Assignment 5

Runar Fosse

I have 6 different operators, made from the combinations of removal/insertion heuristics introduced in a previous lecture:

Removal heuristics:
- Shaw removal; Remove a random amount of similar calls.
- Costly removal; Remove a random amount of the current most costly calls.
- Random removal; Remove a random amount of randomly selected calls.

Insertion heuristics:
- Greedy insertion: Greedily insert the current cheapest call to insert into its position.
- Regret-k insertion: Insert the call with the highest calculated regret-k into its best position.

My escape algorithm consists of iteratively outsourcing a random amount of calls until I've outsourced a total of between 40% and 60% of the problem's total calls.

Instance: Call_7_Vehicle_3				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	1410480.20	1134176.00	65.022906 %	1.646 s
Local Search 1-insert	1225532.80	1134176.00	65.022906 %	0.336 s
Simulated Annealing 1-insert	1134176.00	1134176.00	65.022906 %	0.267 s
SA-new operators (equal weights)	1134176.00	1134176.00	65.022906 %	1.150 s
SA-new operators (tuned weights)	1134176.00	1134176.00	65.022906 %	1.479 s
Adaptive Algorithm	1134176.00	1134176.00	65.022906 %	0.244 s
Best solution: [4, 4, 2, 2, 0, 7, 7, 0, 1, 5, 5, 3, 3, 1, 0, 6, 6]				

Instance: Call_18_Vehicle_5				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	5823937.20	4813395.00	46.277767 %	0.992 s
Local Search 1-insert	2826767.30	2374420.00	73.499132 %	0.450 s
Simulated Annealing 1-insert	2602245.20	2374420.00	73.499132 %	0.441 s
SA-new operators (equal weights)	2375502.40	2374420.00	73.499132 %	5.126 s
SA-new operators (tuned weights)	2375502.40	2374420.00	73.499132 %	5.013 s
Adaptive Algorithm	2374420.00	2374420.00	73.499132 %	1.247 s
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]				

Instance: Call_35_Vehicle_7				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	17986369.00	14373301.00	21.832494 %	1.208 s
Local Search 1-insert	7181838.70	6076993.00	66.950989 %	0.583 s
Simulated Annealing 1-insert	5710323.50	5208574.00	71.673783 %	0.637 s
SA-new operators (equal weights)	5213936.70	4938647.00	73.141750 %	25.026 s
SA-new operators (tuned weights)	5370564.80	5007354.00	72.768095 %	20.065 s
Adaptive Algorithm	4993979.00	4893734.00	73.386004 %	5.667 s
Best solution: [34, 23, 23, 14, 34, 17, 14, 17, 27, 27, 28, 28, 20, 20, 0, 16, 16, 30, 7, 7, 30, 33, 33, 0, 19, 19, 24, 24, 22, 22, 25, 25, 31, 31, 0, 4, 4, 15, 15, 3, 1, 3, 21, 21, 1, 0, 8, 11, 11, 18, 8, 18, 5, 5, 2, 29, 2, 29, 0, 9, 6, 9, 35, 6, 13, 35, 13, 26, 32, 32, 26, 0, 12, 12, 10, 10, 0]				

Instance: Call_80_Vehicle_20				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	46770347.00	46770347.00	0.000000 %	2.235 s
Local Search 1-insert	16717960.80	14829767.00	68.292373 %	2.534 s
Simulated Annealing 1-insert	17164938.80	14732724.00	68.499862 %	2.576 s
SA-new operators (equal weights)	11106858.80	10743058.00	77.030194 %	156.873 s
SA-new operators (tuned weights)	11589600.60	10843726.00	76.814955 %	130.641 s
Adaptive Algorithm	10483792.40	10414910.00	77.731809 %	25.321 s
Best solution: [41, 70, 68, 34, 41, 34, 70, 68, 20, 20, 16, 16, 0, 54, 63, 63, 54, 5, 5, 17, 27, 27, 17, 33, 33, 0, 18, 18, 49, 49, 72, 73, 73, 10, 72, 10, 0, 11, 11, 71, 71, 65, 12, 65, 12, 7, 7, 0, 74, 79, 74, 28, 28, 58, 79, 58, 0, 62, 62, 45, 45, 77, 77, 0, 15, 15, 64, 64, 0, 22, 61, 22, 61, 55, 42, 55, 42, 3, 36, 3, 80, 80, 50, 14, 36, 50, 14, 0, 8, 8, 69, 48, 48, 69, 0, 66, 66, 0, 1, 23, 23, 29, 29, 1, 0, 4, 4, 26, 37, 37, 26, 0, 25, 25, 43, 43, 0, 9, 19, 9, 19, 52, 56, 56, 52, 0, 76, 44, 76, 44, 0, 32, 21, 32, 21, 47, 47, 6, 6, 0, 53, 30, 30, 57, 53, 67, 67, 57, 0, 38, 51, 38, 59, 59, 78, 78, 2, 2, 51, 24, 24, 0, 39, 35, 46, 35, 39, 75, 46, 75, 0, 60, 40, 60, 40, 13, 13, 31, 31, 0]			

Instance: Call_130_Vehicle_40				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	76627567.00	76627567.00	0.000000 %	3.671 s
Local Search 1-insert	27005805.00	24953712.00	67.435072 %	7.316 s
Simulated Annealing 1-insert	27155019.30	24305693.00	68.280745 %	6.171 s
SA-new operators (equal weights)	17692255.50	16885231.00	77.964548 %	601.452 s
SA-new operators (tuned weights)	17304458.10	16960003.00	77.866969 %	453.458 s
Adaptive Algorithm	16643169.60	16469627.00	78.506916 %	59.689 s
Best solution: [3, 3, 121, 121, 107, 107, 37, 28, 36, 28, 77, 36, 77, 37, 0, 60, 60, 124, 67, 124, 92, 67, 46, 92, 46, 0, 115, 69, 69, 115, 39, 39, 0, 126, 126, 45, 40, 40, 45, 56, 56, 64, 64, 0, 120, 120, 104, 79, 79, 104, 0, 42, 96, 96, 50, 42, 118, 118, 9, 17, 9, 17, 50, 0, 25, 25, 59, 51, 59, 51, 0, 73, 102, 102, 99, 99, 73, 0, 33, 33, 125, 122, 91, 125, 122, 91, 0, 88, 88, 130, 61, 61, 130, 110, 110, 48, 48, 0, 21, 90, 21, 90, 0, 103, 103, 23, 23, 55, 109, 55, 10, 109, 53, 30, 10, 30, 53, 0, 32, 32, 117, 117, 0, 105, 105, 97, 97, 81, 94, 94, 12, 81, 12, 0, 11, 11, 62, 62, 63, 83, 83, 63, 0, 15, 15, 16, 16, 41, 41, 4, 4, 7, 7, 0, 84, 98, 98, 114, 84, 114, 65, 127, 65, 127, 0, 123, 74, 123, 74, 34, 68, 70, 34, 70, 68, 20, 20, 0, 5, 5, 22, 22, 26, 26, 0, 129, 129, 0, 49, 27, 49, 27, 108, 108, 47, 47, 71, 14, 71, 14, 0, 87, 87, 128, 128, 0, 6, 44, 6, 44, 0, 106, 66, 66, 106, 0, 38, 38, 1, 31, 1, 31, 0, 119, 119, 0, 72, 112, 112, 72, 0, 2, 2, 78, 78, 0, 85, 85, 89, 43, 43, 89, 0, 0, 116, 116, 57, 57, 0, 75, 75, 0, 8, 8, 0, 100, 100, 76, 76, 0, 19, 95, 19, 52, 95, 35, 52, 35, 0, 58, 29, 82, 58, 29, 82, 24, 24, 0, 80, 80, 0, 86, 86, 113, 18, 18, 113, 0, 93, 93, 13, 101, 13, 101, 0, 54, 111, 111, 54, 0]			

Instance: Call_300_Vehicle_90				
	Average objective	Best objective	Improvement (%)	Running time
Random Search	170784643.00	170784643.00	0.000000 %	8.944 s
Local Search 1-insert	71054331.20	67580835.00	60.429208 %	24.332 s
Simulated Annealing 1-insert	71107759.80	67246387.00	60.625039 %	23.887 s
SA-new operators (equal weights)	38590269.20	37965140.00	77.770168 %	11053.443 s
SA-new operators (tuned weights)	39096420.30	38617010.00	77.388476 %	5974.131 s
Adaptive Algorithm	36482447.30	36203150.00	78.801870 %	335.005 s

Best solution: [0, 206, 206, 0, 217, 217, 0, 7, 7, 11, 11, 0, 67, 273, 61, 61, 273, 67, 28, 28, 129, 129, 0, 152, 152, 272, 272, 0, 10, 10, 0, 0, 183, 185, 183, 62, 62, 289, 185, 289, 0, 155, 155, 0, 110, 110, 259, 259, 0, 0, 245, 245, 0, 126, 207, 126, 207, 108, 108, 262, 262, 258, 258, 0, 293, 209, 293, 209, 0, 158, 171, 171, 158, 0, 53, 59, 53, 59, 231, 231, 0, 0, 0, 83, 83, 0, 278, 278, 228, 89, 228, 89, 0, 233, 233, 0, 63, 154, 154, 63, 0, 68, 265, 265, 68, 115, 115, 0, 23, 23, 279, 279, 281, 281, 0, 118, 41, 41, 118, 287, 287, 196, 90, 196, 90, 0, 35, 215, 200, 200, 164, 35, 164, 215, 3, 3, 0, 214, 111, 214, 111, 0, 0, 0, 180, 180, 79, 191, 297, 79, 191, 297, 20, 20, 0, 43, 43, 5, 226, 226, 73, 5, 22, 22, 73, 0, 218, 218, 145, 145, 0, 274, 274, 119, 119, 46, 46, 4, 4, 156, 156, 0, 243, 243, 107, 107, 106, 106, 0, 82, 29, 82, 29, 246, 246, 266, 64, 64, 266, 0, 66, 66, 181, 124, 101, 101, 181, 124, 0, 193, 193, 220, 189, 220, 189, 0, 48, 225, 48, 225, 234, 234, 0, 277, 222, 222, 210, 277, 210, 98, 98, 9, 294, 294, 9, 251, 251, 0, 247, 247, 159, 159, 199, 125, 125, 199, 0, 244, 244, 221, 91, 91, 221, 97, 97, 0, 242, 242, 77, 151, 151, 77, 52, 52, 8, 8, 0, 179, 271, 179, 271, 109, 240, 250, 240, 250, 109, 204, 204, 132, 132, 0, 269, 123, 269, 123, 290, 70, 290, 70, 166, 166, 267, 267, 0, 202, 202, 56, 56, 186, 18, 186, 18, 0, 137, 137, 230, 230, 127, 120, 120, 127, 100, 100, 161, 161, 0, 136, 208, 136, 208, 249, 144, 249, 144, 253, 148, 253, 148, 192, 192, 292, 198, 198, 292, 0, 232, 49, 49, 300, 212, 300, 141, 232, 212, 141, 21, 163, 163, 21, 0, 143, 143, 149, 149, 14, 104, 14, 104, 0, 105, 295, 105, 74, 194, 194, 295, 74, 34, 50, 34, 298, 298, 50, 0, 142, 142, 47, 47, 113, 140, 140, 113, 0, 248, 248, 72, 184, 72, 84, 184, 187, 17, 17, 187, 84, 0, 94, 65, 94, 131, 65, 131, 170, 170, 16, 16, 0, 24, 24, 288, 167, 167, 60, 60, 112, 112, 288, 0, 168, 168, 256, 256, 165, 146, 165, 146, 296, 296, 0, 138, 138, 261, 236, 261, 203, 236, 153, 153, 275, 55, 203, 275, 55, 0, 237, 237, 177, 177, 282, 282, 99, 12, 99, 12, 0, 133, 133, 150, 150, 71, 71, 33, 33, 139, 139, 130, 130, 0, 263, 36, 263, 88, 88, 285, 36, 285, 197, 197, 117, 117, 0, 81, 85, 85, 81, 0, 116, 116, 45, 95, 58, 45, 95, 58, 0, 96, 188, 96, 188, 38, 38, 0, 39, 280, 280, 42, 182, 39, 80, 42, 182, 80, 0, 299, 264, 299, 205, 173, 173, 264, 205, 0, 57, 270, 286, 286, 57, 270, 0, 160, 51, 51, 160, 0, 103, 30, 103, 30, 190, 190, 0, 134, 134, 169, 291, 169, 291, 252, 252, 0, 238, 157, 157, 238, 0, 235, 32, 235, 27, 27, 32, 0, 78, 78, 260, 257, 260, 257, 0, 147, 147, 229, 283, 229, 283, 0, 19, 224, 224, 19, 0, 172, 69, 227, 219, 69, 227, 172, 219, 0, 76, 44, 76, 44, 0, 15, 15, 86, 268, 86, 216, 216, 93, 268, 93, 0, 195, 26, 26, 195, 0, 54, 211, 211, 54, 0, 174, 284, 284, 174, 0, 223, 114, 114, 223, 0, 201, 239, 201, 239, 0, 31, 176, 31, 176, 0, 276, 37, 254, 276, 254, 128, 37, 122, 122, 128, 0, 25, 213, 25, 75, 75, 213, 0, 178, 255, 178, 255, 2, 102, 2, 102, 0, 241, 162, 162, 6, 241, 6, 0, 121, 1, 92, 92, 121, 175, 175, 1, 0, 87, 87, 0, 135, 40, 135, 40, 13, 13, 0]