Assignment 2

The reliability problem

There is an electronic system consisting of n components. Let p_j be a probability of failure in the j-th component. Then $1 - p_j$ is the probability that the j-th component will operate successfully. Assume that this probability is independent of what is done for the other components. Thus the reliability of the whole system is $\prod_{j=1}^{n}(1 - p_j)$. To increase the reliability of the total system, one might attempt to spend money to decrease the numbers p_j, for example, instead of using one component j, we use two or more in parallel. Let $p_j(x_j)$ be a probability that the j-th component will fail, if we spend x_j to improve it. Suppose that the total sum of money which can be spent cannot be greater than W. Within this budget, it is desired to build the most reliable system possible.

The mathematical problem is:

To find

$$\max \prod_{j=1}^{n}(1 - p_j(x_j))$$

subject to conditions

$$\sum_{j=1}^{n} x_j \leq W,\ x_j \geq 0,\ j \in 1 : n.$$

Write a program which implements the dynamic programming method for the solution of the reliability problem. Input data should be read from a file whose name is 'input.txt'. Result of the solution should be written into a file whose name is 'output.txt'.

Input form

n W (integer numbers);

Functions $p_j(x_j)$ by the following way:

$p_1(0)$ $p_1(1)$ ... $p_1(W)$

$p_2(0)$ $p_2(1)$ ... $p_2(W)$

... ...

$p_n(0)$ $p_n(1)$ ... $p_n(W)$

All numbers are separated by spaces.

Output

Solution of the problem: the maximal value of the target function and vector x.

Deadline for the exercise submission is 16/07/2009. Submit the algorithm description and source files by e-mail: Bregman@bgu.ac.il. The subject should be: NLP Assignment 2. The assignment may be performed by pairs.

Please, write your name and ID in the message text (not in the attachments)