CSE 5311 DSGN & ANLY ALGORITHMS

Project Report

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Project 4: Minimum Spanning Tree

Implement and compare the following Minimum Spanning Trees algorithms: • Kruskal algorithm • Prim algorithm

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Main Data Structures

- Array
- Heap
- Hash Table
- Graph

Main Components of The Algorithm

mst.py

```python
class MST(object):
    """Initialize MST class"""
    def __init__(self, opt, edgelist, nodelist):

    """Generate original graph"""
    def originGraph(self):
```

```

    """Prim tree algorithm"""
    def primTree(self):

    """Prim tree algorithm optimized by using heap"""
    def primTreeWithHeap(self):

    """Kruskal tree algorithm"""
    def kruskalTree(self):
```

User-Interface

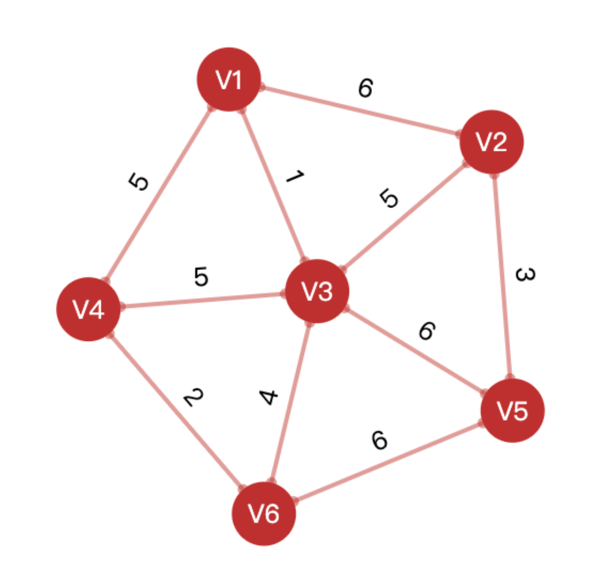
We build a web interface for MST through flask framework.

```
"""Visualize original graph"""
@app.route('/graph', methods=['POST', 'GET'])
def get_graph():

"""Visualize prim tree"""
@app.route('/prim', methods=['POST', 'GET'])
def get_prim_tree():

"""Visualize optimized prim tree"""
@app.route('/prim_with_heap', methods=['POST', 'GET'])
def get_prim_tree_with_heap():

"""Visualize Kruskal tree"""
@app.route('/kruskal', methods=['POST', 'GET'])
def get_kruskal_tree():
```

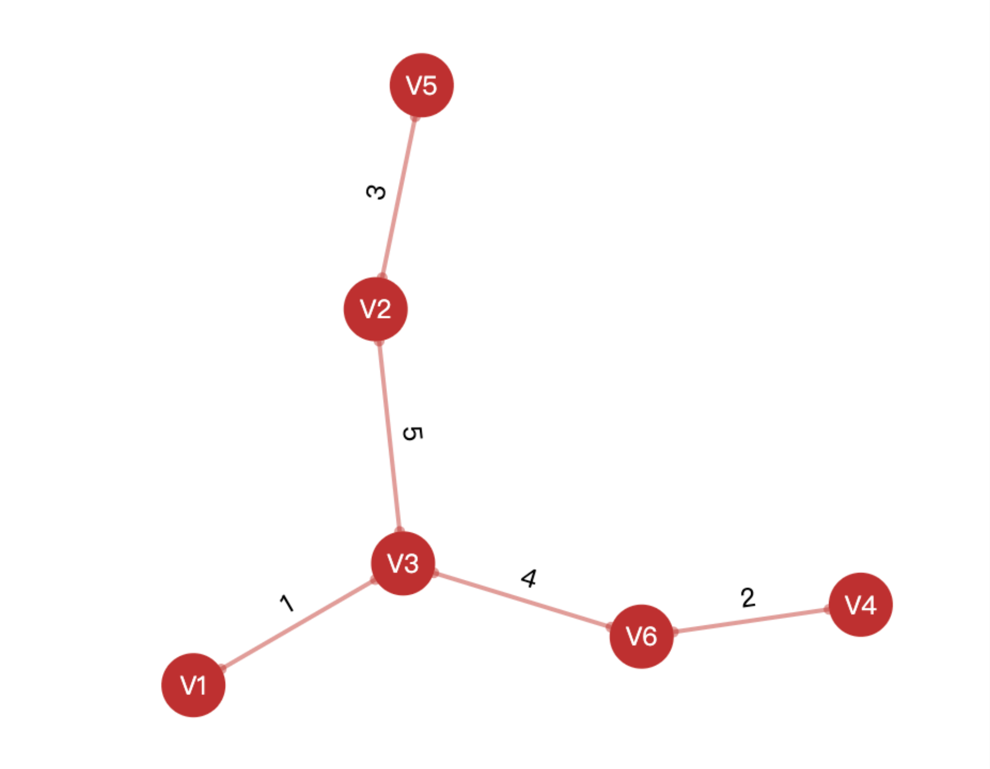
For example, we input a graph:

```
V1-V2-6
V1-V3-1
V1-V4-5
V2-V3-5
V2-V5-3
V3-V4-5
V3-V5-6
V3-V6-4
V4-V6-2
V5-V6-6
```

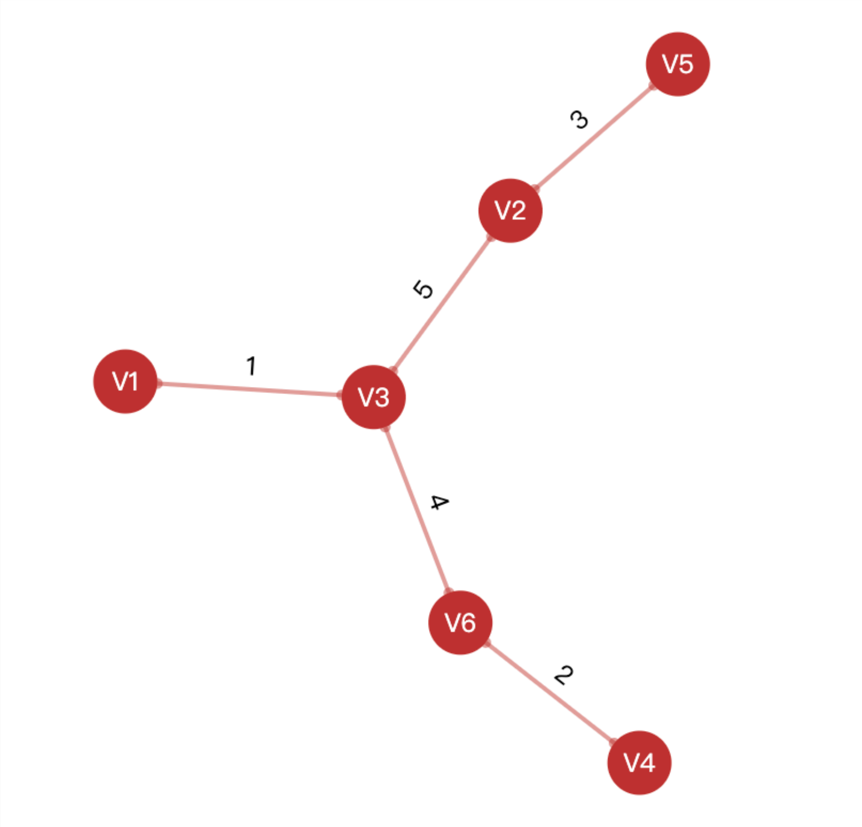
Original graph:



Prim tree:



Kruskal tree:



Run Time Analysis

Algorithm	Nodes	Edges	Time(second)
Prim	10	10	0.00088
Prim with Heap	10	10	0.00066
Kruskal	10	10	0.00058

Algorithm	Nodes	Edges	Time(second)
Prim	10	45	0.00133
Prim with Heap	10	45	0.00060
Kruskal	10	45	0.00071

Algorithm	Nodes	Edges	Time(second)
Prim	100	100	1.39109
Prim with Heap	100	100	0.00111
Kruskal	100	100	0.00096

Algorithm	Nodes	Edges	Time(second)
Prim	100	4950	67.18536
Prim with Heap	100	4950	0.00846
Kruskal	100	4950	0.00877

From the comparison of the time consumption of the above four tables, **the prim tree algorithm is indeed optimized by using heap**.

In addition, we find that **prim tree algorithm is more suitable for dense graph**, and prim algorithm is better than kruskal tree algorithm when calculating the minimum spanning tree of dense graph.