Shortest path from S_a to t_a in H is the shortest even length path from s to t in ~~the~~ G.

Q 5) Let λ be a guess on the smallest mean weight of any cycle. Define the length of an edge e as $l(e) = w(e) - \lambda$. Then a cycle whose mean weight is λ will have a length 0 and any cycle whose mean weight $> \lambda$ will have length > 0. This suggests the following algorithm.

Choose a value of λ ~~& find the~~, compute lengths on edges as given above & ~~find the~~ check if there is a negative cycle. If no then ~~set half~~ reduce λ. If there is a negative cycle you will increase λ. By doing a binary search on λ you can determine the smallest value of λ (say λ^*) for which the graph has no negative cycle. This λ^* is the smallest mean-weight of any cycle in G.

Q4 a) Let uphill ~~roads~~ roads be colored red and downhill roads be colored blue.

1) Find the shortest path from home (s) to all vertices in the graph using only red edges (throw away all blue edges to do this)

2) Find the shortest path from all vertices to work (t) using only blue edges (throw away all red edges to do this).

For each vertex compute the sum of the values it gets in steps 1 & 2 & take the vertex v for which the sum is minimum. The shortest path then is the path from s to v (using red edges) & from v to t (using blue edges)

b) Suppose level edges are colored green. In step 1 compute shortest path from s using red + green edges. In step 2 compute shortest path from all vertices to t using blue + green edges. Once again for each vertex sum the shortest paths computed in steps 1 & 2 & pick the vertex for which the sum is minimum.