HOCHSCHULE
HANNOVER
UNIVERSITY OF
APPLIED SCIENCES
AND ARTS
–
Fakultät IV
Wirtschaft und
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Artificial Feeding Birds

Metaheuristic for TSP

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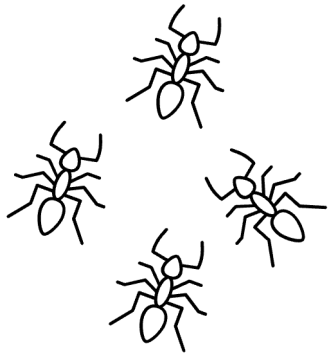
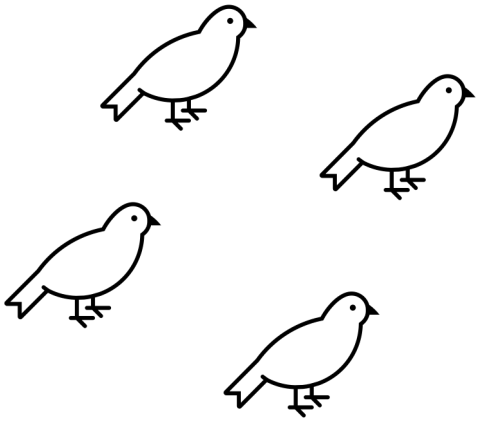
Motivation

- Swarm intelligence
  - Allows a search of the solution space with simple strategies
  - Can yield complex behavior for multiple agents (e.g. ants)

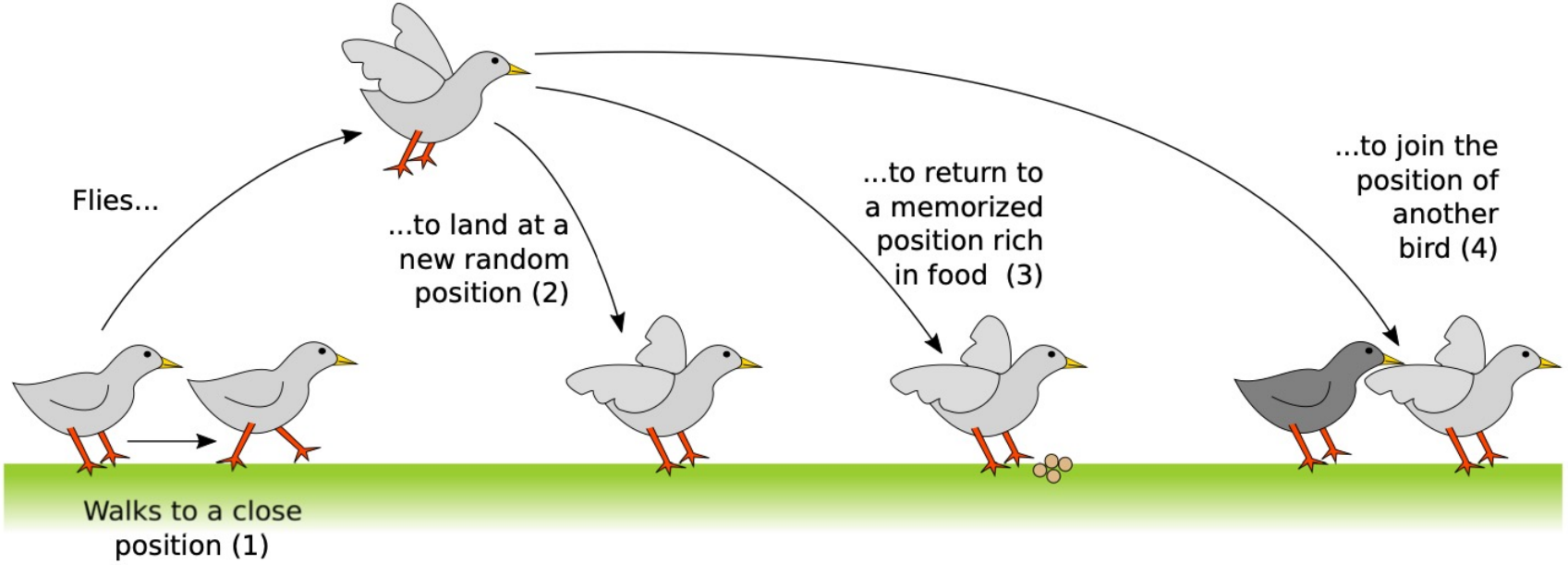


- Inspiration for Artificial Feeding Birds: Pigeons searching for food
  - Behaviors common in nature are more generally effective than rare ones

- Each pigeon (agent) can have the following behavior:
  - Walk a small distance
  - Fly to an arbitrary position
  - Return to a food source
  - Join another bird



Motivation


Flies...
...to land at a new random position (2)
...to return to a memorized position rich in food (3)
...to join the position of another bird (4)
Walks to a close position (1)

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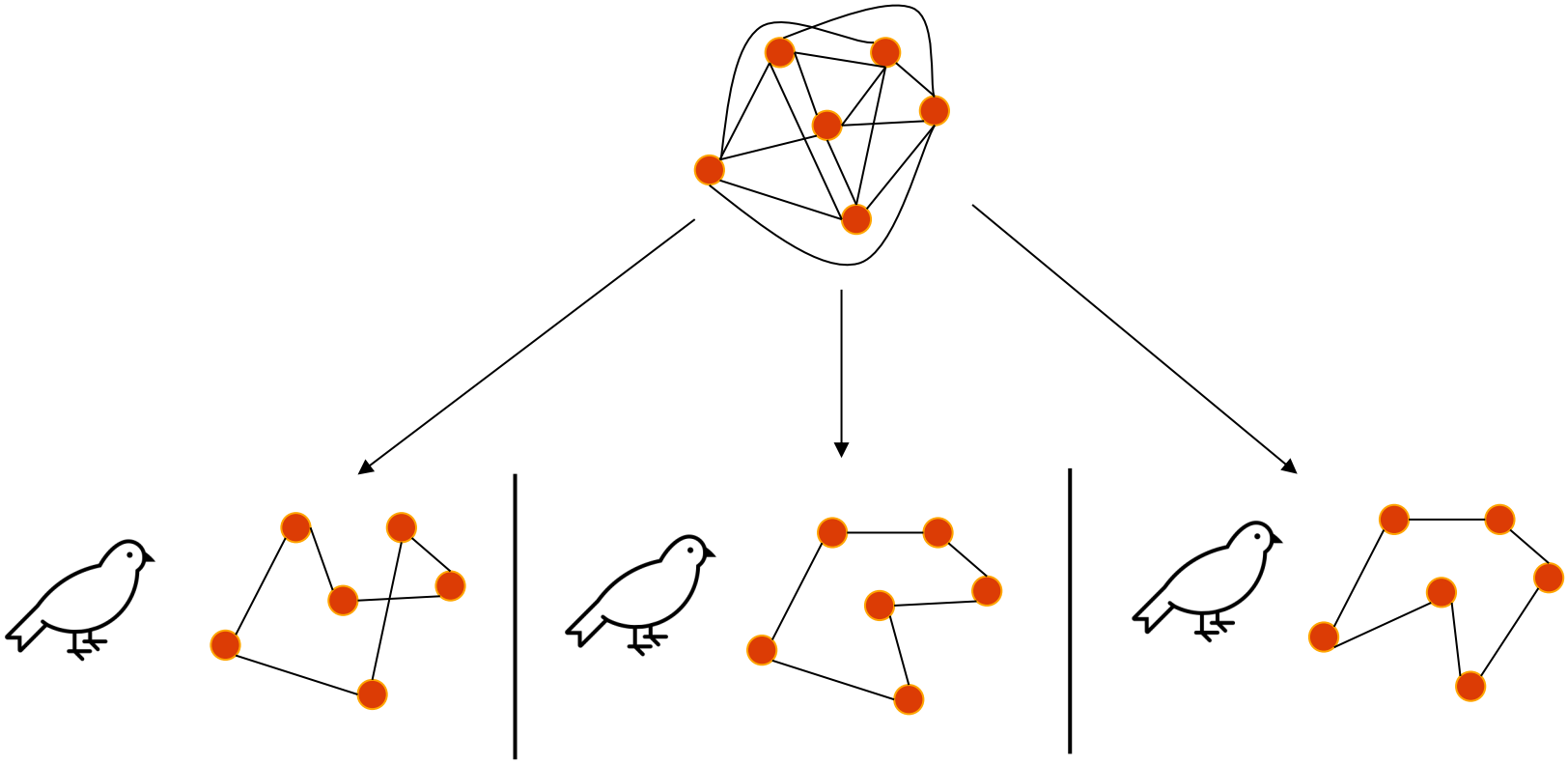
From Birds to TSP

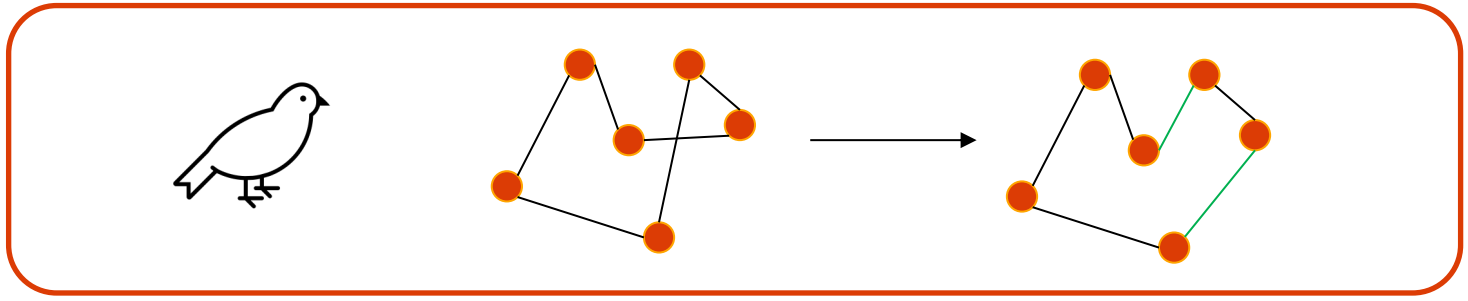
- Each Birds represents one possible solution (one tour)
- Each operation performed by a bird, alters its respective solutions



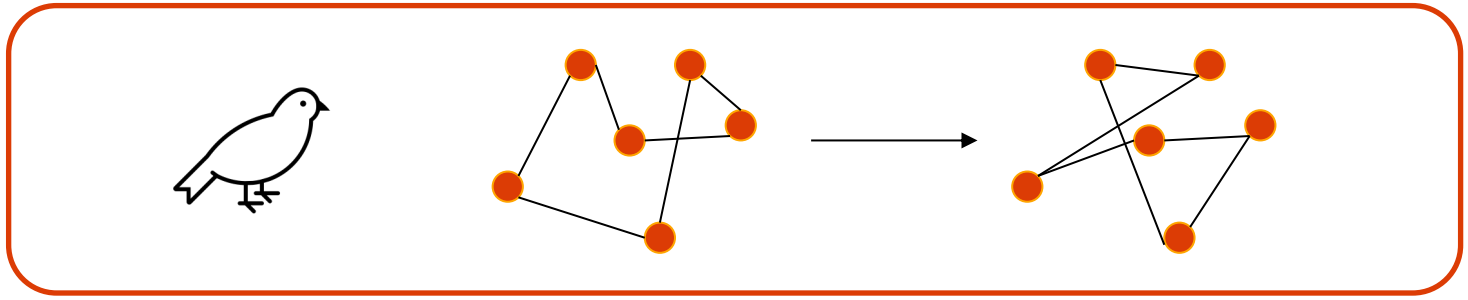
From Birds to TSP

- Each action of a bird corresponds to a change of its own solution
- Each solution is valid
- The number of candidate solutions (or agents respectively) does not change (currently)

(1) Walk

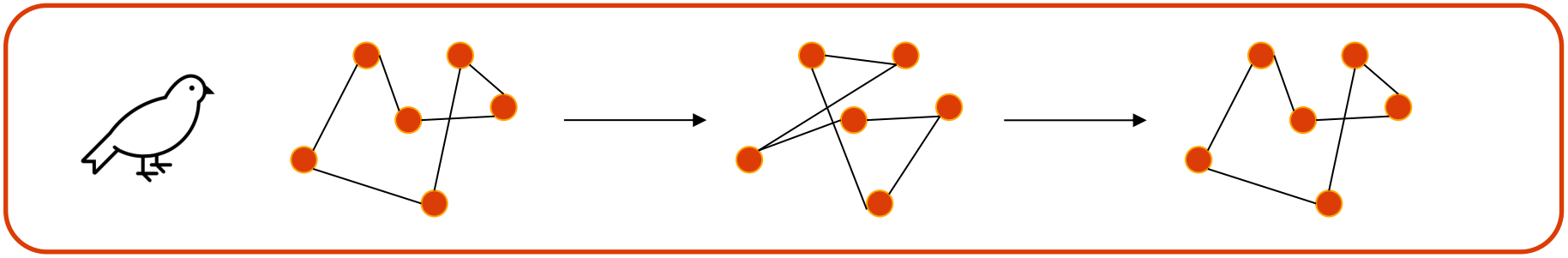


(2) Fly

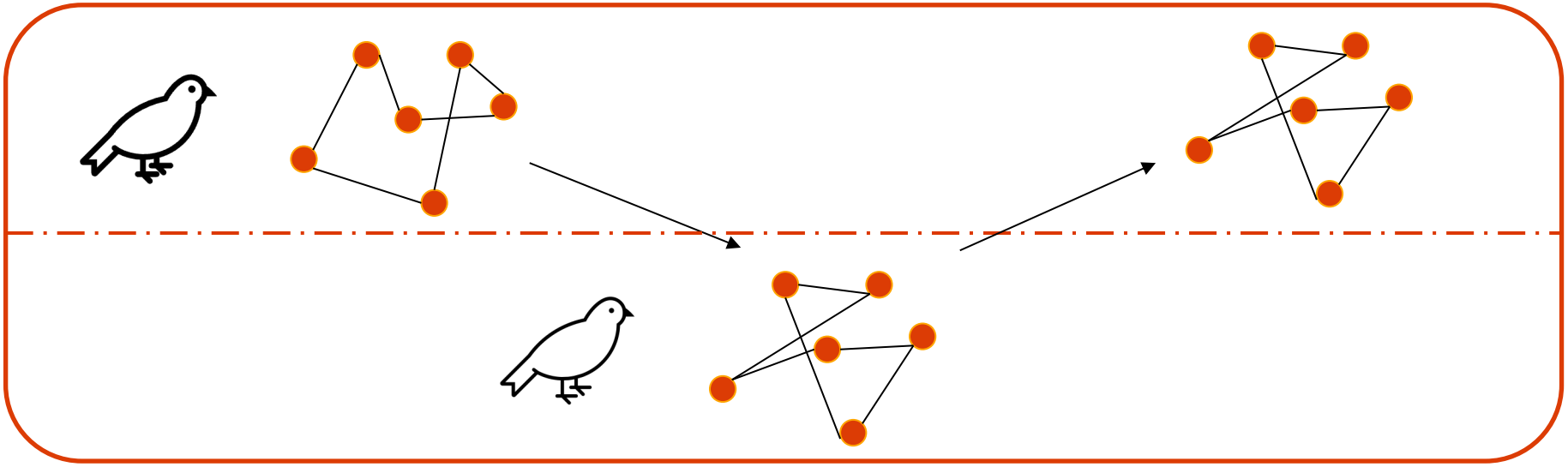


From Birds to TSP

(3) Return



(4) Join



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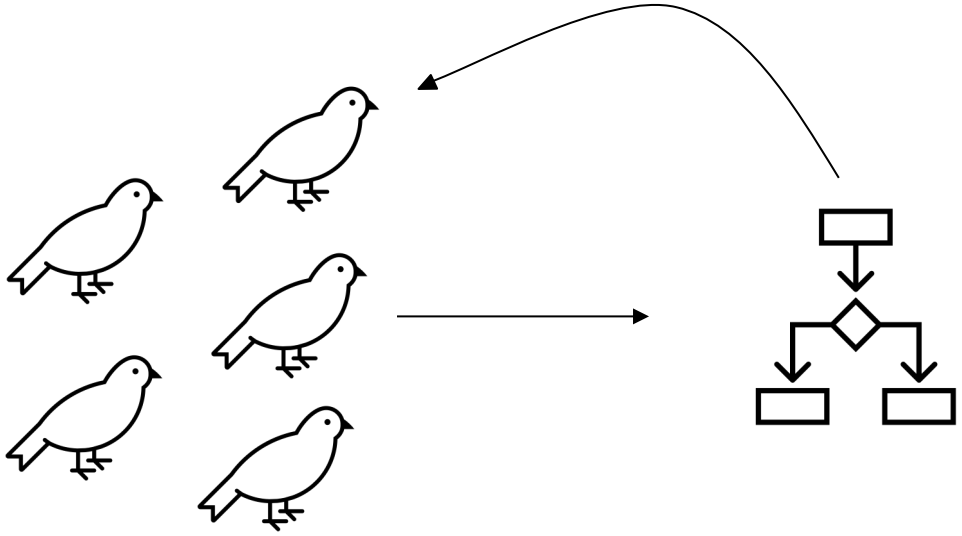
Algorithm Details

Preconditions

- The algorithm runs in iterations
- How many it runs must be set beforehand

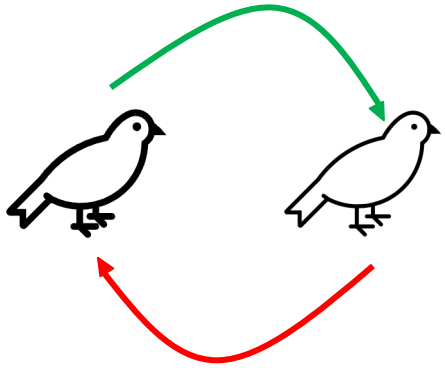


- The number of birds must be set beforehand

- One iteration ≠ All birds move once
- One iteration = The cost of any tour is calculated
  - Return (3) and Join (4) are not counted as an iteration

Algorithm Details

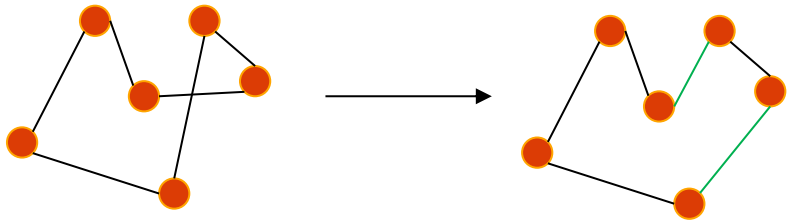
Preconditions



- There are ”big” and “small” birds
  - Ratio set beforehand
- Only a big bird can join a small bird

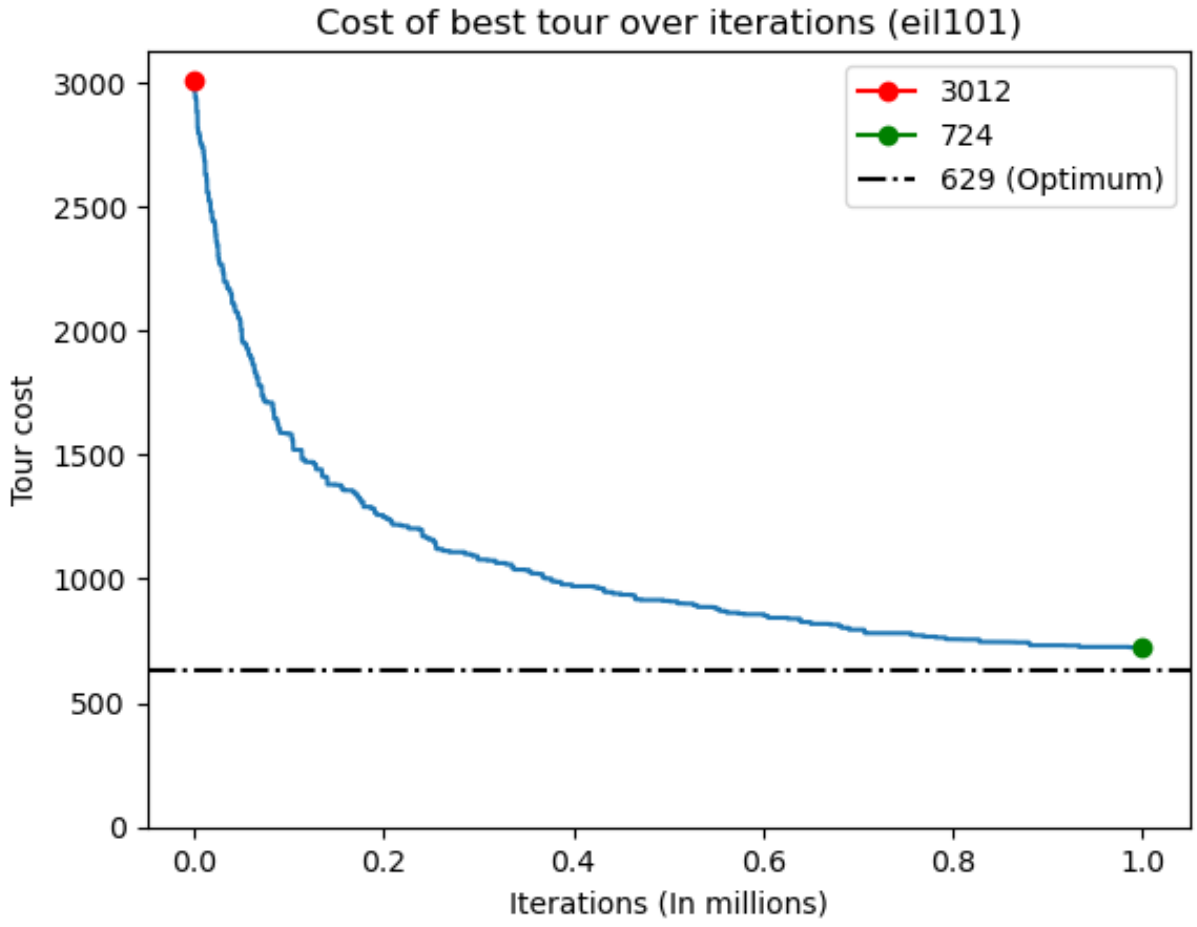
- Which action an agent (bird) performs depends on the probability of the move
  - The probability for a move is a hyperparameter

- A bird walks, if
  1. He currently resides at his best solution
  2. If he flew beforehand
  3. If the action ‘walk’ was randomly selected

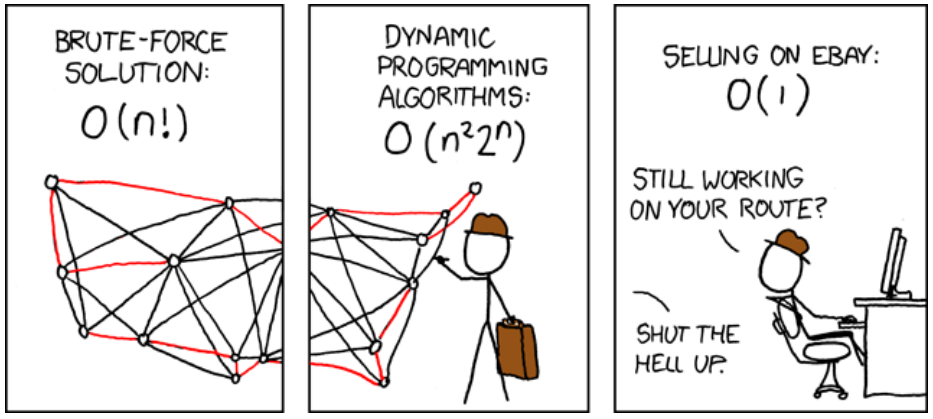


Algorithm Details

Initial Results



Vielen Dank für Ihre Aufmerksamkeit!



Source: https://www.explainxkcd.com/wiki/index.php/399:_Travelling_Salesman_Problem

Literature

- Jean-Baptiste Lamy. Artificial Feeding Birds (AFB): a new metaheuristic inspired by the behavior of pigeons. Advances in nature-inspired computing and applications, 2019, 10.1007/978-3-319-96451- 5_3 . hal-02264232