
Snorkel

Release 0.9.3

Snorkel Team

Nov 20, 2019

PACKAGE REFERENCE

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If you're looking for technical details on Snorkel's API, you're in the right place.

For more narrative walkthroughs of Snorkel fundamentals or example use cases, check out our [homepage](#) and our [tutorials repo](#).

SNORKEL ANALYSIS PACKAGE

Generic model analysis utilities shared across Snorkel.

<i>Scorer</i>	Calculate one or more scores from user-specified and/or user-defined metrics.
<i>get_label_buckets</i>	Return data point indices bucketed by label combinations.
<i>metric_score</i>	Evaluate a standard metric on a set of predictions/probabilities.

1.1 snorkel.analysis.Scorer

class `snorkel.analysis.Scorer` (*metrics=None, custom_metric_funcs=None, abstain_label=-1*)

Bases: `object`

Calculate one or more scores from user-specified and/or user-defined metrics.

Parameters

- **metrics** (`Optional[List[str]]`) – A list of metric names, all of which are defined in METRICS
- **custom_metric_funcs** (`Optional[Mapping[str, Callable[... float]]]`) – An optional dictionary mapping the names of custom metrics to the functions that produce them. Each custom metric function should accept `golds`, `preds`, and `probs` as input (just like the standard metrics in METRICS) and return either a single score (float) or a dictionary of metric names to scores (if the function calculates multiple values, for example). See the unit tests for an example.
- **abstain_label** (`Optional[int]`) – The gold label for which examples will be ignored. By default, follow convention that abstains are -1.

Raises `ValueError` – If a specified standard metric is not found in the METRICS dictionary

metrics

A dictionary mapping metric names to the corresponding functions for calculating that metric

__init__ (*metrics=None, custom_metric_funcs=None, abstain_label=-1*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__</code> ([metrics, custom_metric_funcs, ...])	Initialize self.
<code>score</code> (golds[, preds, probs])	Calculate scores for one or more user-specified metrics.
<code>score_slices</code> (S, golds, preds, probs[, ...])	Calculate user-specified and/or user-defined metrics overall + slices.

score (golds, preds=None, probs=None)

Calculate scores for one or more user-specified metrics.

Parameters

- **golds** (ndarray) – An array of gold (int) labels to base scores on
- **preds** (Optional[ndarray]) – An [n_datapoints,] or [n_datapoints, 1] array of (int) predictions to score
- **probs** (Optional[ndarray]) – An [n_datapoints, n_classes] array of probabilistic (float) predictions
- **most metrics require either preds or probs, but not both, these** (*Because*) –
- **are optional; it is up to the metric function that will be called to** (*values*) –
- **an exception if a field it requires is not passed to the score() method.** (*raise*) –

Returns A dictionary mapping metric names to metric scores

Return type Dict[str, float]

Raises **ValueError** – If no gold labels were provided

score_slices (S, golds, preds, probs, as_dataframe=False)

Calculate user-specified and/or user-defined metrics overall + slices.

Parameters

- **S** (reccarray) – A reccarray with entries of length n_examples corresponding to slice names
- **golds** (ndarray) – Gold (aka ground truth) labels (integers)
- **preds** (ndarray) – Predictions (integers)
- **probs** (ndarray) – Probabilities (floats)
- **as_dataframe** (bool) – A boolean indicating whether to return results as pandas DataFrame (True) or dict (False)

Returns A dictionary mapping slice_name to metric names to metric scores or metrics formatted as pandas DataFrame

Return type Union[Dict, pd.DataFrame]

1.2 snorkel.analysis.get_label_buckets

`snorkel.analysis.get_label_buckets(*y)`

Return data point indices bucketed by label combinations.

Parameters **y* – A list of `np.ndarray` of (int) labels

Returns A mapping of each label bucket to a NumPy array of its corresponding indices

Return type `Dict[Tuple[int, ..], np.ndarray]`

Example

A common use case is calling `buckets = label_buckets(Y_gold, Y_pred)` where `Y_gold` is a set of gold (i.e. ground truth) labels and `Y_pred` is a corresponding set of predicted labels.

```
>>> Y_gold = np.array([1, 1, 1, 0])
>>> Y_pred = np.array([1, 1, -1, -1])
>>> buckets = get_label_buckets(Y_gold, Y_pred)
```

The returned `buckets[(i, j)]` is a NumPy array of data point indices with predicted label `i` and true label `j`.

```
>>> buckets[(1, 1)] # true positives
array([0, 1])
>>> (1, 0) in buckets # false negatives
False
>>> (0, 1) in buckets # false positives
False
>>> (0, 0) in buckets # true negatives
False
>>> buckets[(1, -1)] # abstained positives
array([2])
>>> buckets[(0, -1)] # abstained negatives
array([3])
```

1.3 snorkel.analysis.metric_score

`snorkel.analysis.metric_score(golds=None, preds=None, probs=None, metric='accuracy', filter_dict=None, **kwargs)`

Evaluate a standard metric on a set of predictions/probabilities.

Parameters

- **golds** (Optional[`ndarray`]) – An array of gold (int) labels
- **preds** (Optional[`ndarray`]) – An array of (int) predictions
- **probs** (Optional[`ndarray`]) – An [`n_datapoints`, `n_classes`] array of probabilistic (float) predictions
- **metric** (`str`) – The name of the metric to calculate
- **filter_dict** (Optional[`Dict[str, List[int]]`]) – A mapping from label set name to the labels that should be filtered out for that label set

Returns The value of the requested metric

Return type float

Raises

- **ValueError** – The requested metric is not currently supported
- **ValueError** – The user attempted to calculate roc_auc score for a non-binary problem

SNORKEL AUGMENTATION PACKAGE

Programmatic data set augmentation: TF creation and data generation utilities.

<i>ApplyAllPolicy</i>	Apply all TFs in order to each data point.
<i>ApplyEachPolicy</i>	Apply each TF individually to each data point.
<i>ApplyOnePolicy</i>	Apply a single TF to each data point.
<i>MeanFieldPolicy</i>	Sample sequences of TFs according to a distribution.
<i>PandasTFApplier</i>	TF applier for a Pandas DataFrame.
<i>RandomPolicy</i>	Naive random augmentation policy.
<i>TFApplier</i>	TF applier for a list of data points.
<i>TransformationFunction</i>	Base class for TFs.
<i>transformation_function</i>	Decorate functions to create TFs.

2.1 snorkel.augmentation.ApplyAllPolicy

class snorkel.augmentation.**ApplyAllPolicy** (*n_tfs*, *n_per_original=1*, *keep_original=True*)
Bases: snorkel.augmentation.policy.core.Policy

Apply all TFs in order to each data point.

While this can be used as a baseline policy, using a random policy is more standard. See *RandomPolicy*.

Parameters

- **n_tfs** (int) – Total number of TFs
- **n_per_original** (int) – Number of transformed data points for each original data point
- **keep_original** (bool) – Keep untransformed data point in augmented data set? Note that even if in-place modifications are made to the original data point by the TFs being applied, the original data point will remain unchanged.

Example

```
>>> policy = ApplyAllPolicy(3, n_per_original=2, keep_original=False)
>>> policy.generate_for_example()
[[0, 1, 2], [0, 1, 2]]
```

n
Total number of TFs

n_per_original

See above

keep_original

See above

`__init__(n_tfs, n_per_original=1, keep_original=True)`

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(n_tfs[, n_per_original, keep_original])</code>	Initialize self.
<code>generate()</code>	Generate indices of all TFs in order.
<code>generate_for_example()</code>	Generate all sequences of TF indices for a single example.

generate()

Generate indices of all TFs in order.

Returns Indices of all TFs in order.

Return type List[int]

generate_for_example()

Generate all sequences of TF indices for a single example.

Generates *n_per_original* sequences, and adds an empty sequence if *keep_original* is True.

Returns Sequences of indices of TFs to run on data point in order.

Return type List[List[int]]

2.2 snorkel.augmentation.ApplyEachPolicy

class snorkel.augmentation.**ApplyEachPolicy** (*n_tfs*, *keep_original=True*)

Bases: snorkel.augmentation.policy.core.Policy

Apply each TF individually to each data point.

This can be used as a baseline policy when using complex transformations which might degenerate if combined.

Parameters

- **n_tfs** (int) – Total number of TFs
- **keep_original** (bool) – Keep untransformed data point in augmented data set? Note that even if in-place modifications are made to the original data point by the TFs being applied, the original data point will remain unchanged.

Example

```
>>> policy = ApplyEachPolicy(3, keep_original=True)
>>> policy.generate_for_example()
[[], [0], [1], [2]]
```

n
Total number of TFs

n_per_original
Total number of TFs

keep_original
See above

__init__ (*n_tfs*, *keep_original=True*)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(n_tfs[, keep_original])</code>	Initialize self.
<code>generate()</code>	Generate a sequence of TF indices.
<code>generate_for_example()</code>	Generate all length-one sequences for a single example.

generate ()
Generate a sequence of TF indices.

Returns Indices of TFs to run on data point in order.

Return type List[int]

Raises **NotImplementedError** – Subclasses need to implement this method

generate_for_example ()
Generate all length-one sequences for a single example.

Returns Sequences of indices of TFs to run on data point in order.

Return type List[List[int]]

2.3 snorkel.augmentation.ApplyOnePolicy

class snorkel.augmentation.**ApplyOnePolicy** (*n_per_original=1*, *keep_original=True*)
Bases: snorkel.augmentation.policy.core.ApplyAllPolicy

Apply a single TF to each data point.

__init__ (*n_per_original=1*, *keep_original=True*)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__((n_per_original, keep_original))</code>	Initialize self.
<code>generate()</code>	Generate indices of all TFs in order.
<code>generate_for_example()</code>	Generate all sequences of TF indices for a single example.

generate ()

Generate indices of all TFs in order.

Returns Indices of all TFs in order.

Return type List[int]

generate_for_example ()

Generate all sequences of TF indices for a single example.

Generates *n_per_original* sequences, and adds an empty sequence if *keep_original* is True.

Returns Sequences of indices of TFs to run on data point in order.

Return type List[List[int]]

2.4 snorkel.augmentation.MeanFieldPolicy

```
class snorkel.augmentation.MeanFieldPolicy (n_tfs, sequence_length=1, p=None,  
                                           n_per_original=1, keep_original=True)
```

Bases: snorkel.augmentation.policy.core.Policy

Sample sequences of TFs according to a distribution.

Samples sequences of indices of a specified length from a user-provided distribution. A distribution over TFs can be learned by a TANDA mean-field model, for example. See <https://hazyresearch.github.io/snorkel/blog/tanda.html>

Parameters

- **n_tfs** (int) – Total number of TFs
- **sequence_length** (int) – Number of TFs to run on each data point
- **p** (Optional[Sequence[float]]) – Probability distribution from which to sample TF indices. Must have length *n_tfs* and be a valid distribution.
- **n_per_original** (int) – Number of transformed data points per original
- **keep_original** (bool) – Keep untransformed data point in augmented data set? Note that even if in-place modifications are made to the original data point by the TFs being applied, the original data point will remain unchanged.

n

Total number of TFs

n_per_original

See above

keep_original

See above

sequence_length

See above

__init__ (*n_tfs*, *sequence_length=1*, *p=None*, *n_per_original=1*, *keep_original=True*)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(n_tfs[, sequence_length, p, ...])</code>	Initialize self.
<code>generate()</code>	Generate a sequence of TF indices by sampling from distribution.
<code>generate_for_example()</code>	Generate all sequences of TF indices for a single example.

generate()

Generate a sequence of TF indices by sampling from distribution.

Returns Indices of TFs to run on data point in order.

Return type List[int]

generate_for_example()

Generate all sequences of TF indices for a single example.

Generates *n_per_original* sequences, and adds an empty sequence if *keep_original* is True.

Returns Sequences of indices of TFs to run on data point in order.

Return type List[List[int]]

2.5 snorkel.augmentation.PandasTFApplier

class snorkel.augmentation.PandasTFApplier (*tfs, policy*)

Bases: snorkel.augmentation.apply.core.BaseTFApplier

TF applier for a Pandas DataFrame.

Data points are stored as Series in a DataFrame. The TFs run on data points obtained via a `pandas.DataFrame.iterrows` call, which is single-process and can be slow for large DataFrames. For large datasets, consider `DaskTFApplier` or `SparkTFApplier`.

`__init__(tfs, policy)`

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(tfs, policy)</code>	Initialize self.
<code>apply(df[, progress_bar])</code>	Augment a Pandas DataFrame of data points using TFs and policy.
<code>apply_generator(df, batch_size)</code>	Augment a Pandas DataFrame of data points using TFs and policy in batches.

apply (*df, progress_bar=True*)

Augment a Pandas DataFrame of data points using TFs and policy.

Parameters

- **df** (DataFrame) – Pandas DataFrame containing data points to be transformed
- **progress_bar** (bool) – Display a progress bar?

Returns Pandas DataFrame of data points in augmented data set

Return type `pd.DataFrame`

apply_generator (*df*, *batch_size*)

Augment a Pandas DataFrame of data points using TFs and policy in batches.

This method acts as a generator, yielding augmented data points for a given input batch of data points. This can be useful in a training loop when it is too memory-intensive to pregenerate all transformed examples.

Parameters

- **df** (`DataFrame`) – Pandas DataFrame containing data points to be transformed
- **batch_size** (`int`) – Batch size for generator. Yields augmented data points for the next `batch_size` input data points.

Returns Pandas DataFrame of data points in augmented data set

Return type `pd.DataFrame`

2.6 snorkel.augmentation.RandomPolicy

```
class snorkel.augmentation.RandomPolicy (n_tfs, sequence_length=1, n_per_original=1,  
                                         keep_original=True)
```

Bases: `snorkel.augmentation.policy.sampling.MeanFieldPolicy`

Naive random augmentation policy.

Samples sequences of TF indices a specified length at random from the total number of TFs. Sampling uniformly at random is a common baseline approach to data augmentation.

Parameters

- **n_tfs** (`int`) – Total number of TFs
- **sequence_length** (`int`) – Number of TFs to run on each data point
- **n_per_original** (`int`) – Number of transformed data points per original
- **keep_original** (`bool`) – Keep untransformed data point in augmented data set? Note that even if in-place modifications are made to the original data point by the TFs being applied, the original data point will remain unchanged.

n

Total number of TFs

n_per_original

See above

keep_original

See above

sequence_length

See above

```
__init__ (n_tfs, sequence_length=1, n_per_original=1, keep_original=True)
```

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(n_tfs[, sequence_length, ...])</code>	Initialize self.
<code>generate()</code>	Generate a sequence of TF indices by sampling from distribution.
<code>generate_for_example()</code>	Generate all sequences of TF indices for a single example.

`generate()`

Generate a sequence of TF indices by sampling from distribution.

Returns Indices of TFs to run on data point in order.

Return type List[int]

`generate_for_example()`

Generate all sequences of TF indices for a single example.

Generates *n_per_original* sequences, and adds an empty sequence if *keep_original* is True.

Returns Sequences of indices of TFs to run on data point in order.

Return type List[List[int]]

2.7 snorkel.augmentation.TFApplier

class `snorkel.augmentation.TFApplier` (*tfs, policy*)

Bases: `snorkel.augmentation.apply.core.BaseTFApplier`

TF applier for a list of data points.

Augments a list of data points (e.g. `SimpleNamespace`). Primarily useful for testing.

`__init__` (*tfs, policy*)

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(tfs, policy)</code>	Initialize self.
<code>apply(data_points[, progress_bar])</code>	Augment a list of data points using TFs and policy.
<code>apply_generator(data_points, batch_size)</code>	Augment a list of data points using TFs and policy in batches.

apply (*data_points, progress_bar=True*)

Augment a list of data points using TFs and policy.

Parameters

- **data_points** (`Sequence[Any]`) – List containing data points to be transformed
- **progress_bar** (`bool`) – Display a progress bar?

Returns List of data points in augmented data set

Return type List[DataPoint]

apply_generator (*data_points*, *batch_size*)

Augment a list of data points using TFs and policy in batches.

This method acts as a generator, yielding augmented data points for a given input batch of data points. This can be useful in a training loop when it is too memory-intensive to pregenerate all transformed examples.

Parameters

- **data_points** (*Sequence[Any]*) – List containing data points to be transformed
- **batch_size** (*int*) – Batch size for generator. Yields augmented data points for the next *batch_size* input data points.

Yields *List[DataPoint]* – List of data points in augmented data set for batches of inputs

Return type *Iterator[List[Any]]*

2.8 snorkel.augmentation.TransformationFunction

class `snorkel.augmentation.TransformationFunction` (*name*, *field_names=None*,
mapped_field_names=None,
pre=None, *memoize=False*)

Bases: `snorkel.map.core.Mapper`

Base class for TFs.

See `snorkel.map.core.Mapper` for details.

__init__ (*name*, *field_names=None*, *mapped_field_names=None*, *pre=None*, *memoize=False*)

Initialize self. See `help(type(self))` for accurate signature.

Return type *None*

Methods

<code>__init__(name[, field_names, ...])</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.
<code>run(**kwargs)</code>	Run the mapping operation using the input fields.

__call__ (*x*)

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters *x* (*Any*) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type *DataPoint*

reset_cache ()

Reset the memoization cache.

Return type *None*

run (***kwargs*)

Run the mapping operation using the input fields.

The inputs to this function are fed by extracting the fields of the input data point using the keys of `field_names`. The output field names are converted using `mapped_field_names` and added to the data point.

Returns A mapping from canonical output field names to their values.

Return type `Optional[FieldMap]`

Raises `NotImplementedError` – Subclasses must implement this method

2.9 snorkel.augmentation.transformation_function

class `snorkel.augmentation.transformation_function` (*name=None, pre=None, memoize=False*)

Bases: `snorkel.map.core.lambda_mapper`

Decorate functions to create TFs.

See `snorkel.map.core.lambda_mapper` for details.

Example

```
>>> @transformation_function()
... def square(x):
...     x.num = x.num ** 2
...     return x
>>> from types import SimpleNamespace
>>> square(SimpleNamespace(num=2))
namespace(num=4)
```

__init__ (*name=None, pre=None, memoize=False*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

__init__ (*[name, pre, memoize]*) Initialize self.

__call__ (*f*)

Wrap a function to create a `LambdaMapper`.

Parameters **f** (`Callable[[Any], Optional[Any]]`) – Function executing the mapping operation

Returns New `LambdaMapper` executing operation in wrapped function

Return type `LambdaMapper`

SNORKEL CLASSIFICATION PACKAGE

PyTorch-based multi-task learning framework for discriminative modeling.

<i>Checkpointner</i>	Manager for checkpointing model.
<i>CheckpointnerConfig</i>	Manager for checkpointing model.
<i>DictDataLoader</i>	A DataLoader that uses the appropriate collate_fn for a DictDataset.
<i>DictDataset</i>	A dataset where both the data fields and labels are stored in as dictionaries.
<i>LogManager</i>	A class to manage logging during training progress.
<i>LogManagerConfig</i>	Manager for checkpointing model.
<i>LogWriter</i>	A class for writing logs.
<i>LogWriterConfig</i>	Manager for checkpointing model.
<i>MultitaskClassifier</i>	A classifier built from one or more tasks to support advanced workflows.
<i>Operation</i>	A single operation (forward pass of a module) to execute in a Task.
<i>Task</i>	A single task (a collection of modules and specified path through them).
<i>TensorBoardWriter</i>	A class for logging to Tensorboard during training process.
<i>Trainer</i>	A class for training a MultitaskClassifier.
<i>cross_entropy_with_probs</i>	Calculate cross-entropy loss when targets are probabilities (floats), not ints.

3.1 snorkel.classification.Checkpointer

class snorkel.classification.**Checkpointer** (*counter_unit*, *evaluation_freq*, ****kwargs**)

Bases: object

Manager for checkpointing model.

Parameters

- **counter_unit** (str) – The unit to use when determining when its time to checkpoint (one of [“epochs”, “batches”, “points”]); must match the counter_unit of LogManagerer
- **evaluation_freq** (float) – How frequently the model is being evaluated (this is the maximum frequency that checkpointing can occur, which will happen if checkpoint_factor==1)
- **kwargs** (Any) – Config merged with default_config[“checkpointer_config”]

`__init__` (*counter_unit, evaluation_freq, **kwargs*)
 Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__</code> (<i>counter_unit, **kwargs</i>)	<i>evaluation_freq</i>	Initialize self.
<code>checkpoint</code> (<i>iteration, model, metric_dict</i>)		Check if iteration and current metrics necessitate a checkpoint.
<code>clear</code> ()		Clear existing checkpoint files, besides the best-yet model.
<code>load_best_model</code> (<i>model</i>)		Load the best model from the checkpoint.

checkpoint (*iteration, model, metric_dict*)
 Check if iteration and current metrics necessitate a checkpoint.

Parameters

- **iteration** (float) – Current training iteration
- **model** (MultitaskClassifier) – Model to checkpoint
- **metric_dict** (Dict[str, float]) – Current performance metrics for model

Return type None

clear ()
 Clear existing checkpoint files, besides the best-yet model.

Return type None

load_best_model (*model*)
 Load the best model from the checkpoint.

Return type MultitaskClassifier

3.2 snorkel.classification.CheckpointerConfig

class snorkel.classification.CheckpointerConfig

Bases: tuple

Manager for checkpointing model.

Parameters

- **checkpoint_dir** – The path to a directory where checkpoints will be saved The Trainer will set this to the log directory if it is None
- **checkpoint_factor** – Check for a best model every this many evaluations. For example, if `evaluation_freq` is 0.5 epochs and `checkpoint_factor` is 2, then checkpointing will be attempted every 1 epochs.
- **checkpoint_metric** – The metric to checkpoint on, of the form “task/dataset/split/metric:mode” where mode is “min” or “max”.

- **checkpoint_task_metrics** – Additional metrics to save best models for. Note that the best model according to *checkpoint_metric* will be the one that is loaded after training and used for early stopping.
- **checkpoint_runway** – No checkpointing will occur for the first this many checkpoint_units
- **checkpoint_clear** – If True, clear all checkpoints besides the best so far.

`__init__()`

Initialize self. See `help(type(self))` for accurate signature.

Methods

<code>__init__</code>	Initialize self.
<code>count(value)</code>	
<code>index(value, [start, [stop]])</code>	Raises ValueError if the value is not present.

Attributes

<code>checkpoint_clear</code>	Alias for field number 5
<code>checkpoint_dir</code>	Alias for field number 0
<code>checkpoint_factor</code>	Alias for field number 1
<code>checkpoint_metric</code>	Alias for field number 2
<code>checkpoint_runway</code>	Alias for field number 4
<code>checkpoint_task_metrics</code>	Alias for field number 3

property checkpoint_clear

Alias for field number 5

property checkpoint_dir

Alias for field number 0

property checkpoint_factor

Alias for field number 1

property checkpoint_metric

Alias for field number 2

property checkpoint_runway

Alias for field number 4

property checkpoint_task_metrics

Alias for field number 3

count (*value*) → integer – return number of occurrences of value

index (*value*[, *start*[, *stop*]]) → integer – return first index of value.

Raises ValueError if the value is not present.

3.3 snorkel.classification.DictDataLoader

```
class snorkel.classification.DictDataLoader(dataset, collate_fn=<function collate_dicts>, **kwargs)
    Bases: torch.utils.data.dataloader.DataLoader
```

A DataLoader that uses the appropriate `collate_fn` for a `DictDataset`.

Parameters

- **dataset** (`DictDataset`) – A dataset to wrap
- **collate_fn** (`Callable[... Any]`) – The collate function to use when combining multiple indexed examples for a single batch. Usually the default `collate_dicts()` method should be used, but it can be overridden if you want to use different collate logic.
- **kwargs** (`Any`) – Keyword arguments to pass on to `DataLoader.__init__()`

`__init__` (*dataset*, *collate_fn*=<function *collate_dicts*>, ***kwargs*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__</code> (<i>dataset</i> [, <i>collate_fn</i>])	Initialize self.
--	------------------

3.4 snorkel.classification.DictDataset

class `snorkel.classification.DictDataset` (*name*, *split*, *X_dict*, *Y_dict*)

Bases: `torch.utils.data.dataset.Dataset`

A dataset where both the data fields and labels are stored in as dictionaries.

Parameters

- **name** (`str`) – The name of the dataset (e.g., this will be used to report metrics on a per-dataset basis)
- **split** (`str`) – The name of the split that the data in this object represents
- **X_dict** (`Dict[str, Any]`) – A map from field name to values (e.g., {"tokens": ..., "uids": ...})
- **Y_dict** (`Dict[str, Tensor]`) – A map from task name to its corresponding set of labels

Raises `ValueError` – All values in the `Y_dict` must be of type `torch.Tensor`

name

See above

split

See above

X_dict

See above

Y_dict

See above

`__init__` (*name*, *split*, *X_dict*, *Y_dict*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(name, split, X_dict, Y_dict)</code>	Initialize self.
<code>from_tensors(X_tensor, Y_tensor, split[, ...])</code>	Initialize a <code>DictDataset</code> from PyTorch Tensors.

classmethod `from_tensors(X_tensor, Y_tensor, split, input_data_key='input_data', task_name='task', dataset_name='SnorkelDataset')`
 Initialize a `DictDataset` from PyTorch Tensors.

Parameters

- **X_tensor** (`Tensor`) – Input data of shape [num_examples, feature_dim]
- **Y_tensor** (`Tensor`) – Labels of shape [num_samples, num_classes]
- **split** (`str`) – Name of data split corresponding to this dataset.
- **input_data_key** (`str`) – Name of data field to initialize in `X_dict`
- **task_name** (`str`) – Name of task and corresponding label key in `Y_dict`
- **dataset_name** (`str`) – Name of `DictDataset` to be initialized; See `__init__` above.

Returns Class initialized with single task and label corresponding to input data

Return type `DictDataset`

3.5 snorkel.classification.LogManager

class `snorkel.classification.LogManager(n_batches_per_epoch, log_writer=None, checkpointer=None, **kwargs)`

Bases: `object`

A class to manage logging during training progress.

Parameters

- **n_batches_per_epoch** (`int`) – Total number batches per epoch
- **log_writer** (`Optional[LogWriter]`) – `LogWriter` for current run logs
- **checkpointer** (`Optional[Checkpointer]`) – `Checkpointer` for current model
- **kwargs** (`Any`) – Settings to update in `LogManagerConfig`

`__init__(n_batches_per_epoch, log_writer=None, checkpointer=None, **kwargs)`
 Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(n_batches_per_epoch[, log_writer, ...])</code>	Initialize self.
<code>cleanup(model)</code>	Close the log writer and checkpointer if needed.
<code>reset()</code>	Reset counters.
<code>trigger_checkpointing()</code>	Check if current counts trigger checkpointing.

Continued on next page

Table 7 – continued from previous page

<code>trigger_evaluation()</code>	Check if current counts trigger evaluation.
<code>update(batch_size)</code>	Update the count and total number.

cleanup (*model*)

Close the log writer and checkpointer if needed. Reload best model.

Return type `MultitaskClassifier`

reset ()

Reset counters.

Return type `None`

trigger_checkpointing ()

Check if current counts trigger checkpointing.

Return type `bool`

trigger_evaluation ()

Check if current counts trigger evaluation.

Return type `bool`

update (*batch_size*)

Update the count and total number.

Return type `None`

3.6 snorkel.classification.LogManagerConfig

class `snorkel.classification.LogManagerConfig`

Bases: `tuple`

Manager for checkpointing model.

Parameters

- **counter_unit** – The unit to use when assessing when it’s time to log. Options are [“epochs”, “batches”, “points”]
- **evaluation_freq** – Evaluate performance on the validation set every this many counter_units

__init__ ()

Initialize self. See `help(type(self))` for accurate signature.

Methods

<code>__init__</code>	Initialize self.
<code>count(value)</code>	
<code>index(value, [start, [stop]])</code>	Raises <code>ValueError</code> if the value is not present.

Attributes

<code>counter_unit</code>	Alias for field number 0
<code>evaluation_freq</code>	Alias for field number 1

count (*value*) → integer – return number of occurrences of value

property counter_unit

Alias for field number 0

property evaluation_freq

Alias for field number 1

index (*value*[, *start*[, *stop*]]) → integer – return first index of value.

Raises ValueError if the value is not present.

3.7 snorkel.classification.LogWriter

class `snorkel.classification.LogWriter` (**kwargs)

Bases: object

A class for writing logs.

Parameters **kwargs** (Any) – Settings to merge into LogWriterConfig

config

Merged configuration

run_name

Name of run if provided, otherwise date-time combination

log_dir

The root directory where logs should be saved

run_log

Dictionary of scalar values to log, keyed by value name

__init__ (**kwargs)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__</code> (**kwargs)	Initialize self.
<code>add_scalar</code> (name, value, step)	Log a scalar variable.
<code>cleanup</code> ()	Perform final operations and close writer if necessary.
<code>write_config</code> (config[, config_filename])	Dump the config to file.
<code>write_json</code> (dict_to_write, filename)	Dump a JSON-compatible object to root log directory.
<code>write_log</code> (log_filename)	Dump the scalar value log to file.
<code>write_text</code> (text, filename)	Dump user-provided text to filename (e.g., the launch command).

add_scalar (*name*, *value*, *step*)

Log a scalar variable.

Parameters

- **name** (`str`) – Name of the scalar collection
- **value** (`float`) – Value of scalar
- **step** (`float`) – Step axis value

Return type `None`**cleanup** (`()`)

Perform final operations and close writer if necessary.

Return type `None`**write_config** (`config, config_filename='config.json'`)

Dump the config to file.

Parameters

- **config** (`Namedtuple`) – JSON-compatible config to write to file
- **config_filename** (`str`) – Name of file in logging directory to write to

Return type `None`**write_json** (`dict_to_write, filename`)

Dump a JSON-compatible object to root log directory.

Parameters

- **dict_to_write** (`Mapping[str, Any]`) – JSON-compatible object to log
- **filename** (`str`) – Name of file in logging directory to write to

Return type `None`**write_log** (`log_filename`)

Dump the scalar value log to file.

Parameters **log_filename** (`str`) – Name of file in logging directory to write to**Return type** `None`**write_text** (`text, filename`)

Dump user-provided text to filename (e.g., the launch command).

Parameters

- **text** (`str`) – Text to write
- **filename** (`str`) – Name of file in logging directory to write to

Return type `None`

3.8 snorkel.classification.LogWriterConfig

class `snorkel.classification.LogWriterConfig`Bases: `tuple`

Manager for checkpointing model.

Parameters

- **log_dir** – The root directory where logs should be saved

- **run_name** – The name of this particular run (defaults to date-time combination if None)

`__init__()`

Initialize self. See `help(type(self))` for accurate signature.

Methods

<code>__init__</code>	Initialize self.
<code>count(value)</code>	
<code>index(value, [start, [stop]])</code>	Raises <code>ValueError</code> if the value is not present.

Attributes

<code>log_dir</code>	Alias for field number 0
<code>run_name</code>	Alias for field number 1

count (*value*) → integer – return number of occurrences of value

index (*value*[, *start*[, *stop*]]) → integer – return first index of value.
Raises `ValueError` if the value is not present.

property log_dir

Alias for field number 0

property run_name

Alias for field number 1

3.9 snorkel.classification.MultitaskClassifier

class `snorkel.classification.MultitaskClassifier` (*tasks*, *name=None*, ***kwargs*)

Bases: `torch.nn.modules.module.Module`

A classifier built from one or more tasks to support advanced workflows.

Parameters

- **tasks** (`List[Task]`) – A list of `Tasks` to build a model from
- **name** (`Optional[str]`) – The name of the classifier

config

The config dict containing the settings for this model

name

See above

module_pool

A dictionary of all modules used by any of the tasks (See `Task` docstring)

task_names

See `Task` docstring

op_sequences

See `Task` docstring

loss_funcs

See Task docstring

output_funcs

See Task docstring

scorers

See Task docstring

`__init__(tasks, name=None, **kwargs)`

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(tasks[, name])</code>	Initialize self.
<code>add_module(name, module)</code>	Adds a child module to the current module.
<code>add_task(task)</code>	Add a single task to the network.
<code>apply(fn)</code>	Applies <code>fn</code> recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers([recurse])</code>	Returns an iterator over module buffers.
<code>calculate_loss(X_dict, Y_dict)</code>	Calculate the loss for each task and the number of data points contributing.
<code>children()</code>	Returns an iterator over immediate children modules.
<code>cpu()</code>	Moves all model parameters and buffers to the CPU.
<code>cuda([device])</code>	Moves all model parameters and buffers to the GPU.
<code>double()</code>	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval()</code>	Sets the module in evaluation mode.
<code>extra_repr()</code>	Set the extra representation of the module
<code>float()</code>	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward(X_dict, task_names)</code>	Do a forward pass through the network for all specified tasks.
<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load(model_path)</code>	Load a saved model from the provided file path and moves it to a device.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.

Continued on next page

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<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(dataloader[, remap_labels])</code> , <code>return_preds,</code>	Calculate probabilities, (optionally) predictions, and pull out gold labels.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(model_path)</code>	Save the model to the specified file path.
<code>score(dataloaders[, remap_labels, as_dataframe])</code>	Calculate scores for the provided DictDataLoaders.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([model])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

`dump_patches`

add_task (*task*)

Add a single task to the network.

Parameters `task` (Task) – A Task to add

Return type None

calculate_loss (*X_dict*, *Y_dict*)

Calculate the loss for each task and the number of data points contributing.

Parameters

- **X_dict** (Dict[str, Any]) – A dict of data fields
- **Y_dict** (Dict[str, Tensor]) – A dict from task names to label sets

Returns A dict of losses by task name and seen examples by task name

Return type Dict[str, torch.Tensor], Dict[str, float]

forward (*X_dict*, *task_names*)

Do a forward pass through the network for all specified tasks.

Parameters

- **X_dict** (Dict[str, Any]) – A dict of data fields
- **task_names** (Iterable[str]) – The names of the tasks to execute the forward pass for

Returns A dict mapping each operation name to its corresponding output

Return type OutputDict

Raises

- **TypeError** – If an Operation input has an invalid type
- **ValueError** – If a specified Operation failed to execute

load (*model_path*)

Load a saved model from the provided file path and moves it to a device.

Parameters **model_path** (*str*) – The path to a saved model

Return type *None*

predict (*dataloader*, *return_preds=False*, *remap_labels={}*)

Calculate probabilities, (optionally) predictions, and pull out gold labels.

Parameters

- **dataloader** (*DictDataLoader*) – A *DictDataLoader* to make predictions for
- **return_preds** (*bool*) – If *True*, include predictions in the return dict (not just probabilities)
- **remap_labels** (*Dict[str, Optional[str]]*) – A dict specifying which labels in the dataset’s *Y_dict* (key) to remap to a new task (value)

Returns A dictionary mapping label type (‘golds’, ‘probs’, ‘preds’) to values

Return type *Dict[str, Dict[str, torch.Tensor]]*

save (*model_path*)

Save the model to the specified file path.

Parameters **model_path** (*str*) – The path where the model should be saved

Raises **BaseException** – If the *torch.save()* method fails

Return type *None*

score (*dataloaders*, *remap_labels={}*, *as_dataframe=False*)

Calculate scores for the provided *DictDataLoaders*.

Parameters

- **dataloaders** (*List[DictDataLoader]*) – A list of *DictDataLoaders* to calculate scores for
- **remap_labels** (*Dict[str, Optional[str]]*) – A dict specifying which labels in the dataset’s *Y_dict* (key) to remap to a new task (value)
- **as_dataframe** (*bool*) – A boolean indicating whether to return results as pandas *DataFrame* (*True*) or dict (*False*)

Returns A dictionary mapping metric names to corresponding scores Metric names will be of the form “task/dataset/split/metric”

Return type *Dict[str, float]*

3.10 snorkel.classification.Operation

class *snorkel.classification.Operation* (*module_name*, *inputs*, *name=None*)

Bases: *object*

A single operation (forward pass of a module) to execute in a *Task*.

See `Task` for more detail on the usage and semantics of an `Operation`.

Parameters

- **name** (`Optional[str]`) – The name of this operation (defaults to `module_name` since for most workflows, each module is only used once per forward pass)
- **module_name** (`str`) – The name of the module in the module pool that this operation uses
- **inputs** (`Sequence[Union[str, Tuple[str, str]]]`) – The inputs that the specified module expects, given as a list of names of previous operations (or optionally a tuple of the operation name and a key if the output of that module is a dict instead of a Tensor). Note that the original input to the model can be referred to as “`_input_`”.

Example

```
>>> op1 = Operation(module_name="linear1", inputs=[("_input_", "features")])
>>> op2 = Operation(module_name="linear2", inputs=["linear1"])
>>> op_sequence = [op1, op2]
```

name

See above

module_name

See above

inputs

See above

`__init__(module_name, inputs, name=None)`

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(module_name, inputs[, name])</code>	Initialize self.
--	------------------

3.11 snorkel.classification.Task

class `snorkel.classification.Task` (*name*, *module_pool*, *op_sequence*,
scorer=`<snorkel.analysis.scorer.Scorer object>`,
loss_func=`None`, *output_func*=`None`)

Bases: `object`

A single task (a collection of modules and specified path through them).

Parameters

- **name** (`str`) – The name of the task
- **module_pool** (`ModuleDict`) – A `ModuleDict` mapping module names to the modules themselves
- **op_sequence** (`Sequence[Operation]`) – A list of `Operations` to execute in order, defining the flow of information through the network for this task

- **scorer** (`Scorer`) – A `Scorer` with the desired metrics to calculate for this task
- **loss_func** (`Optional[Callable[... Tensor]]`) – A function that converts final logits into loss values. Defaults to `F.cross_entropy()` if none is provided. To use probabilistic labels for training, use the Snorkel-defined method `cross_entropy_with_probs()` instead.
- **output_func** (`Optional[Callable[... Tensor]]`) – A function that converts final logits into ‘outputs’ (e.g. probabilities) Defaults to `F.softmax(..., dim=1)`.

name
See above

module_pool
See above

op_sequence
See above

scorer
See above

loss_func
See above

output_func
See above

__init__ (*name*, *module_pool*, *op_sequence*, *scorer*=`<snorkel.analysis.scorer.Scorer object>`,
loss_func=`None`, *output_func*=`None`)
Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

__init__ (*name*, *module_pool*, *op_sequence*[, Initialize self.
...])

3.12 snorkel.classification.TensorBoardWriter

class `snorkel.classification.TensorBoardWriter` (***kwargs*)

Bases: `snorkel.classification.training.loggers.log_writer.LogWriter`

A class for logging to Tensorboard during training process.

See `LogWriter` for more attributes.

Parameters *kwargs* (Any) – Passed to `LogWriter` initializer

writer
tensorboardX `SummaryWriter` for logging and visualization

__init__ (***kwargs*)
Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(**kwargs)</code>	Initialize self.
<code>add_scalar(name, value, step)</code>	Log a scalar variable to TensorBoard.
<code>cleanup()</code>	Close the <code>SummaryWriter</code> .
<code>write_config(config[, config_filename])</code>	Dump the config to file and add it to TensorBoard.
<code>write_json(dict_to_write, filename)</code>	Dump a JSON-compatible object to root log directory.
<code>write_log(log_filename)</code>	Dump the scalar value log to file.
<code>write_text(text, filename)</code>	Dump user-provided text to filename (e.g., the launch command).

add_scalar (*name, value, step*)

Log a scalar variable to TensorBoard.

Parameters

- **name** (`str`) – Name of the scalar collection
- **value** (`float`) – Value of scalar
- **step** (`float`) – Step axis value

Return type `None`

cleanup ()

Close the `SummaryWriter`.

Return type `None`

write_config (*config, config_filename='config.json'*)

Dump the config to file and add it to TensorBoard.

Parameters

- **config** (`Namedtuple`) – JSON-compatible config to write to TensorBoard
- **config_filename** (`str`) – File to write config to

Return type `None`

write_json (*dict_to_write, filename*)

Dump a JSON-compatible object to root log directory.

Parameters

- **dict_to_write** (`Mapping[str, Any]`) – JSON-compatible object to log
- **filename** (`str`) – Name of file in logging directory to write to

Return type `None`

write_log (*log_filename*)

Dump the scalar value log to file.

Parameters **log_filename** (`str`) – Name of file in logging directory to write to

Return type `None`

write_text (*text, filename*)

Dump user-provided text to filename (e.g., the launch command).

Parameters

- **text** (`str`) – Text to write
- **filename** (`str`) – Name of file in logging directory to write to

Return type `None`

3.13 snorkel.classification.Trainer

class `snorkel.classification.Trainer` (*name=None, **kwargs*)

Bases: `object`

A class for training a `MultitaskClassifier`.

Parameters

- **name** (`Optional[str]`) – An optional name for this trainer object
- **kwargs** (`Any`) – Settings to be merged into the default Trainer config dict

name

See above

config

The config dict with the settings for the Trainer

checkpointer

Saves the best model seen during training

log_manager

Identifies when its time to log or evaluate on the valid set

log_writer

Writes training statistics to file or TensorBoard

optimizer

Updates model weights based on the loss

lr_scheduler

Adjusts the learning rate over the course of training

batch_scheduler

Returns batches from the `DataLoaders` in a particular order for training

__init__ (*name=None, **kwargs*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__</code> (<i>name</i>)	Initialize self.
<code>fit</code> (<i>model</i> , <i>dataloaders</i>)	Train a <code>MultitaskClassifier</code> .

fit (*model*, *dataloaders*)

Train a `MultitaskClassifier`.

Parameters

- **model** (`MultitaskClassifier`) – The model to train

- **dataloaders** (`List[DictDataLoader]`) – A list of `DataLoaders`. These will split into train, valid, and test splits based on the `split` attribute of the `DataLoaders`.

Return type `None`

3.14 snorkel.classification.cross_entropy_with_probs

`snorkel.classification.cross_entropy_with_probs` (*input*, *target*, *weight=None*, *reduction='mean'*)

Calculate cross-entropy loss when targets are probabilities (floats), not ints.

PyTorch's `F.cross_entropy()` method requires integer labels; it does not accept probabilistic labels. We can, however, simulate such functionality with a for loop, calculating the loss contributed by each class and accumulating the results. Libraries such as `keras` do not require this workaround, as methods like “`categorical_crossentropy`” accept float labels natively.

Note that the method signature is intentionally very similar to `F.cross_entropy()` so that it can be used as a drop-in replacement when target labels are changed from from a 1D tensor of ints to a 2D tensor of probabilities.

Parameters

- **input** (`Tensor`) – A `[num_points, num_classes]` tensor of logits
- **target** (`Tensor`) – A `[num_points, num_classes]` tensor of probabilistic target labels
- **weight** (`Optional[Tensor]`) – An optional `[num_classes]` array of weights to multiply the loss by per class
- **reduction** (`str`) – One of “none”, “mean”, “sum”, indicating whether to return one loss per data point, the mean loss, or the sum of losses

Returns The calculated loss

Return type `torch.Tensor`

Raises `ValueError` – If an invalid reduction keyword is submitted

SNORKEL LABELING PACKAGE

Programmatic data set labeling: LF creation, models, and analysis utilities.

<code>apply.dask.DaskLFApplier</code>	LF applier for a Dask DataFrame.
<code>LFAnalysis</code>	Run analyses on LFs using label matrix.
<code>LFApplier</code>	LF applier for a list of data points (e.g.
<code>LabelModel</code>	A model for learning the LF accuracies and combining their output labels.
<code>LabelingFunction</code>	Base class for labeling functions.
<code>MajorityClassVoter</code>	Majority class label model.
<code>MajorityLabelVoter</code>	Majority vote label model.
<code>lf.nlp.NLPLabelingFunction</code>	Special labeling function type for spaCy-based LFs.
<code>PandasLFApplier</code>	LF applier for a Pandas DataFrame.
<code>apply.dask.PandasParallelLFApplier</code>	Parallel LF applier for a Pandas DataFrame.
<code>RandomVoter</code>	Random vote label model.
<code>apply.spark.SparkLFApplier</code>	LF applier for a Spark RDD.
<code>lf.nlp_spark.SparkNLPLabelingFunction</code>	Special labeling function type for SpaCy-based LFs running on Spark.
<code>filter_unlabeled_dataframe</code>	Filter out examples not covered by any labeling function.
<code>labeling_function</code>	Decorator to define a LabelingFunction object from a function.
<code>lf.nlp.nlp_labeling_function</code>	Decorator to define an NLPLabelingFunction object from a function.
<code>lf.nlp_spark.spark_nlp_labeling_function</code>	Decorator to define a SparkNLPLabelingFunction object from a function.

4.1 snorkel.labeling.apply.dask.DaskLFApplier

```
class snorkel.labeling.apply.dask.DaskLFApplier (lfs)
    Bases: snorkel.labeling.apply.core.BaseLFApplier
```

LF applier for a Dask DataFrame.

Dask DataFrames consist of partitions, each being a Pandas DataFrame. This allows for efficient parallel computation over DataFrame rows. For more information, see <https://docs.dask.org/en/stable/dataframe.html>

```
__init__ (lfs)
```

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(df[, scheduler, fault_tolerant])</code>	Label Dask DataFrame of data points with LFs.

apply (*df*, *scheduler*='processes', *fault_tolerant*=False)
 Label Dask DataFrame of data points with LFs.

Parameters

- **df** (*dask.dataframe.DataFrame*) – Dask DataFrame containing data points to be labeled by LFs
- **scheduler** (*Union[str, dask.distributed.Client]*) – A Dask scheduling configuration: either a string option or a *Client*. For more information, see <https://docs.dask.org/en/stable/scheduling.html#>
- **fault_tolerant** (*bool*) – Output -1 if LF execution fails?

Returns Matrix of labels emitted by LFs

Return type *np.ndarray*

4.2 snorkel.labeling.LFAnalysis

class *snorkel.labeling.LFAnalysis* (*L*, *lfs*=None)

Bases: *object*

Run analyses on LFs using label matrix.

Parameters

- **L** (*ndarray*) – Label matrix where $L_{\{i,j\}}$ is the label given by the *j*th LF to the *i*th candidate (using -1 for abstain)
- **lfs** (*Optional[List[LabelingFunction]]*) – Labeling functions used to generate L

Raises **ValueError** – If number of LFs and number of LF matrix columns differ

L

See above.

`__init__` (*L*, *lfs*=None)

Initialize self. See `help(type(self))` for accurate signature.

Return type *None*

Methods

<code>__init__(L[, lfs])</code>	Initialize self.
<code>label_conflict()</code>	Compute the fraction of data points with conflicting (non-abstain) labels.
<code>label_coverage()</code>	Compute the fraction of data points with at least one label.

Continued on next page

Table 3 – continued from previous page

<code>label_overlap()</code>	Compute the fraction of data points with at least two (non-abstain) labels.
<code>lf_conflicts([normalize_by_overlaps])</code>	Compute frac.
<code>lf_coverages()</code>	Compute frac.
<code>lf_empirical_accuracies(Y)</code>	Compute empirical accuracy against a set of labels Y for each LF.
<code>lf_empirical_probs(Y, k)</code>	Estimate conditional probability tables for each LF.
<code>lf_overlaps([normalize_by_coverage])</code>	Compute frac.
<code>lf_polarities()</code>	Infer the polarities of each LF based on evidence in a label matrix.
<code>lf_summary([Y, est_weights])</code>	Create a pandas DataFrame with the various per-LF statistics.

label_conflict()

Compute the fraction of data points with conflicting (non-abstain) labels.

Returns Fraction of data points with conflicting labels

Return type float

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAnalysis(L).label_conflict()
0.2
```

label_coverage()

Compute the fraction of data points with at least one label.

Returns Fraction of data points with labels

Return type float

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAnalysis(L).label_coverage()
0.8
```

label_overlap()

Compute the fraction of data points with at least two (non-abstain) labels.

Returns Fraction of data points with overlapping labels

Return type float

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAalysis(L).label_overlap()
0.6
```

lf_conflicts (*normalize_by_overlaps=False*)

Compute frac. of examples each LF labels and labeled differently by another LF.

A conflicting example is one that at least one other LF returns a different (non-abstain) label for.

Note that the maximum possible conflict fraction for an LF is the LF's overlaps fraction, unless `normalize_by_overlaps=True`, in which case it is 1.

Parameters `normalize_by_overlaps` (bool) – Normalize by overlaps of the LF, so that it returns the percent of LF overlaps that have conflicts.

Returns Fraction of conflicting examples for each LF

Return type numpy.ndarray

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAalysis(L).lf_conflicts()
array([0.2, 0.2, 0. ])
>>> LFAalysis(L).lf_conflicts(normalize_by_overlaps=True)
array([0.5, 0.33333333, 0. ])
```

lf_coverages ()

Compute frac. of examples each LF labels.

Returns Fraction of labeled examples for each LF

Return type numpy.ndarray

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
```

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```

...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAalysis(L).lf_coverages()
array([0.4, 0.8, 0.4])

```

lf_empirical_accuracies (*Y*)

Compute empirical accuracy against a set of labels *Y* for each LF.

Usually, *Y* represents development set labels.

Parameters *Y* (ndarray) – [n] or [n, 1] np.ndarray of gold labels

Returns Empirical accuracies for each LF

Return type numpy.ndarray

lf_empirical_probs (*Y*, *k*)

Estimate conditional probability tables for each LF.

Computes conditional probability tables, $P(L|Y)$, for each LF using the provided true labels *Y*.

Parameters

- *Y* (ndarray) – The n-dim array of true labels in $\{1, \dots, k\}$
- *k* (int) – The cardinality i.e. number of classes

Returns An $m \times (k+1) \times k$ np.ndarray representing the m $(k+1) \times k$ conditional probability tables P_i , where $P_i[l,y]$ represents $P(LF_i = l | Y = y)$ empirically calculated

Return type np.ndarray

lf_overlaps (*normalize_by_coverage=False*)

Compute frac. of examples each LF labels that are labeled by another LF.

An overlapping example is one that at least one other LF returns a (non-abstain) label for.

Note that the maximum possible overlap fraction for an LF is the LF's coverage, unless *normalize_by_coverage=True*, in which case it is 1.

Parameters *normalize_by_coverage* (bool) – Normalize by coverage of the LF, so that it returns the percent of LF labels that have overlaps.

Returns Fraction of overlapping examples for each LF

Return type numpy.ndarray

Example

```

>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAalysis(L).lf_overlaps()
array([0.4, 0.6, 0.4])
>>> LFAalysis(L).lf_overlaps(normalize_by_coverage=True)
array([1. , 0.75, 1. ])

```

lf_polarities()

Infer the polarities of each LF based on evidence in a label matrix.

Returns Unique output labels for each LF

Return type List[List[int]]

Example

```
>>> L = np.array([
...     [-1, 0, 0],
...     [-1, -1, -1],
...     [1, 0, -1],
...     [-1, 0, -1],
...     [0, 0, 0],
... ])
>>> LFAalysis(L).lf_polarities()
[[0, 1], [0], [0]]
```

lf_summary(Y=None, est_weights=None)

Create a pandas DataFrame with the various per-LF statistics.

Parameters

- **Y** (Optional[ndarray]) – [n] or [n, 1] np.ndarray of gold labels. If provided, the empirical weight for each LF will be calculated.
- **est_weights** (Optional[ndarray]) – Learned weights for each LF

Returns Summary statistics for each LF

Return type pandas.DataFrame

4.3 snorkel.labeling.LFApplier

class snorkel.labeling.LFApplier(*lfs*)

Bases: snorkel.labeling.apply.core.BaseLFApplier

LF applier for a list of data points (e.g. SimpleNamespace) or a NumPy array.

Parameters **lfs** (List[LabelingFunction]) – LFs that this applier executes on examples

Example

```
>>> from snorkel.labeling import labeling_function
>>> @labeling_function()
... def is_big_num(x):
...     return 1 if x.num > 42 else 0
>>> applier = LFApplier([is_big_num])
>>> from types import SimpleNamespace
>>> applier.apply([SimpleNamespace(num=10), SimpleNamespace(num=100)])
array([[0], [1]])
```

```

>>> @labeling_function()
... def is_big_num_np(x):
...     return 1 if x[0] > 42 else 0
>>> applicer = LFApplier([is_big_num_np])
>>> applicer.apply(np.array([[10], [100]]))
array([[0], [1]])

```

`__init__(lfs)`

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(data_points[, progress_bar, ...])</code>	Label list of data points or a NumPy array with LFs.

apply (*data_points*, *progress_bar=True*, *fault_tolerant=False*, *return_meta=False*)

Label list of data points or a NumPy array with LFs.

Parameters

- **data_points** (Union[Sequence[Any], ndarray]) – List of data points or NumPy array to be labeled by LFs
- **progress_bar** (bool) – Display a progress bar?
- **fault_tolerant** (bool) – Output -1 if LF execution fails?
- **return_meta** (bool) – Return metadata from apply call?

Return type Union[ndarray, Tuple[ndarray, ApplierMetadata]]

Returns

- *np.ndarray* – Matrix of labels emitted by LFs
- *ApplierMetadata* – Metadata, such as fault counts, for the apply call

4.4 snorkel.labeling.LabelModel

class snorkel.labeling.LabelModel (*cardinality=2*, ***kwargs*)

Bases: torch.nn.modules.module.Module

A model for learning the LF accuracies and combining their output labels.

This class learns a model of the labeling functions' conditional probabilities of outputting the true (unobserved) label Y , $P(lf|Y)$, and uses this learned model to re-weight and combine their output labels.

This class is based on the approach in [Training Complex Models with Multi-Task Weak Supervision](<https://arxiv.org/abs/1810.02840>), published in AAAI'19. In this approach, we compute the inverse generalized covariance matrix of the junction tree of a given LF dependency graph, and perform a matrix completion-style approach with respect to these empirical statistics. The result is an estimate of the conditional LF probabilities, $P(lf|Y)$, which are then set as the parameters of the label model used to re-weight and combine the labels output by the LFs.

Currently this class uses a conditionally independent label model, in which the LFs are assumed to be conditionally independent given Y .

Examples

```
>>> label_model = LabelModel()
>>> label_model = LabelModel(cardinality=3)
>>> label_model = LabelModel(cardinality=3, device='cpu')
>>> label_model = LabelModel(cardinality=3)
```

Parameters

- **cardinality** (*int*) – Number of classes, by default 2
- ****kwargs** – Arguments for changing config defaults

Raises `ValueError` – If config device set to cuda but only cpu is available

cardinality

Number of classes, by default 2

config

Training configuration

seed

Random seed

__init__ (*cardinality=2, **kwargs*)

Initialize self. See help(type(self)) for accurate signature.

Return type `None`

Methods

<code>__init__</code> ([<i>cardinality</i>])	Initialize self.
<code>add_module</code> (name, module)	Adds a child module to the current module.
<code>apply</code> (fn)	Applies <i>fn</i> recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers</code> ([<i>recurse</i>])	Returns an iterator over module buffers.
<code>children</code> ()	Returns an iterator over immediate children modules.
<code>cpu</code> ()	Moves all model parameters and buffers to the CPU.
<code>cuda</code> ([<i>device</i>])	Moves all model parameters and buffers to the GPU.
<code>double</code> ()	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval</code> ()	Sets the module in evaluation mode.
<code>extra_repr</code> ()	Set the extra representation of the module
<code>fit</code> (<i>L_train</i> [, <i>Y_dev</i> , <i>class_balance</i>])	Train label model.
<code>float</code> ()	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward</code> (* <i>input</i>)	Defines the computation performed at every call.
<code>get_conditional_probs</code> ()	Return the estimated conditional probabilities table.
<code>get_weights</code> ()	Return the vector of learned LF weights for combining LFs.

Continued on next page

Table 5 – continued from previous page

<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load(source)</code>	Load existing label model.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.
<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(L[, return_probs, tie_break_policy])</code>	Return predicted labels, with ties broken according to policy.
<code>predict_proba(L)</code>	Return label probabilities $P(Y \lambda)$.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(destination)</code>	Save label model.
<code>score(L, Y[, metrics, tie_break_policy])</code>	Calculate one or more scores from user-specified and/or user-defined metrics.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

`dump_patches`

fit (*L_train*, *Y_dev*=None, *class_balance*=None, ***kwargs*)

Train label model.

Train label model to estimate μ , the parameters used to combine LFs.

Parameters

- **L_train** (ndarray) – An $[n,m]$ matrix with values in $\{-1,0,1,\dots,k-1\}$
- **Y_dev** (Optional[ndarray]) – Gold labels for dev set for estimating `class_balance`, by default None

- **class_balance** (Optional[List[float]]) – Each class’s percentage of the population, by default None
- ****kwargs** – Arguments for changing train config defaults

Raises Exception – If loss in NaN

Examples

```
>>> L = np.array([[0, 0, -1], [-1, 0, 1], [1, -1, 0]])
>>> Y_dev = [0, 1, 0]
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.fit(L, Y_dev=Y_dev)
>>> label_model.fit(L, class_balance=[0.7, 0.3])
```

Return type None

get_conditional_probs ()

Return the estimated conditional probabilities table.

Return the estimated conditional probabilities table cprobs, where cprobs is an (m, k+1, k)-dim np.ndarray with:

$$\text{cprobs}[i, j, k] = P(\text{lf}_i = j-1 \mid Y = k)$$

where m is the number of LFs, k is the cardinality, and cprobs includes the conditional abstain probabilities $P(\text{lf}_i = -1 \mid Y = y)$.

Returns An [m, k + 1, k] np.ndarray conditional probabilities table.

Return type np.ndarray

get_weights ()

Return the vector of learned LF weights for combining LFs.

Returns [m,1] vector of learned LF weights for combining LFs.

Return type np.ndarray

Example

```
>>> L = np.array([[1, 1, 1], [1, 1, -1], [-1, 0, 0], [0, 0, 0]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L, seed=123)
>>> np.around(label_model.get_weights(), 2) # doctest: +SKIP
array([0.99, 0.99, 0.99])
```

load (source)

Load existing label model.

Parameters **source** (str) – Filename to load model from

Example

Load parameters saved in saved_label_model


```
>>> label_model.load('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

predict (*L*, *return_probs=False*, *tie_break_policy='abstain'*)

Return predicted labels, with ties broken according to policy.

Policies to break ties include: “abstain”: return an abstain vote (-1) “true-random”: randomly choose among the tied options “random”: randomly choose among tied option using deterministic hash

NOTE: if *tie_break_policy*="true-random", repeated runs may have slightly different results due to difference in broken ties

Parameters

- **L** (*ndarray*) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **return_probs** (*Optional[bool]*) – Whether to return probs along with preds
- **tie_break_policy** (*str*) – Policy to break ties when converting probabilistic labels to predictions

Return type Union[*ndarray*, Tuple[*ndarray*, *ndarray*]]

Returns

- *np.ndarray* – An [n,1] array of integer labels
- (*np.ndarray*, *np.ndarray*) – An [n,1] array of integer labels and an [n,k] array of probabilistic labels

Example

```
>>> L = np.array([[0, 0, -1], [1, 1, -1], [0, 0, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.predict(L)
array([0, 1, 0])
```

predict_proba (*L*)

Return label probabilities $P(Y | \lambda)$.

Parameters **L** (*ndarray*) – An [n,m] matrix with values in {-1,0,1,...,k-1}

Returns An [n,k] array of probabilistic labels

Return type *np.ndarray*

Example

```
>>> L = np.array([[0, 0, 0], [1, 1, 1], [1, 1, 1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L, seed=123)
>>> np.around(label_model.predict_proba(L), 1) # doctest: +SKIP
array([[1., 0.],
       [0., 1.],
       [0., 1.]])
```

save (*destination*)

Save label model.

Parameters **destination** (`str`) – Filename for saving model

Example

```
>>> label_model.save('./saved_label_model.pkl') # doctest: +SKIP
```

Return type `None`

score (*L*, *Y*, *metrics*=['accuracy'], *tie_break_policy*='abstain')

Calculate one or more scores from user-specified and/or user-defined metrics.

Parameters

- **L** (`ndarray`) – An $[n,m]$ matrix with values in $\{-1,0,1,\dots,k-1\}$
- **Y** (`ndarray`) – Gold labels associated with data points in **L**
- **metrics** (`Optional[List[str]]`) – A list of metric names
- **tie_break_policy** (`str`) – Policy to break ties when converting probabilistic labels to predictions

Returns A dictionary mapping metric names to metric scores

Return type `Dict[str, float]`

Example

```
>>> L = np.array([[1, 1, -1], [0, 0, -1], [1, 1, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.score(L, Y=np.array([1, 1, 1]))
{'accuracy': 0.6666666666666666}
>>> label_model.score(L, Y=np.array([1, 1, 1]), metrics=["f1"])
{'f1': 0.8}
```

4.5 snorkel.labeling.LabelingFunction

class `snorkel.labeling.LabelingFunction` (*name*, *f*, *resources*=None, *pre*=None)

Bases: `object`

Base class for labeling functions.

A labeling function (LF) is a function that takes a data point as input and produces an integer label, corresponding to a class. A labeling function can also abstain from voting by outputting `-1`. For examples, see the Snorkel tutorials.

This class wraps a Python function outputting a label. Extra functionality, such as running preprocessors and storing resources, is provided. Simple LFs can be defined via a decorator. See `labeling_function`.

Parameters

- **name** (`str`) – Name of the LF

- **f** (Callable[... , int]) – Function that implements the core LF logic
- **resources** (Optional[Mapping[str, Any]]) – Labeling resources passed in to f via kwargs
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run on data points before LF execution

Raises **ValueError** – Calling incorrectly defined preprocessors

name

See above

__init__ (name, f, resources=None, pre=None)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(name, f[, resources, pre])</code>	Initialize self.
--	------------------

__call__ (x)

Label data point.

Runs all preprocessors, then passes preprocessed data point to LF.

Parameters **x** (Any) – Data point to label

Returns Label for data point

Return type int

4.6 snorkel.labeling.MajorityClassVoter

class snorkel.labeling.**MajorityClassVoter** (cardinality=2, **kwargs)

Bases: snorkel.labeling.model.label_model.LabelModel

Majority class label model.

__init__ (cardinality=2, **kwargs)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__([cardinality])</code>	Initialize self.
<code>add_module(name, module)</code>	Adds a child module to the current module.
<code>apply(fn)</code>	Applies fn recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers([recurse])</code>	Returns an iterator over module buffers.
<code>children()</code>	Returns an iterator over immediate children modules.
<code>cpu()</code>	Moves all model parameters and buffers to the CPU.

Continued on next page

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<code>cuda([device])</code>	Moves all model parameters and buffers to the GPU.
<code>double()</code>	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval()</code>	Sets the module in evaluation mode.
<code>extra_repr()</code>	Set the extra representation of the module
<code>fit(balance, *args, **kwargs)</code>	Train majority class model.
<code>float()</code>	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward(*input)</code>	Defines the computation performed at every call.
<code>get_conditional_probs()</code>	Return the estimated conditional probabilities table.
<code>get_weights()</code>	Return the vector of learned LF weights for combining LFs.
<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load(source)</code>	Load existing label model.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.
<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(L[, return_probs, tie_break_policy])</code>	Return predicted labels, with ties broken according to policy.
<code>predict_proba(L)</code>	Predict probabilities using majority class.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(destination)</code>	Save label model.
<code>score(L, Y[, metrics, tie_break_policy])</code>	Calculate one or more scores from user-specified and/or user-defined metrics.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

dump_patches

fit (*balance*, *args, **kwargs)

Train majority class model.

Set class balance for majority class label model.

Parameters **balance** (ndarray) – A [k] array of class probabilities

Return type None

get_conditional_probs ()

Return the estimated conditional probabilities table.

Return the estimated conditional probabilities table cprobs, where cprobs is an (m, k+1, k)-dim np.ndarray with:

$$\text{cprobs}[i, j, k] = P(\text{lf}_i = j-1 \mid Y = k)$$

where m is the number of LFs, k is the cardinality, and cprobs includes the conditional abstain probabilities $P(\text{lf}_i = -1 \mid Y = y)$.

Returns An [m, k + 1, k] np.ndarray conditional probabilities table.

Return type np.ndarray

get_weights ()

Return the vector of learned LF weights for combining LFs.

Returns [m,1] vector of learned LF weights for combining LFs.

Return type np.ndarray

Example

```
>>> L = np.array([[1, 1, 1], [1, 1, -1], [-1, 0, 0], [0, 0, 0]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L, seed=123)
>>> np.around(label_model.get_weights(), 2) # doctest: +SKIP
array([0.99, 0.99, 0.99])
```

load (*source*)

Load existing label model.

Parameters **source** (str) – Filename to load model from

Example

Load parameters saved in saved_label_model

```
>>> label_model.load('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

predict (*L*, *return_probs=False*, *tie_break_policy='abstain'*)

Return predicted labels, with ties broken according to policy.

Policies to break ties include: “abstain”: return an abstain vote (-1) “true-random”: randomly choose among the tied options “random”: randomly choose among tied option using deterministic hash

NOTE: if *tie_break_policy*="true-random", repeated runs may have slightly different results due to difference in broken ties

Parameters

- **L** (*ndarray*) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **return_probs** (*Optional[bool]*) – Whether to return probs along with preds
- **tie_break_policy** (*str*) – Policy to break ties when converting probabilistic labels to predictions

Return type Union[*ndarray*, Tuple[*ndarray*, *ndarray*]]

Returns

- *np.ndarray* – An [n,1] array of integer labels
- (*np.ndarray*, *np.ndarray*) – An [n,1] array of integer labels and an [n,k] array of probabilistic labels

Example

```
>>> L = np.array([[0, 0, -1], [1, 1, -1], [0, 0, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.predict(L)
array([0, 1, 0])
```

predict_proba (*L*)

Predict probabilities using majority class.

Assign majority class vote to each datapoint. In case of multiple majority classes, assign equal probabilities among them.

Parameters **L** (*ndarray*) – An [n, m] matrix of labels

Returns A [n, k] array of probabilistic labels

Return type *np.ndarray*

Example

```
>>> L = np.array([[0, 0, -1], [-1, 0, 1], [1, -1, 0]])
>>> maj_class_voter = MajorityClassVoter()
>>> maj_class_voter.fit(balance=np.array([0.8, 0.2]))
>>> maj_class_voter.predict_proba(L)
array([[1., 0.],
       [1., 0.],
       [1., 0.]])
```

save (*destination*)

Save label model.

Parameters `destination` (`str`) – Filename for saving model

Example

```
>>> label_model.save('./saved_label_model.pkl') # doctest: +SKIP
```

Return type `None`

score (`L`, `Y`, `metrics=['accuracy']`, `tie_break_policy='abstain'`)

Calculate one or more scores from user-specified and/or user-defined metrics.

Parameters

- `L` (`ndarray`) – An $[n,m]$ matrix with values in $\{-1,0,1,\dots,k-1\}$
- `Y` (`ndarray`) – Gold labels associated with data points in `L`
- `metrics` (`Optional[List[str]]`) – A list of metric names
- `tie_break_policy` (`str`) – Policy to break ties when converting probabilistic labels to predictions

Returns A dictionary mapping metric names to metric scores

Return type `Dict[str, float]`

Example

```
>>> L = np.array([[1, 1, -1], [0, 0, -1], [1, 1, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.score(L, Y=np.array([1, 1, 1]))
{'accuracy': 0.6666666666666666}
>>> label_model.score(L, Y=np.array([1, 1, 1]), metrics=["f1"])
{'f1': 0.8}
```

4.7 snorkel.labeling.MajorityLabelVoter

class `snorkel.labeling.MajorityLabelVoter` (`cardinality=2`, `**kwargs`)

Bases: `snorkel.labeling.model.baselines.BaselineVoter`

Majority vote label model.

__init__ (`cardinality=2`, `**kwargs`)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

`__init__`(`cardinality`)

Initialize self.

`add_module`(`name`, `module`)

Adds a child module to the current module.

Continued on next page

Table 10 – continued from previous page

<code>apply(fn)</code>	Applies <code>fn</code> recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers([recurse])</code>	Returns an iterator over module buffers.
<code>children()</code>	Returns an iterator over immediate children modules.
<code>cpu()</code>	Moves all model parameters and buffers to the CPU.
<code>cuda([device])</code>	Moves all model parameters and buffers to the GPU.
<code>double()</code>	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval()</code>	Sets the module in evaluation mode.
<code>extra_repr()</code>	Set the extra representation of the module
<code>fit(*args, **kwargs)</code>	Train majority class model.
<code>float()</code>	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward(*input)</code>	Defines the computation performed at every call.
<code>get_conditional_probs()</code>	Return the estimated conditional probabilities table.
<code>get_weights()</code>	Return the vector of learned LF weights for combining LFs.
<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load(source)</code>	Load existing label model.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.
<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(L[, return_probs, tie_break_policy])</code>	Return predicted labels, with ties broken according to policy.
<code>predict_proba(L)</code>	Predict probabilities using majority vote.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(destination)</code>	Save label model.
<code>score(L, Y[, metrics, tie_break_policy])</code>	Calculate one or more scores from user-specified and/or user-defined metrics.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.

Continued on next page

Table 10 – continued from previous page

<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

`dump_patches`

fit (**args*, ***kwargs*)

Train majority class model.

Set class balance for majority class label model.

Parameters `balance` – A [k] array of class probabilities

Return type None

get_conditional_probs ()

Return the estimated conditional probabilities table.

Return the estimated conditional probabilities table `cprobs`, where `cprobs` is an (m, k+1, k)-dim np.ndarray with:

$$cprobs[i, j, k] = P(lf_i = j-1 \mid Y = k)$$

where m is the number of LFs, k is the cardinality, and `cprobs` includes the conditional abstain probabilities $P(lf_i = -1 \mid Y = y)$.

Returns An [m, k + 1, k] np.ndarray conditional probabilities table.

Return type np.ndarray

get_weights ()

Return the vector of learned LF weights for combining LFs.

Returns [m,1] vector of learned LF weights for combining LFs.

Return type np.ndarray

Example

```
>>> L = np.array([[1, 1, 1], [1, 1, -1], [-1, 0, 0], [0, 0, 0]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L, seed=123)
>>> np.around(label_model.get_weights(), 2) # doctest: +SKIP
array([0.99, 0.99, 0.99])
```

load (*source*)

Load existing label model.

Parameters `source` (str) – Filename to load model from

Example

Load parameters saved in `saved_label_model`

```
>>> label_model.load('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

predict (*L*, *return_probs=False*, *tie_break_policy='abstain'*)

Return predicted labels, with ties broken according to policy.

Policies to break ties include: “abstain”: return an abstain vote (-1) “true-random”: randomly choose among the tied options “random”: randomly choose among tied option using deterministic hash

NOTE: if *tie_break_policy*="true-random", repeated runs may have slightly different results due to difference in broken ties

Parameters

- **L** (*ndarray*) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **return_probs** (*Optional[bool]*) – Whether to return probs along with preds
- **tie_break_policy** (*str*) – Policy to break ties when converting probabilistic labels to predictions

Return type Union[*ndarray*, Tuple[*ndarray*, *ndarray*]]

Returns

- *np.ndarray* – An [n,1] array of integer labels
- (*np.ndarray*, *np.ndarray*) – An [n,1] array of integer labels and an [n,k] array of probabilistic labels

Example

```
>>> L = np.array([[0, 0, -1], [1, 1, -1], [0, 0, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.predict(L)
array([0, 1, 0])
```

predict_proba (*L*)

Predict probabilities using majority vote.

Assign vote by calculating majority vote across all labeling functions. In case of ties, non-integer probabilities are possible.

Parameters **L** (*ndarray*) – An [n, m] matrix of labels

Returns A [n, k] array of probabilistic labels

Return type *np.ndarray*

Example

```
>>> L = np.array([[0, 0, -1], [-1, 0, 1], [1, -1, 0]])
>>> maj_voter = MajorityLabelVoter()
>>> maj_voter.predict_proba(L)
array([[1. , 0. ],
       [0.5, 0.5],
       [0.5, 0.5]])
```

save (*destination*)
Save label model.

Parameters **destination** (str) – Filename for saving model

Example

```
>>> label_model.save('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

score (*L*, *Y*, *metrics*=['accuracy'], *tie_break_policy*='abstain')

Calculate one or more scores from user-specified and/or user-defined metrics.

Parameters

- **L** (ndarray) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **Y** (ndarray) – Gold labels associated with data points in L
- **metrics** (Optional[List[str]]) – A list of metric names
- **tie_break_policy** (str) – Policy to break ties when converting probabilistic labels to predictions

Returns A dictionary mapping metric names to metric scores

Return type Dict[str, float]

Example

```
>>> L = np.array([[1, 1, -1], [0, 0, -1], [1, 1, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.score(L, Y=np.array([1, 1, 1]))
{'accuracy': 0.6666666666666666}
>>> label_model.score(L, Y=np.array([1, 1, 1]), metrics=["f1"])
{'f1': 0.8}
```

4.8 snorkel.labeling.lf.nlp.NLPLabelingFunction

```
class snorkel.labeling.lf.nlp.NLPLabelingFunction (name, f, resources=None,
                                                pre=None, text_field='text',
                                                doc_field='doc', language='en_core_web_sm',
                                                disable=None, memoize=True)
```

Bases: snorkel.labeling.lf.nlp.BaseNLPLabelingFunction

Special labeling function type for spaCy-based LFs.

This class is a special version of LabelingFunction. It has a SpacyPreprocessor integrated which shares a cache with all other NLPLabelingFunction instances. This makes it easy to define LFs that have a text input field and have logic written over spaCy Doc objects. Examples passed into an NLPLabelingFunction will have a new field which can be accessed which contains a spaCy Doc. By default, this field is called doc. A Doc object is a sequence of Token objects, which contain information on

lemmatization, parts-of-speech, etc. Doc objects also contain fields like `Doc.ents`, a list of named entities, and `Doc.noun_chunks`, a list of noun phrases. For details of spaCy Doc objects and a full attribute listing, see <https://spacy.io/api/doc>.

Simple NLPLabelingFunctions can be defined via a decorator. See `nlp_labeling_function`.

Parameters

- **name** (str) – Name of the LF
- **f** (Callable[... , int]) – Function that implements the core LF logic
- **resources** (Optional[Mapping[str, Any]]) – Labeling resources passed in to `f` via `kwargs`
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run before `SpacyPreprocessor` is executed
- **text_field** (str) – Name of data point text field to input
- **doc_field** (str) – Name of data point field to output parsed document to
- **language** (str) – spaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (Optional[List[str]]) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **memoize** (bool) – Memoize preprocessor outputs?

Raises `ValueError` – Calling incorrectly defined preprocessors

Example

```
>>> def f(x):
...     person_ents = [ent for ent in x.doc.ents if ent.label_ == "PERSON"]
...     return 0 if len(person_ents) > 0 else -1
>>> has_person_mention = NLPLabelingFunction(name="has_person_mention", f=f)
>>> has_person_mention
NLPLabelingFunction has_person_mention, Preprocessors: [SpacyPreprocessor...]
```

```
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(text="The movie was good.")
>>> has_person_mention(x)
-1
```

name

See above

__init__(name, f, resources=None, pre=None, text_field='text', doc_field='doc', language='en_core_web_sm', disable=None, memoize=True)

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__</code> (name, f[, resources, pre, ...])	Initialize self.
--	------------------

`__call__` (*x*)
 Label data point.
 Runs all preprocessors, then passes preprocessed data point to LF.
Parameters *x* (Any) – Data point to label
Returns Label for data point
Return type int

4.9 snorkel.labeling.PandasLFApplier

class `snorkel.labeling.PandasLFApplier` (*lfs*)
 Bases: `snorkel.labeling.apply.core.BaseLFApplier`
 LF applier for a Pandas DataFrame.

Data points are stored as `Series` in a `DataFrame`. The LFs are executed via a `pandas.DataFrame.apply` call, which is single-process and can be slow for large DataFrames. For large datasets, consider `DaskLFApplier` or `SparkLFApplier`.

Parameters *lfs* (`List[LabelingFunction]`) – LFs that this applier executes on examples

Example

```
>>> from snorkel.labeling import labeling_function
>>> @labeling_function()
... def is_big_num(x):
...     return 1 if x.num > 42 else 0
>>> applier = PandasLFApplier([is_big_num])
>>> applier.apply(pd.DataFrame(dict(num=[10, 100], text=["hello", "hi"])))
array([[0], [1]])
```

`__init__` (*lfs*)
 Initialize self. See `help(type(self))` for accurate signature.
Return type None

Methods

<code>__init__</code> (<i>lfs</i>)	Initialize self.
<code>apply</code> (<i>df</i> , <i>progress_bar</i> , <i>fault_tolerant</i> , ...))	Label Pandas DataFrame of data points with LFs.

apply (*df*, *progress_bar*=*True*, *fault_tolerant*=*False*, *return_meta*=*False*)
 Label Pandas DataFrame of data points with LFs.

Parameters

- **df** (`DataFrame`) – Pandas DataFrame containing data points to be labeled by LFs
- **progress_bar** (`bool`) – Display a progress bar?
- **fault_tolerant** (`bool`) – Output -1 if LF execution fails?
- **return_meta** (`bool`) – Return metadata from apply call?

Return type Union[ndarray, Tuple[ndarray, ApplierMetadata]]

Returns

- *np.ndarray* – Matrix of labels emitted by LFs
- *ApplierMetadata* – Metadata, such as fault counts, for the apply call

4.10 snorkel.labeling.apply.dask.PandasParallelLFApplier

class snorkel.labeling.apply.dask.**PandasParallelLFApplier** (*lfs*)

Bases: *snorkel.labeling.apply.dask.DaskLFApplier*

Parallel LF applier for a Pandas DataFrame.

Creates a Dask DataFrame from a Pandas DataFrame, then uses *DaskLFApplier* to label data in parallel. See *DaskLFApplier*.

__init__ (*lfs*)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(df[, n_parallel, scheduler, ...])</code>	Label Pandas DataFrame of data points with LFs in parallel using Dask.

apply (*df*, *n_parallel=2*, *scheduler='processes'*, *fault_tolerant=False*)

Label Pandas DataFrame of data points with LFs in parallel using Dask.

Parameters

- **df** (*DataFrame*) – Pandas DataFrame containing data points to be labeled by LFs
- **n_parallel** (*int*) – Parallelism level for LF application. Corresponds to `npartitions` in constructed Dask DataFrame. For `scheduler="processes"`, number of processes launched. Recommended to be no more than the number of cores on the running machine.
- **scheduler** (*Union[str, dask.distributed.Client]*) – A Dask scheduling configuration: either a string option or a *Client*. For more information, see <https://docs.dask.org/en/stable/scheduling.html#>
- **fault_tolerant** (*bool*) – Output -1 if LF execution fails?

Returns Matrix of labels emitted by LFs

Return type *np.ndarray*

4.11 snorkel.labeling.RandomVoter

class snorkel.labeling.**RandomVoter** (*cardinality=2*, ***kwargs*)

Bases: *snorkel.labeling.model.baselines.BaselineVoter*

Random vote label model.

Example

```
>>> L = np.array([[0, 0, -1], [-1, 0, 1], [1, -1, 0]])
>>> random_voter = RandomVoter()
>>> predictions = random_voter.predict_proba(L)
```

`__init__` (*cardinality=2, **kwargs*)

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__</code> (<i>[cardinality]</i>)	Initialize self.
<code>add_module</code> (<i>name, module</i>)	Adds a child module to the current module.
<code>apply</code> (<i>fn</i>)	Applies <i>fn</i> recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers</code> (<i>[recurse]</i>)	Returns an iterator over module buffers.
<code>children</code> ()	Returns an iterator over immediate children modules.
<code>cpu</code> ()	Moves all model parameters and buffers to the CPU.
<code>cuda</code> (<i>[device]</i>)	Moves all model parameters and buffers to the GPU.
<code>double</code> ()	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval</code> ()	Sets the module in evaluation mode.
<code>extra_repr</code> ()	Set the extra representation of the module
<code>fit</code> (<i>*args, **kwargs</i>)	Train majority class model.
<code>float</code> ()	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward</code> (<i>*input</i>)	Defines the computation performed at every call.
<code>get_conditional_probs</code> ()	Return the estimated conditional probabilities table.
<code>get_weights</code> ()	Return the vector of learned LF weights for combining LFs.
<code>half</code> ()	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load</code> (<i>source</i>)	Load existing label model.
<code>load_state_dict</code> (<i>state_dict[, strict]</i>)	Copies parameters and buffers from <i>state_dict</i> into this module and its descendants.
<code>modules</code> ()	Returns an iterator over all modules in the network.
<code>named_buffers</code> (<i>[prefix, recurse]</i>)	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children</code> ()	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules</code> (<i>[memo, prefix]</i>)	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.

Continued on next page

Table 15 – continued from previous page

<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(L[, return_probs, tie_break_policy])</code>	Return predicted labels, with ties broken according to policy.
<code>predict_proba(L)</code>	Assign random votes to the data points.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(destination)</code>	Save label model.
<code>score(L, Y[, metrics, tie_break_policy])</code>	Calculate one or more scores from user-specified and/or user-defined metrics.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

`dump_patches`

fit (*args, **kwargs)

Train majority class model.

Set class balance for majority class label model.

Parameters `balance` – A [k] array of class probabilities

Return type None

get_conditional_probs ()

Return the estimated conditional probabilities table.

Return the estimated conditional probabilities table `cprobs`, where `cprobs` is an (m, k+1, k)-dim np.ndarray with:

$$cprobs[i, j, k] = P(lf_i = j-1 \mid Y = k)$$

where m is the number of LFs, k is the cardinality, and `cprobs` includes the conditional abstain probabilities $P(lf_i = -1 \mid Y = y)$.

Returns An [m, k + 1, k] np.ndarray conditional probabilities table.

Return type np.ndarray

get_weights ()

Return the vector of learned LF weights for combining LFs.

Returns [m,1] vector of learned LF weights for combining LFs.

Return type np.ndarray

Example

```
>>> L = np.array([[1, 1, 1], [1, 1, -1], [-1, 0, 0], [0, 0, 0]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L, seed=123)
>>> np.around(label_model.get_weights(), 2) # doctest: +SKIP
array([0.99, 0.99, 0.99])
```

load (*source*)

Load existing label model.

Parameters **source** (*str*) – Filename to load model from

Example

Load parameters saved in saved_label_model

```
>>> label_model.load('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

predict (*L*, *return_probs=False*, *tie_break_policy='abstain'*)

Return predicted labels, with ties broken according to policy.

Policies to break ties include: “abstain”: return an abstain vote (-1) “true-random”: randomly choose among the tied options “random”: randomly choose among tied option using deterministic hash

NOTE: if *tie_break_policy*="true-random", repeated runs may have slightly different results due to difference in broken ties

Parameters

- **L** (*ndarray*) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **return_probs** (*Optional[bool]*) – Whether to return probs along with preds
- **tie_break_policy** (*str*) – Policy to break ties when converting probabilistic labels to predictions

Return type Union[*ndarray*, Tuple[*ndarray*, *ndarray*]]

Returns

- *np.ndarray* – An [n,1] array of integer labels
- (*np.ndarray*, *np.ndarray*) – An [n,1] array of integer labels and an [n,k] array of probabilistic labels

Example

```
>>> L = np.array([[0, 0, -1], [1, 1, -1], [0, 0, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.predict(L)
array([0, 1, 0])
```

predict_proba (*L*)

Assign random votes to the data points.

Parameters **L** (ndarray) – An [n, m] matrix of labels

Returns A [n, k] array of probabilistic labels

Return type np.ndarray

Example

```
>>> L = np.array([[0, 0, -1], [-1, 0, 1], [1, -1, 0]])
>>> random_voter = RandomVoter()
>>> predictions = random_voter.predict_proba(L)
```

save (*destination*)

Save label model.

Parameters **destination** (str) – Filename for saving model

Example

```
>>> label_model.save('./saved_label_model.pkl') # doctest: +SKIP
```

Return type None

score (*L*, *Y*, *metrics*=['accuracy'], *tie_break_policy*='abstain')

Calculate one or more scores from user-specified and/or user-defined metrics.

Parameters

- **L** (ndarray) – An [n,m] matrix with values in {-1,0,1,...,k-1}
- **Y** (ndarray) – Gold labels associated with data points in L
- **metrics** (Optional[List[str]]) – A list of metric names
- **tie_break_policy** (str) – Policy to break ties when converting probabilistic labels to predictions

Returns A dictionary mapping metric names to metric scores

Return type Dict[str, float]

Example

```
>>> L = np.array([[1, 1, -1], [0, 0, -1], [1, 1, -1]])
>>> label_model = LabelModel(verbose=False)
>>> label_model.fit(L)
>>> label_model.score(L, Y=np.array([1, 1, 1]))
{'accuracy': 0.6666666666666666}
>>> label_model.score(L, Y=np.array([1, 1, 1]), metrics=["f1"])
{'f1': 0.8}
```

4.12 snorkel.labeling.apply.spark.SparkLFApplier

class `snorkel.labeling.apply.spark.SparkLFApplier` (*lfs*)

Bases: `snorkel.labeling.apply.core.BaseLFApplier`

LF applier for a Spark RDD.

Data points are stored as Rows in an RDD, and a Spark map job is submitted to execute the LFs. A common way to obtain an RDD is via a PySpark DataFrame. For an example usage with AWS EMR instructions, see `test/labeling/apply/lf_applier_spark_test_script.py`.

__init__ (*lfs*)

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__</code> (<i>lfs</i>)	Initialize self.
<code>apply</code> (<i>data_points</i> [, <i>fault_tolerant</i>])	Label PySpark RDD of data points with LFs.

apply (*data_points*, *fault_tolerant=False*)

Label PySpark RDD of data points with LFs.

Parameters

- **data_points** (*pyspark.RDD*) – PySpark RDD containing data points to be labeled by LFs
- **fault_tolerant** (*bool*) – Output -1 if LF execution fails?

Returns Matrix of labels emitted by LFs

Return type `np.ndarray`

4.13 snorkel.labeling.lf.nlp_spark.SparkNLPLabelingFunction

class `snorkel.labeling.lf.nlp_spark.SparkNLPLabelingFunction` (*name*, *f*, *resources=None*, *pre=None*, *text_field='text'*, *doc_field='doc'*, *language='en_core_web_sm'*, *disable=None*, *memoize=True*)

Bases: `snorkel.labeling.lf.nlp.BaseNLPLabelingFunction`

Special labeling function type for SpaCy-based LFs running on Spark.

This class is a Spark-compatible version of `NLPLabelingFunction`. See `NLPLabelingFunction` for details.

Parameters

- **name** (*str*) – Name of the LF

- **f** (Callable[... , int]) – Function that implements the core LF logic
- **resources** (Optional[Mapping[str, Any]]) – Labeling resources passed in to f via kwargs
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run before SpacyPreprocessor is executed
- **text_field** (str) – Name of data point text field to input
- **doc_field** (str) – Name of data point field to output parsed document to
- **language** (str) – SpaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (Optional[List[str]]) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **memoize** (bool) – Memoize preprocessor outputs?

Raises **ValueError** – Calling incorrectly defined preprocessors

name
See above

__init__ (name, f, resources=None, pre=None, text_field='text', doc_field='doc', language='en_core_web_sm', disable=None, memoize=True)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

__init__ (name, f[, resources, pre, ...])	Initialize self.
--	------------------

__call__ (x)
Label data point.

Runs all preprocessors, then passes preprocessed data point to LF.

Parameters **x** (Any) – Data point to label

Returns Label for data point

Return type int

4.14 snorkel.labeling.filter_unlabeled_dataframe

`snorkel.labeling.filter_unlabeled_dataframe` (X, y, L)

Filter out examples not covered by any labeling function.

Parameters

- **X** (DataFrame) – Data points in a Pandas DataFrame.
- **y** (ndarray) – Matrix of probabilities output by label model's predict_proba method.
- **L** (ndarray) – Matrix of labels emitted by LFs.

Return type Tuple[DataFrame, ndarray]

Returns

- *pd.DataFrame* – Data points that were labeled by at least one LF in L.
- *np.ndarray* – Probabilities matrix for data points labeled by at least one LF in L.

4.15 snorkel.labeling.labeling_function

class `snorkel.labeling.labeling_function` (*name=None, resources=None, pre=None*)

Bases: `object`

Decorator to define a `LabelingFunction` object from a function.

Parameters

- **name** (`Optional[str]`) – Name of the LF
- **resources** (`Optional[Mapping[str, Any]]`) – Labeling resources passed in to `f` via `kwargs`
- **preprocessors** – Preprocessors to run on data points before LF execution

Examples

```
>>> @labeling_function()
... def f(x):
...     return 0 if x.a > 42 else -1
>>> f
LabelingFunction f, Preprocessors: []
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(a=90, b=12)
>>> f(x)
0
```

```
>>> @labeling_function(name="my_lf")
... def g(x):
...     return 0 if x.a > 42 else -1
>>> g
LabelingFunction my_lf, Preprocessors: []
```

__init__ (*name=None, resources=None, pre=None*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

__init__ (*[name, resources, pre]*)

Initialize self.

__call__ (*f*)

Wrap a function to create a `LabelingFunction`.

Parameters **f** (`Callable[... , int]`) – Function that implements the core LF logic

Returns New `LabelingFunction` executing logic in wrapped function

Return type `LabelingFunction`

4.16 snorkel.labeling.lf.nlp.nlp_labeling_function

```
class snorkel.labeling.lf.nlp.nlp_labeling_function(name=None, resources=None,
                                                    pre=None, text_field='text',
                                                    doc_field='doc', language='en_core_web_sm',
                                                    disable=None, memoize=True)
```

Bases: `snorkel.labeling.lf.nlp.base_nlp_labeling_function`

Decorator to define an NLPLabelingFunction object from a function.

Parameters

- **name** (Optional[str]) – Name of the LF
- **resources** (Optional[Mapping[str, Any]]) – Labeling resources passed in to `f` via `kwargs`
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run before SpacyPreprocessor is executed
- **text_field** (str) – Name of data point text field to input
- **doc_field** (str) – Name of data point field to output parsed document to
- **language** (str) – spaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (Optional[List[str]]) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **memoize** (bool) – Memoize preprocessor outputs?

Example

```
>>> @nlp_labeling_function()
... def has_person_mention(x):
...     person_ents = [ent for ent in x.doc.ents if ent.label_ == "PERSON"]
...     return 0 if len(person_ents) > 0 else -1
>>> has_person_mention
NLPLabelingFunction has_person_mention, Preprocessors: [SpacyPreprocessor...]
```

```
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(text="The movie was good.")
>>> has_person_mention(x)
-1
```

```
__init__(name=None, resources=None, pre=None, text_field='text', doc_field='doc', language='en_core_web_sm', disable=None, memoize=True)
Initialize self. See help(type(self)) for accurate signature.
```

Return type None

Methods

```
__init__([name, resources, pre, text_field, ...]) Initialize self.
```

`__call__(f)`

Wrap a function to create an `BaseNLPLabelingFunction`.

Parameters `f` (`Callable[...]`, `int`) – Function that implements the core NLP LF logic

Returns New `BaseNLPLabelingFunction` executing logic in wrapped function

Return type `BaseNLPLabelingFunction`

4.17 `snorkel.labeling.lf.nlp_spark.spark_nlp_labeling_function`

```
class snorkel.labeling.lf.nlp_spark.spark_nlp_labeling_function (name=None,
                                                                re-
                                                                sources=None,
                                                                pre=None,
                                                                text_field='text',
                                                                doc_field='doc',
                                                                lan-
                                                                guage='en_core_web_sm',
                                                                disable=None,
                                                                memo-
                                                                ize=True)
```

Bases: `snorkel.labeling.lf.nlp.base_nlp_labeling_function`

Decorator to define a `SparkNLPLabelingFunction` object from a function.

Parameters

- **name** (`Optional[str]`) – Name of the LF
- **resources** (`Optional[Mapping[str, Any]]`) – Labeling resources passed in to `f` via `kwargs`
- **pre** (`Optional[List[BaseMapper]]`) – Preprocessors to run before `SpacyPreprocessor` is executed
- **text_field** (`str`) – Name of data point text field to input
- **doc_field** (`str`) – Name of data point field to output parsed document to
- **language** (`str`) – SpaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (`Optional[List[str]]`) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **memoize** (`bool`) – Memoize preprocessor outputs?

Example

```
>>> @spark_nlp_labeling_function()
... def has_person_mention(x):
...     person_ents = [ent for ent in x.doc.ents if ent.label_ == "PERSON"]
...     return 0 if len(person_ents) > 0 else -1
>>> has_person_mention
SparkNLPLabelingFunction has_person_mention, Preprocessors: [SpacyPreprocessor...]
```

```
>>> from pyspark.sql import Row
>>> x = Row(text="The movie was good.")
>>> has_person_mention(x)
-1
```

__init__(*name=None, resources=None, pre=None, text_field='text', doc_field='doc', language='en_core_web_sm', disable=None, memoize=True*)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

__init__(*name, resources, pre, text_field, ...*) Initialize self.

__call__(*f*)

Wrap a function to create an BaseNLPLabelingFunction.

Parameters *f* (Callable[... , int]) – Function that implements the core NLP LF logic

Returns New BaseNLPLabelingFunction executing logic in wrapped function

Return type BaseNLPLabelingFunction

SNORKEL MAP PACKAGE

Generic utilities for data point to data point operations.

<i>BaseMapper</i>	Base class for Mapper and LambdaMapper.
<i>LambdaMapper</i>	Define a mapper from a function.
<i>Mapper</i>	Base class for any data point to data point mapping in the pipeline.
<i>lambda_mapper</i>	Decorate a function to define a LambdaMapper object.
<i>spark.make_spark_mapper</i>	Convert Mapper to be compatible with PySpark.

5.1 snorkel.map.BaseMapper

class `snorkel.map.BaseMapper` (*name, pre, memoize*)

Bases: object

Base class for Mapper and LambdaMapper.

Implements nesting, memoization, and deep copy functionality. Used primarily for type checking.

Parameters

- **name** (*str*) – Name of the mapper
- **pre** (*List[BaseMapper]*) – Mappers to run before this mapper is executed
- **memoize** (*bool*) – Memoize mapper outputs?

Raises `NotImplementedError` – Subclasses need to implement `_generate_mapped_data_point`

memoize

Memoize mapper outputs?

__init__ (*name, pre, memoize*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(name, pre, memoize)</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.

`__call__(x)`

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters `x` (*Any*) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type `DataPoint`

`reset_cache()`

Reset the memoization cache.

Return type `None`

5.2 snorkel.map.LambdaMapper

class `snorkel.map.LambdaMapper` (*name, f, pre=None, memoize=False*)

Bases: `snorkel.map.core.BaseMapper`

Define a mapper from a function.

Convenience class for mappers that execute a simple function with no set up. The function should map from an input data point to a new data point directly, unlike `Mapper.run`. The original data point will not be updated, so in-place operations are safe.

Parameters

- **name** (*str*) – Name of mapper
- **f** (*Callable[[Any], Optional[Any]]*) – Function executing the mapping operation
- **pre** (*Optional[List[BaseMapper]]*) – Mappers to run before this mapper is executed
- **memoize** (*bool*) – Memoize mapper outputs?

`__init__(name, f, pre=None, memoize=False)`Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(name, f[, pre, memoize])</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.

`__call__(x)`

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters `x` (*Any*) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type DataPoint

reset_cache ()

Reset the memoization cache.

Return type None

5.3 snorkel.map.Mapper

class `snorkel.map.Mapper` (*name*, *field_names=None*, *mapped_field_names=None*, *pre=None*, *memoize=False*)

Bases: `snorkel.map.core.BaseMapper`

Base class for any data point to data point mapping in the pipeline.

Map data points to new data points by transforming, adding additional information, or decomposing into primitives. This module provides base classes for other operators like `TransformationFunction` and `Preprocessor`. We don't expect people to construct `Mapper` objects directly.

A `Mapper` maps an data point to a new data point, possibly with a different schema. Subclasses of `Mapper` need to implement the `run` method, which takes fields of the data point as input and outputs new fields for the mapped data point as a dictionary. The `run` method should only be called internally by the `Mapper` object, not directly by a user.

`Mapper` derivatives work for data points that have mutable attributes, like `SimpleNamespace`, `pd.Series`, or `dask.Series`. An example of a data point type without mutable fields is `pyspark.sql.Row`. Use `snorkel.map.spark.make_spark_mapper` for PySpark compatibility.

For an example of a Mapper, see `snorkel.preprocess.nlp.SpacyPreprocessor`

Parameters

- **name** (`str`) – Name of mapper
- **field_names** (`Optional[Mapping[str, str]]`) – A map from attribute names of the incoming data points to the input argument names of the `run` method. If `None`, the parameter names in the function signature are used.
- **mapped_field_names** (`Optional[Mapping[str, str]]`) – A map from output keys of the `run` method to attribute names of the output data points. If `None`, the original output keys are used.
- **pre** (`Optional[List[BaseMapper]]`) – Mappers to run before this mapper is executed
- **memoize** (`bool`) – Memoize mapper outputs?

Raises `NotImplementedError` – Subclasses must implement the `run` method

field_names

See above

mapped_field_names

See above

memoize

Memoize mapper outputs?

__init__ (*name*, *field_names=None*, *mapped_field_names=None*, *pre=None*, *memoize=False*)

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(name[, field_names, ...])</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.
<code>run(**kwargs)</code>	Run the mapping operation using the input fields.

`__call__(x)`

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters `x` (`Any`) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type `DataPoint`

`reset_cache()`

Reset the memoization cache.

Return type `None`

`run(**kwargs)`

Run the mapping operation using the input fields.

The inputs to this function are fed by extracting the fields of the input data point using the keys of `field_names`. The output field names are converted using `mapped_field_names` and added to the data point.

Returns A mapping from canonical output field names to their values.

Return type `Optional[FieldMap]`

Raises `NotImplementedError` – Subclasses must implement this method

5.4 snorkel.map.lambda_mapper

class `snorkel.map.lambda_mapper` (`name=None, pre=None, memoize=False`)

Bases: `object`

Decorate a function to define a `LambdaMapper` object.

Example

```
>>> @lambda_mapper()
... def concatenate_text(x):
...     x.article = f"{x.title} {x.body}"
...     return x
>>> isinstance(concatenate_text, LambdaMapper)
True
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(title="my title", body="my text")
>>> concatenate_text(x).article
'my title my text'
```

Parameters

- **name** (Optional[str]) – Name of mapper. If None, uses the name of the wrapped function.
- **pre** (Optional[List[BaseMapper]]) – Mappers to run before this mapper is executed
- **memoize** (bool) – Memoize mapper outputs?

memoize

Memoize mapper outputs?

`__init__` (*name=None, pre=None, memoize=False*)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__</code> ([name, pre, memoize])	Initialize self.
--	------------------

`__call__` (*f*)

Wrap a function to create a LambdaMapper.

Parameters *f* (Callable[[Any], Optional[Any]]) – Function executing the mapping operation

Returns New LambdaMapper executing operation in wrapped function

Return type *LambdaMapper*

5.5 snorkel.map.spark.make_spark_mapper

`snorkel.map.spark.make_spark_mapper` (*mapper*)

Convert Mapper to be compatible with PySpark.

Parameters *mapper* (Mapper) – Mapper to make compatible with PySpark

Return type Mapper

SNORKEL PREPROCESS PACKAGE

Preprocessors for LFs, TFs, and SFs.

<i>BasePreprocessor</i>	alias of <code>snorkel.map.core.BaseMapper</code>
<i>LambdaPreprocessor</i>	Convenience class for defining preprocessors from functions.
<i>Preprocessor</i>	Base class for preprocessors.
<i>nlp.SpacyPreprocessor</i>	Preprocessor that parses input text via a SpaCy model.
<i>spark.make_spark_preprocessor</i>	Convert <code>Mapper</code> to be compatible with PySpark.
<i>preprocessor</i>	Decorate functions to create preprocessors.

6.1 `snorkel.preprocess.BasePreprocessor`

`snorkel.preprocess.BasePreprocessor`
alias of `snorkel.map.core.BaseMapper`

6.2 `snorkel.preprocess.LambdaPreprocessor`

class `snorkel.preprocess.LambdaPreprocessor` (*name, f, pre=None, memoize=False*)
Bases: `snorkel.map.core.LambdaMapper`

Convenience class for defining preprocessors from functions.

See `snorkel.map.core.LambdaMapper` for details.

__init__ (*name, f, pre=None, memoize=False*)
Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(name, f[, pre, memoize])</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.

__call__ (*x*)
Run mapping function on input data point.
Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`,

an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters \times (Any) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type DataPoint

reset_cache ()

Reset the memoization cache.

Return type None

6.3 snorkel.preprocess.Preprocessor

```
class snorkel.preprocess.Preprocessor (name, field_names=None,
                                     mapped_field_names=None, pre=None, memoize=False)
```

Bases: snorkel.map.core.Mapper

Base class for preprocessors.

See snorkel.map.core.Mapper for details.

__init__ (name, field_names=None, mapped_field_names=None, pre=None, memoize=False)

Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(name[, field_names, ...])</code>	Initialize self.
<code>reset_cache()</code>	Reset the memoization cache.
<code>run(**kwargs)</code>	Run the mapping operation using the input fields.

__call__ (x)

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If memoize is set to True, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters \times (Any) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type DataPoint

reset_cache ()

Reset the memoization cache.

Return type None

run (**kwargs)

Run the mapping operation using the input fields.

The inputs to this function are fed by extracting the fields of the input data point using the keys of field_names. The output field names are converted using mapped_field_names and added to

the data point.

Returns A mapping from canonical output field names to their values.

Return type Optional[FieldMap]

Raises `NotImplementedError` – Subclasses must implement this method

6.4 snorkel.preprocess.nlp.SpacyPreprocessor

```
class snorkel.preprocess.nlp.SpacyPreprocessor (text_field,      doc_field,      lan-
                                             guage='en_core_web_sm',  dis-
                                             able=None,      pre=None,      memo-
                                             ize=False)
```

Bases: `snorkel.preprocess.core.Preprocessor`

Preprocessor that parses input text via a SpaCy model.

A common approach to writing LFs over text is to first use a natural language parser to decompose the text into tokens, part-of-speech tags, etc. SpaCy (<https://spacy.io/>) is a popular tool for doing this. This preprocessor adds a SpaCy `Doc` object to the data point. A `Doc` object is a sequence of `Token` objects, which contain information on lemmatization, parts-of-speech, etc. `Doc` objects also contain fields like `Doc.ents`, a list of named entities, and `Doc.noun_chunks`, a list of noun phrases. For details of SpaCy `Doc` objects and a full attribute listing, see <https://spacy.io/api/doc>.

Parameters

- **text_field** (`str`) – Name of data point text field to input
- **doc_field** (`str`) – Name of data point field to output parsed document to
- **language** (`str`) – SpaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (Optional[List[`str`]]) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run before this preprocessor is executed
- **memoize** (`bool`) – Memoize preprocessor outputs?

```
__init__ (text_field, doc_field, language='en_core_web_sm', disable=None, pre=None, memo-
         ize=False)
```

Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__</code> (text_field, doc_field[, language, ...])	Initialize self.
<code>reset_cache</code> ()	Reset the memoization cache.
<code>run</code> (text)	Run the SpaCy model on input text.

```
__call__ (x)
```

Run mapping function on input data point.

Deep copies the data point first so as not to make accidental in-place changes. If `memoize` is set to `True`, an internal cache is checked for results. If no cached results are found, the computed results are added to the cache.

Parameters **x** (Any) – Data point to run mapping function on

Returns Mapped data point of same format but possibly different fields

Return type DataPoint

reset_cache ()

Reset the memoization cache.

Return type None

run (text)

Run the SpaCy model on input text.

Parameters **text** (str) – Text of document to parse

Returns Dictionary with a single key ("doc"), mapping to the parsed SpaCy Doc object

Return type FieldMap

6.5 snorkel.preprocess.spark.make_spark_preprocessor

`snorkel.preprocess.spark.make_spark_preprocessor` (mapper)

Convert Mapper to be compatible with PySpark.

Parameters **mapper** (Mapper) – Mapper to make compatible with PySpark

Return type Mapper

6.6 snorkel.preprocess.preprocessor

class `snorkel.preprocess.preprocessor` (name=None, pre=None, memoize=False)

Bases: `snorkel.map.core.lambda_mapper`

Decorate functions to create preprocessors.

See `snorkel.map.core.lambda_mapper` for details.

Example

```
>>> @preprocessor()
... def combine_text_preprocessor(x):
...     x.article = f"{x.title} {x.body}"
...     return x
>>> from snorkel.preprocess.nlp import SpacyPreprocessor
>>> spacy_preprocessor = SpacyPreprocessor("article", "article_parsed")
```

We can now add our preprocessors to an LF.

```
>>> preprocessors = [combine_text_preprocessor, spacy_preprocessor]
>>> from snorkel.labeling.lf import labeling_function
>>> @labeling_function(pre=preprocessors)
... def article_mentions_person(x):
...     for ent in x.article_parsed.ents:
...         if ent.label_ == "PERSON":
...             return ABSTAIN
...     return NEGATIVE
```

`__init__` (*name=None, pre=None, memoize=False*)
Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__</code> (<i>name, pre, memoize</i>)	Initialize self.
---	------------------

`__call__` (*f*)

Wrap a function to create a `LambdaMapper`.

Parameters *f* (`Callable[[Any], Optional[Any]]`) – Function executing the mapping operation

Returns New `LambdaMapper` executing operation in wrapped function

Return type *LambdaMapper*

SNORKEL SLICING PACKAGE

Programmatic data set slicing: SF creation, monitoring utilities, and representation learning for slices.

<code>apply.dask.DaskSFApplier</code>	SF applier for a Dask DataFrame.
<code>sf.nlp.NLPSlicingFunction</code>	Special labeling function type for spaCy-based LFs.
<code>apply.dask.PandasParallelSFApplier</code>	Parallel SF applier for a Pandas DataFrame.
<code>PandasSFApplier</code>	SF applier for a Pandas DataFrame.
<code>SFApplier</code>	SF applier for a list of data points.
<code>SliceAwareClassifier</code>	A slice-aware classifier that supports training + scoring on slice labels.
<code>SliceCombinerModule</code>	A module for combining the weighted representations learned by slices.
<code>SlicingFunction</code>	Base class for slicing functions.
<code>apply.spark.SparkSFApplier</code>	alias of <code>snorkel.labeling.apply.spark.SparkLFApplier</code>
<code>add_slice_labels</code>	Modify a dataloader in-place, adding labels for slice tasks.
<code>convert_to_slice_tasks</code>	Add slice labels to dataloader and creates new slice tasks (including base slice).
<code>sf.nlp.nlp_slicing_function</code>	Decorator to define a NLPSlicingFunction child object from a function.
<code>slice_dataframe</code>	Return a dataframe with examples corresponding to specified SlicingFunction.
<code>slicing_function</code>	Decorator to define a SlicingFunction object from a function.

7.1 snorkel.slicing.apply.dask.DaskSFApplier

class `snorkel.slicing.apply.dask.DaskSFApplier` (*lfs*)
 Bases: `snorkel.labeling.apply.dask.DaskLFApplier`
 SF applier for a Dask DataFrame.
 See `snorkel.labeling.apply.dask.DaskLFApplier` for details.

`__init__` (*lfs*)
 Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(df[, scheduler, fault_tolerant])</code>	Label Dask DataFrame of data points with LFs.

apply (*df*, *scheduler*='processes', *fault_tolerant*=False)
Label Dask DataFrame of data points with LFs.

Parameters

- **df** (*dask.dataframe.DataFrame*) – Dask DataFrame containing data points to be labeled by LFs
- **scheduler** (Union[str, *dask.distributed.Client*]) – A Dask scheduling configuration: either a string option or a *Client*. For more information, see <https://docs.dask.org/en/stable/scheduling.html#>
- **fault_tolerant** (bool) – Output -1 if LF execution fails?

Returns Matrix of labels emitted by LFs

Return type np.ndarray

7.2 snorkel.slicing.sf.nlp.NLPSlicingFunction

class `snorkel.slicing.sf.nlp.NLPSlicingFunction` (*name*, *f*, *resources*=None, *pre*=None, *text_field*='text', *doc_field*='doc', *language*='en_core_web_sm', *disable*=None, *memoize*=True)

Bases: `snorkel.labeling.lf.nlp.BaseNLPLabelingFunction`

Special labeling function type for spaCy-based LFs.

This class is a special version of `LabelingFunction`. It has a `SpacyPreprocessor` integrated which shares a cache with all other `NLPLabelingFunction` instances. This makes it easy to define LFs that have a text input field and have logic written over spaCy `Doc` objects. Examples passed into an `NLPLabelingFunction` will have a new field which can be accessed which contains a spaCy `Doc`. By default, this field is called `doc`. A `Doc` object is a sequence of `Token` objects, which contain information on lemmatization, parts-of-speech, etc. `Doc` objects also contain fields like `Doc.ents`, a list of named entities, and `Doc.noun_chunks`, a list of noun phrases. For details of spaCy `Doc` objects and a full attribute listing, see <https://spacy.io/api/doc>.

Simple `NLPLabelingFunctions` can be defined via a decorator. See `nlp_labeling_function`.

Parameters

- **name** (str) – Name of the LF
- **f** (Callable[...], int) – Function that implements the core LF logic
- **resources** (Optional[Mapping[str, Any]]) – Labeling resources passed in to *f* via *kwargs*
- **pre** (Optional[List[BaseMapper]]) – Preprocessors to run before `SpacyPreprocessor` is executed
- **text_field** (str) – Name of data point text field to input
- **doc_field** (str) – Name of data point field to output parsed document to

- **language** (str) – spaCy model to load See <https://spacy.io/usage/models#usage>
- **disable** (Optional[List[str]]) – List of pipeline components to disable See <https://spacy.io/usage/processing-pipelines#disabling>
- **memoize** (bool) – Memoize preprocessor outputs?

Raises **ValueError** – Calling incorrectly defined preprocessors

Example

```
>>> def f(x):
...     person_ents = [ent for ent in x.doc.ents if ent.label_ == "PERSON"]
...     return len(person_ents) > 0
>>> has_person_mention = NLPslicingFunction(name="has_person_mention", f=f)
>>> has_person_mention
NLPslicingFunction has_person_mention, Preprocessors: [SpacyPreprocessor...]
```

```
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(text="The movie was good.")
>>> has_person_mention(x)
False
```

name

See above

__init__(name, f, resources=None, pre=None, text_field='text', doc_field='doc', language='en_core_web_sm', disable=None, memoize=True)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__(name, f[, resources, pre, ...])</code>	Initialize self.
---	------------------

__call__(x)
Label data point.

Runs all preprocessors, then passes preprocessed data point to LF.

Parameters **x** (Any) – Data point to label

Returns Label for data point

Return type int

7.3 snorkel.slicing.apply.dask.PandasParallelSFApplier

class snorkel.slicing.apply.dask.**PandasParallelSFApplier** (lfs)
Bases: *snorkel.labeling.apply.dask.PandasParallelLFApplier*

Parallel SF applier for a Pandas DataFrame.

See `snorkel.labeling.apply.dask.PandasParallelLFApplier` for details.

`__init__(lfs)`
 Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(df, n_parallel, scheduler, ...)</code>	Label Pandas DataFrame of data points with LFs in parallel using Dask.

apply (*df*, *n_parallel=2*, *scheduler='processes'*, *fault_tolerant=False*)
 Label Pandas DataFrame of data points with LFs in parallel using Dask.

Parameters

- **df** (DataFrame) – Pandas DataFrame containing data points to be labeled by LFs
- **n_parallel** (int) – Parallelism level for LF application. Corresponds to `npartitions` in constructed Dask DataFrame. For `scheduler="processes"`, number of processes launched. Recommended to be no more than the number of cores on the running machine.
- **scheduler** (Union[str, dask.distributed.Client]) – A Dask scheduling configuration: either a string option or a Client. For more information, see <https://docs.dask.org/en/stable/scheduling.html#>
- **fault_tolerant** (bool) – Output -1 if LF execution fails?

Returns Matrix of labels emitted by LFs

Return type np.ndarray

7.4 snorkel.slicing.PandasSFApplier

class `snorkel.slicing.PandasSFApplier` (*lfs*)
 Bases: `snorkel.labeling.apply.pandas.PandasLFApplier`

SF applier for a Pandas DataFrame.

See `snorkel.labeling.core.PandasLFApplier` for details.

`__init__(lfs)`
 Initialize self. See `help(type(self))` for accurate signature.

Return type None

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(df, progress_bar, fault_tolerant, ...)</code>	Label Pandas DataFrame of data points with LFs.

apply (*df*, *progress_bar=True*, *fault_tolerant=False*, *return_meta=False*)
 Label Pandas DataFrame of data points with LFs.

Parameters

- **df** (`DataFrame`) – Pandas `DataFrame` containing data points to be labeled by LFs
- **progress_bar** (`bool`) – Display a progress bar?
- **fault_tolerant** (`bool`) – Output `-1` if LF execution fails?
- **return_meta** (`bool`) – Return metadata from apply call?

Return type `Union[ndarray, Tuple[ndarray, ApplierMetadata]]`

Returns

- `np.ndarray` – Matrix of labels emitted by LFs
- `ApplierMetadata` – Metadata, such as fault counts, for the apply call

7.5 snorkel.slicing.SFApplier

class `snorkel.slicing.SFApplier` (*lfs*)

Bases: `snorkel.labeling.apply.core.LFApplier`

SF applier for a list of data points.

See `snorkel.labeling.core.LFApplier` for details.

__init__ (*lfs*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__(lfs)</code>	Initialize self.
<code>apply(data_points[, progress_bar, ...])</code>	Label list of data points or a NumPy array with LFs.

apply (*data_points*, *progress_bar=True*, *fault_tolerant=False*, *return_meta=False*)

Label list of data points or a NumPy array with LFs.

Parameters

- **data_points** (`Union[Sequence[Any], ndarray]`) – List of data points or NumPy array to be labeled by LFs
- **progress_bar** (`bool`) – Display a progress bar?
- **fault_tolerant** (`bool`) – Output `-1` if LF execution fails?
- **return_meta** (`bool`) – Return metadata from apply call?

Return type `Union[ndarray, Tuple[ndarray, ApplierMetadata]]`

Returns

- `np.ndarray` – Matrix of labels emitted by LFs
- `ApplierMetadata` – Metadata, such as fault counts, for the apply call

7.6 snorkel.slicing.SliceAwareClassifier

```
class snorkel.slicing.SliceAwareClassifier(base_architecture, head_dim,
                                         slice_names, input_data_key='input_data',
                                         task_name='task',
                                         scorer=<snorkel.analysis.scorer.Scorer
                                         object>, **multitask_kwargs)
```

Bases: `snorkel.classification.multitask_classifier.MultitaskClassifier`

A slice-aware classifier that supports training + scoring on slice labels.

NOTE: This model currently only supports binary classification.

Parameters

- **base_architecture** (Module) – A network architecture that accepts input data and outputs a representation
- **head_dim** (int) – Output feature dimension of the base_architecture, and input dimension of the internal prediction head: `nn.Linear(head_dim, 2)`.
- **slice_names** (List[str]) – A list of slice names that the model will accept initialize as tasks and accept as corresponding labels
- **scorer** (Scorer) – A Scorer to be used for initialization of the MultitaskClassifier superclass.
- ****multitask_kwargs** – Arbitrary keyword arguments to be passed to the MultitaskClassifier superclass.

base_task

A base `snorkel.classification.Task` that the model will learn. This becomes a `master_head_module` that combines slice tasks information. For more, see `snorkel.slicing.convert_to_slice_tasks`.

slice_names

See above

```
__init__(base_architecture, head_dim, slice_names, input_data_key='input_data',
         task_name='task', scorer=<snorkel.analysis.scorer.Scorer object>, **multitask_kwargs)
Initialize self. See help(type(self)) for accurate signature.
```

Return type None

Methods

<code>__init__(base_architecture, head_dim, ..., [...])</code>	Initialize self.
<code>add_module(name, module)</code>	Adds a child module to the current module.
<code>add_task(task)</code>	Add a single task to the network.
<code>apply(fn)</code>	Applies <code>fn</code> recursively to every submodule (as returned by <code>.children()</code>) as well as self.
<code>buffers([recurse])</code>	Returns an iterator over module buffers.
<code>calculate_loss(X_dict, Y_dict)</code>	Calculate the loss for each task and the number of data points contributing.
<code>children()</code>	Returns an iterator over immediate children modules.
<code>cpu()</code>	Moves all model parameters and buffers to the CPU.
<code>cuda([device])</code>	Moves all model parameters and buffers to the GPU.

Continued on next page

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<code>double()</code>	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval()</code>	Sets the module in evaluation mode.
<code>extra_repr()</code>	Set the extra representation of the module
<code>float()</code>	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward(X_dict, task_names)</code>	Do a forward pass through the network for all specified tasks.
<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load(model_path)</code>	Load a saved model from the provided file path and moves it to a device.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>make_slice_data_loader(dataset, S, ...)</code>	Create DictDataLoader with slice labels, initialized from specified dataset.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.
<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>predict(data_loader[, return_preds, remap_labels])</code>	Calculate probabilities, (optionally) predictions, and pull out gold labels.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>save(model_path)</code>	Save the model to the specified file path.
<code>score(data_loaders[, remap_labels, as_dataframe])</code>	Calculate scores for the provided DictDataLoaders.
<code>score_slices(data_loaders[, as_dataframe])</code>	Scores appropriate slice labels using the overall prediction head.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

`dump_patches`

add_task (*task*)

Add a single task to the network.

Parameters **task** (`Task`) – A `Task` to add

Return type `None`

calculate_loss (*X_dict*, *Y_dict*)

Calculate the loss for each task and the number of data points contributing.

Parameters

- **X_dict** (`Dict[str, Any]`) – A dict of data fields
- **Y_dict** (`Dict[str, Tensor]`) – A dict from task names to label sets

Returns A dict of losses by task name and seen examples by task name

Return type `Dict[str, torch.Tensor]`, `Dict[str, float]`

forward (*X_dict*, *task_names*)

Do a forward pass through the network for all specified tasks.

Parameters

- **X_dict** (`Dict[str, Any]`) – A dict of data fields
- **task_names** (`Iterable[str]`) – The names of the tasks to execute the forward pass for

Returns A dict mapping each operation name to its corresponding output

Return type `OutputDict`

Raises

- **TypeError** – If an `Operation` input has an invalid type
- **ValueError** – If a specified `Operation` failed to execute

load (*model_path*)

Load a saved model from the provided file path and moves it to a device.

Parameters **model_path** (`str`) – The path to a saved model

Return type `None`

make_slice_dataloader (*dataset*, *S*, ***dataloader_kwargs*)

Create `DictDataLoader` with slice labels, initialized from specified dataset.

Parameters

- **dataset** (`DictDataset`) – A `DictDataset` that will be converted into a slice-aware dataloader
- **S** (`recarray`) – A `[num_examples, num_slices]` slice matrix indicating whether each example is in every slice
- **slice_names** – A list of slice names corresponding to columns of `S`
- **dataloader_kwargs** (`Any`) – Arbitrary kwargs to be passed to `DictDataLoader` See `DictDataLoader.__init__`.

Return type `DictDataLoader`

predict (*dataloader*, *return_preds=False*, *remap_labels={}*)

Calculate probabilities, (optionally) predictions, and pull out gold labels.

Parameters

- **dataloader** (*DictDataLoader*) – A *DictDataLoader* to make predictions for
- **return_preds** (*bool*) – If True, include predictions in the return dict (not just probabilities)
- **remap_labels** (*Dict[str, Optional[str]]*) – A dict specifying which labels in the dataset’s *Y_dict* (key) to remap to a new task (value)

Returns A dictionary mapping label type (‘golds’, ‘probs’, ‘preds’) to values

Return type *Dict[str, Dict[str, torch.Tensor]]*

save (*model_path*)

Save the model to the specified file path.

Parameters **model_path** (*str*) – The path where the model should be saved

Raises **BaseException** – If the *torch.save()* method fails

Return type *None*

score (*dataloaders*, *remap_labels={}*, *as_dataframe=False*)

Calculate scores for the provided *DictDataLoaders*.

Parameters

- **dataloaders** (*List[DictDataLoader]*) – A list of *DictDataLoaders* to calculate scores for
- **remap_labels** (*Dict[str, Optional[str]]*) – A dict specifying which labels in the dataset’s *Y_dict* (key) to remap to a new task (value)
- **as_dataframe** (*bool*) – A boolean indicating whether to return results as pandas *DataFrame* (True) or dict (False)

Returns A dictionary mapping metric names to corresponding scores Metric names will be of the form “task/dataset/split/metric”

Return type *Dict[str, float]*

score_slices (*dataloaders*, *as_dataframe=False*)

Scores appropriate slice labels using the overall prediction head.

In other words, uses *base_task* (NOT *slice_tasks*) to evaluate slices.

In practice, we’d like to use a final prediction from a *_single_task* head. To do so, *self.base_task* leverages reweighted slice representation to make a prediction. In this method, we remap all slice-specific pred labels to *self.base_task* for evaluation.

Parameters

- **dataloaders** (*List[DictDataLoader]*) – A list of *DictDataLoaders* to calculate scores for
- **as_dataframe** (*bool*) – A boolean indicating whether to return results as pandas *DataFrame* (True) or dict (False)
- **eval_slices_on_base_task** – A boolean indicating whether to remap slice labels to base task. Otherwise, keeps evaluation of slice labels on slice-specific heads.

Returns A dictionary mapping metric names to corresponding scores. Metric names will be of the form “task/dataset/split/metric”

Return type Dict[str, float]

7.7 snorkel.slicing.SliceCombinerModule

```
class snorkel.slicing.SliceCombinerModule (slice_ind_key='_ind_head',
                                           slice_pred_key='_pred_head',
                                           slice_pred_feat_key='_pred_transform', temperature=1.0)
```

Bases: torch.nn.modules.module.Module

A module for combining the weighted representations learned by slices.

Intended for use with the MultitaskClassifier including:

- Indicator operations
- Prediction operations
- Prediction transform features

NOTE: This module currently only handles binary labels.

Parameters

- **slice_ind_key** (str) – Suffix of operation corresponding to the slice indicator heads
- **slice_pred_key** (str) – Suffix of operation corresponding to the slice predictor heads
- **slice_pred_feat_key** (str) – Suffix of operation corresponding to the slice predictor features heads
- **temperature** (float) – Temperature constant for scaling the weighting between indicator prediction and predictor confidences: $\text{SoftMax}(\text{indicator_pred} * \text{predictor_confidence} / \text{tau})$

slice_ind_key

See above

slice_pred_key

See above

slice_pred_feat_key

See above

```
__init__ (slice_ind_key='_ind_head', slice_pred_key='_pred_head',
          slice_pred_feat_key='_pred_transform', temperature=1.0)
Initialize self. See help(type(self)) for accurate signature.
```

Return type None

Methods

<code>__init__</code> ([slice_ind_key, slice_pred_key, ...])	Initialize self.
<code>add_module</code> (name, module)	Adds a child module to the current module.
<code>apply</code> (fn)	Applies fn recursively to every submodule (as returned by <code>.children()</code>) as well as self.

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<code>buffers([recurse])</code>	Returns an iterator over module buffers.
<code>children()</code>	Returns an iterator over immediate children modules.
<code>cpu()</code>	Moves all model parameters and buffers to the CPU.
<code>cuda([device])</code>	Moves all model parameters and buffers to the GPU.
<code>double()</code>	Casts all floating point parameters and buffers to <code>double</code> datatype.
<code>eval()</code>	Sets the module in evaluation mode.
<code>extra_repr()</code>	Set the extra representation of the module
<code>float()</code>	Casts all floating point parameters and buffers to <code>float</code> datatype.
<code>forward(output_dict)</code>	Reweight and combine predictor representations given output dict.
<code>half()</code>	Casts all floating point parameters and buffers to <code>half</code> datatype.
<code>load_state_dict(state_dict[, strict])</code>	Copies parameters and buffers from <code>state_dict</code> into this module and its descendants.
<code>modules()</code>	Returns an iterator over all modules in the network.
<code>named_buffers([prefix, recurse])</code>	Returns an iterator over module buffers, yielding both the name of the buffer as well as the buffer itself.
<code>named_children()</code>	Returns an iterator over immediate children modules, yielding both the name of the module as well as the module itself.
<code>named_modules([memo, prefix])</code>	Returns an iterator over all modules in the network, yielding both the name of the module as well as the module itself.
<code>named_parameters([prefix, recurse])</code>	Returns an iterator over module parameters, yielding both the name of the parameter as well as the parameter itself.
<code>parameters([recurse])</code>	Returns an iterator over module parameters.
<code>register_backward_hook(hook)</code>	Registers a backward hook on the module.
<code>register_buffer(name, tensor)</code>	Adds a persistent buffer to the module.
<code>register_forward_hook(hook)</code>	Registers a forward hook on the module.
<code>register_forward_pre_hook(hook)</code>	Registers a forward pre-hook on the module.
<code>register_parameter(name, param)</code>	Adds a parameter to the module.
<code>share_memory()</code>	
<code>state_dict([destination, prefix, keep_vars])</code>	Returns a dictionary containing a whole state of the module.
<code>to(*args, **kwargs)</code>	Moves and/or casts the parameters and buffers.
<code>train([mode])</code>	Sets the module in training mode.
<code>type(dst_type)</code>	Casts all parameters and buffers to <code>dst_type</code> .
<code>zero_grad()</code>	Sets gradients of all model parameters to zero.

Attributes

<code>dump_patches</code>	
---------------------------	--

7.8 snorkel.slicing.SlicingFunction

class `snorkel.slicing.SlicingFunction` (*name, f, resources=None, pre=None*)

Bases: `snorkel.labeling.lf.core.LabelingFunction`

Base class for slicing functions.

See `snorkel.labeling.lf.LabelingFunction` for details.

__init__ (*name, f, resources=None, pre=None*)

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

<code>__init__</code> (<i>name, f[, resources, pre]</i>)	Initialize self.
--	------------------

__call__ (*x*)

Label data point.

Runs all preprocessors, then passes preprocessed data point to LF.

Parameters **x** (Any) – Data point to label

Returns Label for data point

Return type `int`

7.9 snorkel.slicing.apply.spark.SparkSFApplier

`snorkel.slicing.apply.spark.SparkSFApplier`

alias of `snorkel.labeling.apply.spark.SparkLFApplier`

7.10 snorkel.slicing.add_slice_labels

`snorkel.slicing.add_slice_labels` (*dataloader, base_task, S*)

Modify a dataloader in-place, adding labels for slice tasks.

Parameters

- **dataloader** (`DictDataLoader`) – A `DictDataLoader` whose `dataset.Y_dict` attribute will be modified in place
- **base_task** (`Task`) – The `Task` for which we want corresponding slice tasks/labels
- **S** (`recarray`) – A `recarray` (output of `SFApplier`) containing data fields with slice indicator information

Return type `None`

7.11 snorkel.slicing.convert_to_slice_tasks

`snorkel.slicing.convert_to_slice_tasks` (*base_task*, *slice_names*)

Add slice labels to dataloader and creates new slice tasks (including base slice).

Each slice will get two slice-specific heads: - an indicator head that learns to identify when DataPoints are in that slice - a predictor head that is trained on only members of that slice

The base task's head is replaced by a master head that makes predictions based on a combination of the predictor heads' predictions that are weighted by the indicator heads' prediction confidences.

WARNING: The current implementation pollutes the `module_pool`—the indicator task's `module_pool` includes predictor modules and vice versa since both are modified in place. This does not affect the result because the op sequences dictate which modules get used, and those do not include the extra modules. An alternative would be to make separate copies of the module pool for each, but that wastes time and memory extra copies of (potentially very large) modules that will be merged in a moment away in the model since they have the same name. We leave resolution of this issue for a future release.

Parameters

- **base_task** (`Task`) – Task for which we are adding slice tasks. As noted in the WARNING, this task's `module_pool` will currently be modified in place for efficiency purposes.
- **slice_names** (`List[str]`) – List of slice names corresponding to the columns of the slice matrix.

Returns Contains original `base_task`, `pred/ind` tasks for the base slice, and `pred/ind` tasks for each of the specified `slice_names`

Return type `List[Task]`

7.12 snorkel.slicing.sf.nlp.nlp_slicing_function

```
class snorkel.slicing.sf.nlp.nlp_slicing_function (name=None, resources=None,
                                                pre=None, text_field='text',
                                                doc_field='doc', language='en_core_web_sm',
                                                disable=None, memoize=True)
```

Bases: `snorkel.labeling.lf.nlp.base_nlp_labeling_function`

Decorator to define a `NLPSlicingFunction` child object from a function.

TODO: Implement a common parent decorator for Snorkel operators

```
__init__ (name=None, resources=None, pre=None, text_field='text', doc_field='doc', lan-
          guage='en_core_web_sm', disable=None, memoize=True)
```

Initialize self. See `help(type(self))` for accurate signature.

Return type `None`

Methods

```
__init__ ([name, resources, pre, text_field, ...]) Initialize self.
```

```
__call__ (f)
    Wrap a function to create an BaseNLPLabelingFunction.
```

Parameters `f` (Callable[... , int]) – Function that implements the core NLP LF logic

Returns New BaseNLPLabelingFunction executing logic in wrapped function

Return type BaseNLPLabelingFunction

7.13 snorkel.slicing.slice_dataframe

`snorkel.slicing.slice_dataframe` (*df*, *slicing_function*)

Return a dataframe with examples corresponding to specified SlicingFunction.

Parameters

- **df** (DataFrame) – A pandas DataFrame that will be sliced
- **slicing_function** (SlicingFunction) – SlicingFunction which will operate over df to return a subset of examples; function returns a subset of data for which `slicing_function` output is True

Returns A DataFrame including only examples belonging to slice_name

Return type pd.DataFrame

7.14 snorkel.slicing.slicing_function

`class snorkel.slicing.slicing_function` (*name=None*, *resources=None*, *pre=None*)

Bases: object

Decorator to define a SlicingFunction object from a function.

Parameters

- **name** (Optional[str]) – Name of the SF
- **resources** (Optional[Mapping[str, Any]]) – Slicing resources passed in to `f` via kwargs
- **preprocessors** – Preprocessors to run on data points before SF execution

Examples

```
>>> @slicing_function()
... def f(x):
...     return x.a > 42
>>> f
SlicingFunction f, Preprocessors: []
>>> from types import SimpleNamespace
>>> x = SimpleNamespace(a=90, b=12)
>>> f(x)
True
```

```
>>> @slicing_function(name="my_sf")
... def g(x):
...     return 0 if x.a > 42 else -1
>>> g
SlicingFunction my_sf, Preprocessors: []
```

`__init__` (*name=None, resources=None, pre=None*)
Initialize self. See help(type(self)) for accurate signature.

Return type None

Methods

<code>__init__</code> ([name, resources, pre])	Initialize self.
--	------------------

`__call__` (*f*)

Wrap a function to create a `SlicingFunction`.

Parameters *f* (Callable[... , int]) – Function that implements the core LF logic

Returns New `SlicingFunction` executing logic in wrapped function

Return type *SlicingFunction*

SNORKEL UTILS PACKAGE

General machine learning utilities shared across Snorkel.

<code>filter_labels</code>	Filter out examples from arrays based on specified labels to filter.
<code>preds_to_probs</code>	Convert an array of predictions into an array of probabilistic labels.
<code>probs_to_preds</code>	Convert an array of probabilistic labels into an array of predictions.
<code>to_int_label_array</code>	Convert an array to a (possibly flattened) array of ints.

8.1 snorkel.utils.filter_labels

`snorkel.utils.filter_labels` (*label_dict*, *filter_dict*)

Filter out examples from arrays based on specified labels to filter.

The most common use of this method is to remove examples whose gold label is unknown (marked with a -1) or examples whose predictions were abstains (also -1) before calculating metrics.

NB: If an example matches the filter criteria for any label set, it will be removed from all label sets (so that the returned arrays are of the same size and still aligned).

Parameters

- **label_dict** (`Dict[str, ndarray]`) – A mapping from label set name to the array of labels. The arrays in a `label_dict.values()` are assumed to be aligned.
- **filter_dict** (`Dict[str, List[int]]`) – A mapping from label set name to the labels that should be filtered out for that label set.

Returns A mapping with the same keys as `label_dict` but with filtered arrays as values.

Return type `Dict[str, np.ndarray]`

Example

```
>>> golds = np.array([-1, 0, 0, 1, 0])
>>> preds = np.array([0, 0, 0, 1, -1])
>>> filtered = filter_labels(
...     label_dict={"golds": golds, "preds": preds},
...     filter_dict={"golds": [-1], "preds": [-1]}
... )
```

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```
>>> filtered["golds"]
array([0, 0, 1])
>>> filtered["preds"]
array([0, 0, 1])
```

8.2 snorkel.utils.preds_to_probs

`snorkel.utils.preds_to_probs` (*preds*, *num_classes*)

Convert an array of predictions into an array of probabilistic labels.

Parameters `pred` – A [*num_datapoints*] or [*num_datapoints*, 1] array of predictions

Returns A [*num_datapoints*, *num_classes*] array of probabilistic labels with probability of 1.0 in the column corresponding to the prediction

Return type `np.ndarray`

8.3 snorkel.utils.probs_to_preds

`snorkel.utils.probs_to_preds` (*probs*, *tie_break_policy*='random', *tol*=1e-05)

Convert an array of probabilistic labels into an array of predictions.

Policies to break ties include: “abstain”: return an abstain vote (-1) “true-random”: randomly choose among the tied options “random”: randomly choose among tied option using deterministic hash

NOTE: if `tie_break_policy`="true-random", repeated runs may have slightly different results due to difference in broken ties

Parameters

- **prob** – A [*num_datapoints*, *num_classes*] array of probabilistic labels such that each row sums to 1.
- **tie_break_policy** (`str`) – Policy to break ties when converting probabilistic labels to predictions
- **tol** (`float`) – The minimum difference among probabilities to be considered a tie

Returns A [*n*] array of predictions (integers in [0, ..., *num_classes* - 1])

Return type `np.ndarray`

Examples

```
>>> probs_to_preds(np.array([[0.5, 0.5, 0.5]]), tie_break_policy="abstain")
array([-1])
>>> probs_to_preds(np.array([[0.8, 0.1, 0.1]]))
array([0])
```

8.4 snorkel.utils.to_int_label_array

`snorkel.utils.to_int_label_array(X, flatten_vector=True)`

Convert an array to a (possibly flattened) array of ints.

Cast all values to ints and possibly flatten `[n, 1]` arrays to `[n]`. This method is typically used to sanitize labels before use with analysis tools or metrics that expect 1D arrays as inputs.

Parameters

- **x** (`ndarray`) – An array to possibly flatten and possibly cast to int
- **flatten_vector** (`bool`) – If True, flatten array into a 1D array

Returns The converted array

Return type `np.ndarray`

Raises **ValueError** – Provided input could not be converted to an `np.ndarray`

Symbols

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