**Advanced Algorithms**

**Exercise for Lecture 12**

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| **Student Name** |  | **Student ID** |  |
| **Problem 1** |  | | |
| **Problem 2** |  | | |
| **Problem 3** |  | | |
| **Total Score** |  | | |
| **Notes** | Deadline: **2023-11-04 24:00**  Submission Format: ‘**Lecture12\_Name\_Student ID.docx**’, and please send to: **[chenlq1997@126.com](mailto:algorithms_23fall@163.com)**.  This assignment is meant to be an evaluation of your **individual** understanding coming into the course and should be completed **without collaboration** or outside help. | | |

**Problem 1.[30 points]**

There is a backpack with a capacity of 70 and 10 items. Now ignoring the actual geometric shape of the item, we believe that as long as the remaining capacity of the backpack is greater than or equal to the volume of the item, it can be loaded into the backpack, and the item can be split proportionally. Each item has two attributes, namely volume w and value p. How can we pack the item back to maximize the total value of the items in the backpack?

|  |  |  |
| --- | --- | --- |
| Item | Value | Volume |
| 1 | 20 | 5 |
| 2 | 24 | 5 |
| 3 | 28 | 10 |
| 4 | 37 | 15 |
| 5 | 40 | 15 |
| 6 | 28 | 10 |
| 7 | 58 | 20 |
| 8 | 11 | 5 |
| 9 | 32 | 10 |
| 10 | 41 | 15 |

**Solution:**

**Problem 2.[30 points]**

There exist 7 characters and we have the occurrence frequency of them. Please give the huffman code of each character.You need show each step of them coding process. Left branch of huffman tree will be 0 and right branch of huffman tree will be 1.

G: 4 D: 8 C: 10 E: 11 B: 16 F: 20 A:31

**Solution:**

**Problem 3.[40 points]**

There exist one person, he is passionate about symmetrical aesthetics. When he places items, he would place them symmetrically. For example, when he places a pair of chopsticks, a bowl and two spoons, he would place them as follows:

**Chopstick1, spoon1, bowl, spoon2, chopstick2**.

3.1 Can this person place a bowl, a spoon, a pair of chopsticks and two boxes of tissues according to his habits? Please explain the reason.

3.2 For a pile of items, if he cannot place them according to his habits, how many items can he place at most? Not all items will be properly placed. For example, for a bowl, a spoon, a pair of chopsticks and two boxes of tissues, he can place at most 5 items as follows

**Chopstick1, a box of tissues, a bowl or a spoon, a box of tissues, chopstick2**

So please provide a pseudocode based on greedy algorithm which can return the maximum number of items that can be placed according to this person’s habit. Briefly introduce the algorithm ideas.

For example, for 2 item A, 2 item B, 3 item C, 4 item D, 5 item E, the result would be 15.

**A B C D D E E C or E E E D D C B A**

**Solution:**