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 $I = \{1, 2, ..., n\}$. 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 :

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

- Let $K \subset I$ such as :

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

- 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.*

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

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

<u>Otherwise :</u> if p is the binary variable such as :

$$p = \begin{cases} 1\ , & \text{if the course is presential} \\ 0\ , & \text{otherwise} \end{cases}$$

let $M \in \mathbb{N}$ be a majoration constant.

Therefore :

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

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

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

$$\sum_{r\in R}\left(\sum_{ac_k\in AC, k\in K} o_{ac_k,d,r,s}\right) \leq 1 \tag{3}$$

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

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

$$\sum_{r\in R}\left(\sum_{ac_i\in AC_g} o_{ac_i,d,r,s}\right) \leq 1 \tag{4}$$

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

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

$$\sum_{ac_i \in AC_g} \left(\sum_{r \in R} \sum_{s \in S} o_{ac_i,d,r,s} \right) \leq 3 \tag{5}$$

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

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

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

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

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

$$\left(\sum_{r \in R} \sum_{s \in S} o_{ac_i,d+1_d,r,s} \right) + \left(\sum_{r \in R} \sum_{s \in S} o_{ac_i,d,r,s} \right) \leq 1 \tag{7}$$

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.

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

$$rc_r - \#g_{ac_i} \geq 0 \tag{8}$$

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 $[d_0, d_q] \subset D,\ d_0 \leq d_q$.

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

$$\sum_{d=d_0}^{d_q} \sum_{r \in R} \sum_{s \in S} o_{ac_i,d,r,s} = D(ac_i) \tag{9}$$