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CSCI-UA 310-001 PS3b

4. To see if there is a patriotic path, we can
    a. Assume that if t is not connected by any blue edges that there immediately is no patriotic path to t. This could be implemented in less than linear time.
    b. Else, create 4 copies of the original graph: $G^{(0)}, G^{(1)}, G^{(2)}, G^{(3)}$. $O(4|V| + 4|E|)$
        i. $G^{(0)}$ will only the starting point $s^{(0)}$. We can map all red edges to $G^{(1)}$. If no red edges come out of s, then there is no patriotic path from s to t. This is in place so that we ensure that the pathfinding algorithm traverses at least one red edge.
        ii. $G^{(1)}$ will only contain red edges. We can map all white edges that emit from these red edges to $G^{(2)}$.
        iii. $G^{(2)}$ will only contain white edges. We can map all blue edges that emit from these white edges to $G^{(3)}$. To avoid the pathfinding algorithm returning back to a red edge after moving to white, we can exclude all the red edges when constructing this graph. This motivation applies for step iv.
        iv. $G^{(3)}$ will only contain blue edges.
    c. Run Dijkstra. $O((|V| + |E|)log(|V|))$
    d. After Dijkstra, if there is a path from $s^{(0)}$ to $t^{(3)}$, meaning t must lie in $G^{(3)}$, then we can conclude there is a patriotic path from s to t in the original graph. $O(1)$

We can see that this runs in $O((|V| + |E|)log(|V|))$.