Vehicle Routing with Pickup and Delivery: A Greedy Approach

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### Introduction
- Bike Sharing Systems (BSSs)
  - Bikes in different stations
- Rebalancing bikes among different stations
  - Use a vehicle to transport bikes
  - Vehicle is capacitated
  - Stations have different demands

### System Model and Algorithm

#### Problem Formulation:
- **Objective**: minimize the total vehicle routing distances
- **Three constraints**: vehicle capacity, station demand, multiple companies

#### Algorithm Design
- **Starting with a TSP and trying to switch when constraints are not satisfied**

#### Experiments
- **Algorithm variations**:
  - Use different greedy criterions to switch the TSP
- **More starting points lead to a smaller total distance**
- **More stations usually require a larger total distance**
- **The algorithm’s run time can be controlled**

### Challenges

#### Extension of TSP
- TSP does not guarantee our constraints (vehicle capacity, station demand, multiple companies)
- Solution: switch the TSP when a constraint is not satisfied (the switch must be efficient and effective)

#### Speed-up the computation
- System scale can be large since bike stations are distributed across the city
- Solution: divide the city based on geometric locations while each location corresponds to a TSP

### Future Work
- Rebalancing bikes among different stations
- Use a vehicle to transport bikes
- Vehicle is capacitated
- Stations have different demands

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**Figure 2**: Different starting point: TSP edges (black) have length 1, rewired edges (red) have length 2

**Experiments**

- **Algorithm variations**:
  - Use different greedy criterions to switch the TSP