Problem Set 2, Problem 4 **Jihong Tang**
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Introduction to the problem

Problem 4 from problem set 2 is about the example problem discussed in class, using greedy algorithm called activity selection problem. For both of the subproblem, we need to provide a counterexample to prove that some greedy ways cannot bring out the optimal answer to the problem.

For question 4a, we need to provide a counterexample for the algorithm which is greedy for the activity of the shortest duration time.

For question 4b, we need to provide a counterexample for the algorithm which is greedy for the activity that overlaps the fewest activities remaining unselected.

Problem 4a

For question 4a, I will present the counterexample based on the thinking procedure as shown following. Perhaps the shortest duration activity will offer more space time for other choices since it cost the shortest time in a solid amount time. However, if this shortest duration activity is between two longer activities, the algorithm will make both of these two activities be deleted from the activity pool which may sometimes cause trouble.

One simple counterexample has been provided as shown in Table1. The result from the algorithm greedy for the shortest duration will be $\{1\}$, whereas the optimal answer is $\{2, 3\}$.

Table 1: Counterexample for problem 4a

Activity i	Start time	End time	Duration time(h)
1	11:00	13:00	2
2	9:00	12:00	3
3	12:30	16:30	4

Problem 4b

For question 4b, I will present the counterexample based on one problem this greedy algorithm may cause. The problem is that by choosing the activity with the least number of overlaps, will some optimal activities that need to be chosen be deleted because many

other activities overlaps it. A simple thinking method is to create some same time activities that will definitely add the number of overlaps, and I think sometimes this algorithm cannot get the optimal output.

One simple counterexample has been provided as shown in Table2. The result from the algorithm greedy for the activity that overlaps the fewest activities remaining unselected will be $\{1, 2, 3\}$, whereas the optimal answer is $\{2, 3, 4, 5\}$.

Table 2: Counterexample for problem 4b

Activity i	Start time	End time	Number of overlaps
1	11:00	13:00	2
2	8:00	10:00	2
3	14:00	16:00	2
4	10:00	12:00	3
5	12:00	14:00	3
6	9:00	11:00	3
7	9:00	11:00	3
8	13:00	15:00	3
9	13:00	15:00	3