
Algorithm 2 VND Optimization Algorithm

Input: s ▷ Initial solution

1: $s^* \leftarrow s$ ▷ Save the initial solution as the best solution

2: $k \leftarrow 0$ ▷ Initialize neighborhood counter

3: $improved \leftarrow True$

4: **while** $improved$ **or** $k \leq 5$ **do**

5: $improved \leftarrow False$

6: **if** $k = 0$ **then**

7: *Perform Change Vehicle Chain optimization*

8: **if** Solution improves **then**

9: Update best solution and cost (s^*)

10: $k \leftarrow 0$ ▷ Reset neighborhood counter

11: $improved \leftarrow True$

12: **else**

13: $k \leftarrow k + 1$ ▷ Explore the next neighborhood structure

14: **end if**

15: **else if** $k = 1$ **then**

16: *Perform Swap optimization*

17: **if** Solution improves **then**

18: Update best solution and cost (s^*)

19: $k \leftarrow 0$

20: $improved \leftarrow True$

21: **else**

22: $k \leftarrow k + 1$

23: **end if**

24: **else if** $k = 2$ **then**

25: *Perform Relocation optimization*

26: **if** Solution improves **then**

27: Update best solution and cost (s^*)

28: $k \leftarrow 0$

29: $improved \leftarrow True$

30: **else**

31: $k \leftarrow k + 1$

32: **end if**

33: **else if** $k = 3$ **then**

34: *Perform 2-opt local-search optimization*

35: **if** Solution improves **then**

36: Update best solution and cost (s^*)

37: $k \leftarrow 0$

38: $improved \leftarrow True$

39: **else**

40: $k \leftarrow k + 1$

41: **end if**

42: **else if** $k = 4$ **or** $k = 5$ **then**

43: *Perform Or-opt optimization*

44: **if** Solution improves **then**

45: Update best solution and cost (s^*)

46: $k \leftarrow 0$

47: $improved \leftarrow True$

48: **else**

49: $k \leftarrow k + 1$

50: **end if**

51: **end if**

Output: s^* ▷ Optimized solution
