

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

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

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	1.25	0.53	1.95	1.11	0.16	0.65	10.71	0.74	0.56	16.83

	<i>N</i>	#	DeepACO	GFACS	NeuFACO(ours)
TSPLib	100–299	30	1.71%	1.25%	1.21%
	300–699	10	4.26%	2.70%	2.60%
	700–1499	12	7.01%	4.08%	3.88%
CVRPLib	100–299	43	2.50%	3.27%	2.69%
	300–699	40	3.75%	4.22%	3.71%
	700–1001	17	4.64%	5.07%	4.32%

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

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 (ours)	16.80	1.56	15s	23.72	2.63	66s

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 (ours)	64.19	1.95	36s	121.80	2.11	1.3m