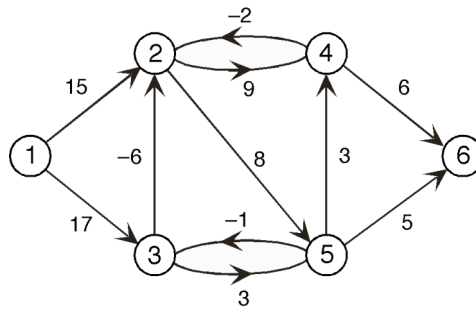
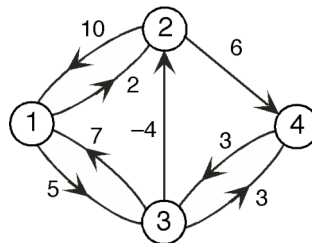


1(a) Apply the **FIFO** label-correcting algorithm to find the shortest path tree rooted at node 1 in the network G below. Assume that the adjacency list of each node is processed by *increasing* head node. Show at each step LIST, the distance labels, and the node being scanned. Upon termination, display the shortest path tree. (b) Now apply **Pape's** label-correcting algorithm to find the shortest path tree rooted at node 1 in the same network G . Show the same information as specified in part (a).



2(a) Use the Floyd-Warshall algorithm to find all shortest paths in the network given below. Show both the distance label and the predecessor matrices ($D, pred$) at each step. (b) At the completion of the algorithm, use the final information to derive a shortest 1-4 path and also a shortest 4-1 path. Clearly explain your reasoning. (c) Now suppose that the length of arc (2,4) is changed to 0, which creates a negative cycle. Carry out the steps of the Floyd-Warshall algorithm, showing the $D, pred$ matrices at each step, and document how the negative cycle is *detected* and how it is *identified*.



3(a) In the network below, find a maximum 1-6 flow using the generic augmenting path algorithm. At each step, augment using a path having the *largest* capacity; in case of ties, select the lexicographically smallest (relative to nodes) such path. Work entirely with the residual network and recover the maximum flow at the end. For each iteration, show the current flow value, the residual network, the augmenting path and its capacity. (b) Then derive the minimum cut produced by the labeling algorithm and verify that the max-flow min-cut theorem holds.

