

Transporting Goods

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INF273 - Meta-Heuristics

Call_7_Vehicle_3				
	Ave. objective	Best objective	Imp (%)	Runtime
Blind Random search	1773020	1509522	54.068 %	0.0404 s
Local search	1855447	1476444	55.074 %	0.0409 s
Simulated annealing	1770229	1476444	55.074 %	0.0346 s
Simulated annealing (new)	2492671	1851768	43.654 %	0.0371 s

Best solution Blind Random search: [7, 7, 1, 1, 0, 3, 3, 0, 5, 5, 6, 6, 0, 2, 4, 4, 2]

Best solution Local search: [3, 3, 0, 7, 1, 7, 1, 0, 5, 5, 6, 6, 0, 2, 2, 4, 4]

Best solution Simulated annealing: [3, 3, 0, 7, 1, 7, 1, 0, 5, 5, 6, 6, 0, 2, 2, 4, 4]

Best solution Simulated annealing (new): [1, 1, 0, 0, 5, 5, 6, 6, 0, 2, 2, 3, 3, 4, 4, 7, 7]

Call_18_Vehicle_5				
	Ave. objective	Best objective	Imp (%)	Runtime
Blind Random search	6969781	6144383	29.871 %	0.0525 s
Local search	3132803	2594424	70.388 %	0.0587 s
Simulated annealing	3390321	3041415	65.287 %	0.0717 s
Simulated annealing (new)	6627022	5978703	31.762 %	0.0583 s

Best solution Blind Random search: [10, 10, 0, 12, 12, 0, 5, 11, 5, 11, 0, 1, 14, 1, 14, 0, 8, 8, 0, 17, 6, 7, 4, 2, 9, 9, 7, 13, 4, 2, 15, 16, 3, 17, 13, 18, 15, 6, 3, 16, 18]

Best solution Local search: [4, 14, 4, 14, 3, 3, 0, 15, 15, 17, 1, 17, 1, 0, 11, 16, 16, 11, 10, 9, 10, 9, 0, 12, 12, 0, 18, 5, 5, 18, 8, 7, 8, 7, 2, 2, 0, 6, 6, 13, 13]

Best solution Simulated annealing: [18, 11, 1, 11, 1, 18, 0, 15, 5, 15, 5, 17, 17, 10, 10, 3, 3, 0, 6, 16, 6, 16, 9, 2, 2, 9, 0, 12, 14, 12, 14, 0, 8, 7, 8, 7, 0, 4, 13, 13, 4]

Best solution Simulated annealing (new): [14, 14, 3, 3, 0, 4, 4, 0, 10, 10, 0, 8, 8, 0, 1, 1, 0, 2, 2, 5, 5, 6, 6, 7, 7, 9, 9, 11, 11, 12, 12, 13, 13, 15, 15, 16, 16, 17, 17, 18, 18]

Call_35_Vehicle_7				
	Ave. objective	Best objective	Imp (%)	Runtime
Blind Random search	18322178	18322178	0.0 %	0.0719 s
Local search	8928865	6318977	65.512 %	0.0916 s
Simulated annealing	8807128	6674719	63.57 %	0.1165 s
Simulated annealing (new)	13272671	12091756	34.005 %	0.2243 s

Best solution Blind Random search: [0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 9, 10, 10, 11, 11, 12, 12, 13, 13, 14, 14, 15, 15, 16, 16, 17, 17, 18, 18, 19, 19, 20, 20, 21, 21, 22, 22, 23, 23, 24, 24, 25, 25, 26, 26, 27, 27, 28, 28, 29, 29, 30, 30, 31, 31, 32, 32, 33, 33, 34, 34, 35, 35]

Best solution Local search: [13, 29, 35, 13, 29, 10, 35, 10, 9, 9, 0, 34, 34, 14, 20, 20, 27, 27, 14, 0, 25, 25, 16, 16, 8, 11, 8, 11, 32, 32, 4, 4, 0, 21, 21, 3, 3, 22, 22, 33, 33, 31, 26, 31, 26, 0, 6, 12, 5, 5, 30, 6, 30, 12, 1, 1, 0, 7, 19, 17, 7, 17, 19, 2, 2, 0, 28, 28, 18, 18, 0, 15, 15, 23, 23, 24, 24]

Best solution Simulated annealing: [35, 11, 11, 35, 2, 2, 0, 23, 23, 17, 17, 10, 10, 33, 33, 0, 34, 21, 21, 18, 18, 34, 32, 32, 4, 4, 0, 19, 12, 5, 5, 19, 30, 30, 20, 12, 20, 27, 27, 0, 16, 29, 8, 16, 29, 8, 31, 26, 26, 31, 0, 7, 3, 7, 3, 22, 22, 15, 15, 0, 28, 28, 13, 13, 14, 14, 1, 1, 0, 9, 6, 24, 6, 25, 9, 24, 25]

Best solution Simulated annealing (new): [1, 1, 4, 4, 0, 18, 18, 20, 20, 0, 19, 19, 30, 30, 33, 33, 0, 3, 3, 10, 10, 0, 2, 2, 0, 25, 25, 8, 8, 0, 13, 13, 31, 31, 0, 5, 5, 6, 6, 7, 7, 9, 9, 11, 11, 12, 12, 14, 14, 15, 15, 16, 16, 17, 17, 21, 21, 22, 22, 23, 23, 24, 24, 26, 26, 27, 27, 28, 28, 29, 29, 32, 32, 34, 34, 35, 35]

Call_80_Vehicle_20				
	Ave. objective	Best objective	Imp (%)	Runtime
Blind Random search	42211425	42211425	0.0 %	0.1735 s
Local search	26833639	25710138	39.092 %	0.1877 s
Simulated annealing	25990309	24305978	42.418 %	0.2371 s
Simulated annealing (new)	30608399	29186222	30.857 %	0.5973 s

Best solution Blind Random search: [0, 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 9, 10, 10, 11, 11, 12, 12, 13, 13, 14, 14, 15, 15, 16, 16, 17, 17, 18, 18, 19, 19, 20, 20, 21, 21, 22, 22, 23, 23, 24, 24, 25, 25, 26, 26, 27, 27, 28, 28, 29, 29, 30, 30, 31, 31, 32, 32, 33, 33, 34, 34, 35, 35, 36, 36, 37, 37, 38, 38, 39, 39, 40, 40, 41, 41, 42, 42, 43, 43, 44, 44, 45, 45, 46, 46, 47, 47, 48, 48, 49, 49, 50, 50, 51, 51, 52, 52, 53, 53, 54, 54, 55, 55,

56, 56, 57, 57, 58, 58, 59, 59, 60, 60, 61, 61, 62, 62, 63, 63,
64, 64, 65, 65, 66, 66, 67, 67, 68, 68, 69, 69, 70, 70, 71, 71,
72, 72, 73, 73, 74, 74, 75, 75, 76, 76, 77, 77, 78, 78, 79, 79,
80, 80]

Best solution Local search: [23, 23, 70, 21, 21, 70, 0, 62, 62, 43,
43, 0, 61, 61, 31, 38, 38, 31, 0, 74, 74, 78, 78, 0, 51, 51, 75,
75, 0, 53, 53, 6, 6, 0, 27, 27, 5, 71, 5, 71, 0, 30, 30, 2, 2,
58, 58, 0, 55, 55, 40, 40, 73, 73, 0, 33, 33, 0, 37, 36, 36, 37,
9, 9, 0, 26, 29, 26, 29, 13, 35, 13, 35, 0, 77, 77, 64, 64, 0,
12, 12, 0, 28, 54, 39, 28, 54, 39, 0, 16, 16, 76, 1, 76, 1, 0,
24, 24, 0, 7, 56, 7, 56, 0, 52, 52, 0, 66, 60, 66, 44, 60, 44, 0,
3, 3, 4, 4, 8, 8, 10, 10, 11, 11, 14, 14, 15, 15, 17, 17, 18, 18,
19, 19, 20, 20, 22, 22, 25, 25, 32, 32, 34, 34, 41, 41, 42, 42,
45, 45, 46, 46, 47, 47, 48, 48, 49, 49, 50, 50, 57, 57, 59, 59,
63, 63, 65, 65, 67, 67, 68, 68, 69, 69, 72, 72, 79, 79, 80, 80]

Best solution Simulated annealing: [61, 61, 5, 11, 11, 71, 71, 5, 0,
22, 22, 64, 64, 0, 50, 50, 40, 70, 40, 70, 0, 80, 80, 51, 51, 0,
36, 24, 36, 24, 0, 52, 52, 43, 43, 0, 12, 12, 18, 6, 35, 35, 6,
18, 0, 37, 30, 37, 31, 31, 30, 0, 41, 1, 41, 1, 0, 7, 13, 7, 13,
0, 68, 68, 54, 28, 28, 54, 0, 59, 14, 59, 14, 0, 75, 75, 0, 26,
26, 0, 72, 72, 39, 42, 39, 38, 42, 38, 0, 3, 29, 3, 29, 0, 17,
17, 76, 76, 0, 77, 77, 23, 23, 25, 25, 0, 65, 10, 65, 10, 0, 66,
53, 66, 53, 0, 63, 63, 34, 34, 62, 44, 44, 62, 4, 60, 45, 45, 60,
32, 33, 33, 20, 27, 20, 74, 74, 55, 73, 73, 57, 57, 49, 49, 8,
8, 4, 55, 32, 46, 46, 67, 67, 16, 16, 56, 56, 15, 15, 47, 47, 21,
58, 58, 19, 48, 19, 9, 9, 27, 78, 78, 69, 69, 79, 79, 2, 2, 21,
48]

Best solution Simulated annealing (new): [10, 10, 0, 19, 19, 1, 1,
0, 66, 66, 60, 60, 2, 2, 0, 61, 61, 5, 5, 8, 8, 0, 42, 42, 0, 14,
14, 6, 6, 0, 11, 11, 0, 0, 73, 73, 0, 4, 4, 0, 53, 53, 9, 9, 0,
75, 75, 0, 25, 25, 0, 44, 44, 15, 15, 0, 46, 46, 38, 38, 0, 49,
49, 0, 41, 41, 0, 45, 45, 0, 65, 65, 0, 3, 3, 7, 7, 0, 12, 12,
13, 13, 16, 16, 17, 17, 18, 18, 20, 20, 21, 21, 22, 22, 23, 23,
24, 24, 26, 26, 27, 27, 28, 28, 29, 29, 30, 30, 31, 31, 32, 32,
33, 33, 34, 34, 35, 35, 36, 36, 37, 37, 39, 39, 40, 40, 43, 43,
47, 47, 48, 48, 50, 50, 51, 51, 52, 52, 54, 54, 55, 55, 56, 56,
57, 57, 58, 58, 59, 59, 62, 62, 63, 63, 64, 64, 67, 67, 68, 68,
69, 69, 70, 70, 71, 71, 72, 72, 74, 74, 76, 76, 77, 77, 78, 78,
79, 79, 80, 80]

Call_130_Vehicle_40				
	Ave. objective	Best objective	Imp (%)	Runtime
Blind Random search	75446687	75446687	0.0 %	0.3111 s
Local search	55482522	53227237	29.451 %	0.2675 s
Simulated annealing	55060247	52784288	30.038 %	0.3073 s

0, 4, 4, 0, 2, 2, 0, 57, 126, 126, 57, 0, 22, 22, 0, 82, 82, 55,
40, 55, 40, 0, 109, 109, 0, 72, 72, 0, 0, 0, 14, 14, 0, 54, 54,
0, 102, 31, 102, 106, 106, 31, 0, 90, 112, 90, 112, 36, 36, 0,
74, 35, 74, 35, 0, 104, 104, 60, 67, 67, 60, 0, 122, 122, 66,
66, 5, 5, 0, 52, 52, 0, 18, 18, 98, 75, 98, 75, 0, 80, 80, 0, 69,
69, 88, 88, 0, 78, 12, 12, 78, 0, 9, 9, 0, 0, 101, 101, 0, 6, 13,
29, 29, 13, 6, 0, 8, 99, 8, 99, 0, 87, 87, 0, 0, 0, 0, 123, 123,
0, 0, 62, 62, 0, 34, 128, 128, 34, 0, 0, 85, 85, 0, 19, 129, 19,
129, 0, 0, 21, 38, 21, 83, 83, 56, 56, 41, 41, 20, 20, 45, 110,
110, 76, 76, 68, 68, 105, 105, 45, 124, 124, 64, 64, 42, 42, 91,
91, 97, 97, 27, 27, 44, 44, 77, 77, 70, 70, 10, 10, 107, 107, 48,
48, 92, 92, 39, 39, 71, 71, 7, 7, 117, 117, 28, 28, 120, 120, 25,
25, 30, 30, 118, 118, 46, 46, 113, 113, 43, 43, 89, 89, 33, 33,
47, 47, 51, 51, 79, 79, 23, 23, 37, 37, 26, 26, 127, 127, 53, 53,
116, 116, 114, 114, 50, 50, 16, 16, 3, 3, 130, 130, 32, 32, 121,
121, 95, 95, 15, 15, 86, 86, 59, 59, 1, 1, 17, 17, 108, 108, 38,
81, 81, 11, 11, 65, 65, 49, 49, 115, 115, 94, 94, 63, 63, 73, 73,
84, 84, 58, 58, 96, 96, 100, 100, 125, 125, 24, 24, 61, 61, 103,
103]

Best solution Simulated annealing (new): [24, 24, 0, 102, 102, 0, 10,
10, 0, 91, 91, 0, 116, 116, 0, 84, 84, 59, 59, 13, 13, 0, 96, 96,
6, 6, 0, 64, 64, 0, 61, 61, 5, 5, 0, 18, 18, 55, 55, 0, 111, 111,
0, 37, 37, 106, 106, 0, 74, 74, 38, 38, 0, 7, 7, 9, 9, 0, 114,
114, 98, 98, 4, 4, 0, 97, 97, 0, 40, 40, 0, 2, 2, 42, 42, 0, 81,
81, 0, 75, 75, 0, 123, 123, 0, 110, 110, 85, 85, 0, 26, 26, 0,
45, 45, 0, 73, 73, 0, 15, 15, 0, 25, 25, 0, 107, 107, 99, 99, 0,
14, 14, 0, 36, 36, 0, 34, 34, 92, 92, 0, 108, 108, 87, 87, 0, 52,
52, 11, 11, 0, 121, 121, 44, 44, 0, 41, 41, 1, 1, 0, 54, 54, 12,
12, 0, 3, 3, 0, 100, 100, 0, 46, 46, 0, 49, 49, 8, 8, 88, 88, 0,
16, 16, 17, 17, 19, 19, 20, 20, 21, 21, 22, 22, 23, 23, 27, 27,
28, 28, 29, 29, 30, 30, 31, 31, 32, 32, 33, 33, 35, 35, 39, 39,
43, 43, 47, 47, 48, 48, 50, 50, 51, 51, 53, 53, 56, 56, 57, 57,
58, 58, 60, 60, 62, 62, 63, 63, 65, 65, 66, 66, 67, 67, 68, 68,
69, 69, 70, 70, 71, 71, 72, 72, 76, 76, 77, 77, 78, 78, 79, 79,
80, 80, 82, 82, 83, 83, 86, 86, 89, 89, 90, 90, 93, 93, 94, 94,
95, 95, 101, 101, 103, 103, 104, 104, 105, 105, 109, 109, 112,
112, 113, 113, 115, 115, 117, 117, 118, 118, 119, 119, 120, 120,
122, 122, 124, 124, 125, 125, 126, 126, 127, 127, 128, 128, 129,
129, 130, 130]

My operations

K_reinsert

This operation takes k calls and inserts them into a random vehicle that can hold that call. This helps in diversification.

Remove expensive from the dummy

In this operation I search the dummy vehicle for the most expensive call and adds the call to a vehicle if it can handle it. In a way this helps with both intensification and diversification. The insertion of the call can make us end up in a deep local optimum, but at the same time it may help to get out of one.

Least time window

Her I take one given vehicle and computes all of its permutations, and find the one with the least time wasted. In other words the one permutation of calls that uses the less time. This is intensifying the solution

These operators, as shown in the results, didn't work as well as intended.