

Assignment 4

Operators

I have made 4 operators:

1. Pick most expensive cargo, move it to the first available spot in a random vehicle that that cargo fits into.
2. Pick random cargo, move it to the first available spot in a random vehicle that that cargo fits into.
3. Pick most expensive cargo, move it to the first available spot in the vehicle that that cargo is the cheapest in.
4. Pick random cargo, move it to the first available spot in the vehicle that that cargo is the cheapest in.


(to find the cheapest vehicle i call the "call_one_vessel()" function with only a pickup and drop of that cargo in the vehicle)

Call_7_Vehicle_3				
✓	Average objective	Best objective	Improvement (%)	Running time
Random	1523967.2	1457231.0	55.06%	0.85s
Local Search	1286266.5	1134176.0	65.02%	16.55s
Simulated annealing	1134176.0	1134176.0	65.02%	13.39s
Simulated annealing 4ops	1204711.1	1134176.0	65.02%	3.43s


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

Call_18_Vehicle_5				
✓	Average objective	Best objective	Improvement (%)	Running time
Random	6997886.2	5981431.0	33.24%	1.76s
Local Search	3441086.2	2773808.0	69.04%	1.12s
Simulated annealing	2412233.4	2374420.0	73.5%	28.05s
Simulated annealing 4ops	2560311.6	2401494.0	73.2%	6.86s


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

Call_35_Vehicle_7				
	Average objective	Best objective	Improvement (%)	Running time
Random	18387821.0	18387821.0	0.0%	1.33s
Local Search	8120836.2	7162000.0	61.05%	3.05s
Simulated annealing	5682199.6	5366140.0	70.82%	47.25s
Simulated annealing 4ops	6354289.7	5954333.0	67.62%	13.43s

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


Call_80_Vehicle_20				
	Average objective	Best objective	Improvement (%)	Running time
Random	46770347.0	46770347.0	0.0%	1.38s
Local Search	19335743.2	17844451.0	61.85%	11.75s
Simulated annealing	12798036.3	12077826.0	74.18%	45.23s
Simulated annealing 4ops	13823008.8	13213966.0	71.75%	24.4s

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

Call_130_Vehicle_40				
	Average objective	Best objective	Improvement (%)	Running time
Random	76627567.0	76627567.0	0.0%	1.94s

Call_130_Vehicle_40				
Local Search	30419769.1	27328673.0	64.34%	28.03s
Simulated annealing	20310804.0	19701086.0	74.29%	50.84s
Simulated annealing 4ops	22233362.1	21429587.0	72.03%	174.04s

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

Call_300_Vehicle_90				
	Average objective	Best objective	Improvement (%)	Running time
Random	170784643.0	170784643.0	0.0%	2.59s
Local Search	70229470.2	65942284.0	61.39%	114.29s
Simulated annealing	47249719.0	46460334.0	72.8%	93.64s
Simulated annealing 4ops	52964294.6	51489693.0	69.85%	399.72s

Best solution: [250, 194, 250, 194, 11, 11, 0, 96, 61, 61, 96, 53, 80, 80, 34, 53, 34, 18, 18, 0, 83, 83, 189, 189, 0, 235, 235, 12, 12, 0, 136, 136, 236, 90, 90, 236, 0, 152, 152, 172, 172, 253, 253, 0, 121, 121, 95, 294, 95, 294, 0, 72, 72, 0, 271, 271, 74, 74, 0, 36, 171, 171, 36, 246, 246, 51, 84, 51, 84, 0, 126, 126, 283, 283, 0, 155, 37, 155, 49, 49, 37, 0, 41, 41, 0, 249, 249, 108, 108, 139, 139, 0, 263, 263, 92, 92, 0, 25, 25, 23, 23, 9, 297, 9, 297, 130, 130, 0, 293, 293, 165, 165, 0, 30, 30, 129, 129, 0, 65, 300, 300, 65, 198, 198, 0, 48, 284, 48, 284, 262, 262, 231, 231, 0, 259, 259, 0, 7, 7, 55, 55, 0, 279, 279, 199, 91, 91, 199, 0, 68, 265, 68, 265, 141, 148, 141, 148, 0, 195, 195, 0, 245, 245, 0, 133, 133, 111, 266, 266, 111, 0, 45, 63, 45, 63, 0, 208, 208, 219, 127, 127, 191, 191, 219, 0, 167, 167, 27, 27, 0, 134, 134, 114, 77, 114, 77, 184, 101, 187, 101, 184, 187, 0, 218, 218, 204, 204, 112, 112, 0, 270, 277, 109, 109, 270, 277, 115, 292, 115, 292, 0, 276, 276, 47, 47, 258, 258, 0, 224, 151, 151, 224, 0, 35, 215, 123, 35, 123, 215, 145, 145, 153, 153, 97, 97, 0, 180, 180, 161, 161, 0, 88, 88, 132, 132, 0, 67, 67, 188, 188, 16, 16, 156, 156, 0, 54, 54, 62, 62, 42, 42, 21, 186, 186, 21, 0, 158, 1, 158, 1, 52, 52, 59, 59, 296, 296, 0,

217, 217, 288, 291, 220, 291, 275, 275, 220, 288, 0, 264, 278, 264, 185, 278, 79, 255, 185, 79, 255, 0,
179, 222, 222, 179, 228, 14, 14, 228, 0, 233, 233, 202, 202, 20, 20, 0, 32, 70, 32, 70, 0, 19, 19, 81, 3, 3,
81, 0, 211, 69, 69, 203, 211, 226, 73, 226, 50, 73, 203, 17, 17, 50, 0, 287, 287, 100, 100, 8, 8, 0, 105,
295, 295, 164, 105, 164, 0, 138, 138, 285, 285, 56, 56, 117, 117, 0, 183, 227, 183, 60, 227, 60, 102,
102, 0, 247, 247, 298, 298, 0, 274, 274, 119, 119, 46, 46, 197, 197, 0, 232, 150, 150, 232, 131, 131,
170, 170, 0, 272, 286, 286, 272, 4, 4, 0, 206, 210, 206, 290, 210, 290, 0, 257, 257, 177, 177, 0, 248,
241, 248, 207, 144, 207, 144, 241, 5, 5, 166, 166, 106, 106, 0, 192, 192, 22, 22, 0, 281, 281, 33, 33, 0,
26, 118, 118, 89, 89, 26, 0, 168, 168, 230, 230, 93, 93, 0, 260, 260, 205, 205, 0, 299, 225, 299, 225,
243, 243, 160, 209, 209, 140, 140, 160, 0, 201, 223, 201, 223, 0, 273, 269, 269, 273, 229, 229, 0, 238,
40, 40, 238, 0, 178, 254, 178, 254, 128, 122, 122, 128, 0, 94, 173, 94, 173, 0, 86, 86, 44, 6, 44, 6, 0, 78,
78, 237, 176, 237, 176, 0, 261, 234, 261, 182, 234, 267, 267, 182, 0, 169, 98, 98, 169, 196, 104, 196,
104, 0, 174, 174, 125, 85, 125, 85, 0, 240, 212, 181, 212, 181, 240, 0, 15, 15, 147, 147, 28, 163, 28, 2,
163, 2, 13, 13, 0, 116, 116, 216, 216, 175, 175, 0, 43, 43, 0, 280, 39, 280, 39, 38, 38, 252, 252, 0, 10,
10, 103, 103, 0, 214, 239, 214, 239, 0, 143, 200, 200, 143, 75, 157, 157, 75, 0, 213, 256, 256, 154, 154,
213, 0, 137, 137, 149, 149, 251, 113, 113, 251, 0, 76, 76, 124, 282, 124, 282, 190, 190, 0, 29, 244, 29,
244, 221, 120, 120, 221, 0, 110, 110, 64, 58, 58, 64, 0, 24, 24, 99, 107, 107, 99, 0, 82, 135, 135, 82,
268, 71, 268, 71, 289, 146, 146, 289, 0, 31, 31, 57, 57, 66, 66, 87, 87, 142, 142, 159, 159, 162, 162,
193, 193, 242, 242]