

scanpy.tl.umap

```
scanpy.tl.umap(adata, min_dist=0.5, spread=1.0, n_components=2, maxiter=None, alpha=1.0,
gamma=1.0, negative_sample_rate=5, init_pos='spectral', random_state=0, a=None, b=None, copy=False,
method='umap', neighbors_key=None)
```

Embed the neighborhood graph using UMAP [McInnes18].

UMAP (Uniform Manifold Approximation and Projection) is a manifold learning technique suitable for visualizing high-dimensional data. Besides tending to be faster than tSNE, it optimizes the embedding such that it best reflects the topology of the data, which we represent throughout Scanpy using a neighborhood graph. tSNE, by contrast, optimizes the distribution of nearest-neighbor distances in the embedding such that these best match the distribution of distances in the high-dimensional space. We use the implementation of [umap-learn](#) [McInnes18]. For a few comparisons of UMAP with tSNE, see this [preprint](#).

Parameters:

adata : `AnnData`

Annotated data matrix.

min_dist : `float` (default: `0.5`)

The effective minimum distance between embedded points. Smaller values will result in a more clustered/clumped embedding where nearby points on the manifold are drawn closer together, while larger values will result on a more even dispersal of points. The value should be set relative to the `spread` value, which determines the scale at which embedded points will be spread out. The default of in the `umap-learn` package is 0.1.

spread : `float` (default: `1.0`)

The effective scale of embedded points. In combination with `min_dist` this determines how clustered/clumped the embedded points are.

n_components : `int` (default: `2`)

The number of dimensions of the embedding.

maxiter : `optional [int]` (default: `None`)

The number of iterations (epochs) of the optimization. Called `n_epochs` in the original UMAP.

alpha : `float` (default: `1.0`)

The initial learning rate for the embedding optimization.

gamma : `float` (default: `1.0`)

Weighting applied to negative samples in low dimensional embedding optimization. Values higher than one will result in greater weight being given to negative samples.

negative_sample_rate : `int` (default: `5`)

The number of negative edge/1-simplex samples to use per positive edge/1-simplex sample in optimizing the low dimensional embedding.

init_pos : `Union [Literal ['paga', 'spectral', 'random'], ndarray, None]` (default: `'spectral'`)

How to initialize the low dimensional embedding. Called `init` in the original UMAP. Options are:

- Any key for `adata.obsm`.
 - 'paga': positions from `paga()`.
 - 'spectral': use a spectral embedding of the graph.
 - 'random': assign initial embedding positions at random.
 - A numpy array of initial embedding positions.
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random_state : `Union [None, int, RandomState]` (default: `0`)

If `int`, `random_state` is the seed used by the random number generator; If `RandomState` or `Generator`, `random_state` is the random number generator; If `None`, the random number generator is the `RandomState` instance used by `np.random`.

a : `Optional [float]` (default: `None`)

More specific parameters controlling the embedding. If `None` these values are set automatically as determined by `min_dist` and `spread`.

b : `Optional [float]` (default: `None`)

More specific parameters controlling the embedding. If `None` these values are set automatically as determined by `min_dist` and `spread`.

copy : `bool` (default: `False`)

Return a copy instead of writing to adata.

method : `Literal` [`'umap'`, `'rapids'`] (default: `'umap'`)

Use the original 'umap' implementation, or 'rapids' (experimental, GPU only)

neighbors_key : `Optional` [`str`] (default: `None`)

If not specified, umap looks `.uns['neighbors']` for neighbors settings and `.obsp['connectivities']` for connectivities (default storage places for `pp.neighbors`). If specified, umap looks `.uns[neighbors_key]` for neighbors settings and `.obsp[.uns[neighbors_key]]['connectivities_key']` for connectivities.

Return type:

`Optional` [`Anndata`]

Returns:

: Depending on `copy`, returns or updates `adata` with the following fields.

X_umap : `adata.obsm` field

UMAP coordinates of data.