

Testlib200	GFACS				DeepACO				NeuFACO			
	min	mean	max	avg time	min	mean	max	avg time	min	mean	max	avg time
a280	2670 (3.53%)	2674 (3.68%)	2682 (3.99%)	16.76	2653 (2.87%)	2665 (3.37%)	2673 (3.64%)	16.99	<b>2642</b> (2.44%)	<b>2646</b> (2.61%)	<b>2663</b> (3.26%)	<b>0.67</b>
bier127	<b>118368</b> (0.07%)	<b>118368</b> (0.07%)	<b>118368</b> (0.07%)	5.20	<b>118368</b> (0.07%)	118450 (0.14%)	118575 (0.25%)	5.29	<b>118368</b> (0.07%)	<b>118368</b> (0.07%)	<b>118368</b> (0.07%)	<b>0.44</b>
ch130	6182 (1.18%)	<b>6186</b> (1.25%)	<b>6203</b> (1.52%)	5.41	6184 (1.21%)	6195 (1.39%)	6208 (1.60%)	5.31	<b>6177</b> (1.10%)	6188 (1.29%)	6232 (2.00%)	<b>0.43</b>
ch150	6631 (1.58%)	6638 (1.69%)	6646 (1.81%)	5.91	6639 (1.70%)	6652 (1.91%)	6678 (2.30%)	5.97	<b>6609</b> (1.24%)	<b>6619</b> (1.40%)	<b>6634</b> (1.62%)	<b>0.46</b>
d198	15930 (0.95%)	15937 (1.00%)	15945 (1.05%)	10.50	15933 (0.97%)	15965 (1.18%)	15990 (1.33%)	10.49	<b>15904</b> (0.79%)	<b>15911</b> (0.83%)	<b>15924</b> (0.91%)	<b>0.58</b>
eil101	<b>702</b> (11.61%)	703 (11.91%)	706 (12.24%)	4.36	<b>702</b> (11.61%)	706 (12.24%)	708 (12.56%)	4.33	<b>702</b> (11.61%)	<b>702</b> (11.67%)	<b>703</b> (11.76%)	<b>0.43</b>
gil262	2557 (7.53%)	2567 (7.99%)	2573 (8.20%)	15.01	2566 (7.91%)	2574 (8.25%)	2582 (8.58%)	15.28	<b>2542</b> (6.90%)	<b>2550</b> (7.25%)	<b>2558</b> (7.57%)	<b>0.59</b>
kroA100	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	4.41	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	4.33	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	<b>21346</b> (0.30%)	<b>0.52</b>
kroB100	<b>22185</b> (0.20%)	<b>22197</b> (0.26%)	<b>22225</b> (0.38%)	4.33	<b>22185</b> (0.20%)	22210 (0.31%)	22236 (0.43%)	4.32	<b>22185</b> (0.20%)	22201 (0.27%)	22243 (0.46%)	<b>0.54</b>
kroC100	<b>20802</b> (0.26%)	<b>20802</b> (0.26%)	<b>20802</b> (0.26%)	4.35	<b>20802</b> (0.26%)	20806 (0.28%)	20822 (0.35%)	4.36	<b>20802</b> (0.26%)	<b>20802</b> (0.26%)	<b>20802</b> (0.26%)	<b>0.51</b>
kroD100	<b>21347</b> (0.25%)	21373 (0.37%)	21403 (0.51%)	4.30	<b>21347</b> (0.25%)	21410 (0.55%)	21429 (0.63%)	4.38	<b>21347</b> (0.25%)	<b>21347</b> (0.25%)	<b>21347</b> (0.25%)	<b>0.51</b>
kroE100	22152 (0.38%)	22170 (0.47%)	22183 (0.52%)	4.32	<b>22123</b> (0.25%)	<b>22134</b> (0.30%)	<b>22161</b> (0.42%)	4.36	22152 (0.38%)	22170 (0.46%)	22174 (0.48%)	<b>0.52</b>
kroA150	<b>26609</b> (0.32%)	26648 (0.47%)	26729 (0.77%)	6.24	<b>26609</b> (0.32%)	26629 (0.40%)	26673 (0.56%)	6.11	<b>26609</b> (0.32%)	<b>26609</b> (0.32%)	<b>26609</b> (0.32%)	<b>0.45</b>
kroB150	26240 (0.42%)	26274 (0.55%)	26290 (0.61%)	6.12	26271 (0.54%)	26310 (0.69%)	26366 (0.90%)	6.15	<b>26207</b> (0.29%)	<b>26208</b> (0.30%)	<b>26209</b> (0.30%)	<b>0.46</b>
kroA200	29529 (0.55%)	29551 (0.62%)	29609 (0.82%)	9.39	29518 (0.51%)	29613 (0.84%)	29677 (1.05%)	9.46	<b>29480</b> (0.38%)	<b>29480</b> (0.38%)	<b>29480</b> (0.38%)	<b>0.60</b>
kroB200	29794 (1.21%)	29914 (1.62%)	30043 (2.06%)	9.40	29719 (0.96%)	29898 (1.57%)	30010 (1.95%)	9.56	<b>29552</b> (0.39%)	<b>29586</b> (0.51%)	<b>29844</b> (1.38%)	<b>0.60</b>
lin105	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	4.61	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	4.47	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	<b>14441</b> (0.43%)	<b>0.42</b>
pr107	<b>44329</b> (0.06%)	<b>44329</b> (0.06%)	<b>44329</b> (0.06%)	4.48	<b>44329</b> (0.06%)	<b>44329</b> (0.06%)	<b>44329</b> (0.06%)	4.53	<b>44329</b> (0.06%)	44337 (0.08%)	44415 (0.25%)	<b>0.42</b>
pr124	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	4.91	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	4.94	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	<b>59102</b> (0.12%)	<b>0.48</b>
pr136	<b>96832</b> (0.06%)	96923 (0.16%)	97021 (0.26%)	5.39	96839 (0.07%)	96942 (0.18%)	97014 (0.25%)	5.33	<b>96832</b> (0.06%)	<b>96850</b> (0.08%)	<b>96930</b> (0.16%)	<b>0.49</b>
pr144	<b>58641</b> (0.18%)	58644 (0.18%)	58675 (0.24%)	5.81	<b>58641</b> (0.18%)	<b>58641</b> (0.18%)	<b>58641</b> (0.18%)	5.98	<b>58641</b> (0.18%)	<b>58641</b> (0.18%)	<b>58641</b> (0.18%)	<b>0.67</b>
pr152	<b>73769</b> (0.12%)	<b>73769</b> (0.12%)	<b>73769</b> (0.12%)	6.25	<b>73769</b> (0.12%)	73769 (0.12%)	73772 (0.12%)	6.28	<b>73769</b> (0.12%)	73824 (0.19%)	73908 (0.31%)	<b>0.46</b>
pr226	80498 (0.16%)	80542 (0.22%)	80629 (0.32%)	12.06	80539 (0.21%)	80571 (0.25%)	80611 (0.30%)	12.04	<b>80457</b> (0.11%)	<b>80457</b> (0.11%)	<b>80457</b> (0.11%)	<b>0.58</b>
pr264	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	14.95	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	15.34	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	<b>49264</b> (0.26%)	<b>0.63</b>
pr299	48541 (0.73%)	48659 (0.97%)	48762 (1.18%)	20.72	48714 (1.09%)	48782 (1.23%)	48841 (1.35%)	20.30	<b>48334</b> (0.30%)	<b>48345</b> (0.32%)	<b>48432</b> (0.50%)	<b>0.68</b>
rat195	2470 (6.33%)	2476 (6.62%)	2484 (6.93%)	8.28	2485 (6.97%)	2495 (7.43%)	2506 (7.88%)	8.38	<b>2457</b> (5.77%)	<b>2457</b> (5.78%)	<b>2458</b> (5.81%)	<b>0.58</b>
rd100	<b>7958</b> (0.61%)	7959 (0.63%)	7964 (0.68%)	4.35	<b>7958</b> (0.61%)	7958 (0.61%)	7959 (0.62%)	4.34	<b>7958</b> (0.61%)	<b>7958</b> (0.61%)	<b>7958</b> (0.61%)	<b>0.53</b>
ts225	126927 (0.22%)	127092 (0.35%)	127218 (0.45%)	11.24	126930 (0.23%)	127086 (0.35%)	127219 (0.45%)	11.35	<b>126760</b> (0.09%)	<b>126774</b> (0.10%)	<b>126828</b> (0.15%)	<b>0.63</b>
tsp225	3958 (1.07%)	3969 (1.36%)	3986 (1.79%)	10.78	3970 (1.38%)	3975 (1.52%)	3987 (1.81%)	10.95	<b>3954</b> (0.97%)	<b>3959</b> (1.10%)	<b>3979</b> (1.61%)	<b>0.64</b>
ul59	<b>42107</b> (0.06%)	42255 (0.42%)	42402 (0.77%)	6.47	<b>42107</b> (0.06%)	<b>42107</b> (0.06%)	<b>42107</b> (0.06%)	6.39	<b>42107</b> (0.06%)	<b>42107</b> (0.06%)	<b>42107</b> (0.06%)	<b>0.52</b>

Testlib500	GFACS				DeepACO				NeuFACO			
	min	mean	max	avg time	min	mean	max	avg time	min	mean	max	avg time
d493	35779 (2.22%)	35841 (2.40%)	35929 (2.65%)	66.22	35974 (2.78%)	36116 (3.18%)	36249 (3.56%)	71.86	<b>35338</b> (0.96%)	<b>35453</b> (1.29%)	<b>35513</b> (1.46%)	<b>1.10</b>
d657	50159 (2.55%)	50272 (2.78%)	50366 (2.97%)	140.31	50446 (3.14%)	50933 (4.13%)	51189 (4.66%)	140.61	<b>49476</b> (1.15%)	<b>49581</b> (1.37%)	<b>49644</b> (1.50%)	<b>1.35</b>
fl417	12174 (2.64%)	12184 (2.72%)	12190 (2.77%)	50.21	12185 (2.73%)	12195 (2.82%)	12206 (2.91%)	54.33	<b>12119</b> (2.18%)	<b>12122</b> (2.20%)	<b>12127</b> (2.24%)	<b>0.99</b>
lin318	42437 (0.97%)	42537 (1.21%)	<b>42654</b> (1.49%)	25.93	42811 (1.86%)	42891 (2.05%)	42950 (2.19%)	25.03	<b>42194</b> (0.39%)	<b>42439</b> (0.98%)	42696 (1.59%)	<b>0.83</b>
p654	34748 (0.30%)	35070 (1.23%)	35143 (1.44%)	164.44	<b>34512</b> (-0.38%)	35036 (1.13%)	35161 (1.50%)	162.94	34919 (0.80%)	<b>34930</b> (0.83%)	<b>34944</b> (0.87%)	<b>1.31</b>
pcb442	51469 (1.36%)	51606 (1.63%)	<b>51690</b> (1.80%)	50.51	51818 (2.05%)	51940 (2.29%)	52037 (2.48%)	44.47	<b>51232</b> (0.89%)	<b>51593</b> (1.61%)	51969 (2.35%)	<b>1.05</b>
pr439	107911 (0.65%)	<b>108104</b> (0.83%)	<b>108196</b> (0.91%)	50.94	108332 (1.04%)	108585 (1.28%)	108799 (1.48%)	47.12	<b>107469</b> (0.24%)	108129 (0.85%)	109522 (2.15%)	<b>1.13</b>
rat575	7226 (6.69%)	7246 (6.98%)	7266 (7.28%)	89.26	7378 (8.93%)	7399 (9.24%)	7413 (9.45%)	83.53	<b>7190</b> (6.16%)	<b>7209</b> (6.44%)	<b>7233</b> (6.79%)	<b>1.18</b>
rd400	15620 (2.22%)	15659 (2.47%)	15696 (2.72%)	43.26	15816 (3.50%)	15894 (4.01%)	15937 (4.29%)	37.70	<b>15521</b> (1.57%)	<b>15586</b> (2.00%)	<b>15648</b> (2.40%)	<b>0.96</b>
u574	37837 (2.53%)	37963 (2.87%)	38066 (3.15%)	94.13	38441 (4.16%)	38528 (4.40%)	38652 (4.73%)	88.98	<b>37343</b> (1.19%)	<b>37625</b> (1.95%)	<b>37749</b> (2.29%)	<b>1.16</b>

Method	Testlib200		Testlib500		Test200		Avg cost	Test500		
	Avg gap (%)	Avg time (s)	Avg gap (%)	Avg time (s)	Avg gap (%)	Avg time (s)		Avg gap (%)	Avg time (s)	Avg cost
DeepACO	1.55	7.91	3.45	75.66	0.97	9.44	10.80	1.98	64.16	17.03
GFACS	1.48	7.88	2.51	77.52	0.84	9.40	10.78	0.60	71.37	16.80
NeuFACO	<b>1.25</b>	<b>0.53</b>	<b>1.95</b>	<b>1.11</b>	<b>0.16</b>	<b>0.65</b>	<b>10.71</b>	0.74	<b>0.56</b>	16.83

	$N$	#	DeepACO	GFACS	NeuFACO(ours)
TSPLib	100–299	30	1.71%	1.25%	<b>1.21%</b>
	300–699	10	4.26%	2.70%	<b>2.60%</b>
	700–1499	12	7.01%	4.08%	<b>3.88%</b>
TSP	100–299	10	<b>2.50%</b>	3.27%	2.69%
	300–699	10	3.75%	4.22%	<b>3.71%</b>
	700–1001	128	4.64%	5.07%	<b>4.32%</b>

Method	TSP500			TSP1000		
	Obj.	Gap(%)	Time	Obj.	Gap(%)	Time
Concorde	16.55	–	10.7s	23.12	–	108s
LKH-3	16.55	0.02	31.7s	23.14	0.10	102s
AM*	21.46	29.07	0.6s	33.55	45.10	1.5s
POMO*	20.57	24.40	0.6s	32.90	42.30	4.1s
+EAS	18.25	10.29	300s	30.77	33.06	600s
+SGBS	18.86	13.98	318s	28.58	23.61	605s
DIMES*	17.01	2.78	11s	24.45	5.75	32s
SO*	16.94	2.40	15s	23.77	2.80	26s
Pointerformer*	17.14	3.56	14s	24.80	7.90	40s
ACO	17.38	5.04	14s	24.76	7.09	57s
DeepACO	16.84	1.77	15s	23.78	2.87	66s
GFACS	<b>16.80</b>	<b>1.56</b>	<b>15s</b>	<b>23.72</b>	<b>2.63</b>	<b>66s</b>

Method	CVRP500			CVRP1000		
	Obj.	Gap(%)	Time	Obj.	Gap(%)	Time
PyVRP	62.96	–	21.0m	119.29	–	1.4h
LKH-3	63.07	0.18	18.6m	119.52	0.20	2.1h
POMO	68.69	9.08	2s	145.74	22.14	3s
+EAS	64.76	2.85	5.0m	126.25	5.83	10.0m
+SGBS	65.44	3.93	5.2m	127.90	7.21	10.1m
Sym-NCO	68.81	9.28	2s	141.82	18.86	3s
+EAS	64.63	2.65	5.0m	125.58	5.27	10.0m
+SGBS	65.40	3.87	5.2m	127.53	6.90	10.1m
ACO	64.62	2.63	36s	122.82	2.96	1.3m
DeepACO	64.49	2.43	36s	122.15	2.40	1.3m
GFACS	<b>64.19</b>	<b>1.95</b>	<b>36s</b>	<b>121.80</b>	<b>2.11</b>	<b>1.3m</b>

	$N$	#	DeepACO	GFACS	NeuFACO
TSP Lib	100–299	30	1.50%	1.44%	<b>1.39%</b>
			13.70s	13.75s	<b>0.22s</b>
	300–699	10	3.43%	2.46%	<b>2.06%</b>
			143.92s	150.49s	<b>0.48s</b>
	700–1499	12	4.86%	3.99%	<b>2.98%</b>
			1047.59s	1141.24s	<b>1.03s</b>
TSP Random	200	64	1.91%	1.83%	<b>1.74%</b>
			16.78s	16.84s	<b>0.32s</b>
	500	64	2.92%	<b>1.45%</b>	1.48%
			118.67s	140.87s	<b>0.77s</b>
	1000	32	4.53%	2.66%	<b>2.19%</b>
			652.46s	731.17s	<b>2.01s</b>

Dataset	N	#	DeepACO		GFACS		NeuFACO	
			Gap(%)	Time(s)	Gap(%)	Time(s)	Gap(%)	Time(s)
TSP Lib	100 – 299	30	1.50	13.70	1.44	13.75	<b>1.39</b>	<b>0.22</b>
	300 – 699	10	3.43	143.92	2.46	150.49	<b>2.06</b>	<b>0.48</b>
	700 – 1499	12	4.86	1047.59	3.99	1141.24	<b>2.98</b>	<b>1.03</b>
TSP Random	200	64	1.89	16.86	1.80	17.36	<b>1.66</b>	<b>0.28</b>
	500	64	3.03	119.58	1.54	136.14	<b>1.50</b>	<b>0.74</b>
	1000	32	4.44	652.46	2.57	731.17	<b>2.19</b>	<b>1.98</b>

Method	TSPLib200		TSPLib500		TSPLib1000	
	Gap(%)	Time	Gap(%)	Time	Gap(%)	Time
DeepACO	1.50	13.70s	3.43	143.92s	4.86	1047.59s
GFACS	1.44	13.75s	2.46	150.49s	3.99	1141.24s
NeuFACO	<b>1.39</b>	<b>0.22s</b>	<b>2.06</b>	<b>0.48s</b>	<b>2.98</b>	<b>1.03s</b>

Method	TSP200		TSP500		TSP1000	
	Gap(%)	Time	Gap(%)	Time	Gap(%)	Time
DeepACO	1.89	16.86s	3.03	119.58s	4.44	652.46s
GFACS	1.80	17.36s	1.54	136.14s	2.57	731.17s
NeuFACO	<b>1.66</b>	<b>0.28s</b>	<b>1.50</b>	<b>0.74s</b>	<b>2.19</b>	<b>1.98s</b>