EE3980 Algorithms

Homework 11. 0/1 Knapsack Problem

Due: Jun. 5, 2021

We have studied the knapsack problem and found that the 0/1 knapsack problem may not be so easy to solve. In this homework assignment, you are required to write a `C` program to solve the problem using backtracking method.

A brief summary of the problem: Given n objects, each with a wight w_i and a profit p_i, $1 \le i \le n$, and a capacity m. Your program should decide which of the objects to be selected such that the total weight does not exceed m and the profit is maximum. That is to find the vector $x = [x_1, x_2, \ldots, x_n]$, such that

$$\begin{aligned} \text{maximiz} \quad & \sum_{i=1}^{n} x_i \cdot p_i, \\ \text{subject to} \quad & \sum_{i=1}^{n} x_i \cdot w_i \le m, \\ \text{and} \quad & x_i \in \{0, 1\}. \end{aligned} \tag{11.1}$$

Again, 10 data files are provided for you to test your program, `t1.dat` – `t10.dat`. The first line of each file is n and m, followed by n lines, each contains name, weight and profit of the object. The output of your program should be as the following.

```
$ a.out < t1.dat
Pick items:
  B1 6 10
  C2 8 11
  F5 6 7
  H7 8 8
  J9 9 9
  A0 9 7
N = 10, M = 50
Weight = 46, Profits = 52
CPU time: 5.10216e-05 sec
```

As usual, above is only to show the format of the output, the solution printed is not guaranteed to be optimal. Though 10 data files are provided, you are not required to run all 10 test cases. If any one takes more than a couple minutes to run, you can skip the larger test cases in your report result section.

Notes.

1. One executable and error-free `C` source file should be turned in. This source file should be named as `hw11.c`.
2. A report file in `pdf` format is also needed. This file should be named as `hw11a.pdf`.
3. Submit your `hw11.c` and `hw11a.pdf` on EE workstations using the following command:

   `~ee3980/bin/submit hw11 hw11.c hw11a.pdf`

   where `hw11` indicates homework 11.
4. Your report should be clearly written such that I can understand it. The writing, including English grammar, is part of the grading criteria.