April 25, 2018

Final Exam

EE/TE 4367: Telecommunications Networks

NOTE: **Please, complete the following table and keep record of your assignment number.**

First Name	
Last Name	
Student ID	
Assignment #	0

Exercise 1. Representing all the relevant intermediate steps, find a minimum weight spanning tree on the

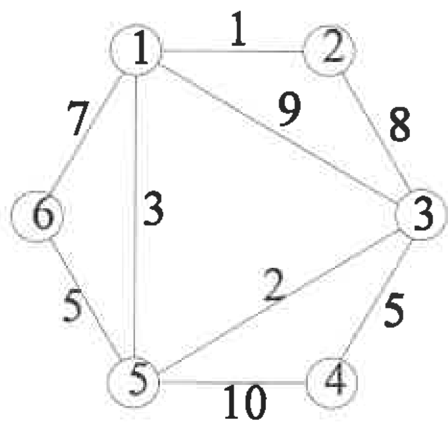

Figure 1: Undirected graph with 6 nodes and 9 edges.

graph shown in Fig. 1 using, respectively,

A) the Prim-Dijkstra algorithm choosing node 4 as the root vertex [pt. 10],

B) the Kruskal algorithm [pt. 10].

Exercise 2. Consider the graph shown in Fig. 2. Note that every arc in the figure represents two distinct

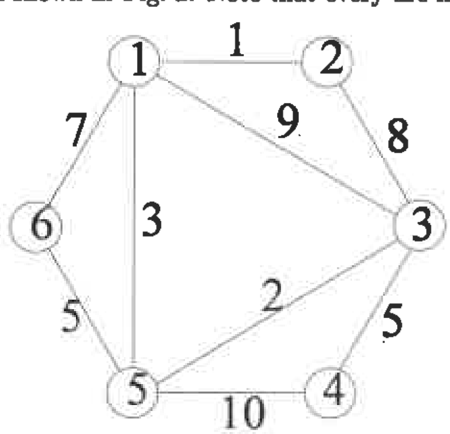

Figure 2: Undirected graph with 6 nodes and 9 edges.

directed arcs with opposite directions and same weight (shown next to the arc). Using a graphical or matrix based representation of each intermediate iteration, find the shortest path from every node to destination node 5 as indicated below.

A) Run the first two iterations of the Dijkstra algorithm and show the path costs at the end of the second iteration [pt. 15].

B) Identify the paths found at the end of the second iteration [pt. 10].

C) Continue to run iterations until a stop condition is reached, reporting the paths found and their respective costs [pt. 15].

Exercise 3. Consider the open network of three queues $Q1$, $Q2$, and $Q3$. Each queue has a single server. The service times at the queues are independent and exponentially distributed with mean $1/\mu_1$, $1/\mu_2$, and $1/\mu_3$, respectively. Customers (or jobs) entering the network form two statistically independent Poisson arrival processes. With rate λ jobs enter $Q1$. With rate 2λ jobs enter $Q2$. Jobs leaving $Q1$ and $Q2$ will always enter $Q3$. Upon completing service in $Q3$, jobs depart from the network of queues.

A) Find the stability conditions for the network of queues [pt. 10].

B) Find N, defined as the average number of jobs in the entire network of queues at steady state [pt. 15].

C) Find T, defined as the average time spent in the network of queues by a generic job [pt. 15].

D) Define $\hat{T}_1$ as the average total time spent in the network of queues by a job arriving into Q_1. Define $\hat{T}_2$ as the average total time spent in the network of queues by a job arriving into Q_2. Find the value of μ_2 which is required to obtain $\hat{T}_1 = \hat{T}_2$. Note that μ_2 is now a dependent variable. [pt. 15].

E) Assuming now that $\mu_1 = 2\lambda$ and $\mu_3 = 4\lambda$, and using the value of μ_2 found in question D), compute N and T as function of λ. [pt. 15].