COMP3121-Ass2-Q1

z5302513, Kihwan Baek

July 2021

Firstly, we check if the first song s_1 is shorter than m minutes. If it is shorter than m minutes, record the song on CD_1 otherwise, it means all the songs are longer than m minutes so we cannot put any songs on CDs. After that, we check if the total minutes of the first song and the second are longer than m. If it is shorter, put the second song on CD_1 otherwise, put the song on CD_2. And so on, if the total time of songs in the current CD and the current song is longer than m, put the current song on the next CD, otherwise, put this on the current CD. The worst case is that all the songs are m minutes so, we only can put one song in a CD and it takes O(n). So, All process takes $O(n)$ time.

We now need to prove that this method is optimal. Assume that there is an assignment of all songs to CDs which satisfies the condition (minimum number of CDs) and the number of CD used is the same as our greedy strategy, but which is different to the method obtained by our greedy strategy. This means that there is at least one CD assignment which violates our greedy assignment policy. Let the second song be k and suppose the second Song is on the CD_2. And also we suppose the third song g is on CD_2 in which the sum of length of k and g is less than or equal to 'm'. Plus, let Song u be the first song which is on CD_1 and the sum of length of u and g is less than or equal to 'm'. Since u and g should be on the CD_1 in the greedy strategy, this method violates our strategy. Hence $l_u + l_g \leq m$, we can move g to CD_1. By repeatedly moving such CDs that violate our greedy strategy in this manner, we eventually reach an assignment that adheres to our greedy strategy. In addition to the proof, with these moving, the number of CDs used is not changed because it is already an optimal solution.