# Discussion 11

**1.** In the *Min-Cost Fast Path* problem, we are given a directed graph $G=(V,E)$ along with positive integer times $t_e$ and positive costs $c_e$ on each edge. The goal is to determine if there is a path $P$ from $s$ to $t$ such that the total time on the path is at most $T$ and the total cost is at most $C$ (both $T$ and $C$ are parameters to the problem). Prove that this problem is **NP**-complete.

**2.** We saw in lecture that finding a Hamiltonian Cycle in a graph is **NP**-complete. Show that finding a Hamiltonian Path -- a path that visits each vertex exactly once, and isn't required to return to its starting point -- is also **NP**-complete.

**3.** Some **NP**-complete problems are polynomial-time solvable on special types of graphs, such as bipartite graphs. Others are still **NP**-complete.
Show that the problem of finding a Hamiltonian Cycle in a bipartite graph is still **NP**-complete.