Faculty of Engineering

Computer Engineering Department

CMPE 323 – Algorithms
HOMEWORK #2

Academic Year: Fall 2022-23
Due Date: 30.11.2022, Hr: 23:59
Instructor: Assoc. Prof. Dr. Hürevren Kılıç
Assistant: Gülşah Ataş

Notes about Homework #2

1. You are required to work either **alone or** in an **at-most-two-person** group.

2. If you wish to work in a two-person group, **both of the group members should send** me (**NOT to the course assistants!**) an e-mail (hurevren.kilic@atilim.edu.tr) indicating the name of his/her agreed group member until 20.11.2022 (Sunday) Hr:23:59. Otherwise, it is assumed that you will work **alone** (**by default**).

3. Note that besides from submitting the homework, you are also required to join to the **face-to-face** code review & demonstration session.

4. Percentages of Moodle submission and demo parts are **70%** and **30%** of your overall Homework #2 grade, respectively. Submissions without joining **face-to-face** code review & demonstration gets overall 0 (zero) grade from Homework #2, directly.

5. **Time table** and **place** for the code review & demos are planned to be announced **later** through the course Moodle site. For the groups, **both** group **members should appear** in the code review & demo simultaneously while being **ready** with their submitted **source code** on their PCs.

6. Your implementation language could either be C, C++ or Python (**No other language!**)

Remote Worker's Overtime Plan: (100 pts)

Remote working is becoming more attractive day by day. ABC company that you work for makes remote working payment to its employees for each portion the task in varying-half-hour slots basis. For example, if an employee works for 0.5 hour to complete a portion of an assigned task then ABC pays 100 TL; for its 1 hour portion 500 TL; for 1.5 hours portion 800 TL etc. (see Figure 1 below). Notice that the payment amount is a strictly increasing function of work-hours.

Assume that your employer assigns you a task that requires total N hour(s) of overtime work for its completion. According to the rules & regulations of the ABC company:

"For each day, you are allowed to complete only one portion of the task in only one overtime working slot. Once you complete a portion of the task your wage is paid, immediately."

For example, if you plan to work for 2.5 hours today, you can't realize it in two consecutive overtime working slots of 1 hour + 1.5 hours on the same day but instead, you can do it today either in one single 2.5 hours slot or in two (or more) separate (not necessarily consecutive) days.

Your aim is to generate a most profitable plan on daily basis to complete the given N hours length task assigned to you and to compute how many days it takes to complete the assigned task.

Portion ID	Task Portion Length (in Hours)	Payment (in TL)
1	0.5	100
2	1	500
3	1.5	800
4	2	900
5	2.5	1000

Figure 1. An example overtime payment values for portions in half-hour slots.

For the above problem instance and an assigned task of length $N = 2.5$ an optimal solution is to complete 1.5 hours portion having ID 3 first then in the following day to complete the 1 hour task having ID 2. By the end, your total gain becomes $800 + 500 = 1300$. Another optimal solution is obtained by completing portion 2 first then portion 3.

   i.   Design a polynomial-time algorithm that solves the **Remote Worker's Overtime Plan** problem on paper by applying the steps of Dynamic Programming and submit it as your project report (**30 pts**)

  ii.   Implement an iterative (not a recursive) algorithm based on your design in part(i) (**60 pts**)

 iii.   Analyze your algorithm's time complexity by making comments about it (**10 pts**)

Enter the assigned total task length (in half-hour(s)): **2.5**

Enter the payment value (in TL) for task portion ID 1 having length 0.5 hour(s): **100**

Enter the payment value (in TL) for task portion ID 2 having length 1 hour(s): **500**

Enter the payment value (in TL) for task portion ID 3 having length 1.5 hour(s): **800**

Enter the payment value (in TL) for task portion ID 4 having length 2 hour(s): **900**

Enter the payment value (in TL) for task portion ID 5 having length 2.5 hour(s): **1000**

A SAMPLE OUTPUT:

On Day 1 do task portion with ID **3**

On Day 2 do task portion with ID **2**

The most profitable completion of the assigned task takes **2** day(s).