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DMP87 - Scheduling, Timetabling and Routing
Weekly Notes
Lecture 11, Fall 2008

Lecture March 3

We treated the following:

- Iterated Greedy for $Fm|prmu|C_{max}$ (Slides or sections 3, 3.4 excluded, of the paper by Ruiz and Stützle)
- Tabu Search for $Fm \mid prmu \mid C_{max}$ (Slides or sections 1-3 of Grabowski and Wodecki)
- Job shop, definition, disjunctive graph representation, and shifting bottleneck heuristic (textbook pages 84 through 93).

The next time:

- Tabu search for $Jm \mid \mid C_{max}$ (slides or photocopies available from the Documents section of the Black Board, pages 194–197).
- Job shop generalizations (photocopies available from the Documents section of the Black Board, pages 203–208).
- Resource Constrained Project Scheduling, Definitions (Slides from Lecture 7).
- Discussion of the Assignments below.

Assignment

Formulate the following problems in the form of RCPSP. [The goal of this assignment is gaining confidence with the RCPSP models and start dealing with timetabling.]

Project Management in Construction Industry

A contractor has to complete n activities. The duration of activity j is p_j and it requires a crew of size W_j. The activities are not subject to precedence constraints. The contractor has W workers at his disposal and his objective is to complete all n activities in minimum time.

Exam Scheduling

Exams in a college may have different duration. The exams have to be held in a gym with W seats. The enrollment in course j is W_j and all W_j students have to take the exam at the same time. The goal is to develop a timetable that schedules all n exams in minimum time. Consider both the cases in which each student has to attend a single exam as well as the situation in which a student can attend more than an exam.

Course scheduling

In a basic high-school timetabling problem we are given m classes $c_1, \ldots, c_m$, h teachers $a_1, \ldots, a_h$ and T teaching periods $t_1, \ldots, t_T$. Furthermore, we have lectures $i = l_1, \ldots, l_n$. Associated with each lecture is a unique teacher and a unique class. A teacher a_j may be available only in certain teaching periods. The corresponding timetabling problem is to assign the lectures to the teaching periods such that

- each class has at most one lecture in any time period
- each teacher has at most one lecture in any time period,
- each teacher has only to teach in time periods where he is available.

Audit-staff scheduling

A set of jobs $J_1, \ldots, J_g$ are to be processed by auditors $A_1, \ldots, A_m$. Job J_l consists of n_l tasks ($l = 1, \ldots, g$). There may be precedence constraints $i_1 \longrightarrow i_2$ between tasks i_1, i_2 of the same job. Associated with each job J_l is a release time r_l, a due date d_l and a weight w_l.
Each task must be processed by exactly one auditor. If task i is processed by auditor A_k, then its processing time is p_{ik}. Auditor A_k is available during disjoint time intervals $[s_k^\nu, l_k^\nu]$ ($\nu = 1, \ldots, m$) with $l_k^\nu < s_k^\nu$ for $\nu = 1, \ldots, m_k - 1$. Furthermore, the total working time of A_k is bounded from below by H_k^- and from above by H_k^+ with $H_k^- \leq H_k^+$ ($k = 1, \ldots, m$).
We have to find an assignment $\alpha(i)$ for each task $i = 1, \ldots, n := \sum_{l=1}^{g} n_l$ to an auditor $A_{\alpha(i)}$ such that

- each task is processed without preemption in a time window of the assigned auditor
- the total workload of A_k is bounded by H_k^- and H_k^k for $k = 1, \ldots, m$.
- the precedence constraints are satisfied,
- all tasks of J_l do not start before time r_l, and
- the total weighted tardiness $\sum_{l=1}^{g} w_l T_l$ is minimized.

(Hint: this case extends the definition of RCPSP by multi-mode case, that is, the possibility that the processing time of an activity i in mode m is given by p_{im} and the per periods usage of renewable resource k is given by r_{ikm}. One has to assign a mode to each activity and schedule the activities in the assinged modes).