DM204 (5 ECTS - 1st Quarter)
Scheduling, Timetabling and Routing

[Skedulering, Skemalægning og Ruteplanlægning]

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Overview

Intro phase:
Theory:

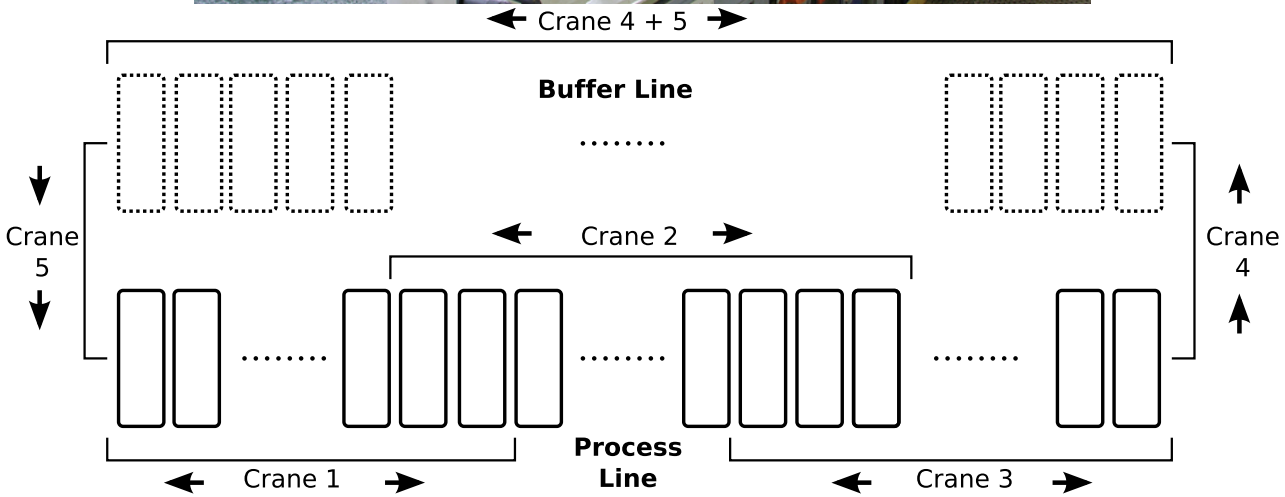
- Classification of problems in
  (i) Scheduling, (ii) Timetabling and (iii) Routing
- MIP modeling: Dantzig-Wolfe decomposition, extended and compact formulations
- Solution algorithm: branch and price = branch and bound + column generation via resource constraint shortest path

Training phase:
Concrete application example bus driver scheduling of the city of Milan

Study phase:
Implementation of solver for disruption management (AMPL & C++)

Outline

Scheduling

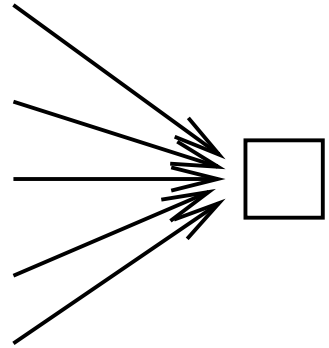


Jakob Skov, *Scheduling of an Anodizing Plant at Bang & Olufsen*. Master Thesis, IMADA, 2007.

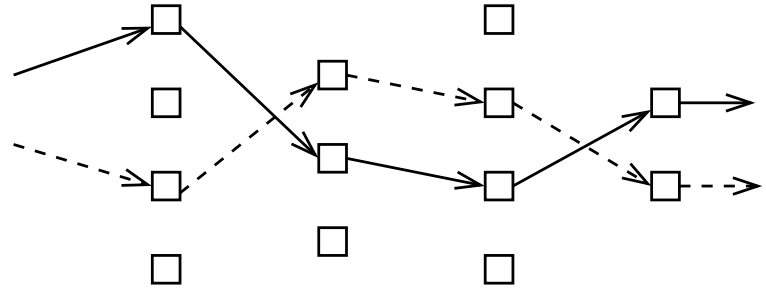
Scheduling

Allocation of scarce resources to tasks over time with the goal of optimizing some objectives

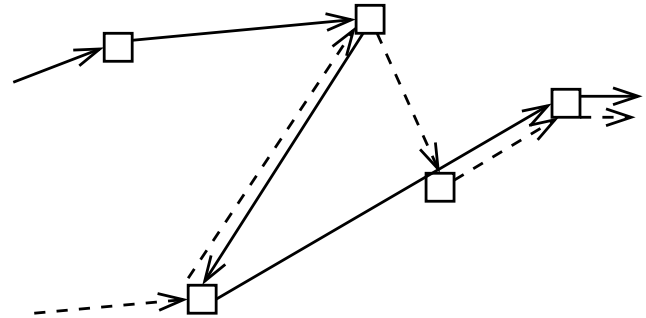
Single machine



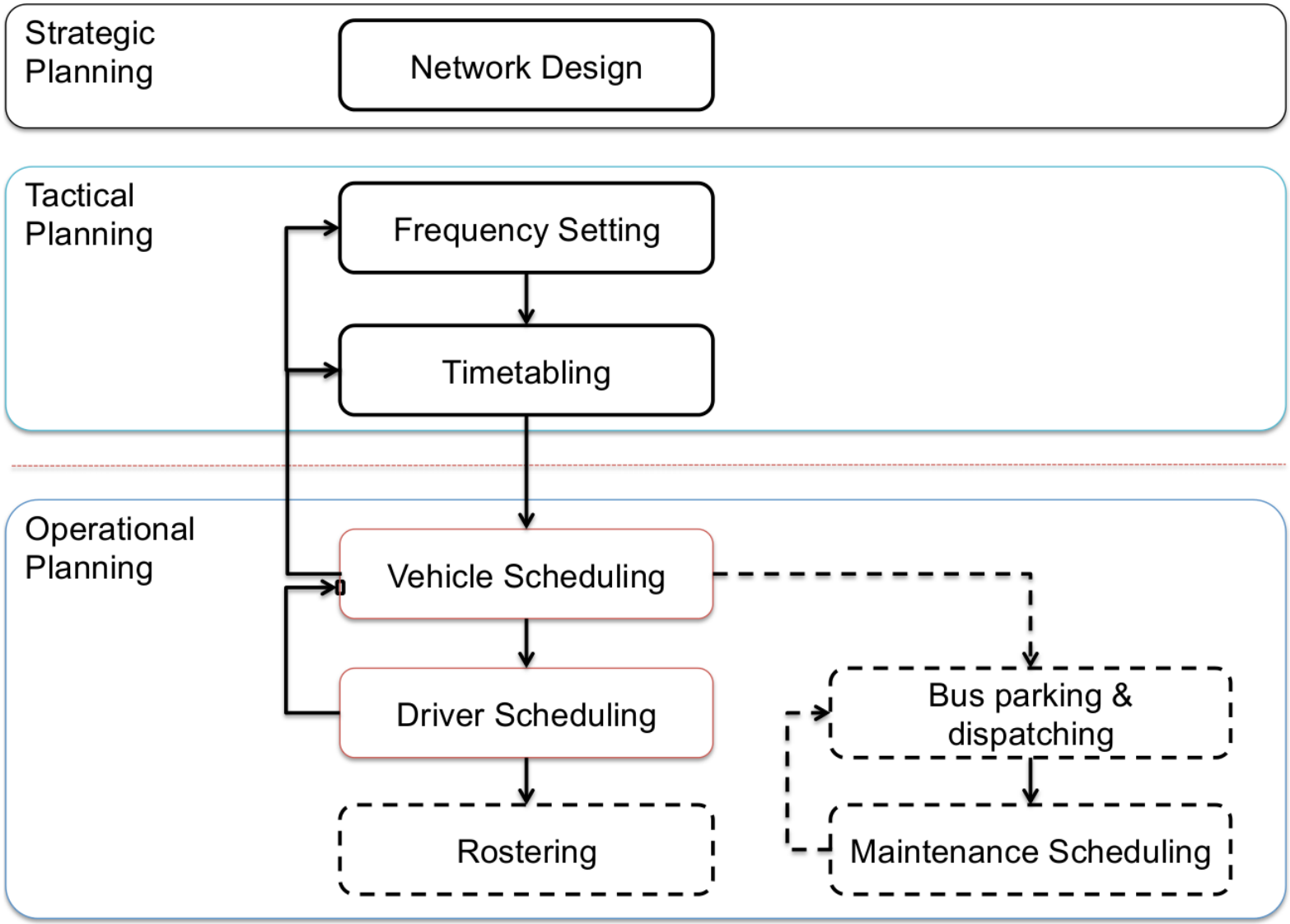
Flow shop and
flexible flow shop



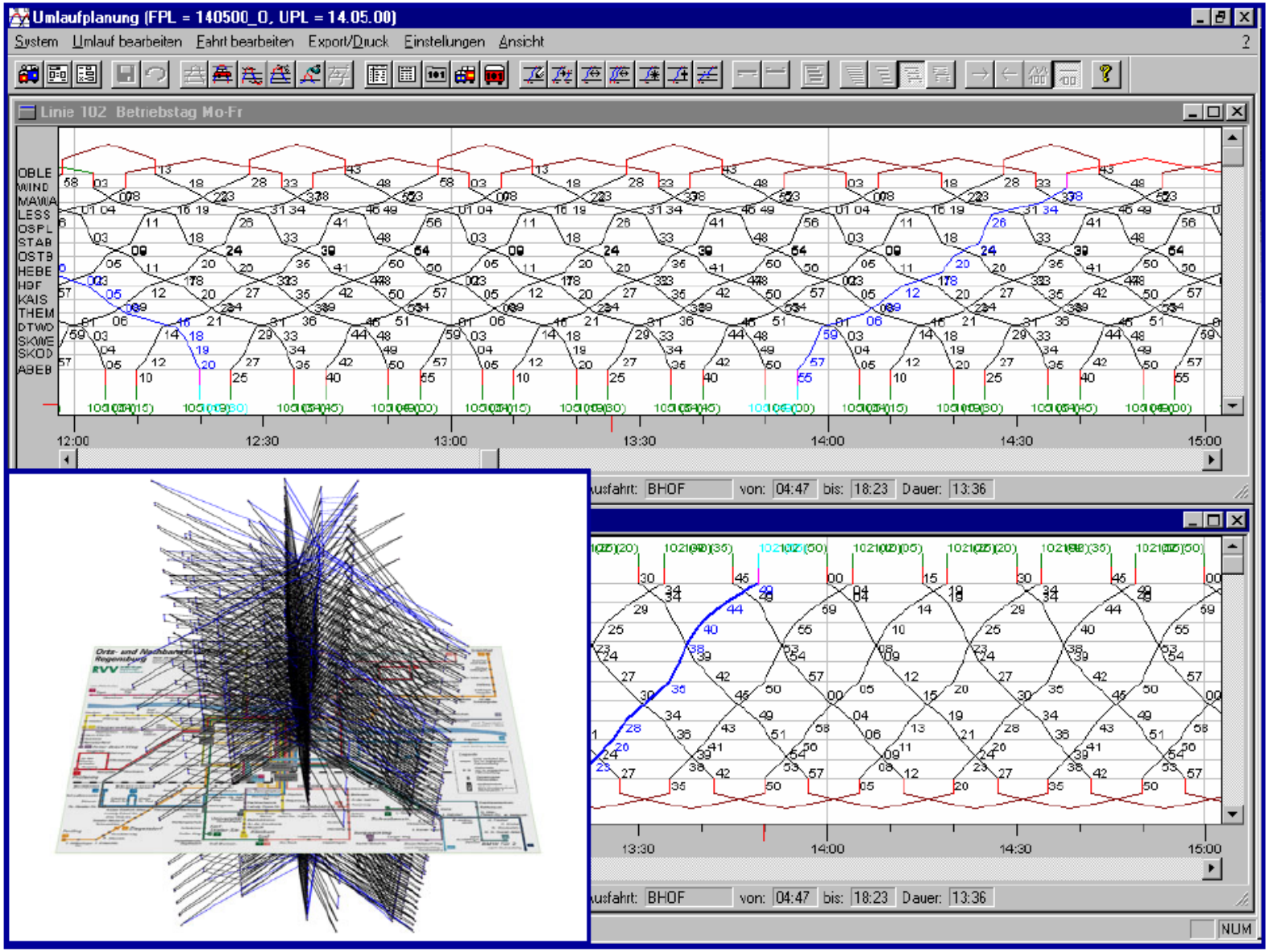
Job shop, Open shop



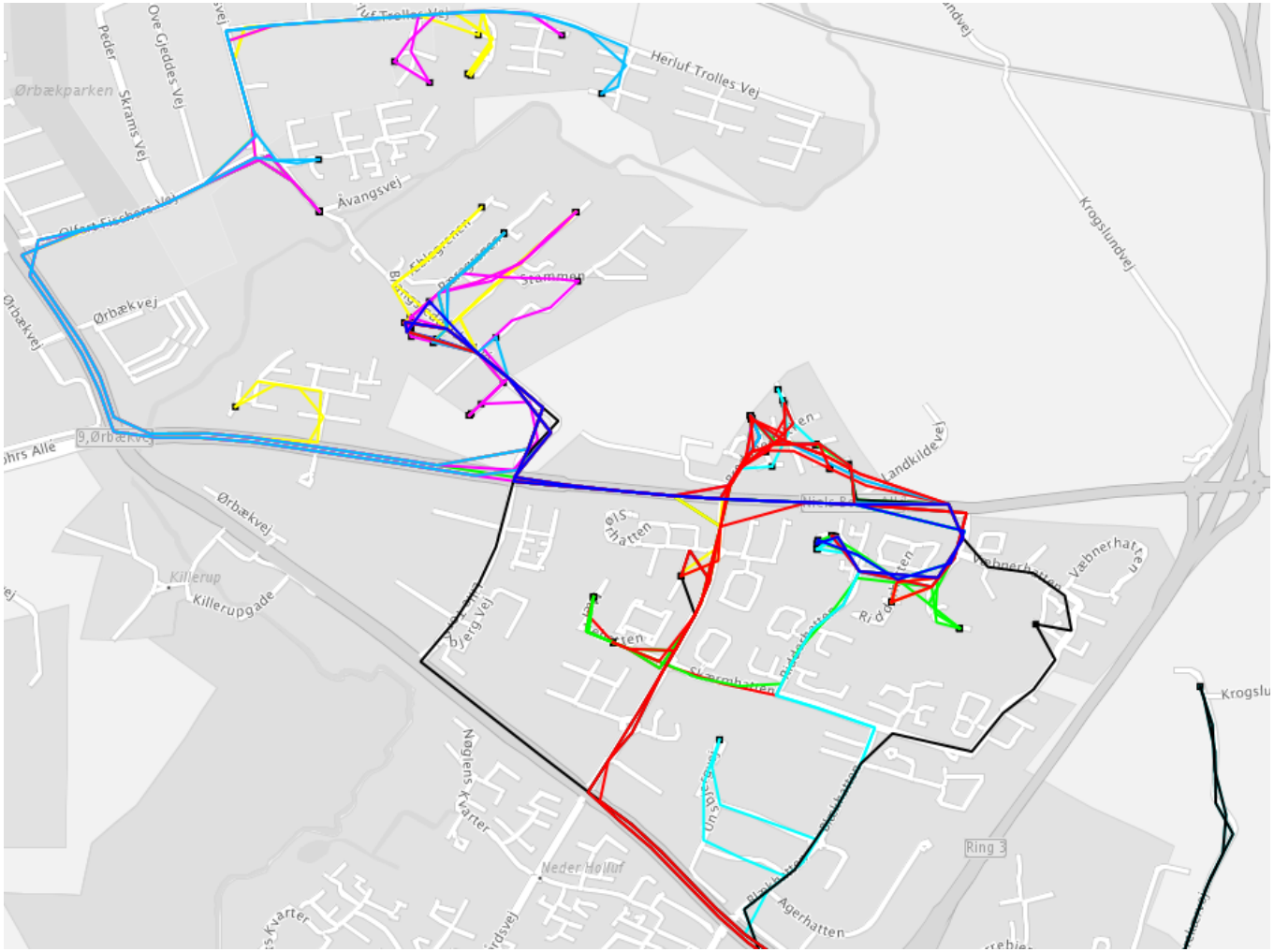
Transport Planning and Timetabling



Transport Planning and Timetabling

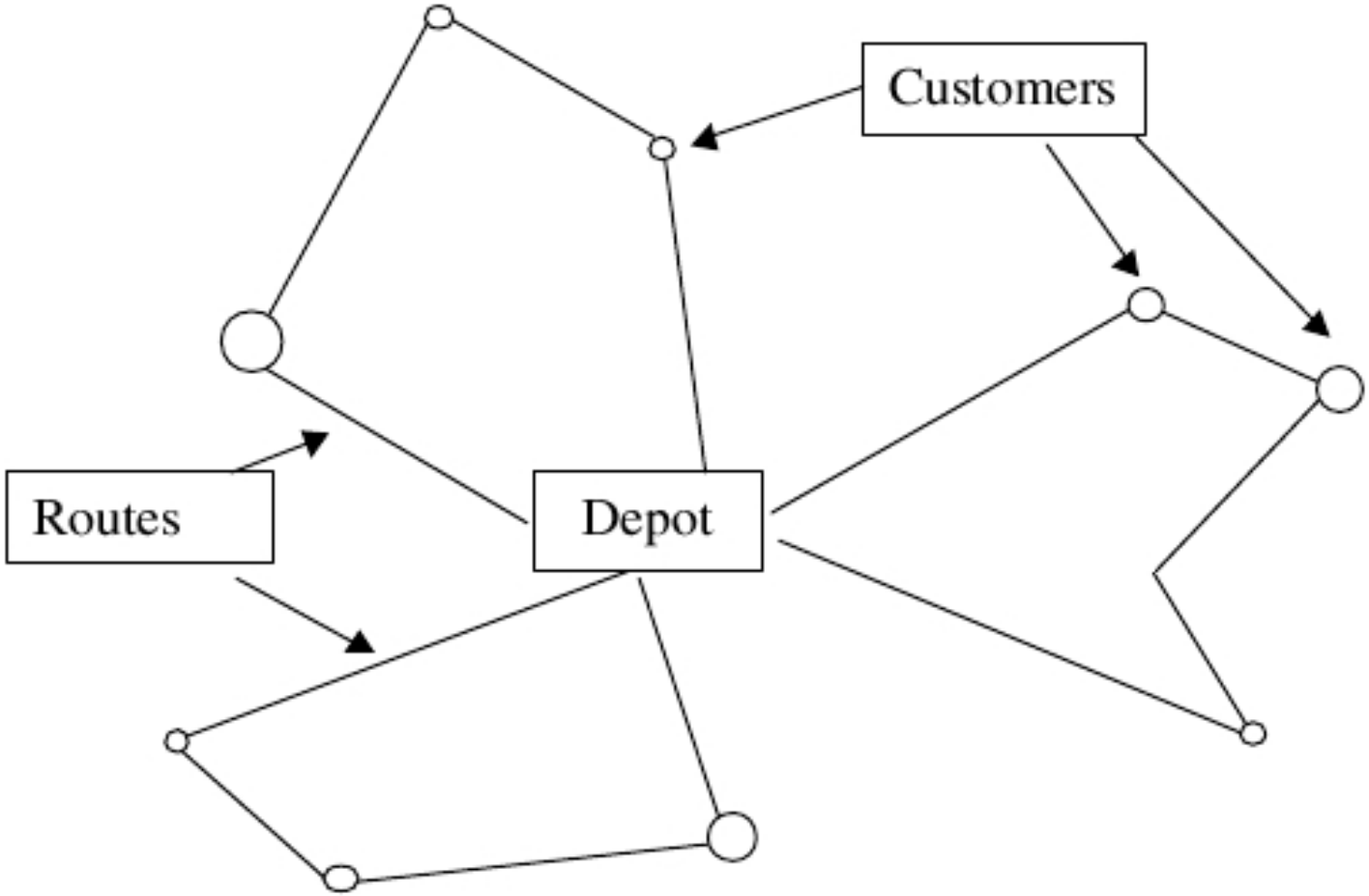


Vehicle Routing

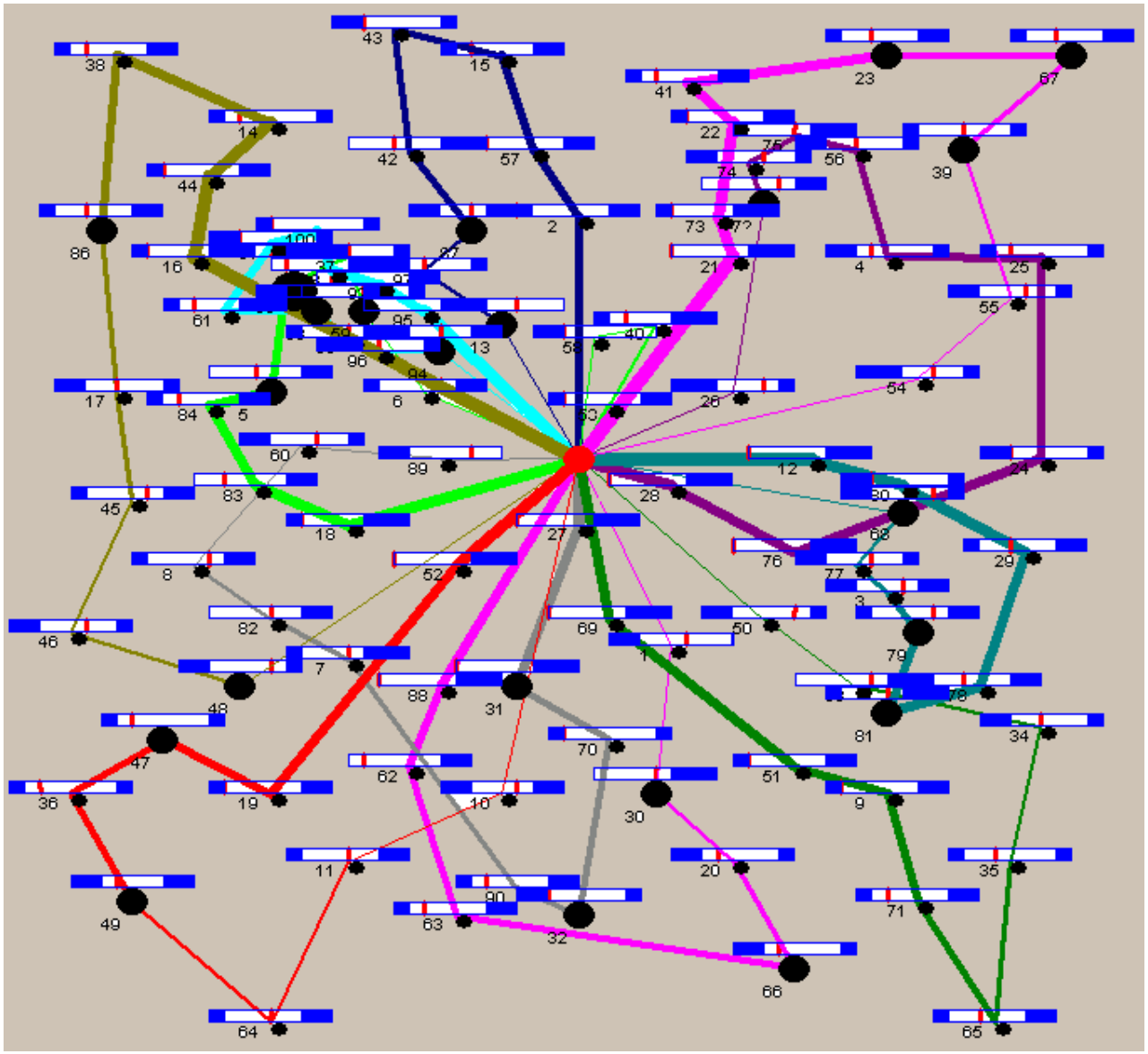


Steffen Elberg Godskesen. *Automated Planning of Work for Home Nurses*. Master Thesis, IMADA, 2006.

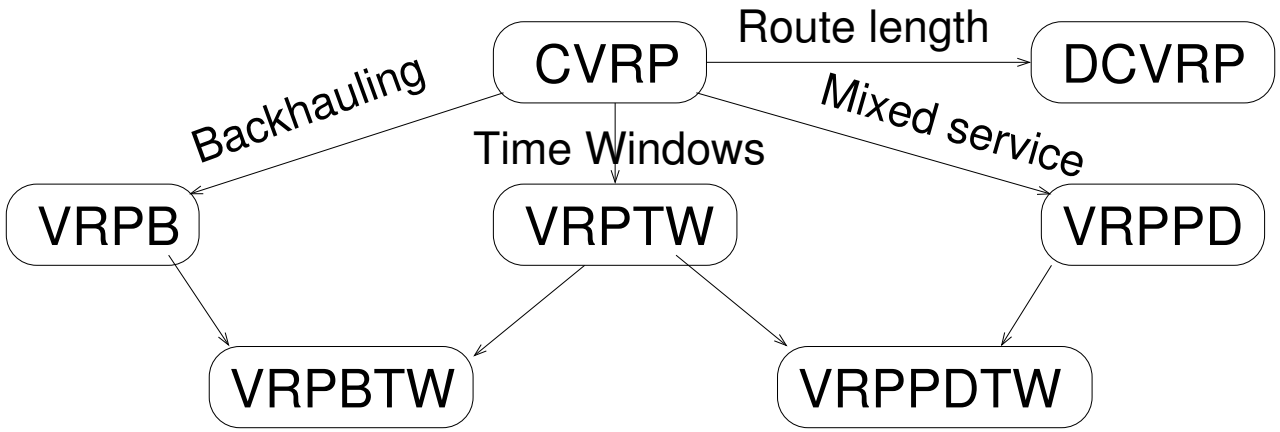
Vehicle Routing



Vehicle Routing



Vehicle Routing



Outline

MIP Models

$$\min \sum_{k \in \mathcal{V}} \sum_{i \in \mathcal{N}} \sum_{j \in \mathcal{N}} c_{ij} x_{ijk} \ \ s.t., \tag{3.1}$$

$$\sum_{k \in \mathcal{V}} \sum_{j \in \mathcal{N}} x_{ijk} = 1 \quad \forall i \in \mathcal{C}, \tag{3.2}$$

$$\sum_{i \in \mathcal{C}} d_i \sum_{j \in \mathcal{N}} x_{ijk} \leq q \quad \forall k \in \mathcal{V}, \tag{3.3}$$

$$\sum_{j \in \mathcal{N}} x_{0jk} = 1 \quad \forall k \in \mathcal{V}, \tag{3.4}$$

$$\sum_{i \in \mathcal{N}} x_{ihk} - \sum_{j \in \mathcal{N}} x_{hjk} = 0 \quad \forall h \in \mathcal{C}, \ \forall k \in \mathcal{V}, \tag{3.5}$$

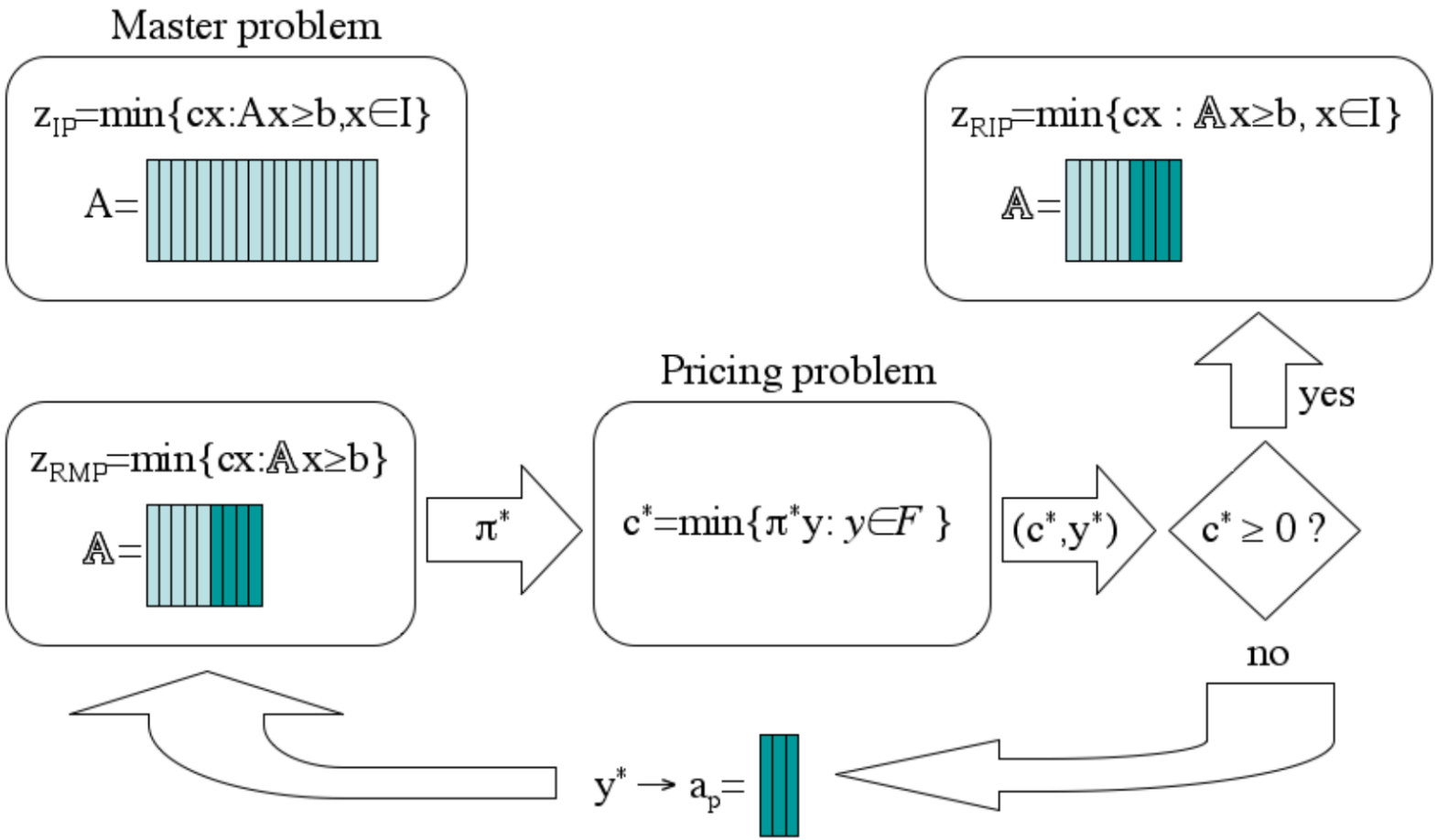
$$\sum_{i \in \mathcal{N}} x_{i,n+1,k} = 1 \quad \forall k \in \mathcal{V}, \tag{3.6}$$

$$x_{ijk}(s_{ik} + t_{ij} - s_{jk}) \leq 0 \quad \forall i, j \in \mathcal{N}, \ \forall k \in \mathcal{V}, \tag{3.7}$$

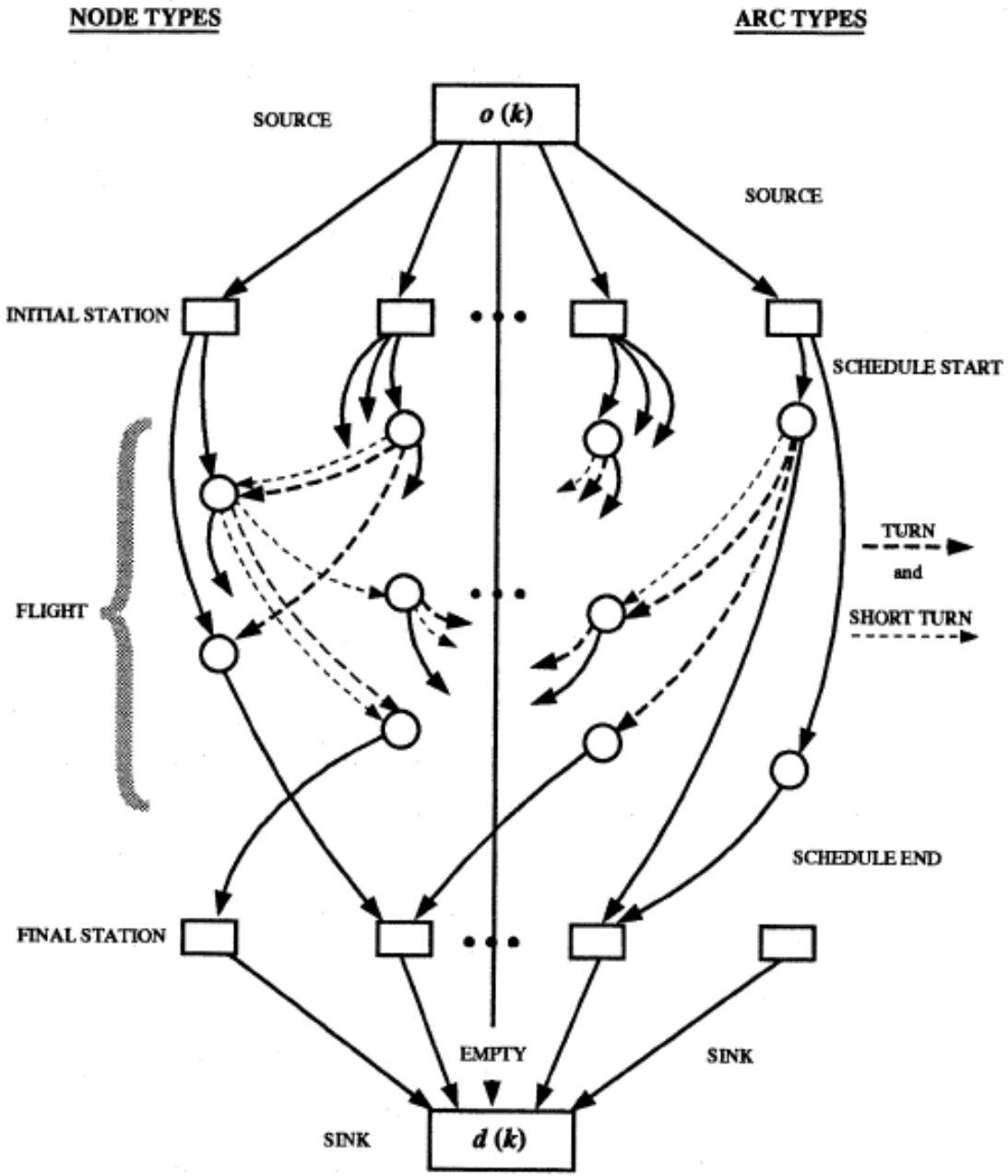
$$a_i \leq s_{ik} \leq b_i \quad \forall i \in \mathcal{N}, \ \forall k \in \mathcal{V}, \tag{3.8}$$

$$x_{ijk} \in \{0, 1\} \quad \forall i, \ j \in \mathcal{N}, \ \forall k \in \mathcal{V}. \tag{3.9}$$

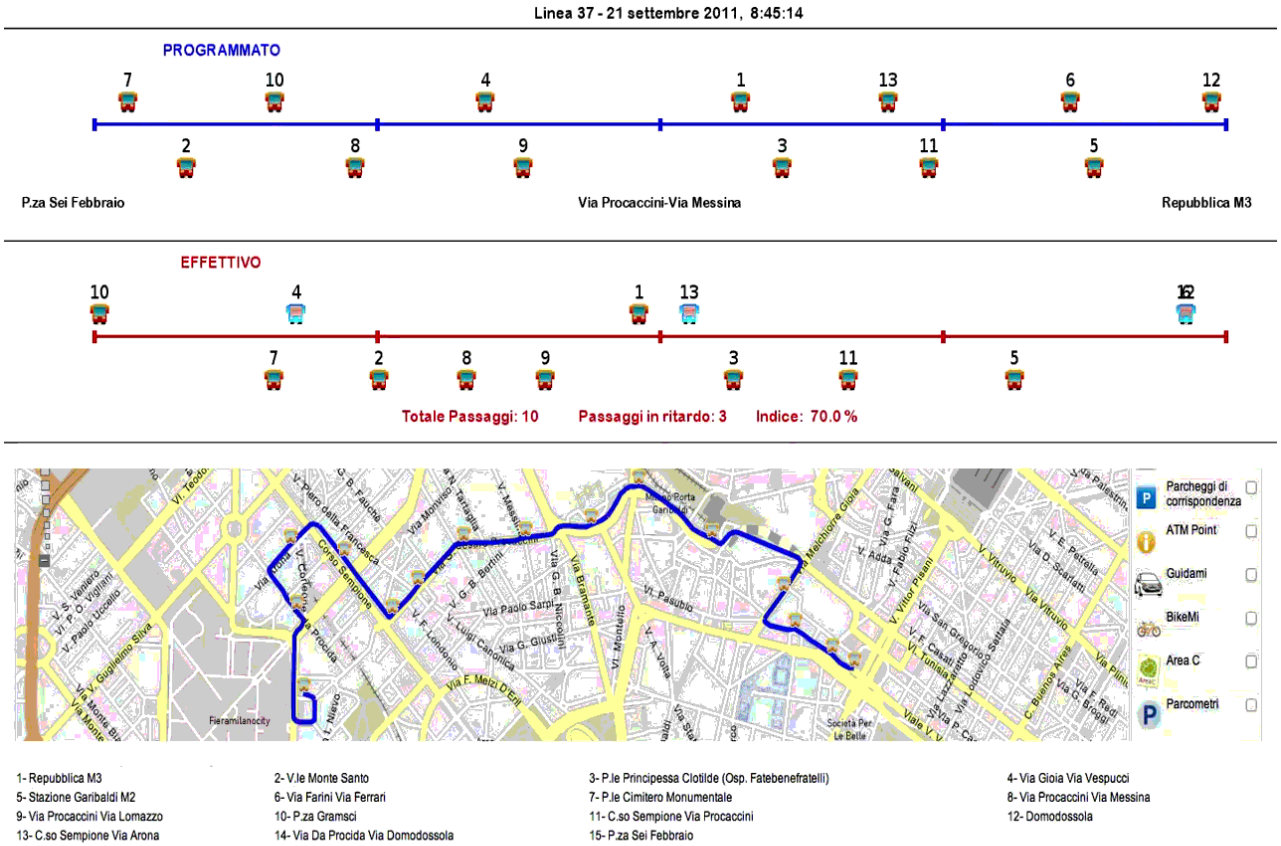
Branch and Price



Resource Constrained Shortest Path



Bus Driver Scheduling



Outline

Course Formalities

Prerequisites:	✓ A bachelor in CS, App. Math or Mat-Øk ✓ DM545 - Linear and Integer Programming ▸ DM811 - Heuristics and Local Search for Combinatorial Optimization
Credits:	5 ECTS
Language:	English
Classes:	$2h \times 8$ intro phase $+$ $2h \times 6$ training phase $+$ $10h$ study phase
Material:	slides $+$ pointers to literature $+$ source code & data sets

Assessment

- Practical part
- Oral exam with external censor on the practical part

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"Hiring" Announcement

Master and Individual Study Activities

- Course/Exam timetabling at NAT-SDU
- Graph coloring problems
- Crew scheduling (AirSupport)
- Aircraft routing (AirSupport)
- Vehicle routing (CargoMatch)
- Distribution of virtualization clusters on the physical infrastructure (APC Schneider Electric)
- ROADEF 2014 competition (FNRS train management)
- Local search framework