

HEI Scheduling constraints problems

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Notations

- Let $p \in \{-1; 1\}$ be a an indicator constant.

$$p = \begin{cases} 1, & \text{if the course is presential} \\ -1, & \text{otherwise} \end{cases}$$

- G denotes the set of all group g .
- Let $I \subset \mathbb{N}$ such as $I = \{1, 2, \dots, n\}$. Where $\#I = n = \#AC$
- All element of the set of all awarded courses AC will be indexed. In other words :

$$ac_i \in AC, i \in I$$

- Let t_{ac_i} and c_{ac_i} be the corresponding teacher and the corresponding course resp. to ac_i .
- Let $J \subset I$ such as :

$$\forall i, j \in J : (t_{ac_i} = t_{ac_j}) \text{ and } (c_{ac_i} = c_{ac_j})$$

- Let $K \subset I$ such as :

$$\forall i, j \in K, i \neq j : (t_{ac_i} = t_{ac_j}) \text{ and } (c_{ac_i} \neq c_{ac_j})$$

- Let $AC_g \subset AC$, the set of all awarded course related to a group g .

About the Constraints

Constraint 1 *A teacher can't teach two or more different groups at the same time for a same course if it is face-to-face session but can if it is a video conference session.*

$\forall s \in S, \forall d \in D :$

$$2p \left[\sum_{r \in R} \left(\sum_{ac_j \in AC, j \in J} o_{ac_j, d, r, s} \right) \right] \leq 3p - 1 \quad (1)$$

Constraint 2 *A teacher cannot simultaneously teach two or more different courses.*

$\forall s \in S, \forall d \in D :$

$$\sum_{r \in R} \left(\sum_{ac_k \in AC, k \in K} o_{ac_k, d, r, s} \right) \leq 1 \quad (2)$$

Constraint 3 *A group cannot simultaneously have two or more different course sessions.*

$\forall g \in G, \forall s \in S, \forall d \in D :$

$$\sum_{r \in R} \left(\sum_{ac_i \in AC_g} o_{ac_i, d, r, s} \right) \leq 1 \quad (3)$$

Constraint 4 *A group should have 2 hours of break per day.*

$\forall g \in G, \forall d \in D :$

$$\sum_{ac_i \in AC_g} \left(\sum_{r \in R} \sum_{s \in S} o_{ac_i, d, r, s} \right) \leq 3 \quad (4)$$

Constraint 5 *Only one session per course in a day.*

$\forall ac_i \in AC, i \in I, \forall d \in D :$

$$\left(\sum_{r \in R} \sum_{s \in S} o_{ac_i, d, r, s} \right) \leq 1 \quad (5)$$

Constraint 6 *Give one day without the same course after a session of this course.*

$\forall d \in D, \forall ac_i \in AC, i \in I :$

$$\left(\sum_{r \in R} \sum_{s \in S} o_{ac_i, d+1_d, r, s} \right) + \left(\sum_{r \in R} \sum_{s \in S} o_{ac_i, d, r, s} \right) \leq 1 \quad (6)$$

where 1_d is the unit of day.

Constraint 7 *Suitable room for every course session.*

- Let g_{ac_i} be the corresponding group to a ac_i .
- Let $\#g_{ac_i}$ be the group size of a group g_{ac_i} .
- Let rc_r be the room capacity of a room r .

$\forall ac_i \in AC, i \in I, \forall r \in R, \forall s \in S, \forall d \in D$

$$rc_r - \#g_{ac_i} \geq 0 \quad (7)$$

Constraint 8 *Finish the total hour of every course.*

Let $D(ac_i, d_q)$ be the total duration of a ac_i within a time interval $[d_0, d_q] \subset D$, $d_0 \leq d_q$.

$\forall ac_i \in AC, i \in I :$

$$\sum_{d=d_0}^{d_q} \sum_{r \in R} \sum_{s \in S} o_{ac_i, d, r, s} = D(ac_i) \quad (8)$$