default = F) Should we suppress information about progress?

Value

A list consiting of

- `ATE_est` ATE estimate.
- `ATE_se` Standard error estimate for the ATE.
- `(images saved to disk if plotResults = T)` If `plotResults = T`, causal salience plots are saved to disk characterizing the image confounding structure. See references for details.

References

- Connor T. Jerzak, Fredrik Johansson, Adel Daoud. Integrating Earth Observation Data into Causal Inference: Challenges and Opportunities. *ArXiv Preprint*, 2023.

Examples

```
# For a tutorial, see
# github.com/cjerzak/causalimages-software/
```

AnalyzeImageHeterogeneity

Decompose treatment effect heterogeneity by image

Description

Implements the image heterogeneity decomposition analysis of Jerzak, Johansson, and Daoud (2023). Users input in treatment and outcome data, along with a function specifying how to load in images using keys referenced to each unit (since loading in all image data will usually not be possible due to memory limitations). This function by default performs estimation, constructs salience maps, and can optionally perform estimation for new areas outside the original study sites in a transportability analysis.

Usage

```
AnalyzeImageHeterogeneity(obsW, obsY, imageKeysOfUnits, acquireImageFxn, kClust_est, ...)
```

Arguments

`obsW`	A numeric vector where `0`'s correspond to control units and `1`'s to treated units.
`obsY`	A numeric vector containing observed outcomes.
`X`	(optional) A numeric matrix containing tabular information used if `orthogonalize = T`.
`orthogonalize`	(default = `F`) A Boolean specifying whether to perform the image decomposition after orthogonalizing with respect to tabular covariates specified in `X`.
`imageKeysOfUnits`	
	(default = `1:length(obsY)`) A vector of length `length(obsY)` specifying the unique image ID associated with each unit. Samples of `imageKeysOfUnits` are fed into `acquireImageFxn` to call images into memory.
`kClust_est`	(default = `2L`) Integer specifying the number of clusters used in estimation.

acquireImageFxn

A function specifying how to load images representations associated with imageKeysOfUnits into memory. For example, if observation 3 has a value of "a34f" in imageKeysOfUnits, acquireImageFxn should extract the image associated with the unique key "a34f". First argument should be image key values and second argument have be training (in case of behavior change in training/inference).

file (default = NULL) Path to a tfrecord file generated by WriteTfRecord.

transportabilityMat

(optional) A matrix with a column named key specifying keys to be used by acquireImageFxn for generating treatment effect predictions for out-of-sample points in earth observation data settings.

long, lat (optional) Vectors specifying longitude and latitude coordinates for units. Used only for describing highest and lowest probability neighorhood units if specified.

conda_env (default = NULL) A string specifying a conda environment wherein tensorflow, tensorflow_probability, and gc are installed.

conda_env_required

(default = F) A Boolean stating whether use of the specified conda environment is required.

figuresTag (default = "") A string specifying an identifier that is appended to all figure names.

figuresPath (default = "./") A string specifying file path for saved figures made in the analysis.

plotBands (default = 1L) An integer or vector specifying which band position (from the acquired image representation) should be plotted in the visual results. If a vector, plotBands should have 3 (and only 3) dimensions (corresponding to the 3 dimensions to be used in RBG plotting).

simMode (default = F) Should the analysis be performed in comparison with ground truth from simulation?

plotResults (default = T) Should analysis results be plotted?

nDepthHidden_conv

(default = 3L) Hidden depth of convolutional layer.

nDepthHidden_dense

(default = 0L) Hidden depth of dense layers. Default of 0L means a single projection layer is performed after the convolutional layer (i.e., no hidden layers are used).

maxPoolSize (default = 2L) Integer specifying the max pooling size used in the convolutional layers.

strides (default = 2L) Integer specifying the strides used in the convolutional layers.=

yDensity (default = normal) Specifies the density for the outcome. Current options include normal and lognormal.

nMonte_variational

(default = 5L) An integer specifying how many Monte Carlo iterations to use in the calculation of the expected likelihood in each training step.

nMonte_predictive

(default = 20L) An integer specifying how many Monte Carlo iterations to use in the calculation of posterior means (e.g., mean cluster probabilities).

nMonte_salience

(default = 100L) An integer specifying how many Monte Carlo iterations to use in the calculation of the salience maps (e.g., image gradients of expected cluster probabilities).

batchSize   (default = 25L) Batch size used in SGD optimization.

kernelSize   (default = 5L) Dimensions used in convolution kernels.

nSGD   (default = 400L) Number of stochastic gradient descent (SGD) iterations.

nDenseWidth   (default = 32L) Width of dense projection layers post-convolutions.

reparameterizationType

        (default = "Flipout") Either "Flipout", or "Reparameterization". Specifies the estimator used in the Bayesian neural components. With "Flipout", convolutions are performed via CPU; with '"Reparameterization", they are performed by GPU if available.

doConvLowerDimProj

        (default = T) Should we project the nFilters convolutional feature dimensions down to nDimLowerDimConv to reduce the number of required parameters.

nDimLowerDimConv

        (default = 3L) If doConvLowerDimProj = T, then, in each convolutional layer, we project the nFilters feature dimensions down to nDimLowerDimConv to reduce the number of parameters needed.

nFilters   (default = 32L) Integer specifying the number of convolutional filters used.

channelNormalize

        (default = T) Should channelwise image feature normalization be attempted? Default is T, as this improves training.

modelClass   (default = "cnn") Either "cnn" or "embeddings".

nEmbedDim   (default = 96L) Integer specifying the image/image sequence embedding dimension. Used if modelClass = "embeddings".

quiet   (default = F) Should we suppress information about progress?

Value

A list consiting of

- clusterTaus_mean default
- clusterTaus_sd Estimated image effect cluster standard deviations.
- clusterProbs_mean. Estimated mean image effect cluster probabilities.
- clusterTaus_sd. Estimated image effect cluster probability standard deviations.
- clusterProbs_lowerConf. Estimated lower confidence for effect cluster probabilities.
- impliedATE. Implied ATE.
- individualTau_est. Estimated individual-level image-based treatment effects.
- transportabilityMat. Transportability matrix withestimated cluster information.
- plottedCoordinates. List containing coordinates plotted in salience maps.
- whichNA_dropped. A vector containing observations dropped due to missingness.

References

- Connor T. Jerzak, Fredrik Johansson, Adel Daoud. Image-based Treatment Effect Heterogeneity. Forthcoming in *Proceedings of the Second Conference on Causal Learning and Reasoning (CLeaR), Proceedings of Machine Learning Research (PMLR)*, 2023.

Examples

```
# For a tutorial, see
# github.com/cjerzak/causalimages-software/
```

AnalyzeImageMediation   *AnalyzeImageMediation*

Description

Under construction.

Usage

```
AnalyzeImageMediation()
```

Arguments

obsW	A numeric vector where 0's correspond to control units and 1's to treated units.
obsY	A numeric vector containing observed outcomes.
X	(optional) A numeric matrix containing tabular information used if `orthogonalize = T`.
doConvLowerDimProj	(default = T) Should we project the `nFilters` convolutional feature dimensions down to `nDimLowerDimConv` to reduce the number of required parameters.
nDimLowerDimConv	(default = 3L) If `doConvLowerDimProj = T`, then, in each convolutional layer, we project the `nFilters` feature dimensions down to `nDimLowerDimConv` to reduce the number of parameters needed.
nFilters	(default = 32L) Integer specifying the number of convolutional filters used.
orthogonalize	(default = F) A Boolean specifying whether to perform the image decomposition after orthogonalizing with respect to tabular covariates specified in `X`.
imageKeysOfUnits	(default = `1:length(obsY)`) A vector of length `length(obsY)` specifying the unique image ID associated with each unit. Samples of `imageKeysOfUnits` are fed into `acquireImageFxn` to call images into memory.
acquireImageRepFxn	A function specifying how to load images representations associated with `imageKeysOfUnits` into memory. For example, if observation 3 has a value of `"a34f"` in `imageKeysOfUnits`, `acquireImageFxn` should extract the image associated with the unique key `"a34f"`. First argument should be image key values and second argument have be `training` (in case behavior in training/)
acquireImageFxn	(default = `acquireImageRepFxn`) Similar to `acquireImageRepFxn`; this is a function specifying how to load images associated with `imageKeysOfUnits` into memory.
transportabilityMat	(optional) A matrix with a column named `keys` specifying keys to be used by `acquireImageRepFxn` for generating treatment effect predictions for out-of-sample points.
long, lat	(optional) Vectors specifying longitude and latitude coordinates for units. Used only for describing highest and lowest probability neighorhood units if specified.

conda_env	(default = NULL) A string specifying a conda environment wherein `tensorflow`, `tensorflow_probability`, and `gc` are installed.
figuresKey	(default = "") A string specifying an identifier that is appended to all figure names.
figuresPath	(default = "./") A string specifying file path for saved figures made in the analysis.
simMode	(default = F) Should the analysis be performed in comparison with ground truth from simulation?
plotResults	(default = T) Should analysis results be plotted?
nDepthHidden_conv	
	(default = 3L) Hidden depth of convolutional layer.
nDepthHidden_dense	
	(default = 0L) Hidden depth of dense layers. Default of 0L means a single projection layer is performed after the convolutional layer (i.e., no hidden layers are used).
maxPoolSize	(default = 2L) Integer specifying the max pooling size used in the convolutional layers.
strides	(default = 2L) Integer specifying the strides used in the convolutional layers.=
yDensity	(default = normal) Specifies the density for the outcome. Current options include `normal` and `lognormal`.
nMonte_variational	
	(default = 5L) An integer specifying how many Monte Carlo iterations to use in the calculation of the expected likelihood in each training step.
nMonte_predictive	
	(default = 20L) An integer specifying how many Monte Carlo iterations to use in the calculation of posterior means (e.g., mean cluster probabilities).
nMonte_salience	
	(default = 100L) An integer specifying how many Monte Carlo iterations to use in the calculation of the salience maps (e.g., image gradients of expected cluster probabilities).
batchSize	(default = 25L) Batch size used in SGD optimization.
kernelSize	(default = 5L) Dimensions used in convolution kernels.
nSGD	(default = 400L) Number of stochastic gradient descent (SGD) iterations.
nDenseWidth	(default = 32L) Width of dense projection layers post-convolutions.
reparameterizationType	
	(default = "Flipout") Either "Flipout", or "Reparameterization". Specifies the estimator used in the Bayesian neural components. With "Flipout", convolutions are performed via CPU; with '"Reparameterization", they are performed by GPU if available.
channelNormalize	
	(default = T) Should channelwise image feature normalization be attempted? Default is T, as this improves training.
quiet	(default = F) Should we suppress information about progress?

Value

A list consiting of

- `ATE_est` ATE estimate.
- `ATE_se` Standard error estimate for the ATE.

References

- TBA.

Examples

```
# For a tutorial, see
# github.com/cjerzak/causalimages-software/
```

```
GetAndSaveGeolocatedImages
```
Getting and saving geo-located images from a pool of .tif's

Description

A function that finds the image slice associated with the `long` and `lat` values, saves images by band (if save_as = "csv") in save_folder.

Usage

```
GetAndSaveGeolocatedImages(long, lat, keys, tif_pool, save_folder)
```

Arguments

`long`	Vector of numeric longitudes.
`lat`	Vector of numeric latitudes.
`keys`	The image keys associated with the long/lat coordinates.
`tif_pool`	A character vector specifying the fully qualified path to a corpus of .tif files.
`image_pixel_width`	An even integer specifying the pixel width (and height) of the saved images.
`save_folder`	(default = ".") What folder should be used to save the output? Example: "~/Downloads"
`save_as`	(default = ".csv") What format should the output be saved as? Only one option currently (.csv)
`lyrs`	(default = NULL) Integer (vector) specifying the layers to be extracted. Default is for all layers to be extracted.

Value

Finds the image slice associated with the `long` and `lat` values, saves images by band (if `save_as` = "csv") in save_folder. The save format is: sprintf("%s/Key%s_BAND%s.csv", save_folder, keys[i], band_)

Examples

```
# Example use (not run)
MASTER_IMAGE_POOL_FULL_DIR <- c("./LargeTifs/tif1.tif","./LargeTifs/tif2.tif")
GetAndSaveGeolocatedImages(
                           long = GeoKeyMat$geo_long,
                           lat = GeoKeyMat$geo_lat,
                           image_pixel_width = 500L,
                           keys = row.names(GeoKeyMat),
                           tif_pool = MASTER_IMAGE_POOL_FULL_DIR,
                           save_folder = "./Data/Uganda2000_processed",
                           save_as = "csv",
                           lyrs = NULL)
```

GetElementFromTfRecordAtIndices
Reads indices from a .tfrecord *file.*

Description

Reads indices from a .tfrecord file saved via a call to causalimages::WriteTfRecord. Assumes a tensorflow environment has been activated in R.

Usage

```
GetElementFromTfRecordAtIndices(indices, file)
```

Arguments

indices	(integer vector) Observation indices to be retrieved from a .tfrecord
conda_env	(Default = NULL) A conda environment where tensorflow v2 lives. Used only if a version of tensorflow is not already active.
conda_env_required	
	(default = F) A Boolean stating whether use of the specified conda environment is required.
file	(character string) A character string stating the path to a .tfrecord

Value

Returns content from a .tfrecord associated with indices

Examples

```
# Example usage:
GetElementFromTfRecordAtIndices(
  indices = 1:10,
  file = "./NigeriaConfoundApp.tfrecord")
```

GetImageEmbeddings	*Generates image and video embeddings useful in earth observation tasks for casual inference, following the approach in Rolf, Esther, et al. (2021).*

Description

Generates image and video embeddings useful in earth observation tasks for casual inference, following the approach in Rolf, Esther, et al. (2021).

Usage

```
GetImageEmbeddings(imageKeysOfUnits, acquireImageFxn, nEmbedDim, ...)
```

Arguments

acquireImageFxn

A function specifying how to load images representations associated with `imageKeysOfUnits` into memory. For example, if observation 3 has a value of `"a34f"` in `imageKeysOfUnits`, `acquireImageFxn` should extract the image associated with the unique key `"a34f"`. First argument should be image key values and second argument have be `training` (in case different behavior in training/inference mode).

imageKeysOfUnits

A vector of length `length(imageKeysOfUnits)` specifying the unique image ID associated with each unit. Samples of `imageKeysOfUnits` are fed into `acquireImageFxn` to call images into memory.

file   (default = NULL) Path to a tfrecord file generated by `WriteTfRecord`.

conda_env   (default = NULL) A string specifying a conda environment wherein `tensorflow`, `tensorflow_probability`, and `gc` are installed.

conda_env_required

(default = F) A Boolean stating whether use of the specified conda environment is required.

nEmbedDim   (default = 128L) Number of embedding features output.

batchSize   (default = 50L) Integer specifying batch size in obtaining embeddings.

strides   (default = 2L) Integer specifying the strides used in the convolutional layers.

temporalKernelSize

(default = 2L) Dimensions used in the temporal part of the convolution kernels if using image sequences.

kernelSize   (default = 5L) Dimensions used in the convolution kernels.

TfRecords_BufferScaler

(default = 10L) The buffer size used in `tfrecords` mode is `batchSize*TfRecords_BufferScaler`. Lower `TfRecords_BufferScaler` towards 1 if out-of-memory problems.

seed   (default = NULL) Integer specifying the seed.

outputType   (default = "R") Either `"R"` or `"tensorflow"` indicating whether to output R or tensorflow arrays.

Value

A list containing two items:

- embeddings (matrix) A matrix containingimage/video embeddings, with rows corresponding to observations.
- embeddings_fxn (function) The functioning performing the embedding, returned for re-use.

Examples

```
# For a tutorial, see
# github.com/cjerzak/causalimages-software/
 @section References:
\begin{itemize}

\item{} Rolf, Esther, et al. "A generalizable and accessible approach to machine learning with global satellite

\end{itemize}
```

---

image2	*Visualizing matrices as heatmaps with correct north-south-east-west orientation*

Description

A function for generating a heatmap representation of a matrix with correct spatial orientation.

Usage

```
image2( x )
```

Arguments

x	(required) The numeric matrix to be visualized.
xaxt	(default = "") The x-axis tick labels.
yaxt	(default = "") The y-axis tick labels.
xlab	(default = "") The x-axis labels.
ylab	(default = "") The y-axis labels.
main	(default = "") The main figure label.
cex.main	(default = 1.) The main figure label sizing factor.
box	(default = F) Should a box be plotted around the image?

Value

Returns a heatmap representation of the matrix, x, with correct north/south/east/west orientation.

Examples

```
#set seed
set.seed(1)

#Geneate data
x <- matrix(rnorm(50*50), ncol = 50)
diag(x) <- 3

# create plot
image2(x, main = "Example Text", cex.main = 2)
```

LongLat2CRS   *Get the spatial point of long/lat coordinates*

Description

A function converts long/lat coordinates into a spatial points object defined by a coordinate reference system (CRS).

Usage

```
LongLat2CRS(long, lat, CRS_ref)
```

Arguments

long   Vector of numeric longitudes.

lat   Vector of numeric latitudes.

CRS_ref   A CRS into which the long-lat point should be projected.

Value

Returns the long/lat location as a spatial point in the new CRS defined by `CRS_ref`

Examples

```
spatialPt <- LongLat2CRS(
                long = 49.932,
                lat = 35.432,
          CRS_ref = sp::CRS("+proj=lcc +lat_1=48 +lat_2=33 +lon_0=-100 +ellps=WGS84"))
```

SimulateImageSystem *Simulate causal systems involving images*

Description

This function generates simulated causal structures using images. It is currently under construction.

Usage

```
SimulateImageSystem(...)
```

Arguments

dag	*(character string)* An input DAG specifying causal structure. This input should be of the form '`i->t,i->y,t->y,....`' Currently, only one node in a DAG can be an image (this should be labeled "`i`"). The non-image nodes can have arbitrary string labels. The image can be a confounder, effect moderator, effect mediator. If the image is to be used as a moderator, use the notation, `t-i>y`.
...	*(optional)* In estimation mode, users input the data matrices associated with the non-image nodes of `DAG` and image node `i`. For example, if `x` is a DAG node, users must, in estimation mode, supply data to `x` in a form that can be coerced to a tensor.
treatment	*(character string, optional)* In estimation mode, users specify the treatment variable here. If `treatment` is specified, users must provide other data inputs to the DAG (see `...`).
image_pool	*(character string, optional)* The path to where analysis specific images are located. This can be specified both in simulation and estimation mode. If not specified, the simulation uses a pool of Landsat images from Nigeria.
analysis_level	*(character string, default is '`scene`')* Defines the unit of analysis used in the simulation framework. This is ignored in estimation mode, where the unit of analysis is inferred from the data dimensions.
control	*(list)* A list containing control parameters in the data generating process.

Value

A list:

- In *simulation mode*, the function returns a list with as many elements as unique nodes in DAG. Each element represents the simulated data.

- In *estimation mode*, the function returns an estimated treatment effect with 95\

References

- Connor T. Jerzak, Fredrik Johansson, Adel Daoud. Image-based Treatment Effect Heterogeneity. Forthcoming in *Proceedings of the Second Conference on Causal Learning and Reasoning (CLeaR), Proceedings of Machine Learning Research (PMLR)*, 2023.

Examples

```
#set seed
set.seed(1)

# Simulation mode
#simulatedData <- causalimage('r->i, i->t, t->y, r->y')
#print(names(simulatedData))

# Estimation mode
#estimatedResults <- causalimage('r->i, i->t, t->y, r->y', y=y, r=r, y=y', treatment='t')
#print( estimatedResults )
```

WriteTfRecord   *Write an image corpus as a .tfrecord file*

Description

Writes an image corpus to a `.tfrecord` file for rapid reading of images into memory for fast ML training.

Usage

```
WriteTfRecord(file,imageKeysOfUnits,acquireImageFxn,conda_env)
```

Arguments

file   A character string naming a file for writing.

imageKeysOfUnits

                    A vector specifying the image keys of the corpus. A key grabs an image via
                    acquireImageFxn(key)

acquireImageFxn

                    A function whose input is an observation index and whose output is an image.

writeVideo   (default = FALSE) Should we assume we're writing image sequence data of form
                    batch by time by height by width by channels?

conda_env   A conda environment where tensorflow v2 lives. Used only if a version of ten-
                    sorflow is not already active.

conda_env_required

                    (default = F) A Boolean stating whether use of the specified conda environment
                    is required.

Value

Writes an key- and index-referenced `.tfrecord` from an image corpus for use in image-based causal inference training.

Examples

```
# Example usage:
#WriteTfRecord(
#  file = "./NigeriaConfoundApp.tfrecord",
#  keys = 1:n,
#  acquireImageFxn = acquireImageFxn,
#  conda_env = "tensorflow_m1")
```

Index