AC Retreat 2015

PART 1 – Methods:
PILOT, GRASP, VNS

PART 2 – Problem:
Balancing Bicycle Sharing Systems Problem

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Meta-heuristic Methods

PILOT (Construction Heuristic)

- PILOT := **P**referred **I**terative **LO**ok ahead **T**echnique
- look ahead to escape the greedy trap

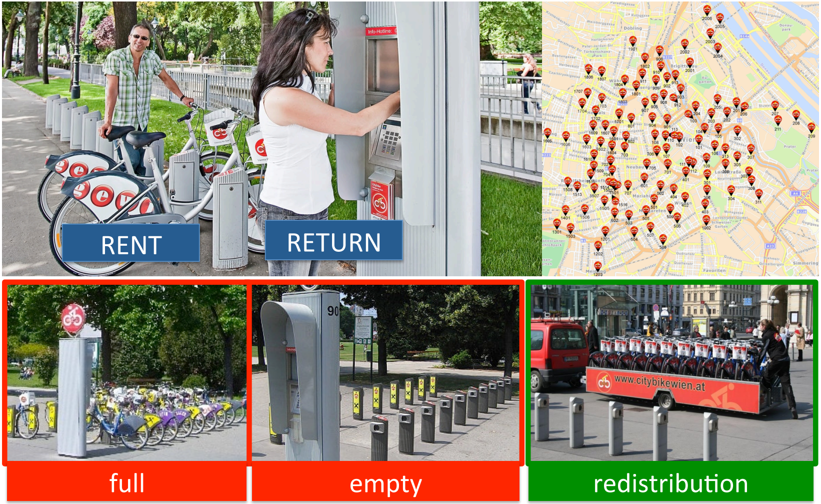
GRASP – Greedy Randomized Adaptive Search Procedure

- multiple iterations of a randomized construction heuristic followed by local search

VNS – Variable Neighborhood Search

- shaking neighborhoods for randomization
- neighborhoods for local optimization

Public Bicycle Sharing Systems and Issues



we optimize daily relocation tours of vehicles with trailers

Optimization Objectives and Constraints

→ satisfy users (convenience) and operators (efficiency)!

balance
demands

working time
loading instructions

Constraints:

- start and return with empty vehicle
- do not exceed working time
- full vehicle loads

Model/Definitions

→ complete graph: depot, stations as vertices

→ arcs weighted with travel times connect stations/depot

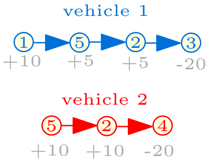
→ stations with capacities, user demands, fill levels

→ vehicle fleet with capacities and maximal tour durations

Static and Dynamic Variant

- static variant: we try to reach target fill levels
- dynamic variant: consider user demands (prognosis data)

Solutions: tours and loading instructions



→ we solve 2 subproblems: routing and loading algorithms

Thank you for your attention!

Are there any questions?

Definitions

- complete directed graph $G_0 = (V_0, A_0)$:
  - $V_0 = V \cup \{0\}$: rental stations V and a depot 0,
  - stations are classified into *pickup* and *delivery stations*
  - A_0: arcs with fastest connections $t_{u,v}$,between $u, v \in V_0$
- for each station $v \in V$:
  - $C_v \geq 0$: capacity
  - p_v: number of originally available bikes
  - q_v: target number of bikes
  - a_v: final number of bikes
- for each transport vehicle $l \in L = \{1, \dots, |L|\}$:
  - Z_l: capacity
  - depot 0: start/end points of l
  - $\hat{t}_l$: time budget for the tour
- Objective Function:

$$\min \quad \underbrace{\tau^{\text{bal}} \sum_{v \in V} |a_v - q_v|}_{\textbf{disbalance}} + \underbrace{\tau^{\text{load}} \sum_{l \in L} \sum_{i=1}^{\rho_l} |y_l^i|}_{\text{loading operations}} + \underbrace{\tau^{\text{work}} \sum_{l \in L} t_l}_{\text{working time}}$$