NURSE SCHEDULING PROBLEM

PROGRESS REPORT

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AGENDA

1. Revision of state of the art
2. Mathematical model
3. Solution strategies

STATE OF THE ART

- As observed in (Burke et al. 2004) many different approaches have been used to solve the NSP
  - Stochastic programming
  - Linear and quadratic models
  - ANSOS
  - Multi objective
  - Expert systems and artificial intelligence
  - All kinds of heuristics

TOP PLACES LAST COMPETITION

Valois et al (2010)	• Strictly mathematical approach • Partition into 2 sub problems or phases
Nonobe (2010)	• Metaheuristic for a COP • Tabu search with an easy transformation • Use of binary variables
Zhipeng y Jin-Hao	• Adaptive local search • Multi start • Diferent neighborhoods • Different strategies to explore neigborhoods
Burke et al (2010)	• Use of previously developed staff rostering model • Variable depth search and branch and pricing

MATHEMATICAL MODEL

$$\min Z = \Delta Z_1 + \Delta Z_2 + \Delta Z_3 + \Delta Z_4 + \Delta Z_5 + \Delta Z_6 \qquad (1)$$

$$\sum_{s \in S} \sum_{k \in K} x_{nsdk} = 1, \qquad \forall\, n \in N,\ d \in D \qquad (2)$$

$$\sum_{n \in N} x_{nsdk} \cdot r_{nk} \geq RM_{sdk}, \qquad \forall\, s \in S,\ d \in D,\ k \in K \qquad (3)$$

$$\sum_{k \in K} \left(x_{n,s_1,d,k} + x_{n,s_2,d+1,k}\right) \leq 1, \qquad \forall\, n \in N,\ d \in D \backslash \{|D|\},\ (s_1, s_2) \in P \qquad (4)$$

$$\sum_{n \in N} x_{nsdk} \cdot s_{nk} + M_{sdk} \geq RO_{sdk}, \qquad \forall\, s \in S,\ d \in D,\ k \in K \qquad (5)$$

$$\Delta Z_1 = C_1 \cdot \sum_{s \in S} \sum_{k \in K} M_{sdk} \qquad (6)$$

- Work in progress
- Use of variables representing nurse, shift day, and shift
- Soft constraints as decision variables

Where

x_{nsdk} : nurse n working on shift s on day d with skill k

ΔZ_i: cost of soft restriction i

Solution strategies

- 2 phases
- Use of assignation of days then shifts
- Improvement through VNS and VSSS

Others

- Familiarization with Gurobi software

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THANK YOU

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