

# Modern Approaches to The Rich Vehicle Routing Problem

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# Outline

- 1 Routing in the real world
- 2 The Vehicle Routing Problem
- 3 Genetic and Memetic Algorithms
- 4 Agent-based models and Probability Collectives
- 5 Human Assisted Routing
- 6 Conclusions

# What is routing?

definition of routing

# Routing Irl!

- The Post Office does routing!
- Uber does routing!
- Routing is expensive!
  - Big!
  - Scary!
  - Numbers!

# Traveling Salesman

- "It's kinda the basic question of routing."
- Define.
- NP-hardness.
- NP-hard is hard!

# Vehicle Routing Problem

- History (verbal only.)
- Pretty graph.
- Description.

# Rich Vehicle Routing Problem

- Describe purpose & intent
- Summarize.

# Decentralized Vehicle Routing Problem



# Vehicle Routing Problem with Time Windows

# Genetic Algorithms I

Loosely describe in a single slide.

# HGSADC

- describe objectives
- describe techniques used

# HGSADC Algorithm, loosely.

It's genuinely horrifying, so it might not actually get pseudocode. As I've gotten more familiar with it, I've actually found that it gives off a persistent feeling of brutality.

# HGSADC Results

- Describe utter and ruthless dominance over everything else.
- Note: that even ~~Conan the barbarian~~ this algorithm can't solve every benchmark in the field.
- "To crush your enemies, to see them driven before you, and to hear the lamentations of their women!" - the goals of the algorithm authors.

# Agents

- Agents definition
- example of agent based algorithm (conway's game?)
- hide picture of 007 on page.

# Reverse Vickrey Auction

- describe objectives
- describe economic rationale

# Distributed RVA routing Algorithm

- describe how it RVA is applied to routing.
- note that much information is private.



# Probability Collectives

- Context
- Problem space difference from DRVA (it's a public-info algorithm; no hiding)

# Probability Collectives Algorithm I

It's worth going into detail for PC - it's easy and really, really cool.

# Probability Collectives Algorithm II

# Human Assisted Routing

- Describe role in routing (uses humans to find locally good routes.)
- Why is it useful (humans are cheap,  $O(n!)$  problem)

# Conclusions

- The HGSADC is *the best*.
- DRVA is best private distributed system
- Probability Collectives is best public distributed system.
- Humans are still better than computers at guessing.
- Challenges remain in routing with dynamic constraints.

# Column Example

Same genome can lead to different physical structures or behavior depending on environmental factors.