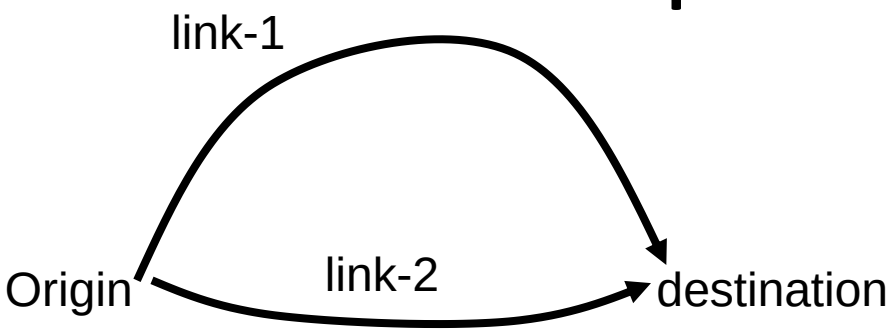
Example-1: question



link cost functions

$$t_1(x_1) = 2 + x_1$$

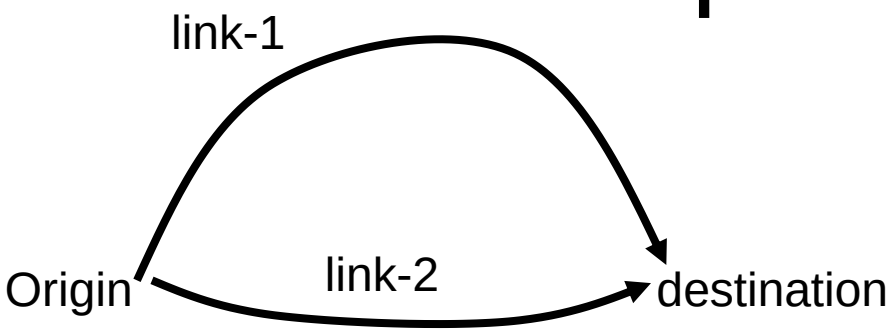
$$t_2(x_2) = 1 + 2x_2$$

demand

$$x_1 + x_2 = 5$$

[Q] Find UE flows and travel times

Example-1: answer



link cost functions

$t_1(x_1) = 2 + x_1$

$t_2(x_2) = 1 + 2x_2$

demand

$x_1 + x_2 = 5$

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link _ flows

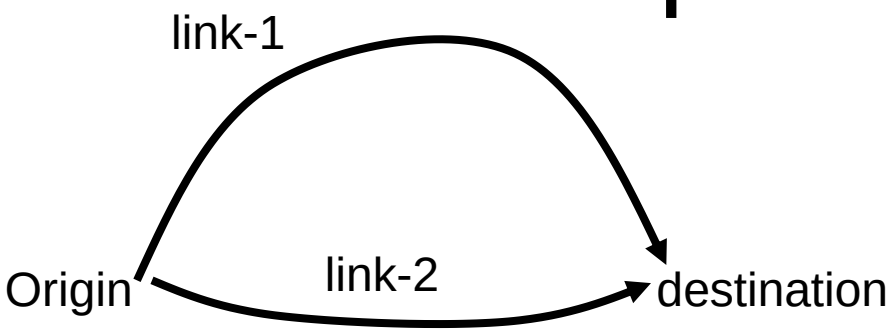
$x_1 = 3$

$x_2 = 2$

travel _ times

$t_1 = t_2 = 5$

Example-2: question



link cost functions

$$t_1(x_1) = 2 + x_1$$

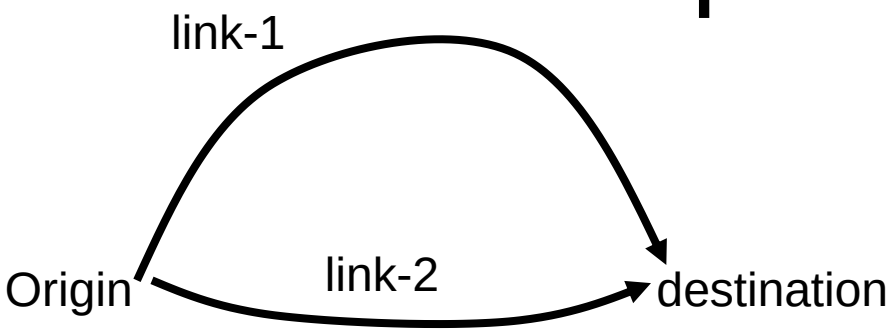
$$t_2(x_2) = 1 + 2x_2$$

demand

$$x_1 + x_2 = 0.4$$

[Q] Find UE flows and travel times

Example-2: answer



link cost functions

$t_1(x_1) = 2 + x_1$

$t_2(x_2) = 1 + 2x_2$

demand

$x_1 + x_2 = 0.4$

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link _ flows

$x_1 = 0$

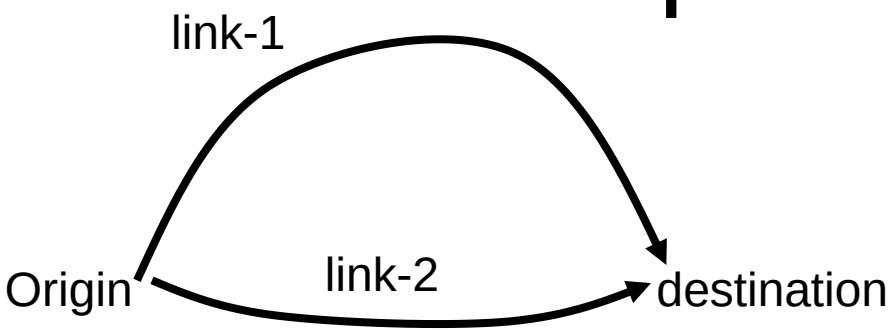
$x_2 = 0.4$

travel _ times

$t_1 = 2$

$t_2 = 1.8$

Example-3: question



link cost functions

$$t_1(x_1) = A_1 + B_1 x_1$$

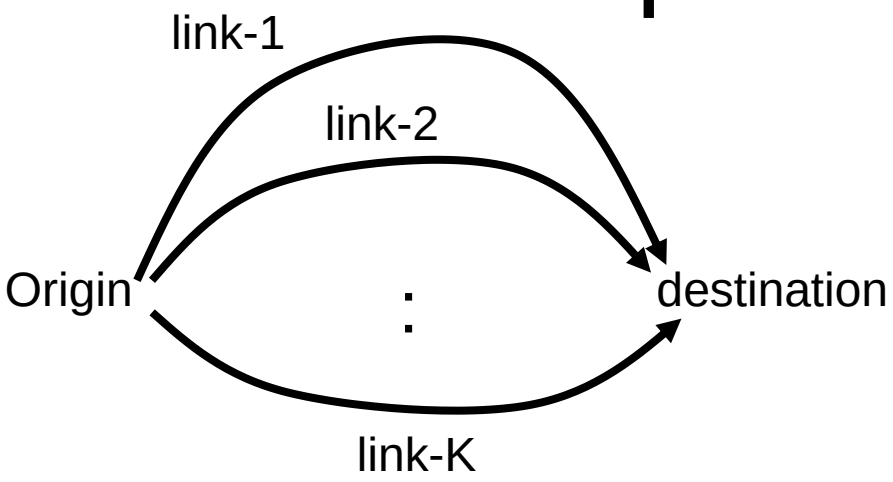
$$t_2(x_2) = A_2 + B_2 x_2$$

demand

$$x_1 + x_2 = q$$

[Q] Assuming that you know that at equilibrium, both two links carry flow, develop an expression for the flow on each link.

Example-4: Text p.25



link cost functions

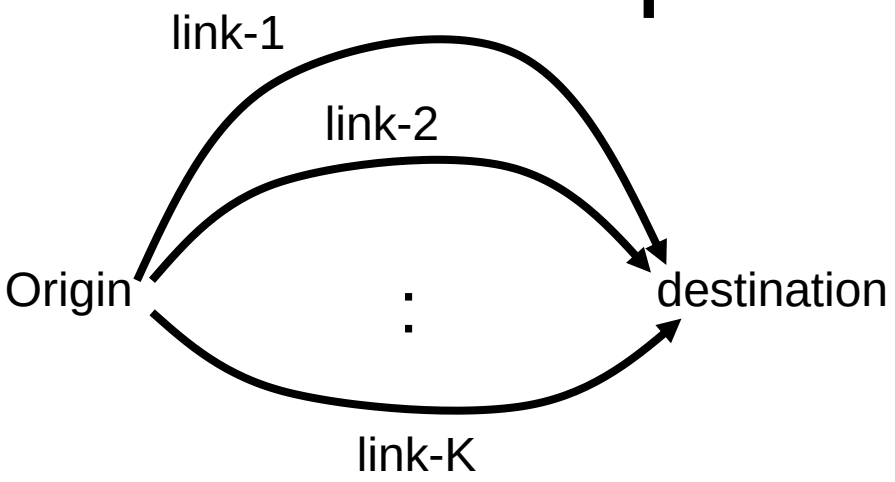
$$t_a(x_a) = A_a + B_a x_a$$

demand

$$\sum_a x_a = q$$

[Q] Assuming that you know that at equilibrium, all links carry flow, develop an expression for the flow on each link.

Example-5: Text p.26



link cost functions

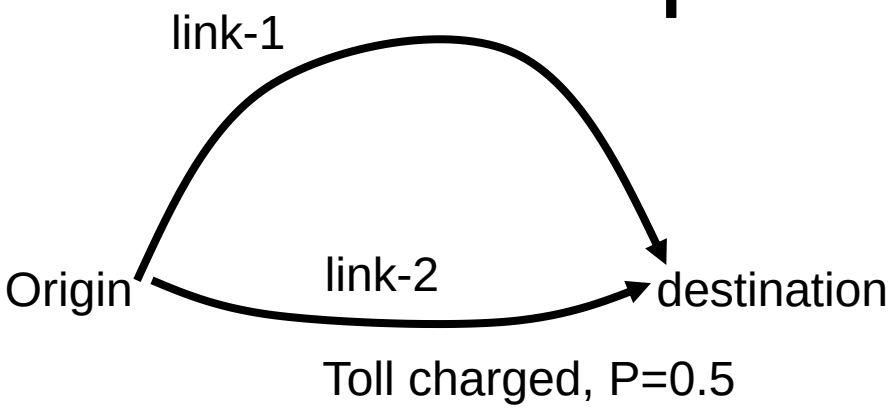
$$t_a(x_a) = A_a + B_a x_a$$

demand

$$\sum_a x_a = q$$

[Q] How would you find the flow on each link in cases where it is not clear that all links are used at equilibrium (i.e. only a subset of the links may be used)?

Example-6: question



link cost functions

$$t_1(x_1) = 2 + x_1$$

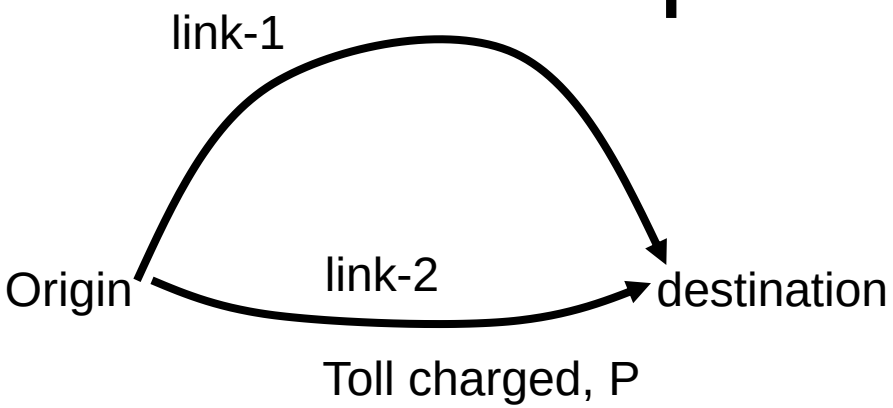
$$t_2(x_2) = 1 + 2x_2$$

demand

$$x_1 + x_2 = 5$$

[Q] UE will be achieved for generalized link cost (time + toll).
Find UE flows, travel times and link costs, when toll (P=0.5) is charged on link 2.
You can assume that the value of travel time is equal to 1.

Example-7: question



link cost functions

$$t_1(x_1) = 2 + x_1$$

$$t_2(x_2) = 1 + 2x_2$$

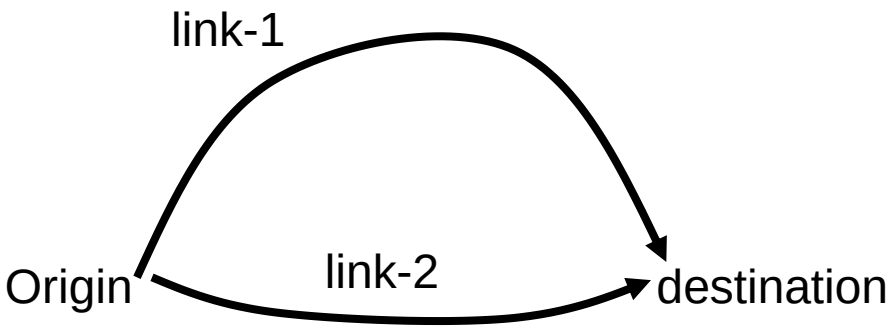
demand

$$x_1 + x_2 = 5$$

[Q] Find UE flows, travel times and total travel times in the network as the function of toll P, when toll (P) is charged on link 2.
You can assume that the value of travel time is equal to 1.

[Q] Find the toll which minimizes the total travel time in the network.

Problems



link cost functions

$$t_1(x_1) = 2 + x_1$$

$$t_2(x_2) = 1 + 2x_2$$

demand

$$x_1 + x_2 = 5$$

[Q] Develop your problem using the toy network.
You can assume that the demand may not be fixed.