Prof. Friedrich Eisenbrand
Location: MA A3 31

Due date: 21.12.09

Practical exercises

Optimization Methods in Finance

Fall 2009

Practical exercise 5 (2 points)

Our friend *Bruno the Burglar* plans to brake into the main safe of the UB Credit Bank. From a reliable informant he knows that the safe contains n items, where the informant also told the exact weight $w_i \in \mathbb{N}$ (say in 100gr) and value $p_i \in \mathbb{N}$ (say in thousand CHF) for each $i = 1, \ldots, n$. Unfortunately Bruno can carry only B weight units in his bag. Since we want to help our friend, you have to *implement a dynamic programming algorithm in C++ (or Matlab)* such that the cumulated value of the taken items is maximized, while the weight bound of B is not exceeded. In other words, solve

$$\begin{aligned} \max \sum_{i=1}^{n} x_i p_i & \\ \sum_{i=1}^{n} x_i w_i & \leq B \\ x_i & \in \{0,1\} \quad \forall i = 1, \ldots, n \end{aligned}$$

by dynamic programming. In detail:

1. Implement a method

   ```
   void solveKnapsack(long* p, long* w, int n, long B)
   ```

   that computes and outputs the optimum value of the mentioned problem. Extend your dynamic program, such that it outputs additionally the found optimum solution.

2. Apply your program to the following instance:

   ```
   int n = 50;
   long B = 1000;
   int p[50] = {1617, 792, 775, 968, 725, 1599, 1247, 1277, 927, 1065, 1281,
   1009, 521, 1405, 458, 382, 586, 482, 707, 306, 1513, 342, 566, 309, 1201,
   1329, 881, 659, 1432, 1322, 628, 464, 466, 1205, 367, 620, 1283, 1093,
   922, 625, 924, 465, 1223, 919, 1689, 1508, 1093, 295, 597, 617};
   int w[50] = {148, 76, 76, 87, 76, 134, 106, 138, 108, 133, 108, 112, 54,
   118, 46, 32, 52, 50, 61, 30, 127, 32, 66, 34, 145, 118, 77, 60, 137, 143,
   55, 48, 42, 112, 33, 56, 134, 135, 77, 63, 78, 40, 109, 99, 148, 139, 92,
   31, 72, 73};
   ```

   Hint: It might be helpful to first check on smaller instances, whether your program works correctly.

3. Send your (compilable) C++/Matlab code till **21.12.09** to yanick.raja@epfl.ch.