2024 CSE431531 In class Quiz 6 Schedule

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Note:

- Form groups of EXACTLY **two** students. You may form a group through a Piazza post.
- Discuss the **assigned** problem
  - Students with answer sheet Number $1, 4, 7, ..., 3i + 1$: Problem 1
  - Students with answer sheet Number $2, 5, 8, ..., 3i + 2$: Problem 2
  - Students with answer sheet Number $3, 6, 9, ..., 3i$: Problem 3

  We will review the problems in class.
- Outline your solution in the Answer Sheet
  - Optimal Solution for the Problem Instance
  - State Your Strategy for the First Step
  - Efficient Greedy Algorithm Pseudocode
  - Proof of Correctness: safety strategy proof + self-reduction argument
  - An analysis of the algorithm's running time.

  We will distribute the answer sheets during class to each group, consisting of exactly two students seated together. Each pair of students will receive one answer sheet, which will have a designated **SheetNumber**.
- After the class, please scan your assigned Answer Sheet and name your PDF file: Quiz6_SheetNumber_FirstStudentUBIDnumber_SecondStudentUBIDnumber

  For example: Quiz6_53_12345678_12345678
- Both students in a group must submit the same scanned answer sheet. Please note that submissions for "In class Quiz 6 submission" on Ublearns Assignment will close at 11:59 PM on Oct 1st.
- You should view your submission after you upload it to make sure that it is not corrupted or malformed. Submissions that are rotated, upside down, or that do not load will not receive credit. Illegible submissions may also lose credit depending on what can be read. You are responsible for making sure your submission went through successfully.
- No makeup in-class quiz will be given except in provably extreme circumstances.

Problem 1: Job Scheduling with Deadlines

- Input: n jobs each $i \in [n]$ has a unit-length, an associated deadlines d_i and profit p_i
- Output: find the maximum profit that can be earned by scheduling the jobs in one machine such that each job is completed before its deadline.

Instance: given are 5 unit-length jobs with deadlines and profits

jobs	1	2	3	4	5
deadline	3	5	2	1	3
profit	4	5	10	8	6

Answer example, our solution is to schedule 3 jobs $\{1, 2, 5\}$. The schedule could be as follows: schedule job 1 to time slot $[0, 1)$, schedule job 2 to time slot $[1, 2)$, schedule job 5 to time slot $[2, 3)$. Thus the total profit is $4 + 5 + 6 = 15$.

Problem 2: Clustering Problem

- Input: a set of n objects $C = \{c_1, c_2, ..., c_n\}$. Distances (or differences) between any two objects are $D = \{d(c_i, c_j)\}_{i,j \in [n]}$. An integer $k > 1$.
- Output: Group n objects into exactly k groups that maximizes the grouping distance. The grouping distance is defined as the minimum distance among the pairwise distances between any two objects from different groups.

Instance: given 5 objects $C = \{a, b, c, d, e\}$, distances D and $k = 3$.

$$D = \begin{array}{c|ccccc} & a & b & c & d & e \\ a & 0 & 9 & 2 & 3 & 5 \\ b & 9 & 0 & 6 & 5 & 2 \\ c & 2 & 6 & 0 & 3 & 7 \\ d & 3 & 5 & 3 & 0 & 5 \\ e & 5 & 2 & 7 & 5 & 0 \end{array}$$

Answer example, our solution is to form 3 groups: $\{a\}$, $\{b, c\}$, $\{d, e\}$, and the grouping distance is $\min\{d(a, b), d(a, c), d(a, d), d(a, e), d(b, d), d(b, e), d(c, d), d(c, e)\} = \min\{9, 2, 3, 5, 5, 2, 3, 7\} = 2$.

Problem 3: Weighted Scheduling Problem

- Input: Given are n jobs each $i \in [n]$ has a weight (or the importance) w_i and the length (or the time required) l_i. We define the completion time c_i of job i to be the sum of the lengths of jobs in the ordering up to and including l_i.
- Output: An ordering of jobs that minimizes the weighted sum of completion times $\sum_{i \in [n]} w_i c_i$.

Instance: given are 5 jobs with the following weights and lengths:

jobs	1	2	3	4	5
weight	2	6	5	4	2
length	5	4	10	8	3

Answer example, our solution orders the jobs as follows: Job 2, Job 1, Job 4, Job 3, Job 5. The weighted sum of completion times is $6 \times 4 + 2 \times (4 + 5) + 4 \times (4 + 5 + 8) + 5 \times (4 + 5 + 8 + 10) + 2 \times (4 + 5 + 8 + 10 + 3) = 24 + 18 + 68 + 135 + 60 = 305$.