Assignment 1
CSL 333

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February 10, 2015

1 Optimal Search

We used DFS Branch and Bound for optimal search, because of the large branching factor involved in the state space formulation. For k strings, the branching factor per node would become $2^k - 1$, and therefore the frontier in A* search or IDA* would become too large to store and explore.
The heuristic used involved using dynamic programming to find the optimal solution for pairs of two strings, while keeping $CC = 0$. Therefore, for k strings, $\binom{k}{2}$ DPs would be performed, and we take the sum of all these $\binom{k}{2}$ DP values.
For a state space coordinate $(n_1, n_2, n_3, ..., n_k)$, the heuristic would be

$$h(n_1, n_2, ..., n_k) = \Big(\sum_{i=0} \sum_{j=1+1} \text{coordinates } (n_i, n_j) \text{ of the } DP(i^{th} \text{ string}, j^{th} \text{ string}) \Big) + K$$

where K is the CC cost of inserting the obvious number of dashes to make all strings equal.

2 Suboptimal Search

We used local search with a randomized initial state, and on reaching a local hill, we perturb the local minima obtained to get the new start state.
The neighbourhood function consists of exchanging a dash with it's nearest non-dash neighbour. Perturbations are done by finding a random block of consecutive dashes in a random string, removing it from that string, and then randomly inserting it at some other position on the string. The logic behind this is that we use a move belonging to another neighbourhood state (blocks of dashes being moved instead of single dashes), and so we're guaranteed with a very high probability that we won't end up with the same local minima that we initially perturbed again. Now, for deciding the next start state, we generate k larger states by randomly adding dashes, and k smaller states, by randomly reducing dashes is possible. We also perturb the current local minima. Therefore, $2k + 1$ states are perturbed, and we choose that start state with the lowest cost.

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