Homework 4 (計算方法設計，Design and Analysis of Algorithms)

Due date: May 11, 2022

Given n objects $\{1,2,\dots,n\}$ with each object i having profit value P_i and weight W_i and a knapsack with maximum capacity M, the *0/1 knapsack problem* is to find a subset S of objects to put into the knapsack such that the total profit value of the objects placed in the knapsack is as large as possible (that is, $\sum_{i\in S} P_i$ is maximum) and the total weight of these objects is at most M (that is, $\sum_{i\in S} W_i \le M$). Note that all P_i, W_i and M are positive integers, where $1 \le i \le n$. The formats of the input and output files, as well as the constraints for n, P_i, W_i and M, are described as follows.

Input:

n, M

P_1, W_1

P_2, W_2

…

P_n, W_n

Output:

The maximum total profit value of the objects placed in the knapsack.

Constraints:

$1 \le n \le 100$

$1 \le P_i \le 1000$ for each i

$1 \leq W_i \leq 1000$ for each i

$1 \leq M \leq 10000$

Use a programming language you familiar with to implement the branch and bound algorithm, which was already introduced in the class (refer to Section 5.8 of the text book), for solving the 0/1 knapsack problem. Also compare its performance with the brute force method by plotting their running times as curves of the object number n, where n is from 5 to 40 in steps of 5. Note that for each n, you should generate three problem instances and average the running time of your branch and bound program for solving these three instances. Note that just submit your branch and bound program through the eeclass system and do not submit your brute force program.