Algorithms Design and Analysis [ETCS-301]

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Task-scheduling problem I

The problem of scheduling unit-time tasks with deadlines and penalties/profits for a single processor has the following inputs:

- Set $S = \{a_1, a_2, \ldots, a_n\}$ is a set of n tasks.
- Each task requires unit time to complete
- Every task a_i having some deadline d_i such that $1 \leq d_i \leq n$
- There is n task and every task requires unit time so in n unit of time starting from 0 to n all tasks will be finished.
- If task a_i finishes before deadline d_i then there will be no penalty but if the task is late and finishes after deadline then there will be a penalty p_i
- Or if task a_i finishes before deadline d_i then there will be profit p_i but if the task is late and finishes after deadline then there will be no profit.

Task-scheduling problem II

- Our aim is to minimize the penalty or maximize the profit.

  minimize $Penalty(S) = \sum_{a_i \in S} p_i$ if a_i finishes after deadline d_i

  maximize $Profit(S) = \sum_{a_i \in S} p_i$ if a_i finishes before deadline d_i

Solution

- Suppose task a_i having deadline $d_i = 5$ is late and task a_j having deadline $d_j = 6$ is early
- If we execute task a_i on or after 6, still it will be late
- If we execute task a_j on or before 5, still it will be early
- So a early task will be early if we execute that task on or before the deadline and a late task will be late if we execute that task anywhere after deadline.
- We try to execute the high penalty task on time and if any task is late then we can make that task maximum late.
- We try to execute the early task at the scheduled deadline or before.
- We can always transform an arbitrary schedule into early-first form, in which the early tasks precede the late tasks
- Complexity of the algorithm will be $O(n^2)$ using Greedy because n independence check takes $O(n)$ time.

Thank you

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