Course Project of Algorithmic Methods for Mathematical Models (AMMM)

Author: X

Facultad de Informática de Barcelona

de Universitat Politècnica de Catalunya

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1 Formulation of problem

Input data

- $numNurses$: total number of nurses
- $hours$: total hour
- $minHours$: minimum hour should a single nurse be working
- $maxHours$: maximum hour can a single nurse be working
- $maxConsec$: maximum consecutive hour can a single nurse be working
- $maxPresence$: maximum hour can a single nurse be in the hospital
- $demand_h$: number of nurses required for hour h

Decision variables

- $works_{n,h}$: nurse n is working in hour h
- $working_n$: nurse n works
- $worksBefore_{n,h}$: nurse n works some hour before h
- $worksAfter_{n,h}$: nurse n works some hour after h

Math formulation

$$\boxed{Min : \sum_{n \in N} working_n} \tag{1}$$

$$\sum_{n \in N} works_{n,h} \geq demand_h \quad \forall h \in H \tag{2}$$

$$\sum_{h \in H} works_{n,h} \geq working_n * minHours \quad \forall n \in N \tag{3}$$

$$\sum_{h \in H} works_{n,h} \leq working_n * maxHours \quad \forall n \in N \tag{4}$$

$$\sum_{i \in [h, h+maxConsec+1]} works_{n,i} \leq maxConsec \quad \forall n \in N \quad \forall h \in [1, hours - maxConsec + 1] \tag{5}$$

$$worksBefore_{n,h} * hours \geq \sum_{i \in [1, h-1]} works_{n,i} \quad \forall n \in N \quad \forall h \in H \tag{6}$$

$$worksBefore_{n,h} \leq \sum_{i \in [1,h-1]} works_{n,i} \quad \forall n \in N \quad \forall h \in H \tag{7}$$

$$worksAfter_{n,h} * hours \geq \sum_{i \in [h+1,hours]} works_{n,i} \quad \forall n \in N \quad \forall h \in H \tag{8}$$

$$worksAfter_{n,h} \leq \sum_{i \in [h+1,hours]} works_{n,i} \quad \forall n \in N \quad \forall h \in H \tag{9}$$

$$\sum_{h \in H} worksAfter_{n,h} + \sum_{h \in H} worksBefore_{n,h} + 2 - hours \leq maxPresence \quad \forall n \in N \tag{10}$$

$$\begin{aligned} works_{n,h} + works_{n,h+1} + 2 \geq worksAfter_{n,h} + worksBefore_{n,h} + \\ worksAfter_{n,h+1} + worksBefore_{n,h+1} \quad \forall n \in N \quad \forall h \in H \end{aligned} \tag{11}$$