Solution Concept

last mile designs

Goals

Recipients:

- help set the delivery arrival time
- know when the delivery will arrive

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Delivery Company:

- has a better delivery success rate
- additional route costs are negligible

Routing

the Traveling Salesman Problem

The problem:

given a list of addresses and a map, find the shortest route that visits each address once

optimal route through the 15 largest German cities

Fifteen addresses,
43.6 BILLION
possible routes!

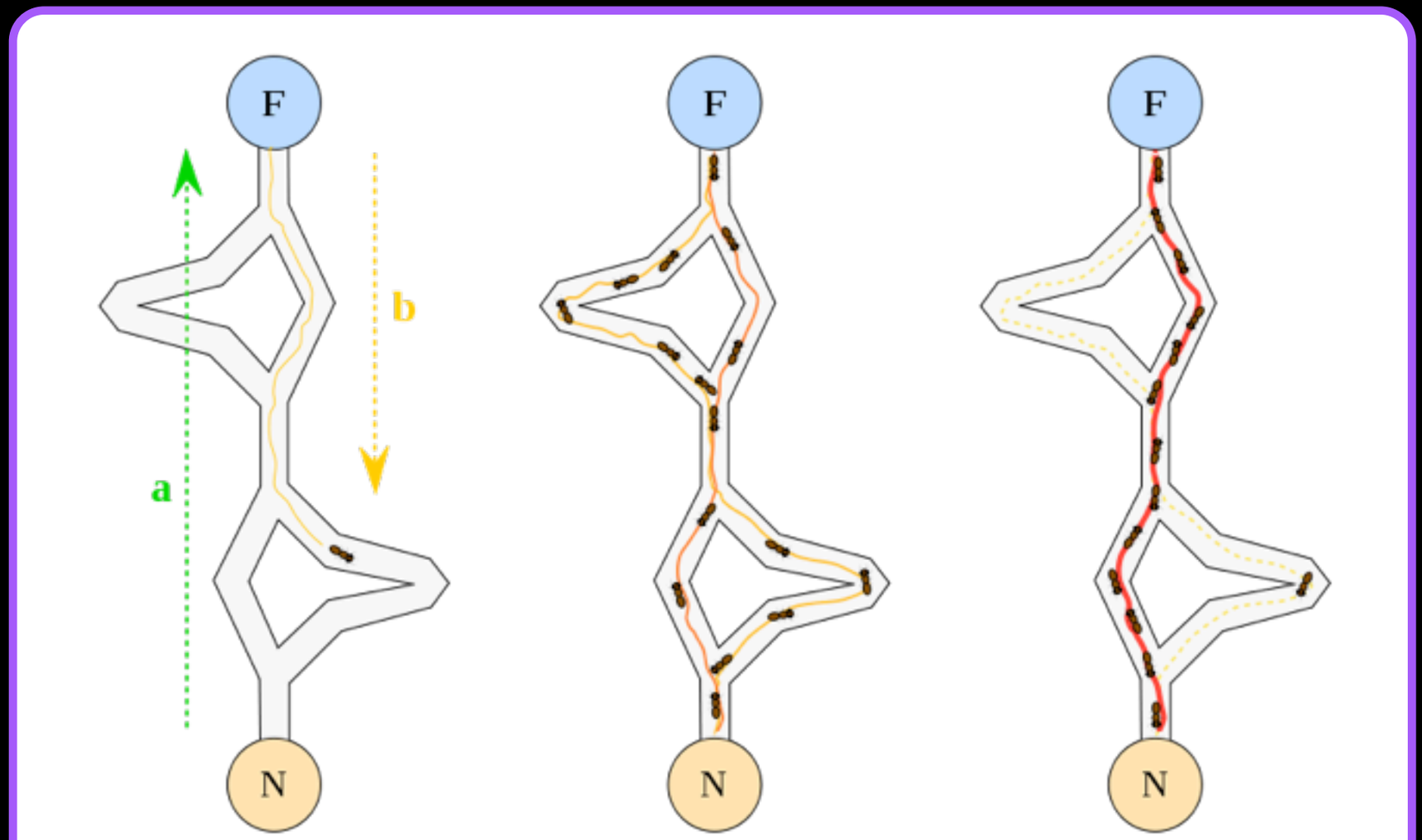
How to solve it

heuristics

- Don’t really care to get the *best* route
- Within ~1% is fine
- LOTS of approximation techniques
  - Ant Colony Optimization
- Our added value will be in handling time windows

Ant Colony Optimization

- Real ants find the shortest path from nest to food
- Collective phenomenon due to pheromone trails



good intro at http://en.wikipedia.org/wiki/Ant_colony_optimization

Right place, right time

- Fastest route problem is already solved
  - but has no time constraints
- Route+fixed times already solved
  - but requires manual/rigid scheduling

Right place, right time

Our innovation:

Present reasonable choices to many customers

Allow them to **choose times** that work for them

Find the route that **maximizes satisfaction** and **minimizes cost**

development needs to be driven by
market research + technical needs simultaneously

Algorithm outline

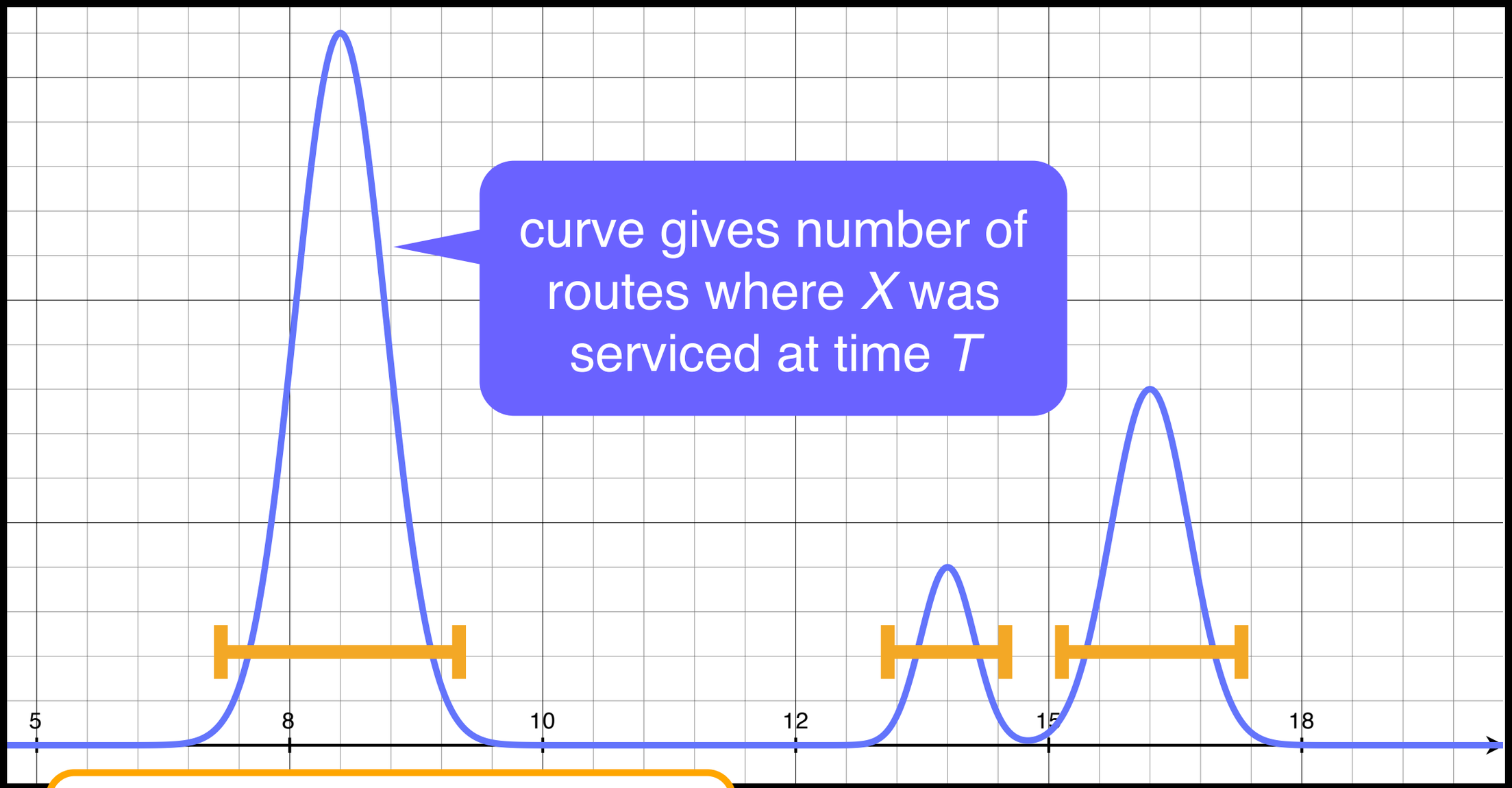
presenting choices

- Day before delivery, Fedex has information for next day
- Ignoring times, find a diverse set of good routes
- Construct choices for each customer based on simulated routes
- Present (how?) choices to customers

Presenting choices

example

simulated arrival time at destination *X*



present customer choices based on likely routes

Routing

best cost route

- All TSP solver algorithms require definition of route cost
- For route *R* define cost as sum of:
  - (route time) x ($/hour) (i.e. labor)
  - (route length) x ($/mile) (i.e. gas)
  - route ‘satisfaction cost’

$$\sum_{i}^{n} (1 - P_i(\ddot\smile | R)) \times C_i(\ddot\frown)$$

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cost of an ‘unhappy’ customer tuned by market research

$$\sum_{i}^{n} (1 - P_i(\ddot\smile | R)) \times C_i(\ddot\frown)$$

Summary

key points

- Find feasible choices for each customer by simulating different routes
- Solve the route by minimizing cost
  - Incorporate timing preferences as an ‘satisfaction’ cost

ToDos

- Market research on approach
- Finish implementation
- Make sure it works
- Tune algorithm

code at http://www.github.com/ekfriis/lastmile