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# **dendrogram**

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## DENDROGRAM: N-DIMENSIONAL DENDROGRAM

dendrogram is a toolkit for creating N-dimensional (ND) dendrogram. See [documentation](#) for details.

### 1.1 Table of Contents

- *Intro*
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### 1.2 Intro

*Placeholder*

### 1.3 Install

The prerequisites of dendrogram are

```
python >= 3.8
numpy >= 1.18
```

Lower versions may also work (and higher versions may not work). Please [raise an issue](#) if it doesn't work for you. Next, you can `git clone` the source package from [GitHub](#):

```
$ git clone https://github.com/EnthalpyBill/Dendrogram.git
```

To build and install dendrogram, `cd` the folder and `pip install` it:

```
$ cd Dendrogram/
$ pip install -e .
```

The `-e` command allows you to make changes to the code. Remove it if you don't want to do so. `dendrogram` has not been published to PyPI yet.

## 1.4 Usage

To use the package, import it as

```
>>> import dendrogram as dg
```

Let's consider a simple two-dimensional bimodal data.

```
>>> data = np.array([[2,1], [1,2]])
>>> print(data)
[[2 1]
 [1 2]]
```

We can easily generate the dendrogram tree with the following command:

```
>>> tree = makeTree(data, min_value=0)
```

`min_value` specifies the minimum value to consider when making the tree, and `print_progress` determines whether to print the progress or not. Other arguments include

- `min_delta` (scalar, default to 0): Lag to be ignored.
- `min_npix` (int, default to 1): Minimum number of pixels to form a cluster.
- `num_level` (int, default to 100): Number of levels.
- `print_progress` (bool, default to False): Whether to print progress or not.

The `makeTree()` method returns a `dendrogram.structureTree.clusterTree` object. To visualize it, use the following command to show the topology of the tree:

```
>>> tp = tree.topology()
└─(-1)
  └─(2)
    └─(0)
      └─(1)
```

As expected, two branches labeled 0 and 1 illustrates the bimodality. See [Module API](#) for more details about `makeTree()`.

## 1.5 Contribute

Feel free to dive in! [Raise an issue](#) or submit pull requests.

### 1.5.1 Authors

- @mxmintaka (Xi Meng)
- @EnthalpyBill (Bill Chen)

### 1.5.2 Maintainers

- @EnthalpyBill (Bill Chen)

## 1.6 License

dendrogram is available at [GitHub](#) under the [MIT](#) license.





## MODULE API

### 2.1 `dendrogram.lattice` module

An N-dimensional lattice class with an `identify_cluster` method.

**class** `dendrogram.lattice.latticeND` (*data*, *level*)

Bases: `object`

An N-dimensional lattice class.

**property** `shape`

Shape of the lattice.

**Type** *numpy.ndarray* of int

**property** `dim`

Dimension of the lattice.

**Type** int

**property** `len`

Total number of elements in the lattice.

**Type** int

**property** `lattice`

Area occupied by the lattice.

**Type** *numpy.ndarray* of int

**property** `label`

Label of clusters.

**Type** *numpy.ndarray* of int

**identify\_cluster** ()

Identify clusters in the lattice.

A cluster is a group of connected (neighboring) pixels.

**Returns** Label of clusters.

**Return type** *numpy.ndarray* of int

## 2.2 dendrogram.structureTree module

A tree class and a makeTree function.

**class** dendrogram.structureTree.**clusterTree** (*label, mask, isleaf=True*)

Bases: object

A tree class.

---

**Note:** *clusterTree* can be either the tree itself or the branch of a tree.

---

**property label**

Label of this tree/branch.

**Type** int

**property mask**

Area occupied by this tree/branch.

**Type** *numpy.ndarray* of bool

**property isleaf**

Whether this is a leaf or not.

**Type** bool

**property branches**

All branches of the tree. Empty if this is a branch.

**Type** dict of int

**property children**

Children of this branch/tree. Empty if this is a leaf.

**Type** dict of int

**property parent**

Parent of this branch. Empty if this is a tree.

**Type** dict of int

**create\_leaf** (*label, mask*)

Create a new leaf to the tree.

---

**Note:** This method does *not* connect the new leaf to any of the presenting branch!

---

### Parameters

- **label** (*int*) – Label of the new leaf.
- **mask** (*numpy.ndarray* of bool) – The area occupied by the new leaf.

**merge\_branch** (*label, mask, branch*)

Merge many old branches to a new branch.

---

**Note:** Here, “merge” means setting the new branch to be the parent of old branches, *not* removing them!

---

**Parameters**

- **label** (*int*) – Label of the new branch.
- **mask** (*numpy.ndarray* of *bool*) – The area occupied by the new branch.
- **branch** (*set or list of int*) – Labels of branches to be merged.

**merge\_final** (*branch*)

Merge final branches to the tree.

---

**Note:** Even if there is only one final branch, we still need to merge (or, more properly, “link”) it to the tree. Mind the difference between “tree” and “branch”.

---

**Parameters branch** (*set or list of int*) – Labels of branches to be merged.**topology** (*stdout=True*)

Print topology of the tree in pure text.

---

**Note:** Applying this method to large (with more than 100 branches) or deep (with more than 100 levels) trees is not recommend.

---

**Parameters stdout** (*bool*) – Whether to print to screen or not.**Returns** Visualized topology of this tree.**Return type** *str*

`dendrogram.structureTree.makeTree` (*data*, *min\_value*, *min\_delta=0*, *min\_npix=1*,  
*num\_level=100*, *print\_progress=False*)

Make dendrogram tree from N-dimensional data.

---

**Note:** Applying this method to large (with more than 100 branches) or deep (with more than 100 levels) trees is not recommend.

---

**Parameters**

- **data** (*numpy.ndarray* of *scalar*) – Data to make dendrogram tree.
- **min\_value** (*scalar*) – Minimum value to consider.
- **min\_delta** (*scalar*, *default to 0*) – Lag to be ignored.
- **min\_npix** (*int*, *default to 1*) – Minimum number of pixels to form a cluster.
- **num\_level** (*int*, *default to 100*) – Number of levels.
- **print\_progress** (*bool*, *default to False*) – Whether to print progress or not.

**Returns** Tree for the dendrogram.**Return type** *clusterTree*

## Examples

Consider a simple two-dimensional bimodal data, let's generate the tree with *min\_value=0*:

```
>>> data = np.array([[2,1], [1,2]])
>>> tree = makeTree(data, min_value=0)
```

To check the result, we can print the topology of tree:

```
>>> tp = tree.topology()
└─(-1)
  └─(2)
    └─(0)
    └─(1)
```

As expected, two branches 0 and 1 illustrates the bimodality. Similarly, the script below generates dendrogram for a three-peak distribution:

```
>>> data = np.array([[3,1,1], [1,1,1], [2,1,3]])
>>> tree = makeTree(data, min_value=0)
>>> tp = tree.topology()
└─(-1)
  └─(3)
    └─(0)
    └─(1)
    └─(2)
```

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