CE 392C: Semester Exam

Thursday, November 29

12:30 – 1:45 PM

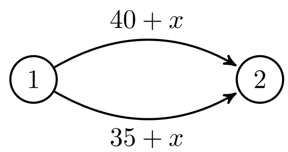
Name ____

Instructions:

- **SHOW ALL WORK** unless instructed otherwise. No shown work means no partial credit!
- If you require additional space, you may use the back of each sheet and/or staple additional pages to the end of the exam.
- If you need to make any additional assumptions, state them clearly.
- You may use any handwritten notes.
- No calculator is required.
- The number of points associated with each part of each problem is indicated.

Problem	Points	Possible
1		25
2		20
3		20
4		25
5		10
TOTAL		100

Problem 1. (25 points). Consider the two-link network shown below, where the demand from node 1 to node 2 is 25 vehicles, and where the link performance functions are indicated next to each link. You are considering a proposal to improve the top link by better coordinating the signals, which would result in an "upgraded" link performance function of $30 + x$.



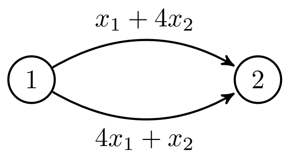
(a) (5) Using the current link performance functions (before upgrading), what are the user equilibrium link flows? What is the average travel time? (Average travel time is total system travel time divided by the demand).

(b) (5) What would the average travel time be after the upgrade, *if no drivers switched routes from the solution you found in part (a)*?

(c) (5) Now solve for the new user equilibrium after the upgrade. What are the new link flows and average travel time?

(d) (10) Instead of a fixed demand of 25 vehicles, now assume that the demand from node 1 to node 2 is given by the demand function $D(\kappa) = 175 - 3\kappa$. After upgrading the link, what are the new equilibrium link flows and average travel time?

Problem 2. (20 points). Consider a two-link network, where link 1 is drawn on top and link 2 is drawn on bottom. The demand The link performance functions are indicated next to each link — notice that these functions include link interactions.

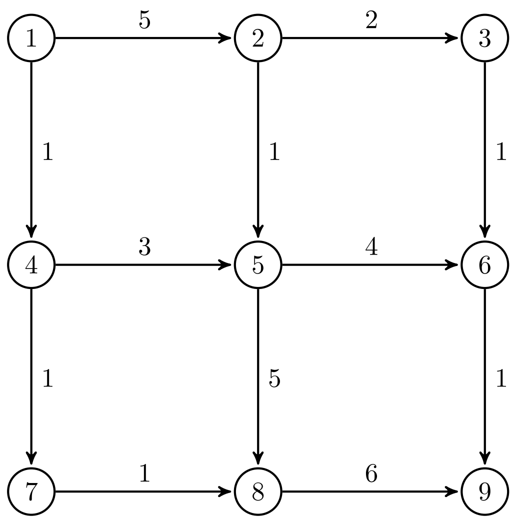


(a) (5) Write the variational inequality representing the user equilibrium problem on this network. (Substitute the given link performance functions and calculate the dot product; also write out the constraints defining the feasible set.)

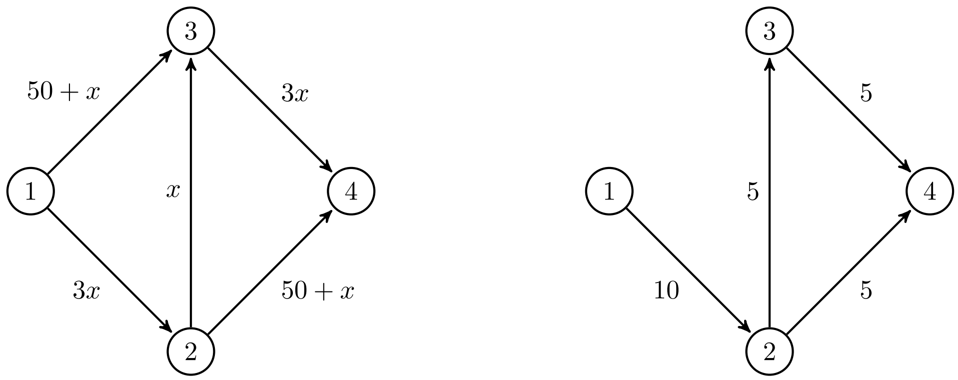
(b) (10) Link interactions may cause multiple equilibria, but not always. How many equilibria does this network have? List all of them.

(c) (5) Are these link performance functions symmetric? Are they strictly monotone? (Explain your answers, do not just say yes or no.)

Problem 3. (20 points). In the network shown below, the link labels indicate the travel times. The total demand is 120 vehicles from node 1 to node 9. Use Dial's method to compute $\mathbf{x}^*$ if $\theta = 1$.



Problem 4. (25 points). The diagrams below show a transportation network at some point during Algorithm B. The left panel shows the link performance functions, and the right panel shows the current bush and link flows.



(a) (5) For the current flows, calculate the L and U labels on the bush.

(b) (10) Perform one iteration of Algorithm B flow shifting on the bush, and report the new link flows.

(c) (10) Recalculate the L and U labels, and update the bush according to Algorithm B. Report the new bush links.

Problem 5. (10 points). A recent mayoral candidate in Austin has suggested implementing reversible lanes on South Lamar (so that in the morning there would be three inbound lanes and one outbound lane, and that during the evening peak there would be three outbound lanes and one inbound). Discuss how you would use one or more of the network models discussed in this class to quantify how effective this strategy would be. Your discussion should include (a) the specific models used; (b) what assumptions you are making; (c) the input data required; (d) how you might obtain this data; and (e) what specific model outputs you would use to make your recommendation. Your answers should be concise, but specific (e.g. do not just say you will "collect data" or "give a survey" without any more details on what data you would collect.)