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Optimization and its **A**pplications in **L**earning and **I**ndustry (OptALI)

IRSES

Ongoing Deliverable D1.2

Description of Research Seminar: The train marshalling problem

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Participants:	UGOE UNIKL DTU UOA UC
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Research Seminar

offered by Katharina Beygang (ES-UNIKL-2)

in March 2011,

in Auckland, New Zealand

Subject: Optimization in public transportation - The train marshalling problem

Problem: Marshalling yards (hump yards) play a decisive role in railroad life. They are responsible for arranging freight cars into specific sequences to assemble specific trains. A shunting yard consists of a hump, a set of parallel classification tracks (sorting tracks) and a roll-in and pull-out track. Any car which arrives at the shunting yard, rolls down from the hump, via the roll-in track to a classification track. The pull-out track reunites the cars resp. the block of cars by placing all cars from one of the tracks at the beginning of the rearranged train, followed by the cars of another track and so on such that all cars with the same destination are blocked together. In such a marshalling yard, the most elementary operations are

- decoupling the trains in front of the hump and pulling them over the hump (roll-in operations), and
- pulling the cars out of the classification tracks and reuniting them at the pull-out track (pull-out operations).

We study the *Train Marshalling Problem* where the car capacity of each classification track is set to be infinity. Additionally we allow one roll-in operation for every car and just one pull-out operation per track. This keeps the coupling and decoupling operations within a limit. Since it might be better that cars of a certain property, in particular with the same destination, appear consecutively (due to timetable restrictions etc.), we consider the problem of creating an outgoing train from a set

of arriving trains where the cars with certain properties are grouped together, i.e., form a block. Thereby, we do not require that the blocks have to appear in a certain ordering.

Main Results: We studied the offline and online version of the Train Marshalling Problem. In the offline case, which is known to NP-hard, our focus was on new lower and upper bounds on optimal solutions by using several techniques from combina- torial optimization such as linear programming relaxation or concepts from graph theory. We considered the corresponding online version where each car has to be assigned to a classification track before the destination of the next car becomes known. We showed that interval coloring achieves an optimal competitive ratio among all deterministic algorithms. Thereby, we presented computational results to evaluate the presented bounds and heuristics.

Participants: students and researchers from UOA.

Publication: -