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/*********************************************
 * OPL 12.8.0.0 Model
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 *********************************************/

range   Week = 1..54;
range   Intern = 1..11;
range   Rotation = 1..16;


dvar boolean    x[Intern][Rotation][Week];


dvar boolean    y1[Intern][Week];
dvar boolean    y2[Intern][Week];
dvar boolean    y3[Intern][Week];
dvar boolean    y4[Intern][Week];
dvar boolean    y5[Intern][Week];
dvar boolean    y6[Intern][Week];
dvar boolean    y7[Intern][Week];
dvar boolean    y8[Intern][Week];
dvar boolean    y9[Intern][Week];
dvar boolean    y10[Intern][Week];
dvar boolean    y11[Intern][Week];


dvar boolean    L1[Week];
dvar boolean    L2[Week];
dvar boolean    L3[Week];

int             M = 1000;

dexpr int   z = sum(i in Intern, j in Rotation, k in Week) x[i][j][k];

minimize z;


subject to{

//let Rotation 18 be Weeks 1-4 when Interns 7-11 have not yet begun and
// Weeks 51-54 when Intern 1-6 have finished

forall(i in 1..6)
  sum(k in 51..54)x[i][16][k] ==4;

forall(i in 7..11)
  sum(k in 1..4)x[i][16][k] ==4;

forall(i in 1..6)
  sum(k in 1..50)x[i][16][k] ==0;

forall(i in 7..11)
  sum(k in 5..54)x[i][16][k] ==0;

//Orientation Constraints

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```
58 forall(i in 1..6)
59   sum(k in 1..4)x[i][5][k] ==1;
60
61 forall(i in 7..11)
62   sum(k in 5..8)x[i][5][k] ==1;
63
64 forall(i in 1..6)
65   sum(k in 1..4)x[i][9][k] ==1;
66
67 forall(i in 7..11)
68   sum(k in 5..8)x[i][9][k] ==1;
69
70 forall(i in 1..6)
71   sum(k in 1..4)x[i][10][k] ==2;
72
73 forall(i in 7..11)
74   sum(k in 5..8)x[i][10][k] ==2;
75
76 ///Intern Physical Constraint (can only be in one place at a time)
77 forall(i in Intern, k in Week)
78   sum(j in Rotation)x[i][j][k] <= 1;
79
80 ///Intern Rotation Completiion Constraint (everyone must do one of the rotations)
81
82 //CDP-G (j=1)
83 forall(i in Intern)
84   sum(k in Week)x[i][1][k] == 8;
85
86 //CDP-V (j=2)
87 forall(i in Intern)
88   sum(k in Week)x[i][2][k] == 4;
89
90 //AP (j=3)
91 forall(i in Intern)
92   sum(k in Week)x[i][3][k] == 4;
93
94 //MIC (j=4)
95 forall(i in Intern)
96   sum(k in Week)x[i][4][k] == 4;
97
98 //MCH (j=5)
99 forall(i in Intern)
100   sum(k in Week)x[i][5][k] == 3;
101
102 //CPCa (j=6)
103 forall(i in Intern)
104   sum(k in Week)x[i][6][k] == 3;
105
106 //CPM (j=7)
107 forall(i in Intern)
108   sum(k in Week)x[i][7][k] == 3;
109
110 //CPK (j=8)
111 forall(i in Intern)
112   sum(k in Week)x[i][8][k] == 2;
113
114 //IP (j=9)
```

```
115 forall(i in Intern)
116   sum(k in Week)x[i][9][k] == 5;
117
118 //DISP (j=10)
119 forall(i in Intern)
120   sum(k in Week)x[i][10][k] == 5;
121
122 //CPC (j=11)
123 forall(i in Intern)
124   sum(k in Week)x[i][11][k] >= 5;
125
126 //QUM (j=12)
127 forall(i in Intern)
128   sum(k in Week)x[i][12][k] == 1;
129
130 //H (j=13)
131 forall(i in Intern)
132   sum(k in Week)x[i][13][k] == 1;
133
134 //These constraint are the binders for the leave constraints
135
136 //A/L_1
137 forall(i in Intern)
138   sum(k in Week)x[i][14][k] == 1;
139
140 //A/L_2
141 forall(i in Intern)
142   sum(k in Week)x[i][15][k] ==1;
143
144
145 ///Intern Rotation Capacity Constraint
146
147 //CDP-G (j=1)
148 forall(k in Week)
149   sum(i in Intern)x[i][1][k] >= 0;
150
151 //CDP-V (j=2)
152 forall(k in Week)
153   sum(i in Intern)x[i][2][k] <= 1;
154
155 //AP (j=3)
156 forall(k in Week)
157   sum(i in Intern)x[i][3][k] <= 1;
158
159 //MIC (j=4)
160 forall(k in Week)
161   sum(i in Intern)x[i][4][k] <= 1;
162
163 //MCH (j=5)
164 forall(k in 5..50)
165   sum(i in 1..6)x[i][5][k] <= 1;
166 forall(k in 9..54)
167   sum(i in 7..11)x[i][5][k] <= 1;
168
169 //CPCa (j=6)
170 forall(k in Week)
171   sum(i in Intern)x[i][6][k] <= 1;
```

```
172
173 //CPM (j=7)
174 forall(k in Week)
175   sum(i in Intern)x[i][7][k] <= 11;
176
177 //CPK (j=8)
178 forall(k in Week)
179   sum(i in Intern)x[i][8][k] <= 11;
180
181 //IP (j=9)
182 forall(k in 5..50)
183   sum(i in 1..6)x[i][9][k] <= 2;
184 forall(k in 9..54)
185   sum(i in 7..11)x[i][9][k] <= 2;
186
187 //DISP (j=10)
188 forall(k in 5..50)
189   sum(i in 1..6)x[i][10][k] <= 5;
190 forall(k in 9..54)
191   sum(i in 7..11)x[i][10][k] <= 5;
192
193 //CPC (j=11)
194 forall(k in Week)
195   sum(i in Intern)x[i][11][k] <= 11;
196
197 //QUM (j=12)
198 forall(k in Week)
199   sum(i in Intern)x[i][12][k] <= 1;
200
201 //H (j=13)
202 forall(k in Week)
203   sum(i in Intern)x[i][13][k] <= 1;
204
205
206 //Intern Rotation Duration Constraint
207
208 //CDP-G (j=1)
209 forall(i in Intern)
210   sum(k in 1..47)y1[i][k] ==1;
211 forall(i in Intern, k in 1..47)
212   8 -(sum(a in 0..7)x[i][1][k + a]) <= M*(1-y1[i][k]);
213 //forall(i in Intern, k in 1..47)
214 //  2 -(sum(a in 0..10)x[1 + a][1][k]) <= M*(1-y1[i][k]);
215
216 //CDP-V (j=2)
217 forall(i in Intern)
218   sum(k in 1..51)y2[i][k] ==1;
219 forall(i in Intern, k in 1..51)
220   4 -(sum(a in 0..3)x[i][2][k + a]) <= M*(1-y2[i][k]);
221
222 //AP (j=3)
223 forall(i in Intern)
224   sum(k in 1..51)y3[i][k] ==1;
225 forall(i in Intern, k in 1..51)
226   4 -(sum(a in 0..3)x[i][3][k + a]) <= M*(1-y3[i][k]);
227
228 //MIC (j=4)
```

```
forall(i in Intern)
  sum(k in 1..26)y4[i][k] ==1;
forall(i in Intern, k in 1..26)
  2 -(sum(a in 0..1)x[i][4][k + a]) <= M*(1-y4[i][k]);
forall(i in Intern)
  sum(k in 27..53)y4[i][k] ==1;
forall(i in Intern, k in 27..53)
  2 -(sum(a in 0..1)x[i][4][k + a]) <= M*(1-y4[i][k]);


//MCH (j=5)
forall(i in Intern)
  sum(k in 1..53)y5[i][k] ==1;
forall(i in Intern, k in 1..53)
  2 -(sum(a in 0..1)x[i][5][k + a]) <= M*(1-y5[i][k]);

//CPCa (j=6)
forall(i in Intern)
  sum(k in 1..52)y6[i][k] ==1;
forall(i in Intern, k in 1..52)
  3 -(sum(a in 0..2)x[i][6][k + a]) <= M*(1-y6[i][k]);

//CPM (j=7)
forall(i in Intern)
  sum(k in 1..52)y7[i][k] ==1;
forall(i in Intern, k in 1..52)
  3 -(sum(a in 0..2)x[i][7][k + a]) <= M*(1-y7[i][k]);

//CPK (j=8)
forall(i in Intern)
  sum(k in 1..53)y8[i][k] ==1;
forall(i in Intern, k in 1..53)
  2 -(sum(a in 0..1)x[i][8][k + a]) <= M*(1-y8[i][k]);

//IP (j=9)
forall(i in Intern)
  sum(k in 1..51)y9[i][k] ==1;
forall(i in Intern, k in 1..51)
  4 -(sum(a in 0..3)x[i][9][k + a]) <= M*(1-y9[i][k]);

//DISP (j=10)
forall(i in Intern)
  sum(k in 1..52)y10[i][k] ==1;
forall(i in Intern, k in 1..52)
  3 -(sum(a in 0..2)x[i][10][k + a]) <= M*(1-y10[i][k]);

//CPC (j=11)
forall(i in Intern)
  sum(k in 1..50)y11[i][k] ==1;
forall(i in Intern, k in 1..50)
  5 -(sum(a in 0..4)x[i][11][k + a]) <= M*(1-y11[i][k]);


//Intern Leave Constraints

//Week 1
sum(k in 9..50)L1[k] ==1;
```

```
forall(k in 9..50)
  11 - (sum(i in Intern)x[i][14][k]) <= M*(1-L1[k]);

//Week 2
//sum(k in 9..50)L2[k] ==1;
//sum(k in 9..50)L3[k] ==1;
//forall(k in 9..50)
//  6 - (sum(i in Intern)x[i][15][k]) <= M*(1 -L2[k]);
//forall(k in 9..50)
//  5 - (sum(i in Intern)x[i][15][k]) <= M*(1 - L3[k]);

//Avoidance Constraint (no one week rotations during seminar weeks/public holidays)

forall(i in Intern, j in 12..13)
  x[i][j][5] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][8] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][11] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][15] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][17] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][18] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][21] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][26] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][28] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][33] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][43] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][45] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][46] ==0;

forall(i in Intern, j in 12..13)
  x[i][j][49] ==0;


}
```