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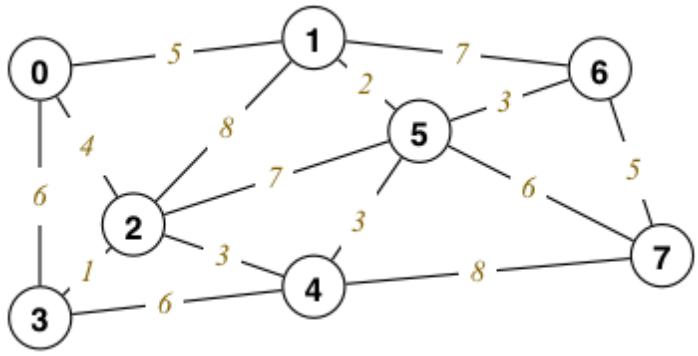
Week 9 Exercises

Dijkstra.txt

Dijkstra's algorithm computes the minimum path costs from the source node 0 to all the other vertices, resulting in the Shortest Path Tree (SPT). For the following graph:



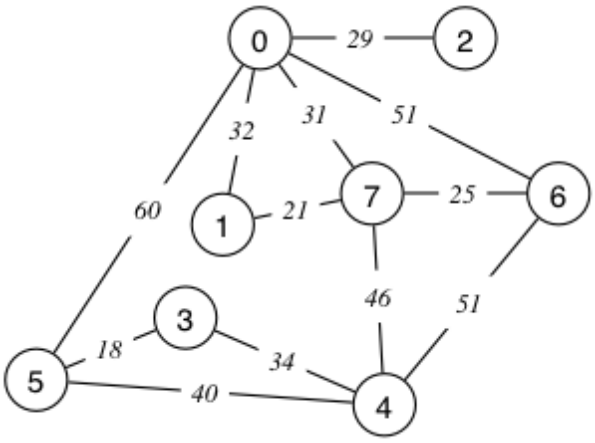
把visit的顺序与pacost一起写

a. show the order that vertices are visited, and the path cost *pacost[]* of each of the vertices
    - (when faced with a choice, select the edge to the lowest vertex)
b. there are 3 vertices that undergo *non-trivial edge relaxation*. What are they, and what is the reduction in cost for each vertex? non-trival edge relaxation表示具体数字的减少
c. draw the SPT

SPT表示了最短路径的顺序，顺着树的方向就可以找到最短路径

Prim.txt

Prim's Algorithm generates a Minimum Spanning Tree (MST). For the following graph:



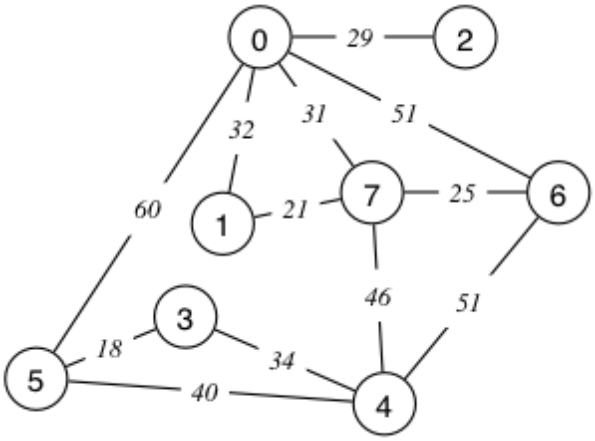
a. by hand, use the sets *mst* and *rest* to build an MST one vertex at a time Do this in the form of a table, where the first 2 lines have been completed for you.

mst	rest vertex	cost
{0}	2	29
{0,2}	7	31
...	...	...

b. draw the MST
c. how many edges in the MST?
d. what is the cost of the MST?

Kruskal.txt

Kruskal's Algorithm also generates an MST. For the following graph:



a. show which edges are considered at each step and ... 注意回答问题的文本格式
   - whether the edge gets accepted, or rejected (because it causes a cycle)

b. draw the MST.
   - is the MST the same of different to the MST generated by Prim's algorithm?

eulerianCycle.c

a. What determines whether a graph is Eulerian or not?

b. Write a C program that reads a graph, prints the graph, and determines whether an input graph is Eulerian or not.
   - if the graph is Eulerian, the program prints an Eulerian path
     - you should start with vertex 0
     - note that you may use the function *findEulerianCycle()* from the lecture on Graph Search Applications
   - if it is not Eulerian, the program prints the message *Not Eulerian*

For example,

- The graph:

```
#4
0 1 0 2 0 3 1 2 2 3
```

  is not Eulerian (*can you see why?*). Using this as input, your program should output:

```
V=4, E=5
<0 1> <0 2> <0 3>
<1 0> <1 2>
<2 0> <2 1> <2 3>
<3 0> <3 2>
Not Eulerian
```

- In the above-named lecture I showed a 'concentric squares' graph (called *concsquares*):

```
#8
0 7 7 5 5 1 1 0
6 0 6 7
2 5 2 7
4 1 4 5
3 0 3 1
```

  which is Eulerian, although I've labelled the vertices differently here. For this input your program should produce the output:

```
V=8, E=12
<0 1> <0 3> <0 6> <0 7>
<1 0> <1 3> <1 4> <1 5>
<2 5> <2 7>
<3 0> <3 1>
<4 1> <4 5>
<5 1> <5 2> <5 4> <5 7>
<6 0> <6 7>
<7 0> <7 2> <7 5> <7 6>
Eulerian cycle: 0 1 4 5 2 7 5 1 3 0 6 7 0
```

  Draw *concsquares*, label it as given in the input file above, and check the cycle is indeed Eulerian.

- The function *findEulerCycle()* in the lecture notes does not handle disconnected

graphs. In a disconnected Eulerian graph, each subgraph has an Eulerian cycle.

- Modify this function to handle disconnected graphs.
- With this change, your program should now work for the graph consisting of 2 disconnected triangles:

```
#6
0 1 0 2 1 2 3 4 3 5 4 5
```

It should now find 2 Eulerian paths:

```
V=6, E=6
<0 1> <0 2>
<1 0> <1 2>
<2 0> <2 1>
<3 4> <3 5>
<4 3> <4 5>
<5 3> <5 4>
Eulerian cycle: 0 1 2 0
Eulerian cycle: 3 4 5 3
```

对于这个graph会删掉edge，因此执行一个graph之后，可以查找接下来关联的最小的顶点然后从那个顶点开始继续

unreachable.c

Write a program that uses a *fixed-point computation* to find all the vertices in a graph that are *unreachable* from the start vertex (assume it to be 0). Note the following:

一个个往外扩散，看看最终能扩展到哪里

- the fixed-point computation should be iterative
- **you should not use recursion, or stacks or queues**

If a graph is disconnected:

- then those vertices not reachable (say vertices 8 and 9) should be output as follows:

```
Unreachable vertices = 8 9
```

If a graph is connected then all vertices are reachable and the output is :

```
Unreachable vertices = none
```

For example:

- Here is a graph that consists of 2 disconnected triangles:

```
#6
0 1 0 2 1 2 3 4 3 5 4 5
```

If the start vertex is 0, then the output should be:

```
V=6, E=6
<0 1> <0 2>
<1 0> <1 2>
```

```
<2 0> <2 1>
<3 4> <3 5>
<4 3> <4 5>
<5 3> <5 4>
Unreachable vertices = 3 4 5
```

because obviously the vertices in the second triangle are not reachable from the first.

- here is a connected graph:

```
#5
0 1 1 2 2 3 3 4 4 0
1 3 1 4
2 4
```

Starting at any vertex, the result should be:

```
V=5, E=8
<0 1> <0 4>
<1 0> <1 2> <1 3> <1 4>
<2 1> <2 3> <2 4>
<3 1> <3 2> <3 4>
<4 0> <4 1> <4 2> <4 3>
Unreachable vertices = none
```

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