ACP Summer School 2014
Optimization Competition
A Production Planning Problem

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Abstract. This document describes the problem to solve, the input format and the submission process. Every participant is welcome to solve this problem with his favorite technique, although the learning objective is to model it with CP.

1 A production problem

In this problem, a single machine can produce at each time slot at most one item to satisfy input orders. If the production time of a corresponding order is before its actual due-date, an inventory cost must be paid (per day which is the same for every items. Backlogging is not allowed so each due date is a hard constraint. There are several types of items to produce. A changeover cost must be paid to configure the machine from one type to another. The objective is to minimize the sum of the total changeover costs plus the total inventory cost.

Next example shows a tiny instance of the problem.

Example 1. Consider the problem with the following input data: number of items type $nbItems = 2$; number of periods $nbPeriods = 5$; inventory cost $h = 2$; due dates for items of type 1 $d^1_{t\in\{1,\ldots,5\}} = (0, 1, 0, 0, 1)$ and for items of type 2 $d^2_{t\in\{1,\ldots,5\}} = (1, 0, 0, 0, 1)$. The two possible change-over costs are $q^{1,2} = 5$ for configuring the machine such that it produces items of type 2 after having produced items of type 1, $q^{2,1} = 3$ in the other direction. A feasible solution of this problem is $productionPlan = (2, 1, 2, -1, 1)$ which means that an item of type 2 will be produced in period 1; an item of type 1 in period 2; an item 2 in period 3 and item 1 in period 5. Note that there is no production in period 4, it is thus an idle period (illustrated with the -1). The cost associated to this solution is $q^{2,1}+q^{1,2}+q^{2,1}+2*h = 15$ but it is not the optimal cost. The optimal solution is $productionPlan = (2, 1, 0, 1, 2)$ with the cost $q^{2,1} + q^{1,2} + h = 10$.

2 Input format

Number of periods (15), number of item types (8). There is one line of length 15 (number of periods) for each item type with a 1 if an order must be produced at this particular date. After this (15x8) matrix, the inventory cost is given (10).

Then the change-over cost matrix (8x8) is given. For instance a change from type 1 to type 2 costs 193.

```
15
8
0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0 0 1 0 0
0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
0 0 0 0 0 0 0 0 0 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 0 0 0 1
0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0 1 0 0 0
10
  0   78   86   93  120 12 155 20
165    0  193  213  178 12  90 20
214  170    0  190  185 12  40 20
178  177  185    0  196 12 155 66
201  199  215  190    0 12 155 20
201  100   88  190   14  0  75 70
 50  44   155  190   111 12 0  20
201  199  215  190   123 70 155 0
```

3 Output format

The solution must be contained in text file with at each time slot, the item to produce or -1 if nothing must be produced at this time slot. For instance a valid (non optimal) solution for the instance above is:

```
0 1 -1 1 5 2 6 4 4 7 -1 7 -1 3 5
```

The cost of this solution is 503.