**COS 226 – Data Structures and Algorithms**

**Fall 2014 – Flipped Lecture Section**

**Group worksheet**

**Week 9 – 11.13.14**

**Topics covered: shortest path, maxflow-mincut**

**Instructions:** This worksheet covers shortest path algorithms and flow diagrams. Answer questions as a group (3-4 students)

1. **Fattest Path** : Given an edge-weighted digraph and two vertices s and t, design an algorithm to find a fattest path from s to t. The bottleneck capacity of a path is the minimum weight of an edge on the path. A fattest path is a path such that no other path has a higher bottleneck capacity.
2. **Modified Dijkstra’s algorithm (fin-f13)**

The standard version of Dijkstra’s algorithm does not consider a vertex once it is removed from the minPQ. However a modified version of Dijkstra’s algorithm that may reconsider a vertex (even after removing from the minPQ) is given below.

private void relax(Graph G, vertex v)

for (Edge e: G.adj(v)) {

w = e.to();

if (distTo[w] > distTo[v] = e.weight()) {

distTo[w] = distTo[v] + e.weight();

edgeTo[w] = e;

if (pq.contains(w)) pq.change(w, distTo[w])

else pq.insert(w, distTo[w]);

}

}

}

Will this code work if there are negative edges in the graph? What is the complexity of the algorithm?

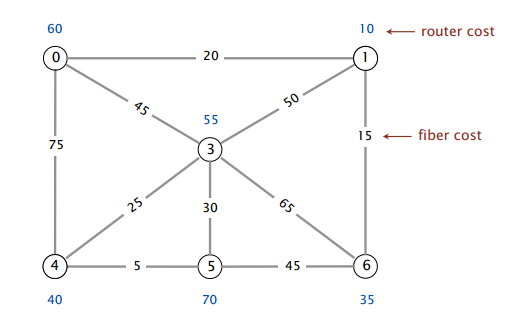
1. **Shortest directed cycle.**

Given a directed graph with V vertices and E edges, design an efficient algorithm to find a directed cycle with the minimum number of edges (or report that the graph is acyclic). Your answer will be graded on correctness, efficiency, clarity, and succinctness.

1. Describe your algorithm in the space below
2. What is the order of growth of the worst-case running time of your algorithm?
3. What is the order of growth of the memory usage of your algorithm?
4. **Algorithm Design [fin-s14]**

There are N dorm rooms, each of which needs a secure internet connection. It costs wi > 0 dollars to install a secure router in dorm room i and it costs cij > 0 dollars to build a secure fiber connection between rooms i and j. A dorm room receives a secure internet connection if either there is a router installed there or there is some path of

fiber connections between the dorm room and a dorm room with an installed router. The goal is to determine in which dorm rooms to install the secure routers and which pairs of dorm rooms to connect with fiber so as to minimize the total cost.



Formulate the problem as a minimum spanning tree problem. To demonstrate your formulation, modify the figure above to show the MST problem that you would solve to find the minimum cost set of routers and fiber connections.