ECE 4/579
Sp '24
HW 1 Sample Solutions

In class we found the safe/unsafe combinations of traffic "turns/routes" and constructed a graph where each node is a turn. In the graph, turns that are unsafe to simultaneously take place are connected by edges (i.e., unsafe pairs of nodes from the table are connected by edges). We then applied a graph coloring algorithm, which colors the nodes such that no two nodes with the same color are connected by edges.

Possible implementations:

A

For each turn, we install a traffic signal that has three lights: red (traffic should stop), yellow (only traffic already in intersection should pass through), and green (all traffic on path can proceed). We know that nodes in the graph that share the same color cannot be connected by an edge. Hence, all nodes of the same color in the graph represent turns/routes that are safe to make simultaneously. Then design a controller loops through each color in the graph, and does the following: (1) turn all lights of all turns with selected color to green and all other turns' lights to red, (2) hold for a short period of time to allow traffic to traverse the intersection, (3) turn light of turns with selected color to yellow (keeping all other lights red), (4) hold to allow for final vehicles to exit intersection, (5) turn all lights to red. Then, a new color is selected, and the process is repeated. The method generalizes to an arbitrary number of colors without any changes.

B

Cycle among the color groups, sending the green signal to the turns of one group, while sending red to the rest. This solution would be safe but would likely not balance traffic very well. A second solution would be to alter the amount of time that each group has a green light according to the amount of traffic passing through those routes.