Algorithmic Methods for Mathematical Models

Lab Session 2

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a)

After the implementation of the P2 model in OPL, its solution using CPLEX is the following:

```
Total load 1238.47
Total capacity 1711.13
Computers have enough capacity
// solution (optimal) with objective 0.799239077773661
CPU 1 loaded at 72.5908201%
CPU 2 loaded at 61.648268742%
CPU 3 loaded at 79.923907777%
```

We keep almost the same implementation of main.mod with the necessary changes in variables.

b)

	P1(LP)	**P2(MILP)**
Optimal Solution	72.38%	79.92%
Solving Time (ms)	12	14
Number of Variables	nTasks*nCPUs	nTasks*nCPUs
Number of Constraints	3	3

As expected, the optimal solution in LP is better than the optimal solution in MILP, since the aim is to minimize the same objective function z. The reason is that some constrains in LP are relaxed in comparison with MILP.

c)

We use the new Table 1 data file and obtain the following results for the problems P1 and P2, respectively:

P1:

```
Total load 1583.17
Total capacity 1711.13
Computers have enough capacity
Max load 92.521900732%
CPU 1 loaded at 92.521900732%
CPU 2 loaded at 92.521900732%
CPU 3 loaded at 92.521900732%
```

P2:

```
Total load 1583.17
Total capacity 1711.13
Computers have enough capacity
Not solution found
```

We notice that in P2 there is not any solution. This is expected because of the input data. In other words, in P1 (LP) the load distributed uniformly in CPUs to minimize the Max load z. But, in P2 (MILP) the demands of each load cannot be divided, so in this case the whole values of each load cannot distributed in a combination of CPUs.

d)

We introduce the parameter K and the Boolean variable r_k [t] which denotes if the task t is chosen (1) or not (0). Also, we put the constraint that the number of chosen tasks must be greater or equal than the number of all tasks minus K:

$$\sum_{t \epsilon T} r_k[t] \geq nTasks - K$$

We obtain the following results for K=1:

```
Total capacity 1711.13
Computers have enough capacity
Max load 64.193906922%
CPU 1 loaded at 61.405659818%
CPU 2 loaded at 51.872220457%
CPU 3 loaded at 64.193906922%
```

e)

We introduce the following objective function to minimize the amount of not served load:

$$\min \{\sum_{t \epsilon T} (1 - r_k[t]) \cdot r_t[t]\}$$

We obtain the following results:

```
Total load 1583.17
Total capacity 1711.13
Computers have enough capacity
Min amount of rejected load 261.27
CPU 1 loaded at 61.405659818%
CPU 2 loaded at 68.436308767%
CPU 3 loaded at 94.999857505%
```

f)

	P1 (LP)	**P2 (MILP)**	**P2e (MILP)**
Number of Variables	nTasks*nCPUs	nTasks*nCPUs	nTasks*nCPUs + nTasks
Number of Constraints	3	3	4
Execution time [ms]	12	14	26

We notice that execution time in P2e is slightly higher than two other problems.