CSE 3004: Design and Analysis of Algorithms

Greedy Technique (Module 3)

1. Algorithms for optimization problems typically go through a sequence of steps, with a set of choices at each step.
2. A greedy algorithm always makes the choice that looks best at the moment. **Or** Construct a solution iteratively, via a sequence of myopic decisions, and hope that everything works out in the end.
3. That is, it makes a locally optimal choice in the hope that this choice will lead to a globally optimal solution.
4. Greedy algorithms do not always yield optimal solutions, but for many problems they do.

Features and Bugs of the Greedy Paradigm

1. Easy to come up with one or more greedy algorithms.
2. Easy to analyze the running time.
3. Hard to establish correctness.

Warning

1. **Most greedy algorithms are not always correct.**

Properties:

1. **Greedy-choice property**

   we can assemble a globally optimal solution by making locally optimal (greedy) choices.

2. **Optimal substructure**

   If an optimal solution to the problem contains within it optimal solutions to subproblems.

Job Sequencing with Deadlines

Problem Statement:

1. We are given n jobs or tasks.
2. Job i has a profit p_i associated with it but the contraint is that the job i must be completed within a deadline. If the job i is not completed within the deadline then profit will be 0.
3. The objective is to have that set of jobs that can be completed within their deadlines such that the profit is maximized.
4. **Example: The Typist**

Example 1:

Jobs	J1	J2	J3	J4	J5
Profit	20	15	10	5	1
Deadlines	2	2	1	3	3

Assume that each job is taking time 1 unit to get completed.

1. Are all the jobs completed in the optimal schedule?
2. What is the maximum earned profit?
3. Write the optimal schedule that gives maximum profit.

Solution:

Approach: 1. Select the jobs in decreasing order of their profits.
2. Identify how many slots are available.
3. Each time place the selected job in the suitable slot, if possible.

0__J2___1__J1___2__J4___3
9 10 11 12

OR

0__J1___1__J2___2__J4___3
9 10 11 12

Profit: 20 + 15 + 5 = 40

Example 2:

Jobs	J1	J2	J3	J4	J5	J6	J7
Profit	35	30	25	20	15	12	5
Deadlines	3	4	4	2	3	1	2

Assume that each job is taking time 1 unit to get completed.

1. Are all the jobs completed in the optimal schedule?
2. What is the maximum earned profit?
3. Write the optimal schedule that gives maximum profit.

Example 3:

Jobs	J1	J2	J3	J4	J5	J6
Profit	200	180	190	300	120	100
Deadlines	5	3	3	2	4	2

Assume that each job is taking time 1 unit to get completed.

4. Are all the jobs completed in the optimal schedule?

5.What is the maximum earned profit?

6. Write the optimal schedule that gives maximum profit.

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