

Assignment 1: Lecture Room Scheduling

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Some Notations & Conventions

Some variables like teacher and course are given index to use it easily

t = index of first teacher of course

s = index of course

g = batch number

n = n 'th lecture of course s in this week

d = day

p = period

$tsgn$ (we called it lesson also) = (first teacher of course, course name, batch, n 'th lecture)

$periods(d)$ = list of all periods in day d

$duration(tsgn)$ = duration of lecture (in terms of number of time slots of .5 hours)
associated with $tsgn$

$min(list)$ = minimum element in the list

$max(list)$ = maximum element in the list

$lessons(t)$ = list of lessons ($tsgn$) taught by teacher t

$lessons(g)$ = list of lessons ($tsgn$) taught to batch g

$$single(\{v_1, \dots, v_k\}) = \bigwedge_{1 \leq i < j \leq k} (\neg v_i \vee \neg v_j)$$

Some Assumptions :

- One course can't be taught to more than one batch.

1. Propositions

1.1. x_{tsgndp} - lesson $tsgn$ will be scheduled at day d and in period p

1.2. x'_{tsgndp} - lesson $tsgn$ will start at day d and in period p

1.3. x_{tsgnd} - lesson $tsgn$ will be scheduled at day d

1.4. x_{gdp} - batch g will have a lecture on day d and in period p

1.5. x_{tdp} - teacher t will have a lecture on day d and in period p

1.6. $x_{tsgndpr}$ - lesson $tsgn$ will be scheduled at day d and in period p and room r

1.7. $x'_{tsgndpr}$ - lesson $tsgn$ will start at day d and in period p and room r

2. Constraints (formulas)

2.1.

$$\begin{aligned} & \text{for each } \textit{tsgn} : \\ & \quad (i) \\ & \quad x'_{\textit{tsgnd}p_1} \implies x_{\textit{tsgnd}p_2} \\ & \quad \text{where } d \in \textit{days}, \\ & \quad \min(\textit{periods}(d)) \leq p_1 \leq \max(\textit{periods}(d)) - \textit{duration}(\textit{tsgn}) + 1, \\ & \quad p_1 \leq p_2 \leq p_1 + \textit{duration}(\textit{tsgn}) - 1 \\ & \quad (ii) \\ & \quad x_{\textit{tsgnd}p_2} \implies x'_{\textit{tsgnd}p_1} \\ & \quad \text{where } d \in \textit{days}, \\ & \quad p_2 - \textit{duration}(\textit{tsgn}) + 1 \leq p_1 \leq p_2 \\ & \quad \min(\textit{periods}(d)) \leq p_1 \leq \max(\textit{periods}(d)) - \textit{duration}(\textit{tsgn}) + 1, \\ & \quad \min(\textit{periods}(d)) \leq p_2 \leq \max(\textit{periods}(d)) \end{aligned}$$

2.2.

$$\begin{aligned} & \text{for each } \textit{tsgn} \text{ and } d : \\ & \quad (i) \\ & \quad x_{\textit{tsgnd}p} \implies x_{\textit{tsgnd}} \\ & \quad \text{where } p \in \textit{periods}(d) \\ & \quad (ii) \\ & \quad x'_{\textit{tsgnd}p} \implies x_{\textit{tsgnd}} \\ & \quad \text{where } p \in \textit{periods}(d) \\ & \quad (iii) \\ & \quad x_{\textit{tsgnd}} \implies \bigvee_{p \in \textit{periods}(d)} x_{\textit{tsgnd}p} \\ & \quad (iv) \\ & \quad x_{\textit{tsgnd}} \implies \bigvee_{\min(\textit{periods}(d)) \leq p \leq \max(\textit{periods}(d)) - \textit{duration}(\textit{tsgn}) + 1} x'_{\textit{tsgnd}p} \end{aligned}$$

2.3.

$$\begin{aligned} & \text{for each teacher } t, \text{ day } d \text{ and period } p : \\ & \quad (i) \\ & \quad x_{\textit{tsgnd}p} \implies x_{\textit{tdp}} \\ & \quad \text{where } \textit{tsgn} \in \textit{lessons}(t) \\ & \quad (ii) \\ & \quad x_{\textit{tdp}} \implies \bigvee_{\textit{tsgn} \in \textit{lessons}(t)} x_{\textit{tsgnd}p} \end{aligned}$$

2.4.

for each batch g , day d and period p :

(i)

$$x_{tsgndp} \implies x_{gdp}$$

where $tsgn \in \text{lessons}(g)$

(ii)

$$x_{gdp} \implies \bigvee_{tsgn \in \text{lessons}(g)} x_{tsgndp}$$

2.5.

for each $tsgn$,

$$\bigvee_{d \in \text{days}} x_{tsgnd}$$

2.6.

(i)

for each $tsgn$:

$$\text{single}(\{x_{tsgnd} \mid d \in \text{days}\})$$

(ii)

for $tsgnd$:

$$\text{single}(\{x'_{tsgndp} \mid p \in \text{periods}(d)\})$$

2.7.

for each $tsgn$:

$$\text{single}(\{x_{tsgndp} \mid tsgn \in \text{lessons}(g)\})$$

$d \in \text{days}$ and $p \in \text{periods}$

2.8.

for each $tsgn$ and r :

(i)

$$x'_{tsgndp_1r} \implies x_{tsgndp_2r}$$

where $d \in \text{days}$,

$$\min(\text{periods}(d)) \leq p_1 \leq \max(\text{periods}(d)) - \text{duration}(tsgn) + 1,$$

$$p_1 \leq p_2 \leq p_1 + \text{duration}(tsgn) - 1$$

(ii)

$$x_{tsgndp_2r} \implies x'_{tsgndp_1r}$$

where $d \in \text{days}$,

$$p_2 - \text{duration}(tsgn) + 1 \leq p_1 \leq p_2$$

$$\min(\text{periods}(d)) \leq p_1 \leq \max(\text{periods}(d)) - \text{duration}(tsgn) + 1,$$

$$\min(\text{periods}(d)) \leq p_2 \leq \max(\text{periods}(d))$$

2.9.

for each tsgn and d :

(i)

$$x_{\text{tsgndpr}} \implies x_{\text{tsgndp}}$$

where $p \in \text{periods}(d)$

(ii)

$$x'_{\text{tsgndpr}} \implies x'_{\text{tsgndp}}$$

where $p \in \text{periods}(d)$

(iii)

$$x'_{\text{tsgndp}} \implies \bigvee_{r \in \text{rooms}(\text{tsgn})} x'_{\text{tsgndpr}}$$

(iv)

$$x_{\text{tsgndp}} \implies \bigvee_{r \in \text{rooms}(\text{tsgn})} x_{\text{tsgndpr}}$$

(v)

$$x_{\text{tdpr}} \implies x_{\text{tdp}}$$

(vi)

$$x_{\text{tdp}} \implies \bigvee_{r \in \text{rooms}(\text{tsgn})} x_{\text{tdpr}}$$

2.10.

(i)

for each d, p and r

$$\text{single}\{x_{\text{tdpr}} \mid t \in \text{teachers}\}$$

(ii)

for each t, p, and d

$$\text{single}\{x_{\text{tdpr}} \mid r \in \text{rooms}\}$$

2.11.

for each tsgn, d and p :

$$x_{\text{tsgndp}} \implies \bigwedge \neg x_{t_1 dp}$$

where, $t_1 \in (\text{teachers of course } s) - t$

i. e. t_1 belongs to set of all teachers other than t for course s

2.12.

(i)

for each tsgn :

$$\bigvee_{d \in \text{days}, p \in \text{periods}} x'_{tsgndp}$$

Our formula is (Constraint 2.1 - 2.12 concatenated by "AND")

3. BONUS

3.1. Teacher can choose their preferred time slots

$$\bigwedge_{i \in \text{index}(L)} x_{t_i d_i p_i}$$

$$L = \{t_i d_i p_i \mid \text{teacher } t_i \text{ prefers his class at } d_i \text{ and } p_i\}$$

3.2. Teacher can choose time slots on which, they don't want their classes

$$\bigwedge_{i \in \text{index}(L)} \neg x_{t_i d_i p_i}$$

$$L = \{t_i d_i p_i \mid \text{teacher } t_i \text{ don't want his class at } d_i \text{ and } p_i\}$$

3.3. Batch can choose their preferred time slots

$$\bigwedge_{i \in \text{index}(L)} x_{g_i d_i p_i}$$

$$L = \{g_i d_i p_i \mid \text{group } g_i \text{ prefers his class at } d_i \text{ and } p_i\}$$

3.4. Batch can choose time slots on which, they don't want their classes

$$\bigwedge_{i \in \text{index}(L)} \neg x_{g_i d_i p_i}$$

$$L = \{g_i d_i p_i \mid \text{group } g_i \text{ prefers his class at } d_i \text{ and } p_i\}$$

These are soft constraints, if we can't find any solution by applying these constraints (3.1-3.4) we can remove some constraints to get a timetable.