E.A.5.8 (Social Golfers)

1.1 Modellazione

Dati i parametri P, W, G siano
- $S = \frac{|P|}{G}$
- $\mathcal{W} = \{1, 2, ..., W\}$
- $\mathcal{G} = \{1, 2, ..., G\}$
- $\mathcal{S} = \{1, 2, ..., S\}$
- $\mathcal{P} = \{1, 2, ..., |P|\}$, per cui ad ogni socio è assegnato un id da 1 a $|P|$

E sia (X, D, C) l'istanza parametrica di CSP t.c.

$$X = \big\{ X_{w,g,p} \mid w \in \mathcal{W} \wedge g \in \mathcal{G} \wedge p \in \mathcal{S} \big\} \tag{1}$$

Dove $X_{w,g,p}$ è l'id del socio in posizione p, nel gruppo g alla w-esima settimana

$$D = \Big\{ D_{X_{w,g,p}} \mid D_{X_{w,g,p}} = \mathcal{P} \Big\} \tag{2}$$

Poiché in ogni settimana, in ogni gruppo e in ogni posizione ci può essere uno qualsiasi dei giocatori.

$$C = \bigcup_{i=1}^{4} C_i \text{ dove} \tag{3}$$

Un socio non può comparire in più gruppi nella stessa settimana, e deve comparire in almeno un gruppo.

$$C_1 = \big\{ \text{alldifferent}\big(X_{w,g,s}\big) \mid w \in \mathcal{W} \big\} \tag{4}$$

All'interno di un gruppo l'ordine non conta, quindi per semplificare e fare symmetry breaking si accetta solo la permutazione in cui i soci sono ordinati per id.

$$
\begin{aligned}
C_2 = \big\{ & \\
& \langle \big\{ X_{w,g,p}, X_{w,g,p+1} \big\}, X_{w,g,p} < X_{w,g,p+1} \rangle \mid \\
& w \in \mathcal{W} \wedge g \in \mathcal{G} \wedge p \in \mathcal{S} \\
\big\} &
\end{aligned} \tag{5}
$$

L'ordine fra i gruppi non conta, quindi si accetta solo la permutazione in cui i gruppi sono ordinati usando l'id del primo socio nel gruppo.

$$
\begin{aligned}
C_3 = \big\{ & \\
& \langle \big\{ X_{w,g,1}, X_{w,g+1,1} \big\}, X_{w,g,1} < X_{w,g+1,1} \rangle \mid \\
& w \in \mathcal{W} \wedge g \in \mathcal{G} \\
\big\} &
\end{aligned} \tag{6}
$$

Se una coppia di soci ha giocato insieme nella settimana w' e nel gruppo g', non c'è una settimana w'' successiva a w', e non c'è un gruppo g'' nella settimana w'' in cui questi due soci giocano nuovamente insieme.

$$
\begin{aligned}
C_4 = \{ \\
\quad \langle \\
\qquad \left\{ X_{w',g',i'}, X_{w',g',j'}, X_{w'',g'',i''}, X_{w'',g'',j''} \right\}, \\
\qquad X_{w',g',i'} = X_{w'',g'',i''} \rightarrow X_{w',g',j'} \neq X_{w'',g'',j''} \\
\quad \rangle \mid \\
\qquad w' \in \mathcal{W} \wedge w'' \in \mathcal{W} \wedge w' < w'' \wedge \\
\qquad g' \in \mathcal{G} \wedge g'' \in \mathcal{G} \wedge \\
\qquad i' \in \mathcal{S} \wedge j' \in \mathcal{S} \wedge i' < j' \wedge \\
\qquad i'' \in \mathcal{S} \wedge j'' \in \mathcal{S} \wedge i'' < j'' \\
\}
\end{aligned}
\tag{7}
$$

1.2 Istanziazione

Dati i parametri $P = 9, W = 4, G = 3$ quindi $S = 3$, si hanno (X, D, C) t.c.

$$X = \{$$
$$X_{1,1,1}, X_{1,1,2}, X_{1,1,3}, X_{1,2,1}, X_{1,2,2}, X_{1,2,3}, X_{1,3,1}, X_{1,3,2}, X_{1,3,3},$$
$$X_{2,1,1}, X_{2,1,2}, X_{2,1,3}, X_{2,2,1}, X_{2,2,2}, X_{2,2,3}, X_{2,3,1}, X_{2,3,2}, X_{2,3,3},$$
$$X_{3,1,1}, X_{3,1,2}, X_{3,1,3}, X_{3,2,1}, X_{3,2,2}, X_{3,2,3}, X_{3,3,1}, X_{3,3,2}, X_{3,3,3},$$
$$X_{4,1,1}, X_{4,1,2}, X_{4,1,3}, X_{4,2,1}, X_{4,2,2}, X_{4,2,3}, X_{4,3,1}, X_{4,3,2}, X_{4,3,3},$$
$$\}$$

$$D = \left\{ D_{X_{w,g,p}} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} \mid w \in \{1, ..., 4\} \wedge g \in \{1, ..., 3\} \wedge p \in \{1, ..., 3\} \right\}$$

$$C = \bigcup_{i=1}^{4} C_i$$

$$C_1 = \{$$
$$\text{alldifferent}(X_{1,g,p}),$$
$$\text{alldifferent}(X_{2,g,p}),$$
$$\text{alldifferent}(X_{3,g,p}),$$
$$\text{alldifferent}(X_{4,g,p}),$$
$$\}$$

$$C_2 = \{$$
$$\langle\{X_{1,1,1}, X_{1,1,2}\}, X_{1,1,1} < X_{1,1,2}\rangle, \quad \langle\{X_{1,1,2}, X_{1,1,3}\}, X_{1,1,2} < X_{1,1,3}\rangle,$$
$$\langle\{X_{1,2,1}, X_{1,2,2}\}, X_{1,2,1} < X_{1,2,2}\rangle, \quad \langle\{X_{1,2,2}, X_{1,2,3}\}, X_{1,2,2} < X_{1,2,3}\rangle,$$
$$\langle\{X_{1,3,1}, X_{1,3,2}\}, X_{1,3,1} < X_{1,3,2}\rangle, \quad \langle\{X_{1,3,2}, X_{1,3,3}\}, X_{1,3,2} < X_{1,3,3}\rangle,$$
$$\langle\{X_{2,1,1}, X_{2,1,2}\}, X_{2,1,1} < X_{2,1,2}\rangle, \quad \langle\{X_{2,1,2}, X_{2,1,3}\}, X_{2,1,2} < X_{2,1,3}\rangle,$$
$$\langle\{X_{2,2,1}, X_{2,2,2}\}, X_{2,2,1} < X_{2,2,2}\rangle, \quad \langle\{X_{2,2,2}, X_{2,2,3}\}, X_{2,2,2} < X_{2,2,3}\rangle,$$
$$\langle\{X_{2,3,1}, X_{2,3,2}\}, X_{2,3,1} < X_{2,3,2}\rangle, \quad \langle\{X_{2,3,2}, X_{2,3,3}\}, X_{2,3,2} < X_{2,3,3}\rangle,$$
$$\langle\{X_{3,1,1}, X_{3,1,2}\}, X_{3,1,1} < X_{3,1,2}\rangle, \quad \langle\{X_{3,1,2}, X_{3,1,3}\}, X_{3,1,2} < X_{3,1,3}\rangle,$$
$$\langle\{X_{3,2,1}, X_{3,2,2}\}, X_{3,2,1} < X_{3,2,2}\rangle, \quad \langle\{X_{3,2,2}, X_{3,2,3}\}, X_{3,2,2} < X_{3,2,3}\rangle,$$

$$\langle\{X_{3,3,1}, X_{3,3,2}\}, X_{3,3,1} < X_{3,3,2}\rangle, \quad \langle\{X_{3,3,2}, X_{3,3,3}\}, X_{3,3,2} < X_{3,3,3}\rangle,$$
$$\langle\{X_{4,1,1}, X_{4,1,2}\}, X_{4,1,1} < X_{4,1,2}\rangle, \quad \langle\{X_{4,1,2}, X_{4,1,3}\}, X_{4,1,2} < X_{4,1,3}\rangle,$$
$$\langle\{X_{4,2,1}, X_{4,2,2}\}, X_{4,2,1} < X_{4,2,2}\rangle, \quad \langle\{X_{4,2,2}, X_{4,2,3}\}, X_{4,2,2} < X_{4,2,3}\rangle,$$
$$\langle\{X_{4,3,1}, X_{4,3,2}\}, X_{4,3,1} < X_{4,3,2}\rangle, \quad \langle\{X_{4,3,2}, X_{4,3,3}\}, X_{4,3,2} < X_{4,3,3}\rangle,$$
$$\}$$

$C_3 = \{$

$$\langle\{X_{1,1,1}, X_{1,2,1}\}, X_{1,1,1} < X_{1,2,1}\rangle, \quad \langle\{X_{1,2,1}, X_{1,3,1}\}, X_{1,2,1} < X_{1,3,1}\rangle, \quad \langle\{X_{1,3,1}, X_{1,4,1}\}, X_{1,3,1} < X_{1,4,1}\rangle,$$
$$\langle\{X_{2,1,1}, X_{2,2,1}\}, X_{2,1,1} < X_{2,2,1}\rangle, \quad \langle\{X_{2,2,1}, X_{2,3,1}\}, X_{2,2,1} < X_{2,3,1}\rangle, \quad \langle\{X_{2,3,1}, X_{2,4,1}\}, X_{2,3,1} < X_{2,4,1}\rangle,$$
$$\langle\{X_{3,1,1}, X_{3,2,1}\}, X_{3,1,1} < X_{3,2,1}\rangle, \quad \langle\{X_{3,2,1}, X_{3,3,1}\}, X_{3,2,1} < X_{3,3,1}\rangle, \quad \langle\{X_{3,3,1}, X_{3,4,1}\}, X_{3,3,1} < X_{3,4,1}\rangle,$$
$$\langle\{X_{4,1,1}, X_{4,2,1}\}, X_{4,1,1} < X_{4,2,1}\rangle, \quad \langle\{X_{4,2,1}, X_{4,3,1}\}, X_{4,2,1} < X_{4,3,1}\rangle, \quad \langle\{X_{4,3,1}, X_{4,4,1}\}, X_{4,3,1} < X_{4,4,1}\rangle,$$

$\}$

$C_4 = \{$

$$\langle\{X_{1,1,1}, X_{1,1,2}X_{2,1,2}X_{2,1,3}\}, X_{1,1,1} = X_{2,1,2} \rightarrow X_{1,1,2} \neq X_{2,1,3}\rangle$$
$$\langle\{X_{1,1,1}, X_{1,1,3}X_{2,1,2}X_{2,1,3}\}, X_{1,1,1} = X_{2,1,2} \rightarrow X_{1,1,3} \neq X_{2,1,3}\rangle$$
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$\langle\{X_{1,2,1}, X_{1,2,3}X_{3,3,2}X_{3,3,3}\}, X_{1,2,1} = X_{3,3,2} \rightarrow X_{1,2,3} \neq X_{3,3,3}\rangle$

$\langle\{X_{1,2,2}, X_{1,2,3}X_{3,3,2}X_{3,3,3}\}, X_{1,2,2} = X_{3,3,2} \rightarrow X_{1,2,3} \neq X_{3,3,3}\rangle$

$\langle\{X_{1,3,1}, X_{1,3,2}X_{3,1,2}X_{3,1,3}\}, X_{1,3,1} = X_{3,1,2} \rightarrow X_{1,3,2} \neq X_{3,1,3}\rangle$

$$\langle\{X_{1,3,1}, X_{1,3,3}X_{3,1,2}X_{3,1,3}\}, X_{1,3,1} = X_{3,1,2} \rightarrow X_{1,3,3} \neq X_{3,1,3}\rangle$$

$$\langle\{X_{1,3,2}, X_{1,3,3}X_{3,1,2}X_{3,1,3}\}, X_{1,3,2} = X_{3,1,2} \rightarrow X_{1,3,3} \neq X_{3,1,3}\rangle$$

$$\langle\{X_{1,3,1}, X_{1,3,2}X_{3,2,2}X_{3,2,3}\}, X_{1,3,1} = X_{3,2,2} \rightarrow X_{1,3,2} \neq X_{3,2,3}\rangle$$

$$\langle\{X_{1,3,1}, X_{1,3,3}X_{3,2,2}X_{3,2,3}\}, X_{1,3,1} = X_{3,2,2} \rightarrow X_{1,3,3} \neq X_{3,2,3}\rangle$$

$$\langle\{X_{1,3,2}, X_{1,3,3}X_{3,2,2}X_{3,2,3}\}, X_{1,3,2} = X_{3,2,2} \rightarrow X_{1,3,3} \neq X_{3,2,3}\rangle$$

$$\langle\{X_{1,3,1}, X_{1,3,2}X_{3,3,2}X_{3,3,3}\}, X_{1,3,1} = X_{3,3,2} \rightarrow X_{1,3,2} \neq X_{3,3,3}\rangle$$

$$\langle\{X_{1,3,1}, X_{1,3,3}X_{3,3,2}X_{3,3,3}\}, X_{1,3,1} = X_{3,3,2} \rightarrow X_{1,3,3} \neq X_{3,3,3}\rangle$$

$$\langle\{X_{1,3,2}, X_{1,3,3}X_{3,3,2}X_{3,3,3}\}, X_{1,3,2} = X_{3,3,2} \rightarrow X_{1,3,3} \neq X_{3,3,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,2}X_{4,1,2}X_{4,1,3}\}, X_{1,1,1} = X_{4,1,2} \rightarrow X_{1,1,2} \neq X_{4,1,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,3}X_{4,1,2}X_{4,1,3}\}, X_{1,1,1} = X_{4,1,2} \rightarrow X_{1,1,3} \neq X_{4,1,3}\rangle$$

$$\langle\{X_{1,1,2}, X_{1,1,3}X_{4,1,2}X_{4,1,3}\}, X_{1,1,2} = X_{4,1,2} \rightarrow X_{1,1,3} \neq X_{4,1,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,2}X_{4,2,2}X_{4,2,3}\}, X_{1,1,1} = X_{4,2,2} \rightarrow X_{1,1,2} \neq X_{4,2,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,3}X_{4,2,2}X_{4,2,3}\}, X_{1,1,1} = X_{4,2,2} \rightarrow X_{1,1,3} \neq X_{4,2,3}\rangle$$

$$\langle\{X_{1,1,2}, X_{1,1,3}X_{4,2,2}X_{4,2,3}\}, X_{1,1,2} = X_{4,2,2} \rightarrow X_{1,1,3} \neq X_{4,2,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,2}X_{4,3,2}X_{4,3,3}\}, X_{1,1,1} = X_{4,3,2} \rightarrow X_{1,1,2} \neq X_{4,3,3}\rangle$$

$$\langle\{X_{1,1,1}, X_{1,1,3}X_{4,3,2}X_{4,3,3}\}, X_{1,1,1} = X_{4,3,2} \rightarrow X_{1,1,3} \neq X_{4,3,3}\rangle$$

$$\langle\{X_{1,1,2}, X_{1,1,3}X_{4,3,2}X_{4,3,3}\}, X_{1,1,2} = X_{4,3,2} \rightarrow X_{1,1,3} \neq X_{4,3,3}\rangle$$

$$\langle\{X_{1,2,1}, X_{1,2,2}X_{4,1,2}X_{4,1,3}\}, X_{1,2,1} = X_{4,1,2} \rightarrow X_{1,2,2} \neq X_{4,1,3}\rangle$$

$$\langle\{X_{1,2,1}, X_{1,2,3}X_{4,1,2}X_{4,1,3}\}, X_{1,2,1} = X_{4,1,2} \rightarrow X_{1,2,3} \neq X_{4,1,3}\rangle$$

$$\langle\{X_{1,2,2}, X_{1,2,3}X_{4,1,2}X_{4,1,3}\}, X_{1,2,2} = X_{4,1,2} \rightarrow X_{1,2,3} \neq X_{4,1,3}\rangle$$

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$$\}$$

1.3 Codifica MiniZinc

```
include "globals.mzn";

int: card_P = 9;
int: W = 4;
int: G = 3;
int: S = card_P div G;

array[1..W, 1..G, 1..S] of var 1..card_P: X;

constraint forall(w in 1..W)(
  alldifferent([X[w,g,p] | g in 1..G, p in 1..S])
);

constraint forall(w in 1..W, g in 1..G, p in 1..S - 1)(
  X[w,g,p] < X[w,g,p+1]
);

constraint forall(w in 1..W, g in 1..G - 1)(
  X[w,g,1] < X[w, g+1, 1]
);

constraint forall(w1 in 1..W, w2 in w1 + 1..W, g1 in 1..G, g2
in 1..G, i1 in 1..S, j1 in i1 + 1..S, i2 in 1..S, j2 in i2 +
1..S)(
  X[w1, g1, i1] = X[w2, g2, i2] → X[w1, g1, j1] ≠ X[w2, g2,
j2]
);

output [
  "week " ++ show(w) ++ ": | " ++ concat(
    [concat([show_int(-2, X[w, g, p]) ++ " " | p in 1..S]) +
+ "| " | g in 1..G]
  ) ++ "\n" | w in 1..W
];
```