
treelib Documentation

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Xiaming Chen

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Tree data structure is an important data structure in computer programming languages. It has important applications where hierarchical data connections are present such as computer folder structure and decision-tree algorithm in Machine Learning. Thus **treelib** is created to provide an efficient implementation of tree data structure in Python.

The main features of *treelib* includes:

- Simple to use in both python 2 and 3.
- Efficient operation of node indexing with the benefit of dictionary type.
- Support various tree operations like **traversing, insertion, deletion, node moving, shallow/deep copying, subtree cutting** etc.
- Support user-defined data payload to accelerate your model construction.
- Has pretty tree showing and text/json dump for pretty show and offline analysis.

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CHAPTER 1

Install

The rapidest way to install treelib is using the package management tools like `easy_install` or `pip` with command

```
$ sudo easy_install -U treelib
```

or the setup script

```
$ sudo python setup.py install
```

Note: With the package management tools, the hosted version may be falling behind current development branch on [Github](#). If you encounter some problems, try the freshest version on Github or open [issues](#) to let me know your problem.

This *treelib* is a simple module containing only two classes: `Node` and `Tree`. `Tree` is a self-contained structure with some nodes and connected by branches. One tree has and only has one root, while a node (except root) has several children and merely one parent.

Note: To solve the string compatibility between Python 2.x and 3.x, *treelib* follows the way of porting Python 3.x to 2/3. That means, all strings are manipulated as unicode and you do not need `u''` prefix anymore. The impacted functions include `str()`, `show()` and `save2file()` routines. But if your data contains non-ascii characters and Python 2.x is used, you have to trigger the compatibility by declaring `unicode_literals` in the code:

```
>>> from __future__ import unicode_literals
```

2.1 Node Objects

class `treelib.Node` (`[tag[, identifier[, expanded]]]`)

A *Node* object contains basic properties such as node identifier, node tag, parent node, children nodes etc., and some operations for a node.

Class attributes are:

`Node.ADD`

Addition mode for method `update_fpointer()`.

`Node.DELETE`

Deletion mode for method `update_fpointer()`.

`Node.INSERT`

Behave in the same way with `Node.ADD` since version 1.1.

Instance attributes:

`node.identifier`

The unique ID of a node within the scope of a tree. This attribute can be accessed and modified with `.` and `=` operator respectively.

`node.tag`

The readable node name for human. This attribute can be accessed and modified with `.` and `=` operator respectively.

`node.bpointer`

The parent ID of a node. This attribute can be accessed and modified with `.` and `=` operator respectively.

`node.fpointer`

With a getting operator, a list of IDs of node's children is obtained. With a setting operator, the value can be list, set, or dict. For list or set, it is converted to a list type by the package; for dict, the keys are treated as the node IDs.

Instance methods:

`node.is_leaf()`

Check if the node has children. Return False if the `fpointer` is empty or None.

`node.is_root()`

Check if the node is the root of present tree.

`node.update_bpointer(nid)`

Set the parent (indicated by the `nid` parameter) of a node.

`node.update_fpointer(nid, mode=Node.ADD)`

Update the children list with different modes: addition (`Node.ADD` or `Node.INSERT`) and deletion (`Node.DELETE`).

2.2 Tree Objects

class `node.Tree` (*tree=None, deep=False*)

The *Tree* object defines the tree-like structure based on *Node* objects. A new tree can be created from scratch without any parameter or a shallow/deep copy of another tree. When `deep=True`, a deepcopy operation is performed on feeding `tree` parameter and *more memory is required to create the tree*.

Class attributes are:

`Tree.ROOT`

Default value for the `level` parameter in tree's methods.

`Tree.DEPTH`

The depth-first search mode for tree.

`Tree.WIDTH`

The width-first search mode for tree.

`Tree.ZIGZAG`

The *ZIGZAG* *search* mode for tree.

Instance attributes:

`tree.root`

Get or set the ID of the root. This attribute can be accessed and modified with `.` and `=` operator respectively.

Instance methods:

`tree.size()`

Get the number of nodes in this tree.

`tree.contains(nid)`

Check if the tree contains given node.

`tree.parent(nid)`
Obtain specific node's parent (Node instance). Return None if the parent is None or does not exist in the tree.

`tree.all_nodes()`
Get the list of all the nodes randomly belonging to this tree.

`tree.depth()`
Get depth of the tree.

`tree.leaves(nid)`
Get leaves from given node.

`tree.add_node(node[, parent])`
Add a new node object to the tree and make the parent as the root by default.

`tree.create_node(tag[, identifier[, parent]])`
Create a new node and add it to this tree.

`tree.expand_tree([nid[, mode[, filter[, key[, reverse]]]])`
Traverse the tree nodes with different modes. `nid` refers to the expanding point to start; `mode` refers to the search mode (Tree.DEPTH, Tree.WIDTH); `filter` refers to the function of one variable to act on the Node object; `key`, `reverse` are present to sort :class:Node objects at the same level.

`tree.get_node(nid)`
Get the object of the node with ID of `nid` An alternative way is using '[]' operation on the tree. But small difference exists between them: the `get_node()` will return None if `nid` is absent, whereas '[]' will raise `KeyError`.

`tree.is_branch(nid)`
Get the children (only sons) list of the node with ID == `nid`.

`tree.siblings(nid)`
Get all the siblings of given `nid`.

`tree.move_node(source, destination)`
Move node (source) from its parent to another parent (destination).

`tree.paste(nid, new_tree)`
Paste a new tree to an existing tree, with `nid` becoming the parent of the root of this new tree.

`tree.remove_node(nid)`
Remove a node and free the memory along with its successors.

`tree.link_past_node(nid)`
Remove a node and link its children to its parent (root is not allowed).

`tree.rsearch(nid[, filter])`
Search the tree from `nid` to the root along links reservedly. Parameter `filter` refers to the function of one variable to act on the Node object.

`tree.show([nid[, level[, idhidden[, filter[, key[, reverse[, line_type]]]])`
Print the tree structure in hierarchy style. `nid` refers to the expanding point to start; `level` refers to the node level in the tree (root as level 0); `idhidden` refers to hiding the node ID when printing; `filter` refers to the function of one variable to act on the Node object; `key`, `reverse` are present to sort Node object in the same level.

You have three ways to output your tree data, i.e., stdout with `show()`, plain text file with `save2file()`, and json string with `to_json()`. The former two use the same backend to generate a string of tree structure in a text graph.

Version >= 1.2.7a: you can also specify the `line_type` parameter (now supporting 'ascii' [default], 'ascii-ex', 'ascii-exr', 'ascii-em', 'ascii-emv', 'ascii-emh') to the change graphical form.

`tree.subtree(nid)`

Return a soft copy of the subtree with `nid` being the root. The softness means all the nodes are shared between subtree and the original.

`tree.remove_subtree(nid)`

Return a subtree with `nid` being the root, and remove all nodes in the subtree from the original one.

`tree.save2file(filename[, nid[, level[, idhidden[, filter[, key[, reverse]]]]]])`

Save the tree into file for offline analysis.

`tree.to_json()`

To format the tree in a JSON format.

3.1 Basic Usage

```
>>> from treelib import Node, Tree
>>> tree = Tree()
>>> tree.create_node("Harry", "harry") # root node
>>> tree.create_node("Jane", "jane", parent="harry")
>>> tree.create_node("Bill", "bill", parent="harry")
>>> tree.create_node("Diane", "diane", parent="jane")
>>> tree.create_node("Mary", "mary", parent="diane")
>>> tree.create_node("Mark", "mark", parent="jane")
>>> tree.show()
Harry
- Bill
- Jane
  - Diane
    | - Mary
  - Mark
```

3.2 API Examples

Example 1: Expand a tree with specific mode (Tree.DEPTH [default], Tree.WIDTH, Tree.ZIGZAG).

```
>>> print(', '.join([tree[node].tag for node in \
    tree.expand_tree(mode=Tree.DEPTH)]))
Harry,Bill,Jane,Diane,Mary,Mark
```

Example 2: Expand tree with custom filter.

```
>>> print(', '.join([tree[node].tag for node in \
    tree.expand_tree(filter = lambda x: \
```

```
        x.identifier != 'diane']]))
Harry, Bill, Jane, Mark
```

Example 3: Get a subtree with the root of ‘diane’.

```
>>> sub_t = tree.subtree('diane')
>>> sub_t.show()
Diane
- Mary
```

Example 4: Paste a new tree to the original one.

```
>>> new_tree = Tree()
>>> new_tree.create_node("n1", 1) # root node
>>> new_tree.create_node("n2", 2, parent=1)
>>> new_tree.create_node("n3", 3, parent=1)
>>> tree.paste('bill', new_tree)
>>> tree.show()
Harry
- Bill
|   - n1
|       - n2
|       - n3
- Jane
    - Diane
      | - Mary
    - Mark
```

Example 5: Remove the existing node from the tree

```
>>> tree.remove_node(1)
>>> tree.show()
Harry
- Bill
- Jane
    - Diane
      | - Mary
    - Mark
```

Example 6: Move a node to another parent.

```
>>> tree.move_node('mary', 'harry')
>>> tree.show()
Harry
- Bill
- Jane
|   - Diane
|   - Mark
- Mary
```

Example 7: Get the height of the tree.

```
>>> tree.depth()
2
```

Example 8: Get the level of a node.

```
>>> node = tree.get_node("bill")
>>> tree.depth(node)
1
```

Example 9: Print or dump tree structure. For example, the same tree in basic example can be printed with ‘ascii-em’:

```
>>> tree.show(line_type="ascii-em")
Harry
  Bill
  Jane
    Diane
    Mark
  Mary
```

In the JSON form, `to_json()` takes optional parameter `with_data` to trigger if the data field is appended into JSON string. For example,

```
>>> print(tree.to_json(with_data=True))
{"Harry": {"data": null, "children": [{"Bill": {"data": null}}, {"Jane": {"data": null, "children": [{"Diane": {"data": null}}, {"Mark": {"data": null}}]}]}, {"Mary": {"data": null}}]}
```

3.3 Advanced Usage

Sometimes, you need trees to store your own data. The newest version of *treelib* supports `.data` variable to store whatever you want. For example, to define a flower tree with your own data:

```
>>> class Flower(object): \
    def __init__(self, color): \
        self.color = color
```

You can create a flower tree now:

```
>>> ftree = Tree()
>>> ftree.create_node("Root", "root")
>>> ftree.create_node("F1", "f1", parent='root', data=Flower("white"))
>>> ftree.create_node("F2", "f2", parent='root', data=Flower("red"))
```

Notes: Before version 1.2.5, you may need to inherit and modify the behaviors of tree. Both are supported since then. For flower example,

```
>>> class FlowerNode(treelib.Node): \
    def __init__(self, color): \
        self.color = color
>>> # create a new node
>>> fnode = FlowerNode("white")
```


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