HOCHSCHULE
HANNOVER
UNIVERSITY OF
APPLIED SCIENCES
AND ARTS
–
Fakultät IV
Wirtschaft und
Informatik

Improvements on AFB

Advancing the Metaheuristic for TSP

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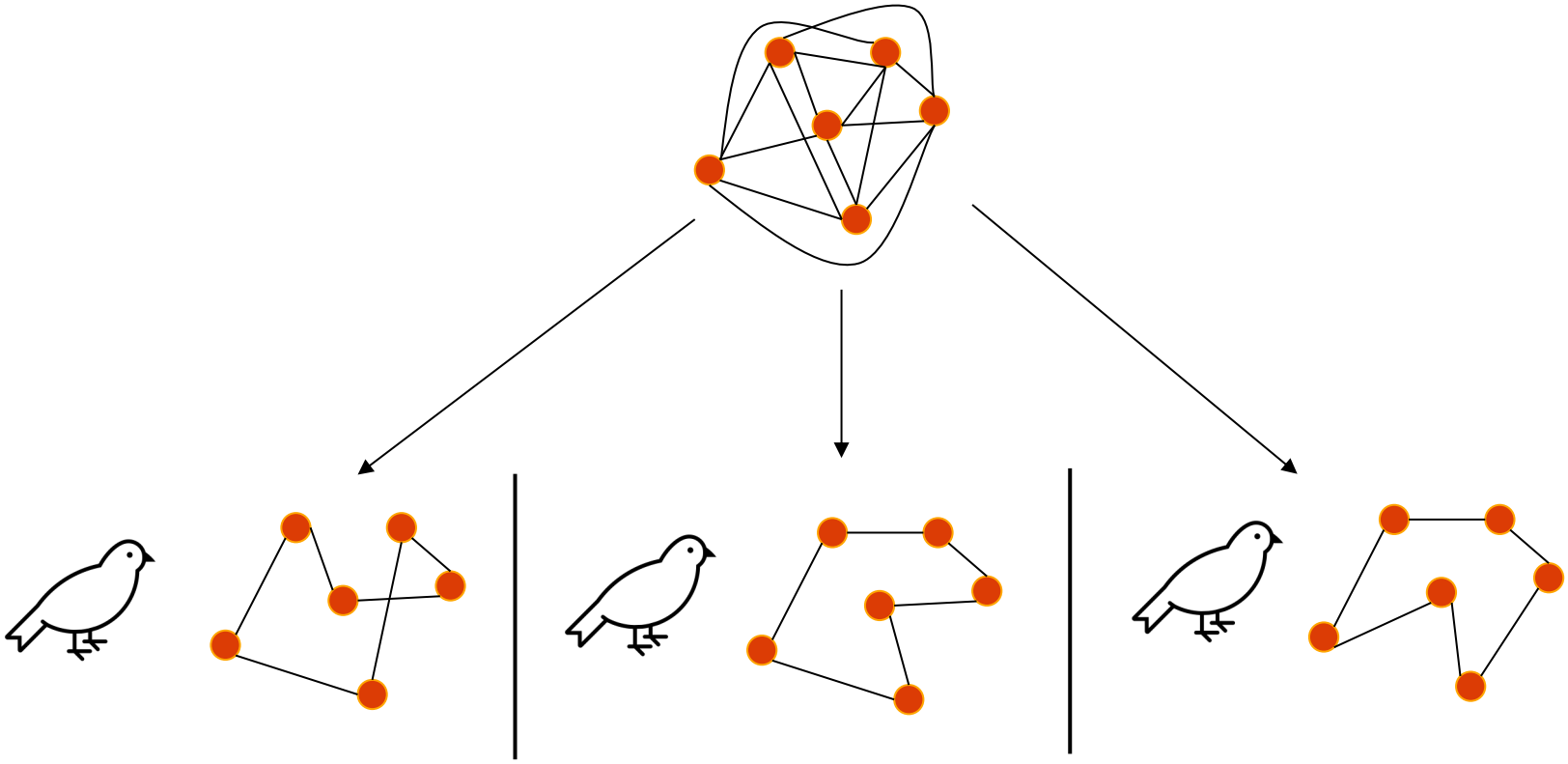
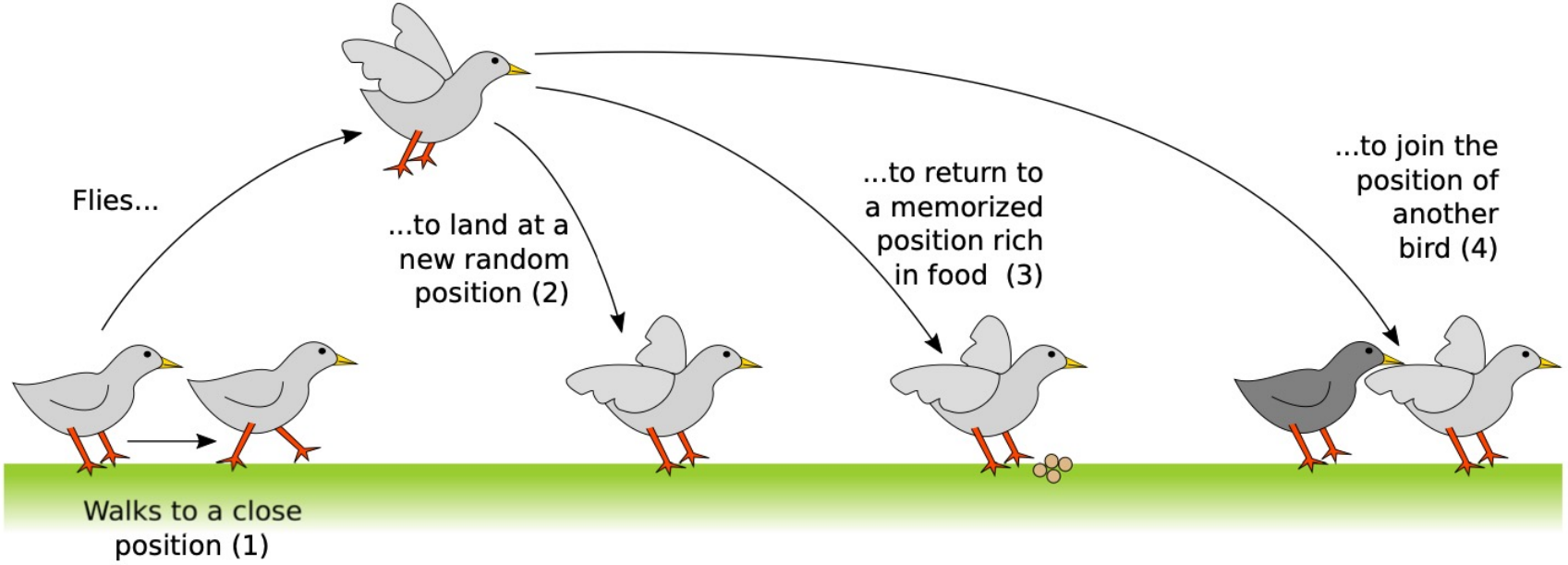
Recap

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



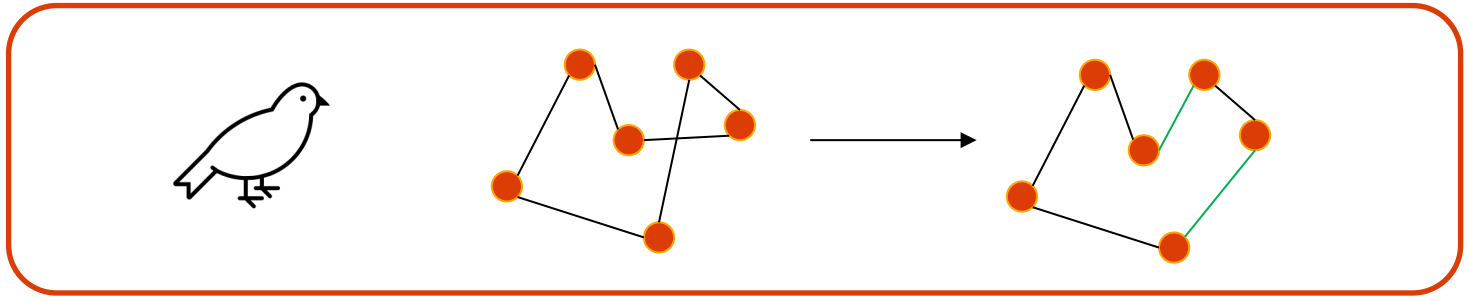
Recap


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)

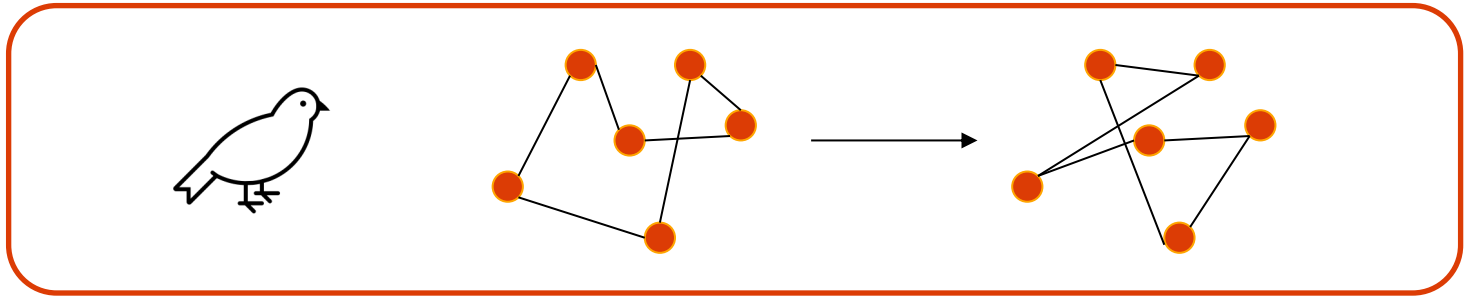
Recap

- 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

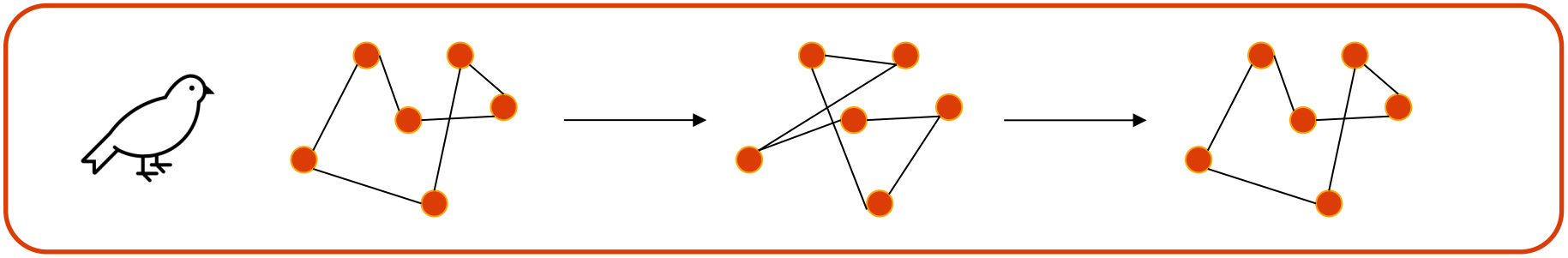


(2) Fly

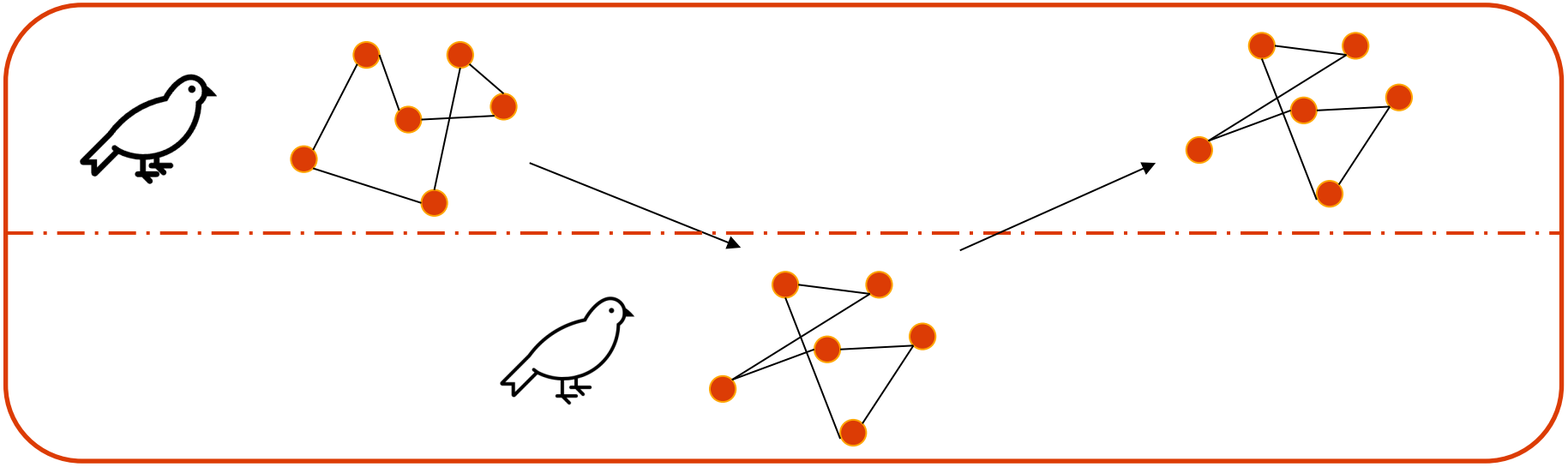


Recap

(3) Return



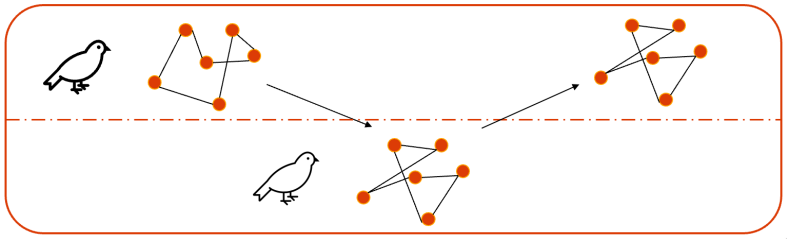
(4) Join



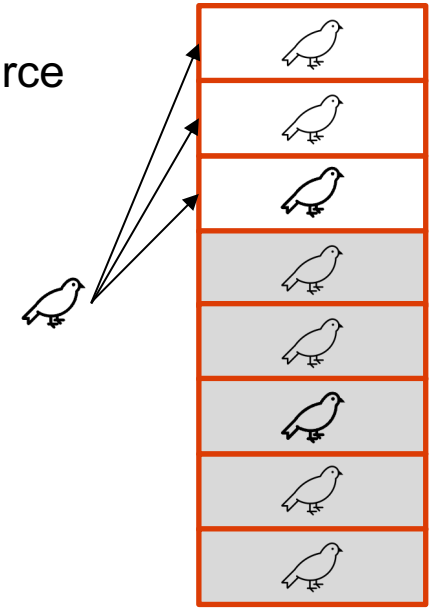
Methodology

- To benchmark our improvements, we select all feasible solutions from TSPLIB (86 problems)
  - Up to 6000 nodes
- Each problem is run 10x, to account for the randomness (860 test in total)
- We record the median percentage error, and the median time in seconds

Top-b Join



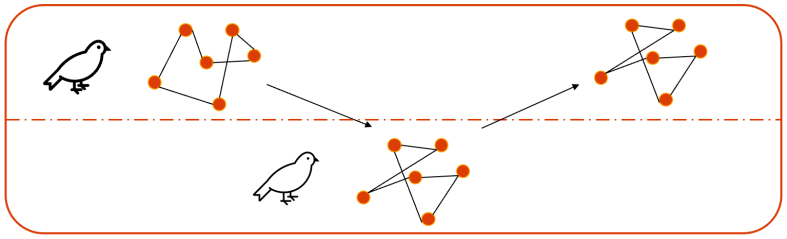
- Default behavior: If a big bird joins another, he chooses one randomly
- Contradicts the idea that birds tend to join others, if they found a good food source
  - Good food source translates to a good solution



- That is why we decide to allow a big bird to only join the top-b percent
  - Pick one of the top-b birds randomly

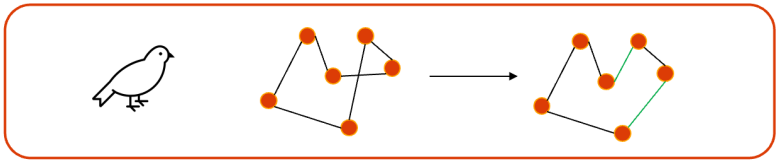
- Means ordering the birds by their tour length after each iteration/phase
  - Increases runtime due to sorting complexity

Top-b Join

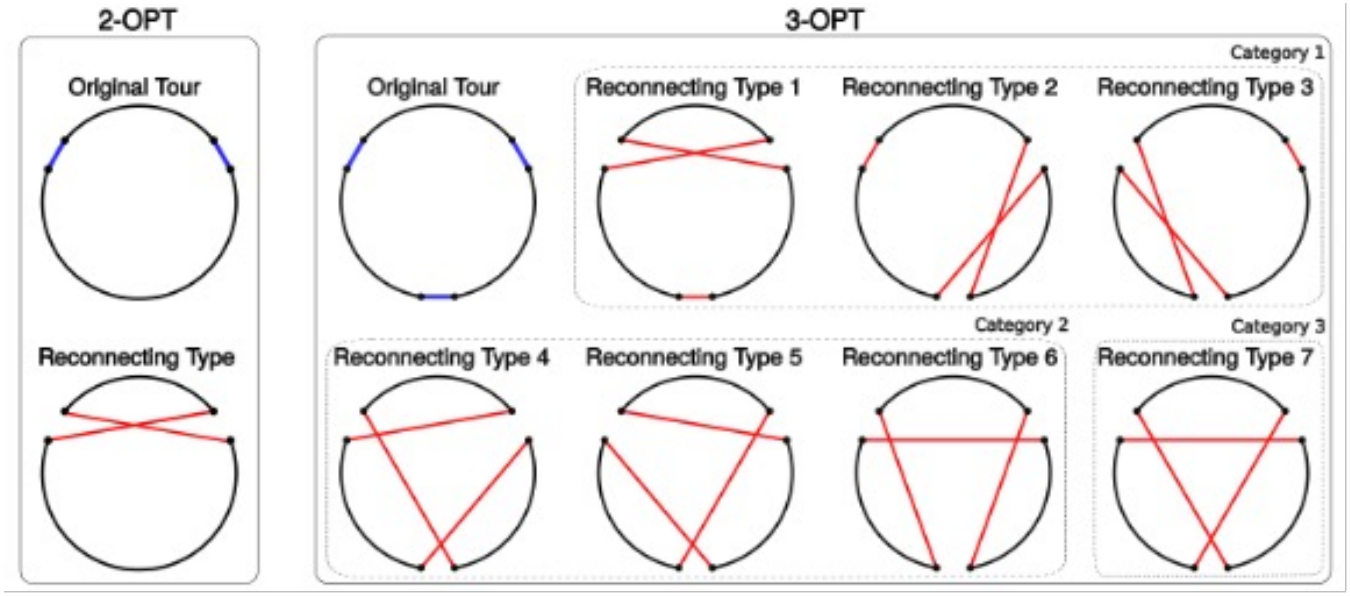


Top-b	1	0.25	0.20	0.15	0.05	**0.01**
PercentError	215	122	5.92	6.14	6.01	**5.2**
Time (in s)	**7.6**	8.6	8.7	8.1	8.3	8.1

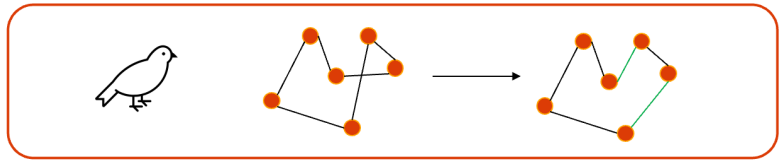
3-Opt



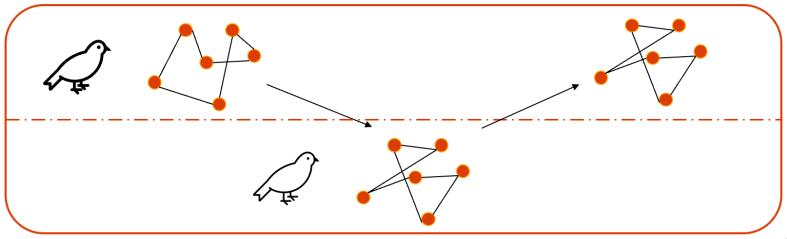
- When performing the walk-operation, so the local search, a bird uses 2-opt to search for a potential better solution
- Naturally, we also tested 3-opt as a more powerful alternative



3-Opt

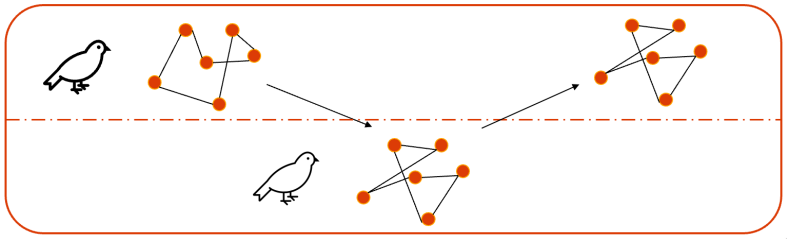


Delegating Responsibility

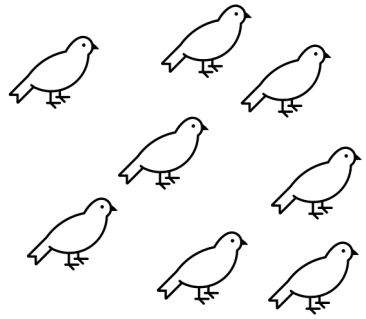


- Seen before: 3-opt (+ sorting for top-b join), yield very high computation effort
- How can one make the algorithm faster while keeping the performance close to before?
- Answer: Allow only big/small birds to perform 3-opt, the other 2-opt
  - Both were tested, but big birds make more sense regarding their “superiority”

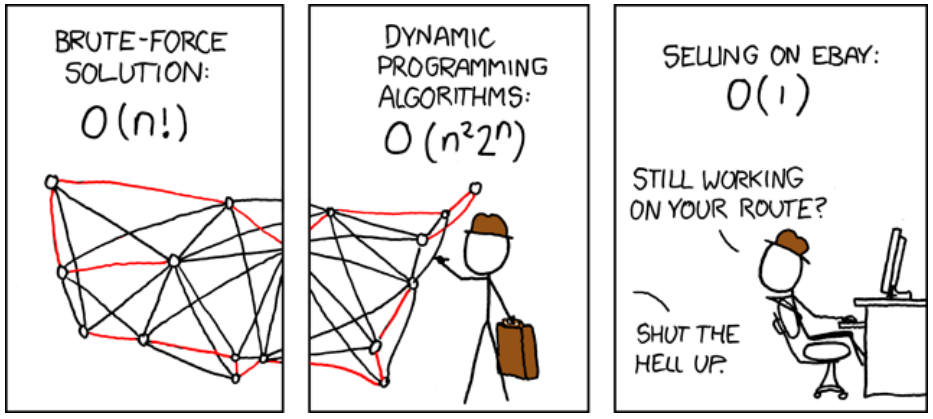
Delegating Responsibility



Nearest-Neighbor Initialization



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