Assignment 1: Lecture Room Scheduling

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Some Notations & Convensions

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

$$t = index\ of\ first\ teacher\ of\ course$$
$$s = index\ of\ course$$
$$g = batch\ number$$
$$n = n'th\ lecture\ of\ course\ s\ in\ this\ week$$
$$d = day$$
$$p = period$$
$$tsgn(we\ called\ it\ lesson\ also) = (first\ teacher\ of\ course,\ course\ name,\ batch,\ n'th\ lecture)$$
$$periods(d) = list\ of\ all\ periods\ in\ day\ d$$
$$duration(tsgn) = duration\ of\ lecutre\ (in\ terms\ of\ number\ of\ time\ slots\ of\ .5\ hours)\ associated\ with\ tsgn$$
$$min(list) = minimum\ element\ in\ the\ list$$
$$max(list) = maximum\ element\ in\ the\ list$$
$$lessons(t) = list\ of\ lessons\ (tsgn)\ taught\ by\ teacher\ t$$
$$lessons(g) = list\ of\ lessons\ (tsgn)\ taught\ to\ batch\ g$$
$$single(\{v_1,...,v_k\}) = \bigwedge_{1\le i<j\le k} (\neg v\ i \vee \neg v\ j)$$

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.

$$\text{for each } tsgn:$$
$$(i)$$
$$x'_{tsgndp_1} \implies x_{tsgndp_2}$$
$$\text{where } d \in days,$$
$$min(periods(d)) \leqslant p_1 \leqslant max(periods(d)) - duration(tsgn) + 1,$$
$$p_1 \leqslant p_2 \leqslant p_1 + duration(tsgn) - 1$$
$$(ii)$$
$$x_{tsgndp_2} \implies x'_{tsgndp_1}$$
$$\text{where } d \in days,$$
$$p_2 - duration(tsgn) + 1 \leqslant p_1 \leqslant p_2$$
$$min(periods(d)) \leqslant p_1 \leqslant max(periods(d)) - duration(tsgn) + 1,$$
$$min(periods(d)) \leqslant p_2 \leqslant max(periods(d))$$

2.2.

$$\text{for each } tsgn \text{ and } d:$$
$$(i)$$
$$x_{tsgndp} \implies x_{tsgnd}$$
$$\text{where } p \in periods(d)$$
$$(ii)$$
$$x'_{tsgndp} \implies x_{tsgnd}$$
$$\text{where } p \in periods(d)$$
$$(iii)$$
$$x_{tsgnd} \implies \bigvee_{p \in periods(d)} x_{tsgndp}$$
$$(iv)$$
$$x_{tsgnd} \implies \bigvee_{min(periods(d)) \leqslant p \leqslant max(periods(d)) - duration(tsgn) + 1} x'_{tsgndp}$$

2.3.

$$\text{for each teacher } t, \text{ day } d \text{ and period } p:$$
$$(i)$$
$$x_{tsgndp} \implies x_{tdp}$$
$$\text{where } tsgn \in lessons(t)$$
$$(ii)$$
$$x_{tdp} \implies \bigvee_{tsgn \in lessons(t)} x_{tsgndp}$$

2.4.

$$\text{for each batch } g,\ \text{day } d \text{ and period } p:$$
$$(i)$$
$$x_{tsgndp} \implies x_{gdp}$$
$$\text{where } tsgn \in lessons(g)$$
$$(ii)$$
$$x_{gdp} \implies \bigvee_{tsgn \in lessons(g)} x_{tsgndp}$$

2.5.

$$\text{for each } tsgn,$$
$$\bigvee_{d \in days} x_{tsgnd}$$

2.6.

$$(i)$$
$$\text{for each } tsgn:$$
$$single(\{x_{tsgnd} \mid d \in days\})$$
$$(ii)$$
$$\text{for } tsgnd:$$
$$single(\{x'_{tsgndp} \mid p \in periods(d)\})$$

2.7.

$$\text{for each } tsgn:$$
$$single(\{x_{tsgndp} \mid tsgn \in lessons(g)\})$$
$$d \in days \text{ and } p \in periods$$

2.8.

$$\text{for each } tsgn \text{ and } r:$$
$$(i)$$
$$x'_{tsgndp_1r} \implies x_{tsgndp_2r}$$
$$\text{where } d \in days,$$
$$min(periods(d)) \leqslant p_1 \leqslant max(periods(d)) - duration(tsgn) + 1,$$
$$p_1 \leqslant p_2 \leqslant p_1 + duration(tsgn) - 1$$
$$(ii)$$
$$x_{tsgndp_2r} \implies x'_{tsgndp_1r}$$
$$\text{where } d \in days,$$
$$p_2 - duration(tsgn) + 1 \leqslant p_1 \leqslant p_2$$
$$min(periods(d)) \leqslant p_1 \leqslant max(periods(d)) - duration(tsgn) + 1,$$

$$min(periods(d)) \leqslant p_2 \leqslant max(periods(d))$$

2.9.

$$for\ each\ tsgn\ and\ d\ :$$

$$(i)$$

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

$$where\ p\ \in periods(d)$$

$$(ii)$$

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

$$where\ p\ \in periods(d)$$

$$(iii)$$

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

$$(iv)$$

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

$$(v)$$

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

$$(vi)$$

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

2.10.

$$(i)$$

$$for\ each\ d, p\ and\ r$$

$$single\{x_{tdpr}\ |\ t\ \in\ teachers\}$$

$$(ii)$$

$$for\ each\ t, p, and\ d$$

$$single\{x_{tdpr}\ |\ r\ \in\ rooms\}$$

2.11.

$$for\ each\ tsgn,\ d\ and\ p\ :$$

$$x_{tsgndp} \implies \bigwedge \neg x_{t_1dp}$$

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

$$i.e.\ t_1\ belongs\ to\ set\ of\ all\ teachers\ other\ that\ t\ for\ course\ s$$

Our farmula is (Constraint 2.1 - 2.11 concatenated by "AND")

3. BONUS

3.1. Teacher can choose their preferred time slots

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

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

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

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

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

3.3. Batch can choose their preferred time slots

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

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

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

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

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

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.