

**Assignment 5 is due Sunday, June 5, 23:30.**

Suppose that a travel agent asks you to design and develop an algorithm that computes a shortest itinerary  $I_c$  from *Istanbul* to every city/town  $c$  in a given set  $C$  of cities/towns in Turkey. For instance, if  $C = \{Ankara, Izmir\}$ , then the goal is to compute a shortest itinerary from *Istanbul* to *Ankara*, and a shortest itinerary from *Istanbul* to *Izmir*.

The travel agent has an additional request. For every city/town  $c$  in  $C$ , there is a set  $S_c$  of cities/towns that the tourists are usually interested in visiting on their way to  $c$ . The travel agent desires all the cities/towns in  $S_c$  to be included exactly once in the itinerary  $I_c$  computed by your algorithm. For instance, for  $c=Ankara$  and  $S_{Ankara}=\emptyset$ , according to the travel distances between cities/towns provided to you by the travel agent, a shortest itinerary from *Istanbul* to *Ankara* may be

$$I_{Ankara} = \langle Istanbul, Izmit, Bolu, Ankara \rangle.$$

If  $S_{Ankara} = \{Bolu, Duzce, Zonguldak\}$  then,

$$I_{Ankara} = \langle Istanbul, Izmit, Duzce, Zonguldak, Bolu, Ankara \rangle.$$

If  $S_{Ankara} = \{Kirikkale\}$  then

$$I_{Ankara} = \langle Istanbul, Izmit, Bolu, Kirikkale, Ankara \rangle.$$

- (a) Define the decision version of the optimization problem described above.
- (b) Prove that this decision problem is NP-complete: Membership? Hardness?

A pdf copy of your own solution should be submitted at SUCourse+.