

HNCO

Comparison of various black box optimization algorithms

November 3, 2017

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1 Plan

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```

2 Rankings

algorithm	rank distribution									
	1	2	3	4	5	6	7	8	9	10
pbil	10	1	0	2	0	1	2	1	0	2
sa	8	2	1	3	0	1	0	0	2	2
ga	7	2	1	2	0	2	3	2	0	0
ea-1p1	6	2	1	2	1	3	1	1	2	0
umda	6	2	0	1	3	0	3	1	1	2
rls	5	5	1	3	2	0	0	1	0	2
hc	5	4	2	3	0	1	0	0	1	3
ea-1c10	5	3	5	3	1	0	1	0	1	0
ea-10p1	4	4	3	5	1	0	1	1	0	0
ea-1p10	4	2	0	4	0	1	3	2	3	0

3 Function one-max

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	100	100	100	100	100	1	0.000	0.000
hc	100	100	100	100	100	1	0.000	0.000
sa	100	100	100	100	100	1	0.003	0.005
ea-1p1	100	100	100	100	100	1	0.000	0.000
ea-1p10	100	100	100	100	100	1	0.002	0.004
ea-10p1	100	100	100	100	100	1	0.021	0.008
ea-1c10	100	100	100	100	100	1	0.001	0.002
ga	100	100	100	100	100	1	0.010	0.002
pbil	100	100	100	100	100	1	0.034	0.005
umda	100	100	100	100	100	1	0.003	0.004

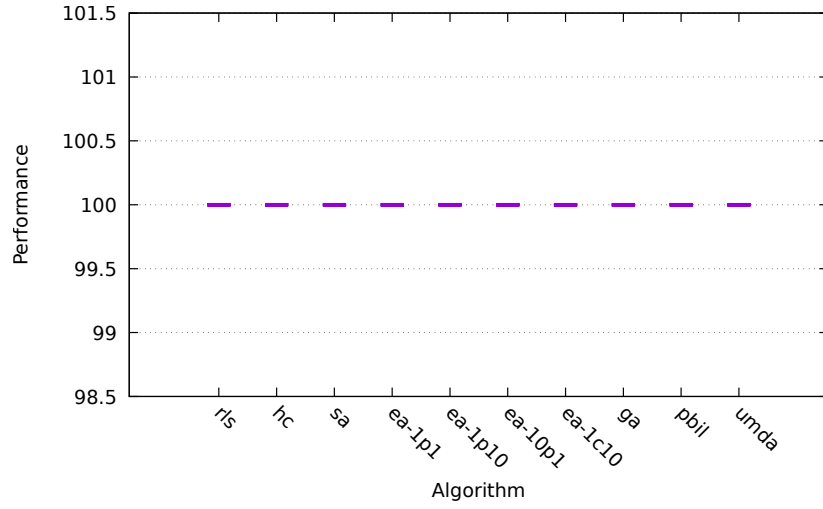


Figure 1: one-max

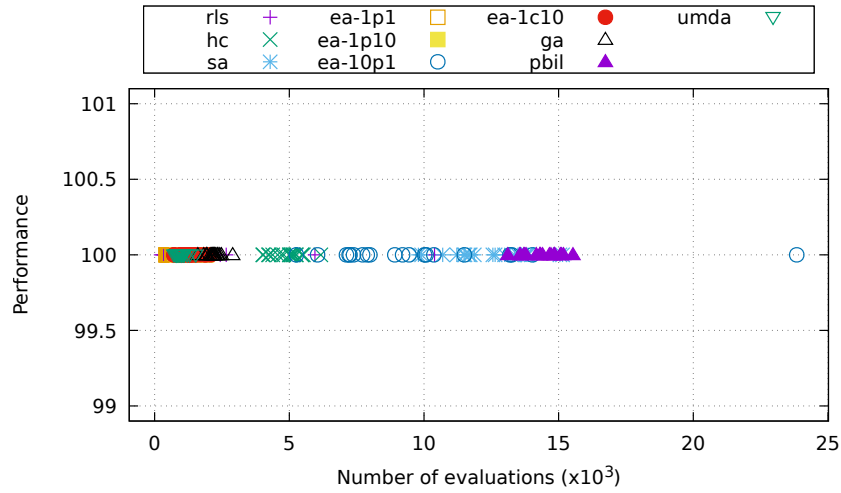


Figure 2: one-max

4 Function lin

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	45.03	45.03	45.03	45.03	45.03	1	0.101	0.006
hc	45.03	45.03	45.03	45.03	45.03	1	0.079	0.004
sa	45.03	45.03	45.03	45.03	45.03	1	0.092	0.004
ea-1p1	45.03	45.03	45.03	45.03	45.03	1	0.159	0.005
ea-1p10	45.03	45.03	45.03	45.03	45.03	1	0.515	0.009
ea-10p1	45.03	45.03	45.03	45.03	45.03	1	0.538	0.007
ea-1c10	45.03	45.03	45.03	45.03	45.03	1	0.520	0.009
ga	45.03	45.03	45.03	45.03	45.03	1	1.040	0.013
pbil	45.03	45.03	45.03	45.03	45.03	1	0.544	0.008
umda	45.03	45.03	45.03	45.03	45.03	1	0.523	0.006

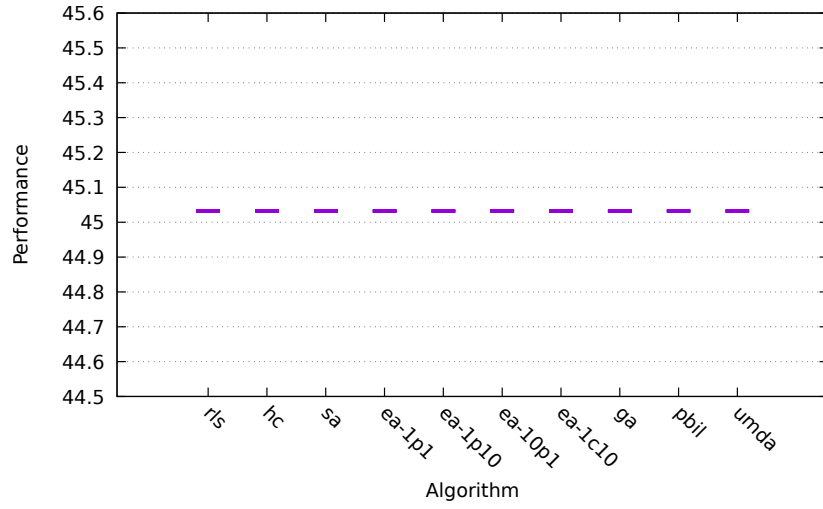


Figure 3: lin

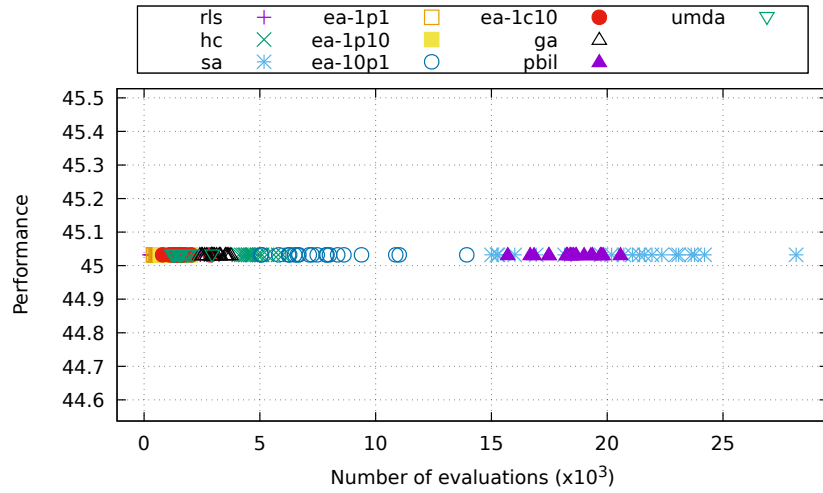


Figure 4: lin

5 Function leading-ones

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	100	100	100	100	100	1	0.009	0.007
hc	100	100	100	100	100	1	0.000	0.000
sa	4	100	100	100	100	10	0.015	0.024
ea-lp1	100	100	100	100	100	1	0.004	0.005
ea-lp10	100	100	100	100	100	1	0.017	0.005
ea-10p1	100	100	100	100	100	1	0.109	0.019
ea-1c10	100	100	100	100	100	1	0.021	0.009
ga	100	100	100	100	100	1	0.047	0.007
pbil	100	100	100	100	100	1	0.158	0.012
umda	100	100	100	100	100	1	0.025	0.006

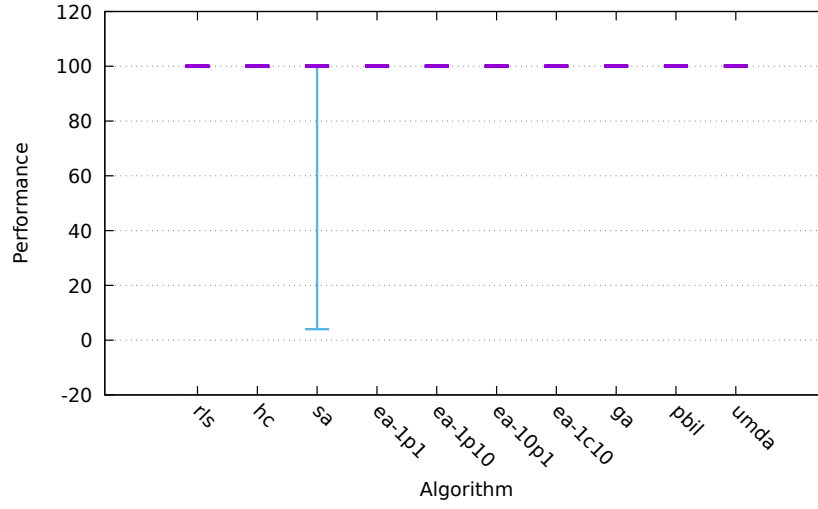


Figure 5: leading-ones

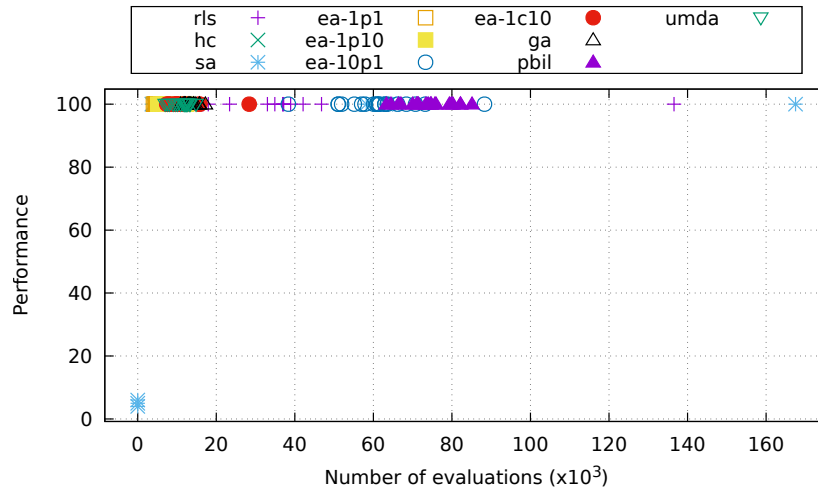


Figure 6: leading-ones

6 Function ridge

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	104	105	106	107	112	10	0.075	0.005
hc	200	200	200	200	200	1	0.003	0.004
sa	200	200	200	200	200	1	0.008	0.004
ea-lp1	200	200	200	200	200	1	0.012	0.005
ea-lp10	200	200	200	200	200	1	0.051	0.006
ea-10p1	196	200	200	200	200	7	0.496	0.046
ea-1c10	117	124	128	130	148	9	0.508	0.021
ga	200	200	200	200	200	1	0.177	0.010
pbil	153	154	155	155	156	8	0.550	0.029
umda	200	200	200	200	200	1	0.087	0.006

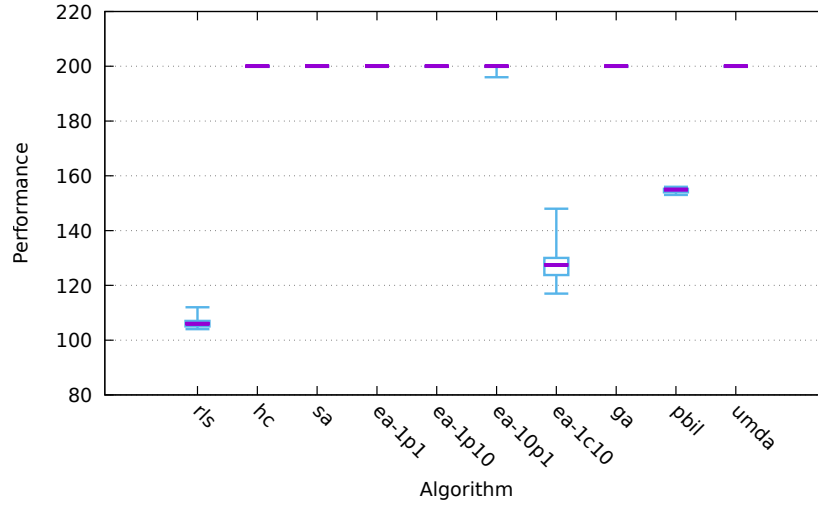


Figure 7: ridge

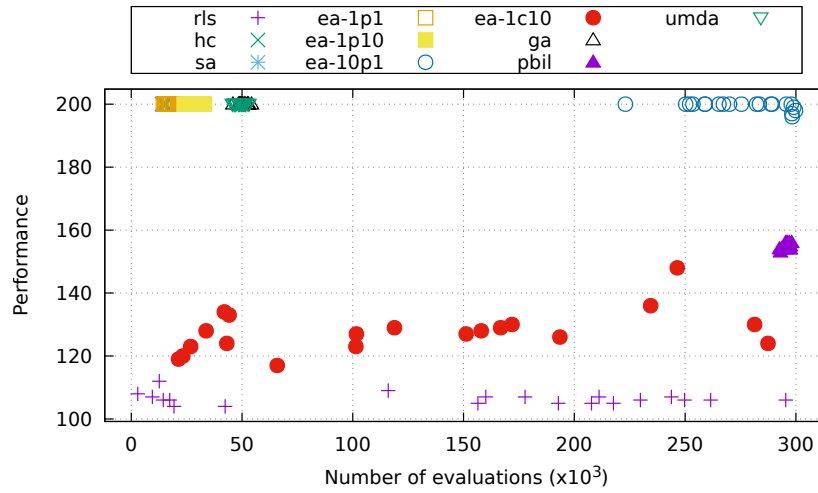


Figure 8: ridge

7 Function jmp-5

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	95	95	95	95	95	4	0.071	0.002
hc	95	95	95	95	95	4	0.059	0.003
sa	95	95	95	95	95	4	0.076	0.005
ea-lp1	95	95	95	95	95	4	0.141	0.004
ea-lp10	95	95	95	95	95	4	0.508	0.022
ea-10p1	95	95	95	95	95	4	0.536	0.023
ea-1c10	95	95	95	95	95	4	0.499	0.007
ga	100	100	100	100	100	1	0.237	0.243
pbil	100	100	100	100	100	1	0.038	0.004
umda	100	100	100	100	100	1	0.096	0.095

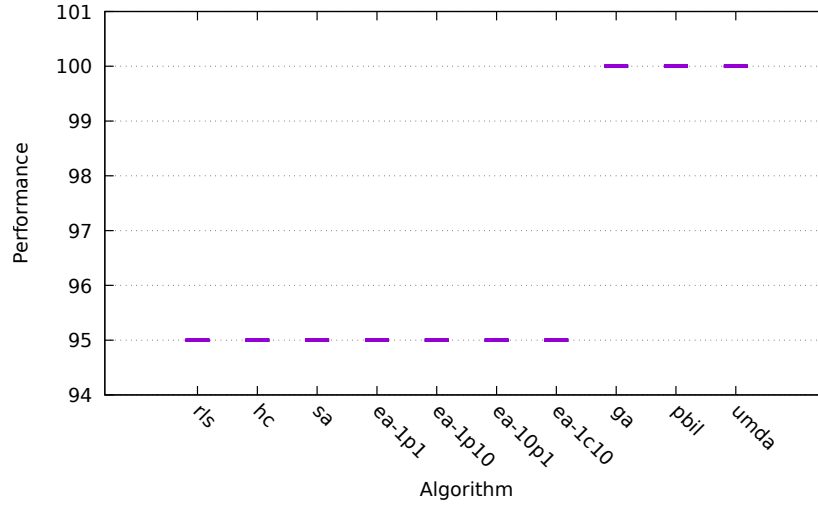


Figure 9: jmp-5

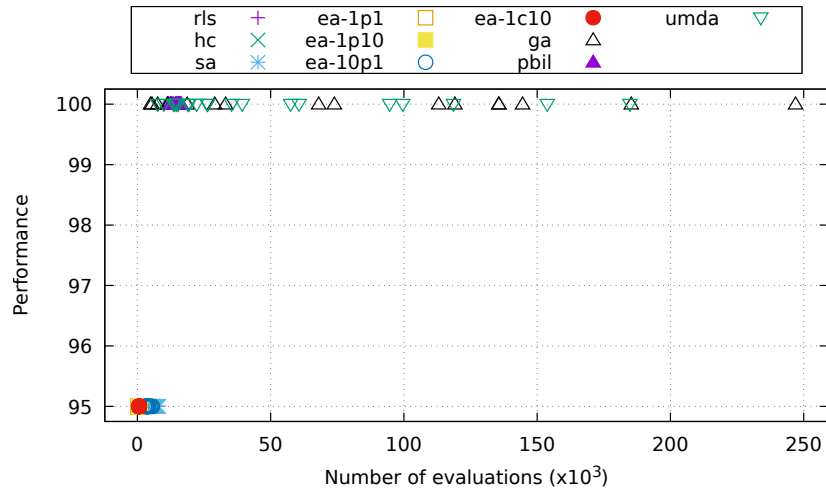


Figure 10: jmp-5

8 Function jmp-10

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	90	90	90	90	90	2	0.074	0.006
hc	90	90	90	90	90	2	0.057	0.005
sa	90	90	90	90	90	2	0.076	0.005
ea-lp1	90	90	90	90	90	2	0.140	0.000
ea-lp10	90	90	90	90	90	2	0.495	0.008
ea-10p1	90	90	90	90	90	2	0.515	0.006
ea-1c10	90	90	90	90	90	2	0.493	0.006
ga	90	90	90	90	90	2	1.029	0.045
pbil	90	90	100	100	100	1	0.282	0.261
umda	90	90	90	90	90	2	0.559	0.009

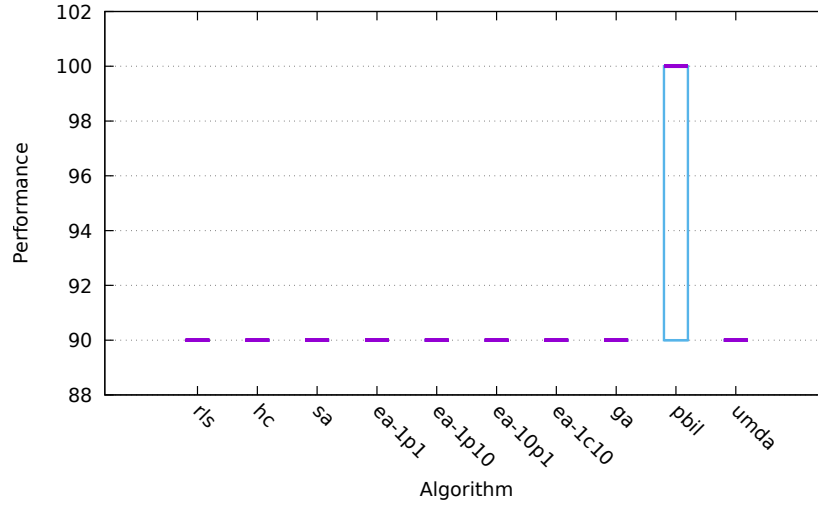


Figure 11: jmp-10

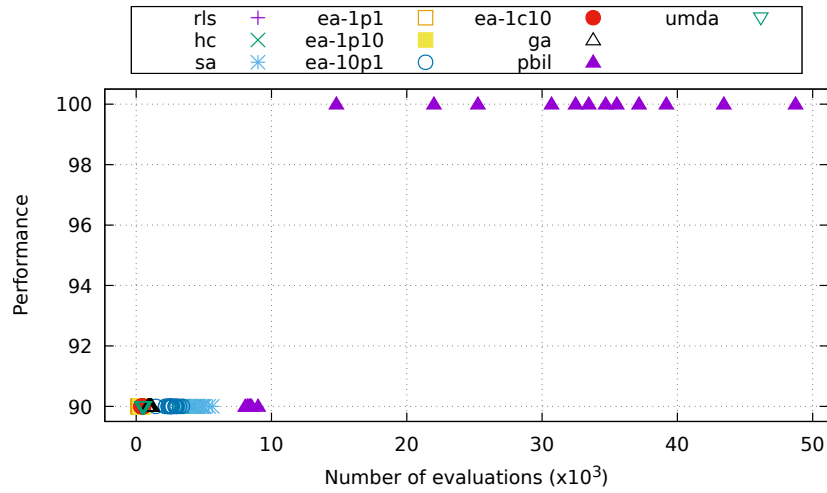


Figure 12: jmp-10

9 Function djmp-5

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	100	100	100	100	100	4	0.071	0.002
hc	100	100	100	100	100	4	0.058	0.004
sa	100	100	100	100	100	4	0.076	0.005
ea-lp1	100	100	100	100	100	4	0.140	0.002
ea-lp10	100	100	100	100	100	4	0.500	0.012
ea-10p1	100	100	100	100	100	4	0.536	0.014
ea-lc10	100	100	100	100	100	4	0.496	0.005
ga	105	105	105	105	105	1	0.255	0.251
pbil	105	105	105	105	105	1	0.038	0.004
umda	105	105	105	105	105	1	0.068	0.075

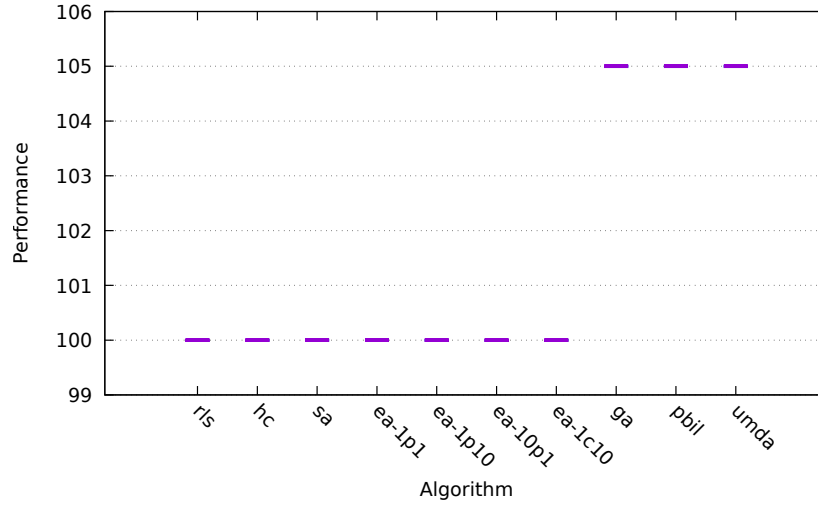


Figure 13: djmp-5

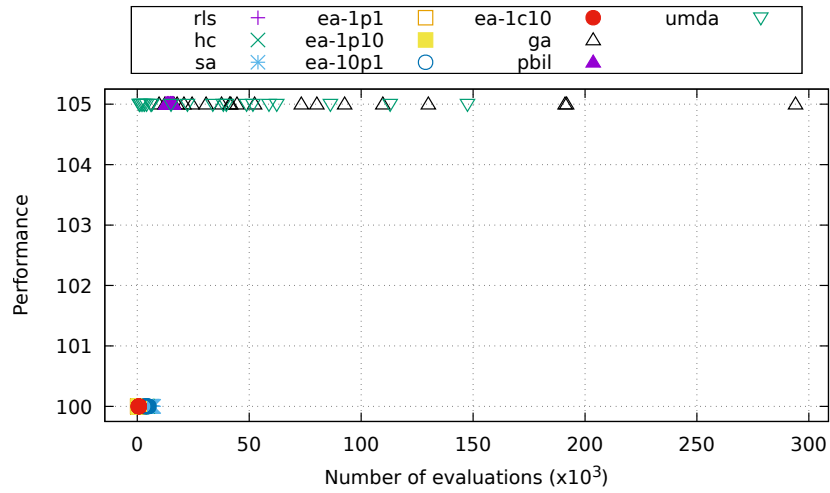


Figure 14: djmp-5

10 Function djmp-10

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	100	100	100	100	100	2	0.073	0.005
hc	100	100	100	100	100	2	0.058	0.004
sa	100	100	100	100	100	2	0.076	0.005
ea-lp1	100	100	100	100	100	2	0.140	0.000
ea-lp10	100	100	100	100	100	2	0.491	0.007
ea-10p1	100	100	100	100	100	2	0.513	0.004
ea-1c10	100	100	100	100	100	2	0.499	0.011
ga	100	100	100	100	100	2	1.015	0.026
pbil	100	100	110	110	110	1	0.263	0.242
umda	100	100	100	100	100	2	0.552	0.004

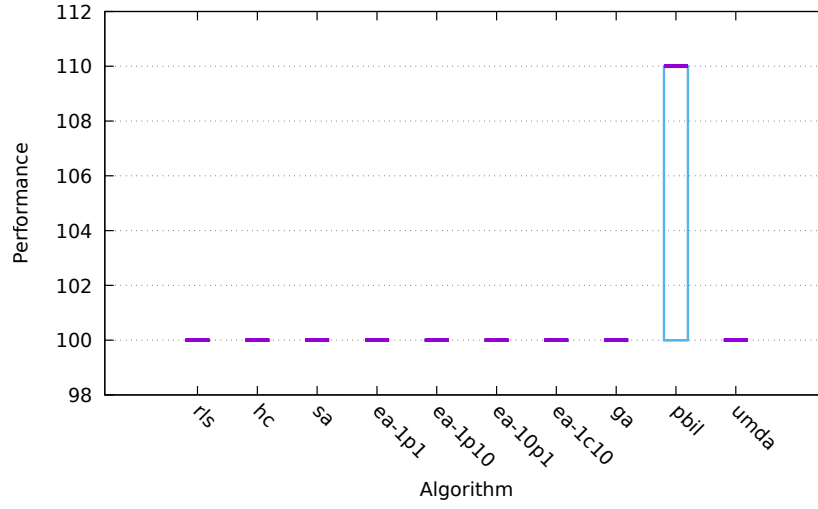


Figure 15: djmp-10

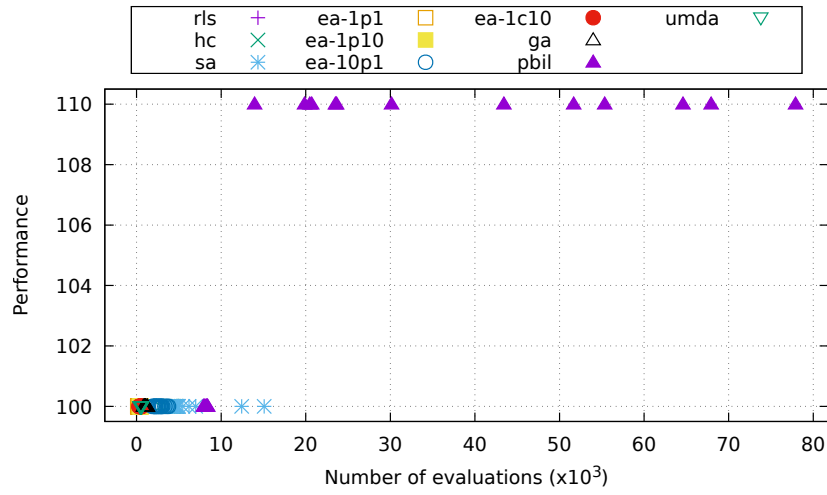


Figure 16: djmp-10

11 Function fp-5

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	194	194	194	194	194	1	0.006	0.005
hc	100	100	194	194	194	10	0.039	0.020
sa	5	194	194	194	194	9	0.005	0.014
ea-lp1	194	194	194	194	194	1	0.004	0.005
ea-lp10	100	194	194	194	194	7	0.042	0.106
ea-10p1	194	194	194	194	194	1	0.105	0.019
ea-1c10	194	194	194	194	194	1	0.022	0.005
ga	194	194	194	194	194	1	0.046	0.007
pbil	194	194	194	194	194	1	0.175	0.018
umda	100	194	194	194	194	7	0.047	0.112

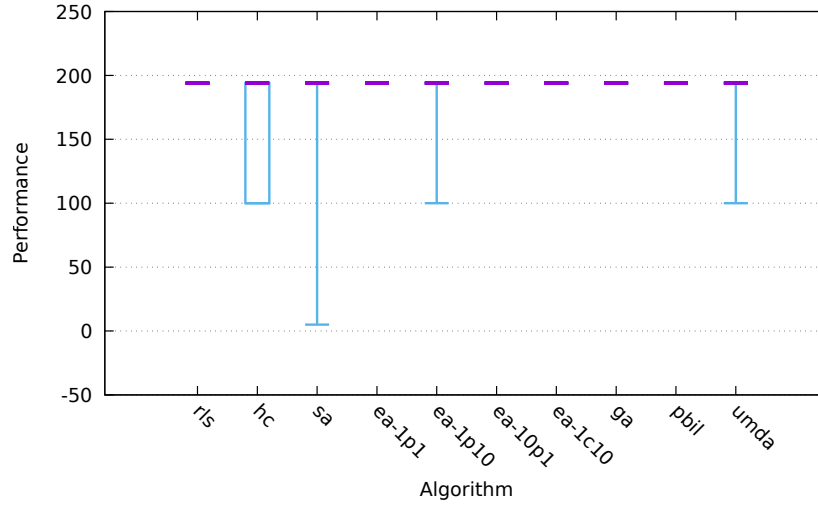


Figure 17: fp-5

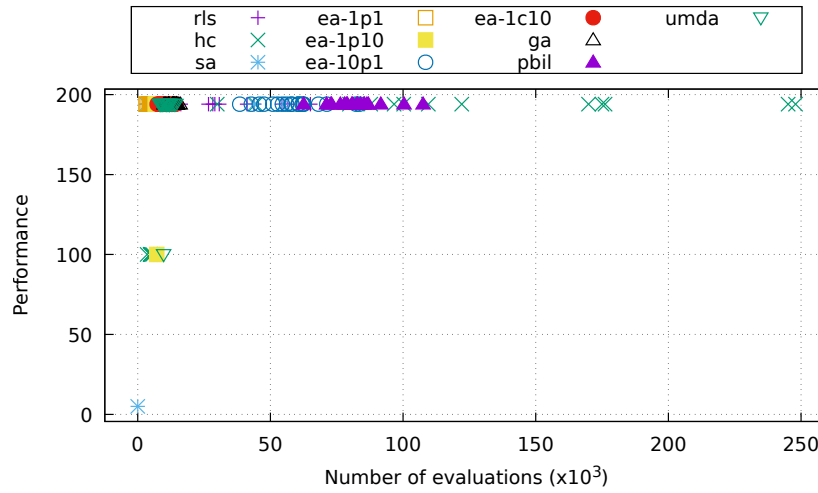


Figure 18: fp-5

12 Function fp-10

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	188	189	189	189	189	2	0.031	0.019
hc	100	100	100	100	100	9	0.060	0.000
sa	4	7	100	100	189	10	0.067	0.025
ea-lp1	100	100	100	122	189	6	0.110	0.065
ea-lp10	100	100	100	100	189	8	0.454	0.152
ea-10p1	100	189	189	189	189	3	0.151	0.136
ea-1c10	100	189	189	189	189	3	0.221	0.186
ga	100	100	100	122	189	6	0.779	0.432
pbil	189	189	189	189	189	1	0.152	0.012
umda	100	100	100	189	189	5	0.372	0.232

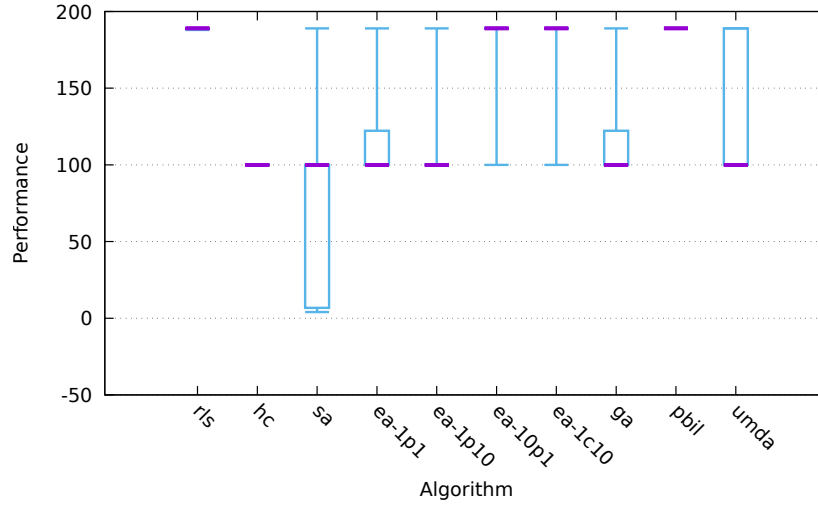


Figure 19: fp-10

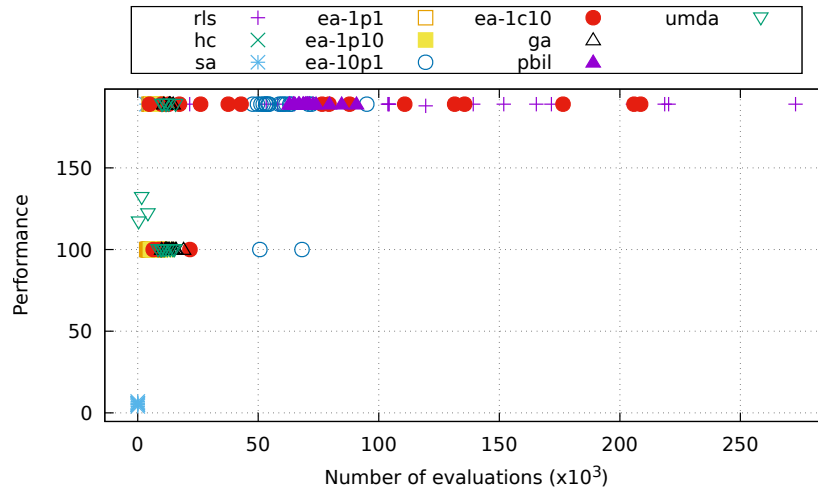


Figure 20: fp-10

13 Function nk

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	0.96	0.98	0.99	1.00	1.04	5	0.278	0.016
hc	0.96	0.99	0.99	1.02	1.05	3	0.253	0.004
sa	0.99	1.03	1.06	1.06	1.10	1	0.276	0.005
ea-1p1	0.86	0.92	0.95	0.96	1.06	9	0.354	0.015
ea-1p10	0.84	0.92	0.95	1.00	1.09	8	0.695	0.009
ea-10p1	0.91	0.98	0.99	1.03	1.10	4	0.714	0.005
ea-1c10	0.96	1.02	1.03	1.05	1.10	2	0.702	0.009
ga	0.90	0.94	0.97	0.99	1.03	7	1.208	0.006
pbil	0.95	0.98	0.99	1.02	1.06	6	0.732	0.004
umda	0.86	0.90	0.93	0.97	1.03	10	0.708	0.006

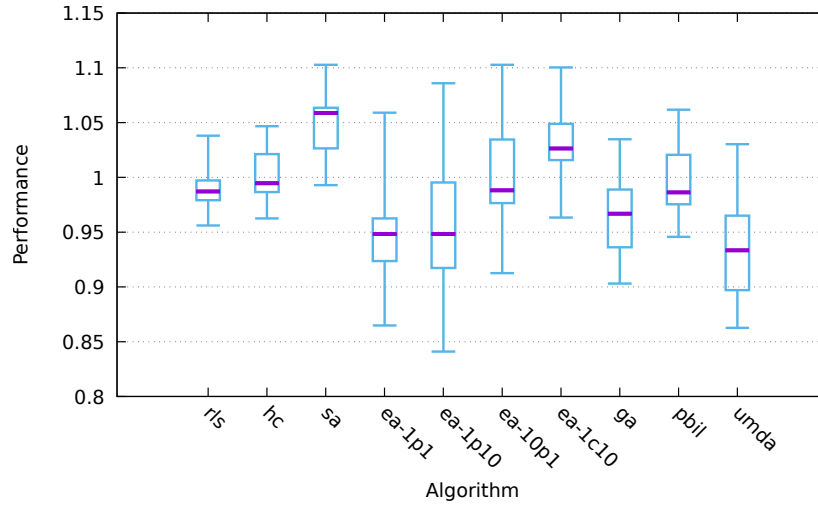


Figure 21: nk

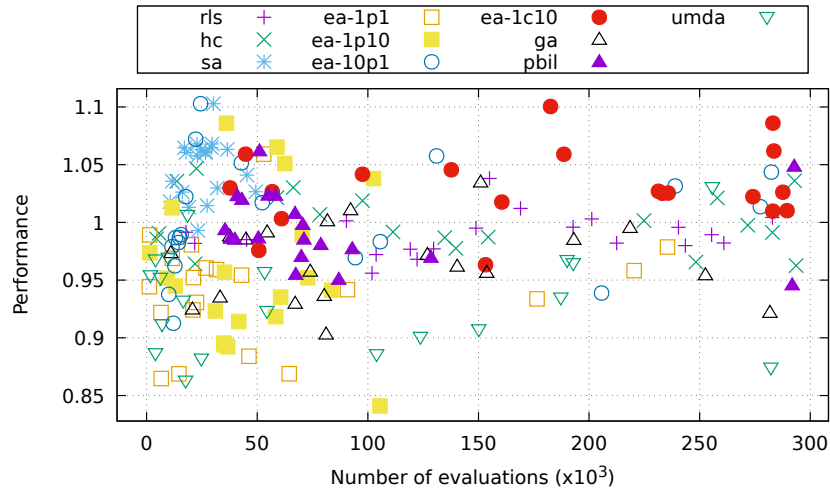


Figure 22: nk

14 Function max-sat

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	971	971	972	972	972	2	1.921	0.008
hc	960	964	966	969	972	10	0.257	0.040
sa	969	972	972	972	972	1	0.623	0.067
ea-1p1	962	966	968	970	972	6	0.835	0.143
ea-1p10	960	964	967	969	972	9	1.068	0.080
ea-10p1	961	964	967	969	972	8	2.037	0.073
ea-1c10	965	968	971	971	972	3	1.258	0.100
ga	962	966	969	971	972	4	1.601	0.087
pbil	965	966	967	967	968	7	1.460	0.052
umda	964	968	968	970	972	5	1.177	0.087

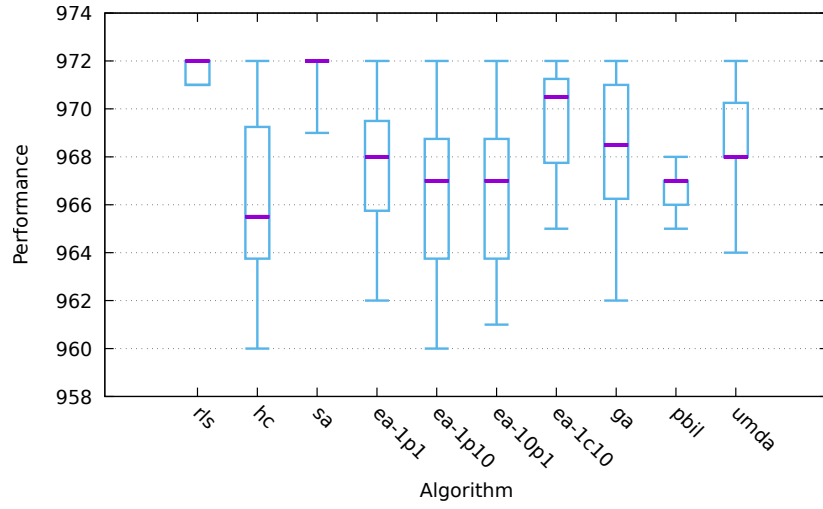


Figure 23: max-sat

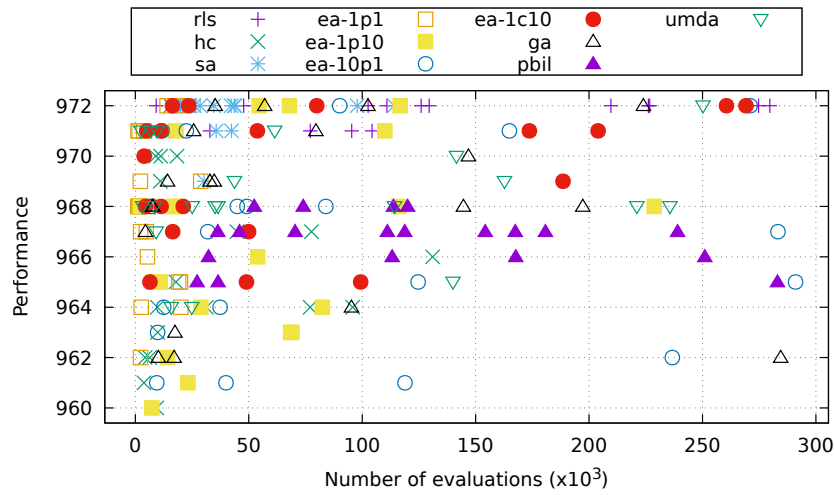


Figure 24: max-sat

15 Function labs

algorithm	performance					time (s)		
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	4.23	4.41	4.54	4.61	4.73	5	1.604	0.020
hc	4.47	4.68	4.78	4.95	5.40	2	1.592	0.021
sa	4.23	4.55	4.64	4.78	5.29	4	1.590	0.018
ea-1p1	3.57	3.85	4.09	4.16	4.47	7	1.658	0.013
ea-1p10	3.56	3.90	4.17	4.34	4.78	6	2.027	0.024
ea-10p1	4.38	4.51	4.75	4.86	5.45	3	2.044	0.018
ea-1c10	4.55	4.77	4.92	5.20	5.42	1	2.017	0.024
ga	3.38	3.71	4.03	4.23	4.64	8	2.515	0.012
pbil	3.55	3.69	3.81	3.89	4.55	10	2.139	0.026
umda	3.42	3.67	3.93	4.14	4.84	9	2.053	0.043

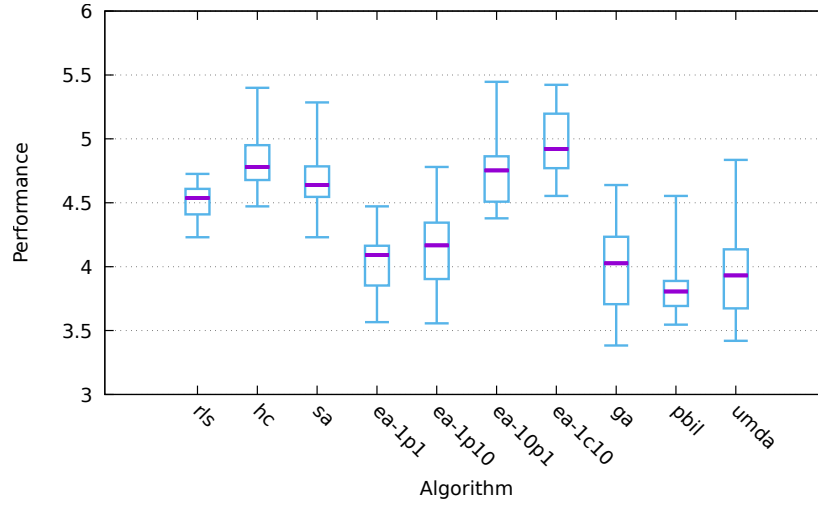


Figure 25: labs

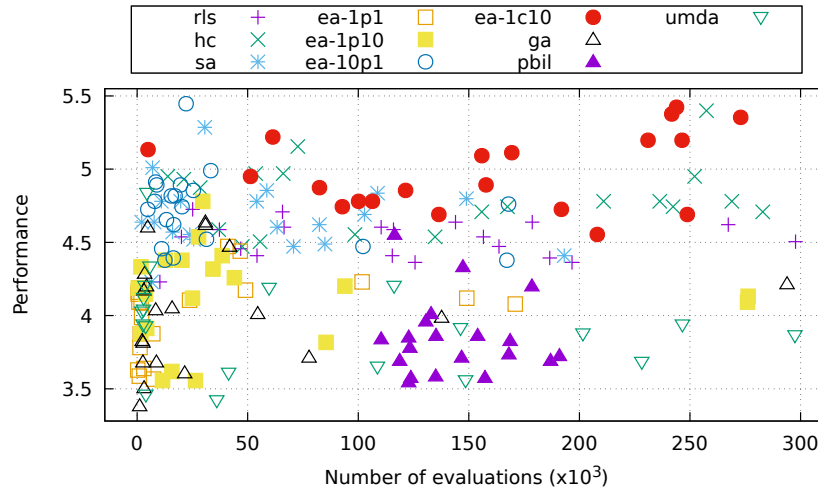


Figure 26: labs

16 Function ep

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	7.9×10^{-32}	1.6×10^{-30}	2.3×10^{-30}	4.1×10^{-30}	1.1×10^{-29}	1	0.123	0.004
hc	4.2×10^{-31}	1.7×10^{-30}	3.6×10^{-30}	5.6×10^{-30}	1.7×10^{-29}	4	0.097	0.005
sa	2.5×10^{-31}	1.5×10^{-30}	5.7×10^{-30}	1.4×10^{-29}	5.5×10^{-29}	6	0.106	0.005
ea-1p1	8.7×10^{-31}	4.1×10^{-30}	1.5×10^{-29}	2.2×10^{-29}	5.6×10^{-29}	9	0.169	0.004
ea-1p10	8.8×10^{-31}	9.2×10^{-30}	1.3×10^{-29}	2.2×10^{-29}	6.1×10^{-29}	7	0.522	0.005
ea-10p1	1.1×10^{-31}	2.1×10^{-30}	4.8×10^{-30}	1.1×10^{-29}	3.0×10^{-29}	5	0.553	0.009
ea-1c10	7.7×10^{-31}	2.9×10^{-30}	3.5×10^{-30}	1.0×10^{-29}	3.0×10^{-29}	3	0.540	0.025
ga	1.4×10^{-30}	5.0×10^{-30}	1.4×10^{-29}	2.5×10^{-29}	8.0×10^{-29}	8	1.045	0.008
pbil	1.1×10^{-31}	1.2×10^{-30}	2.7×10^{-30}	5.0×10^{-30}	1.3×10^{-29}	2	0.756	0.019
umda	4.9×10^{-31}	1.3×10^{-29}	2.3×10^{-29}	4.9×10^{-29}	1.7×10^{-28}	10	0.541	0.004

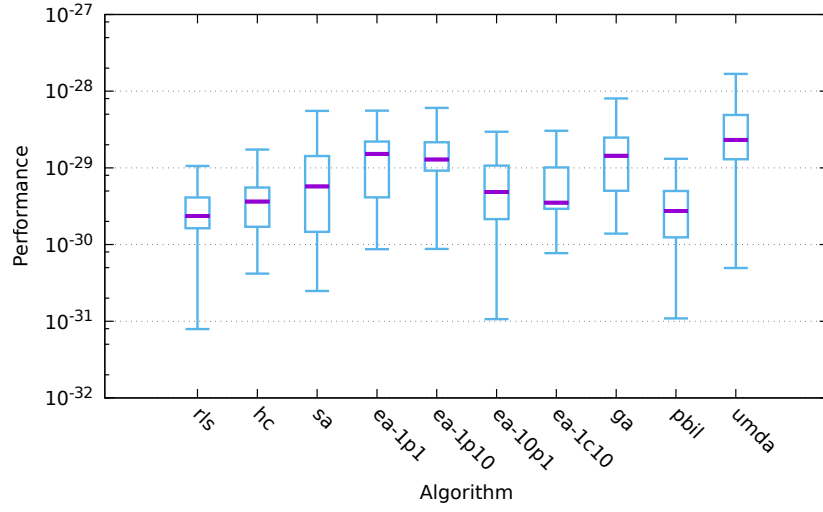


Figure 27: ep

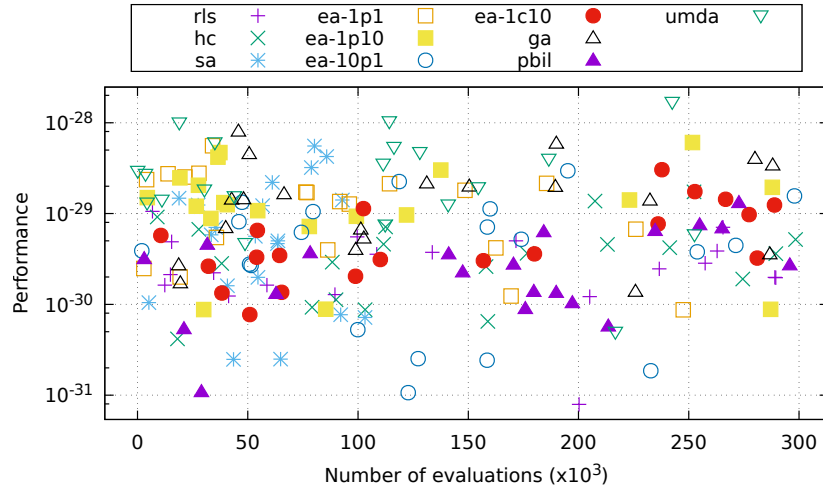


Figure 28: ep

17 Function cancel

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	0.85	1.18	1.61	1.91	2.31	8	0.095	0.005
hc	2.55	3.79	4.34	5.32	8.95	10	0.080	0.000
sa	0.12	0.97	1.96	2.70	3.98	9	0.101	0.002
ea-1p1	0.22	0.57	0.80	1.33	2.66	5	0.166	0.005
ea-1p10	0.16	0.36	0.73	1.66	2.59	4	0.533	0.019
ea-10p1	0.06	0.27	0.69	1.32	1.99	2	0.540	0.009
ea-1c10	0.05	0.15	0.70	1.34	2.26	3	0.532	0.036
ga	0.06	0.37	0.89	1.35	1.97	6	1.035	0.022
pbil	0.05	0.08	0.10	0.13	1.33	1	0.586	0.008
umda	0.08	0.30	1.16	1.84	2.75	7	0.543	0.022

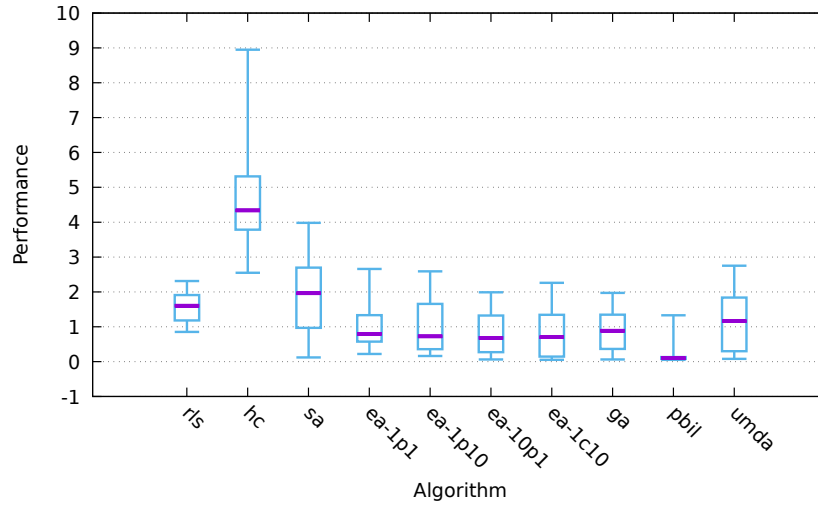


Figure 29: cancel

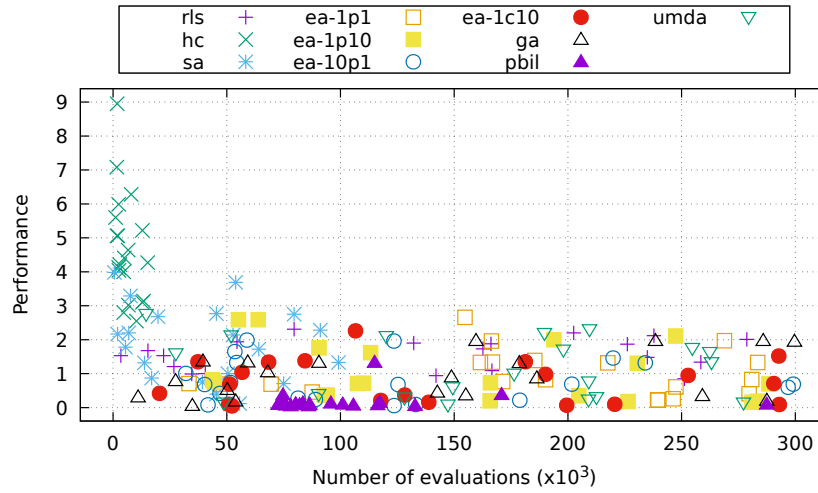


Figure 30: cancel

18 Function trap

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	91	91	91	91	92	2	0.097	0.006
hc	91	91	91	91	92	1	0.081	0.003
sa	90	90	90	90	91	3	0.100	0.006
ea-lp1	90	90	90	90	91	3	0.164	0.005
ea-lp10	90	90	90	90	90	7	0.524	0.015
ea-10p1	90	90	90	90	91	3	0.547	0.019
ea-1c10	90	90	90	90	90	7	0.519	0.007
ga	90	90	90	90	91	3	1.023	0.005
pbil	90	90	90	90	90	7	0.539	0.004
umda	90	90	90	90	90	7	0.526	0.005

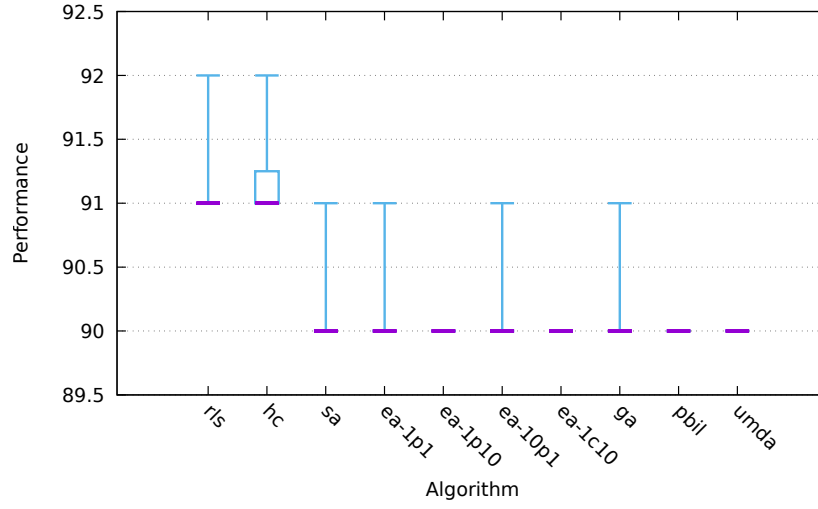


Figure 31: trap

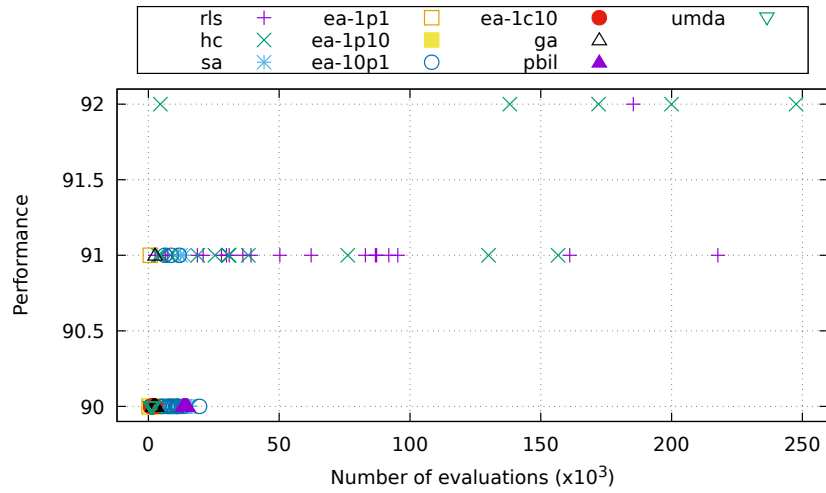


Figure 32: trap

19 Function hiff

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	406	412	419	423	436	10	0.297	0.005
hc	480	488	496	516	528	6	0.279	0.004
sa	222	672	704	744	832	1	0.317	0.013
ea-1p1	448	456	488	518	552	8	0.369	0.008
ea-1p10	432	464	484	504	568	9	0.824	0.009
ea-10p1	576	608	672	704	768	2	0.883	0.010
ea-1c10	592	638	668	705	784	3	0.845	0.008
ga	440	464	492	514	560	7	1.442	0.007
pbil	488	527	548	564	600	4	0.898	0.008
umda	444	470	498	514	548	5	0.844	0.009

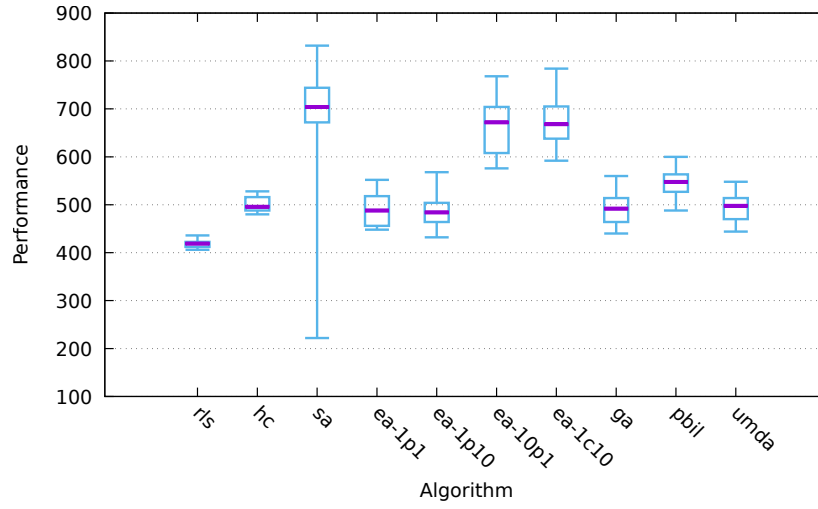


Figure 33: hiff

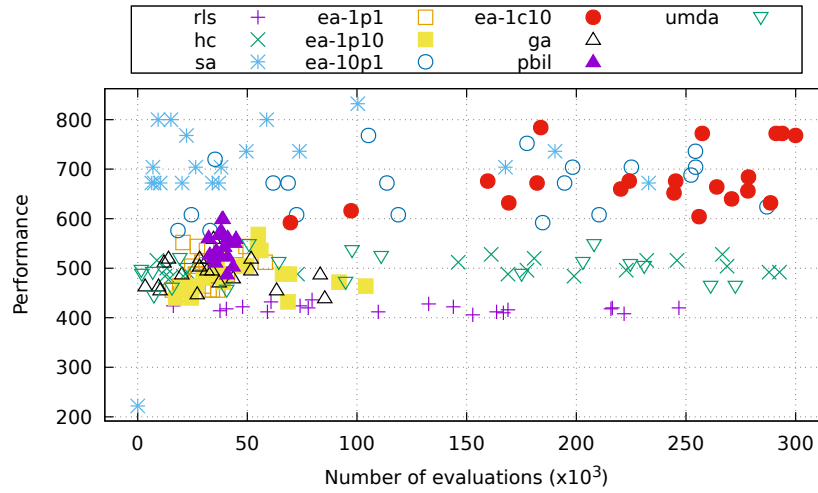


Figure 34: hiff

20 Function plateau

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	101	101	101	101	101	4	0.073	0.004
hc	101	101	101	101	102	3	0.064	0.009
sa	101	101	101	102	102	1	0.082	0.016
ea-lp1	101	101	101	102	102	1	0.145	0.019
ea-lp10	101	101	101	101	101	4	0.498	0.004
ea-10p1	101	101	101	101	101	4	0.523	0.006
ea-1c10	101	101	101	101	101	4	0.502	0.006
ga	101	101	101	101	101	4	1.011	0.002
pbil	101	101	101	101	101	4	0.526	0.005
umda	101	101	101	101	101	4	0.513	0.006

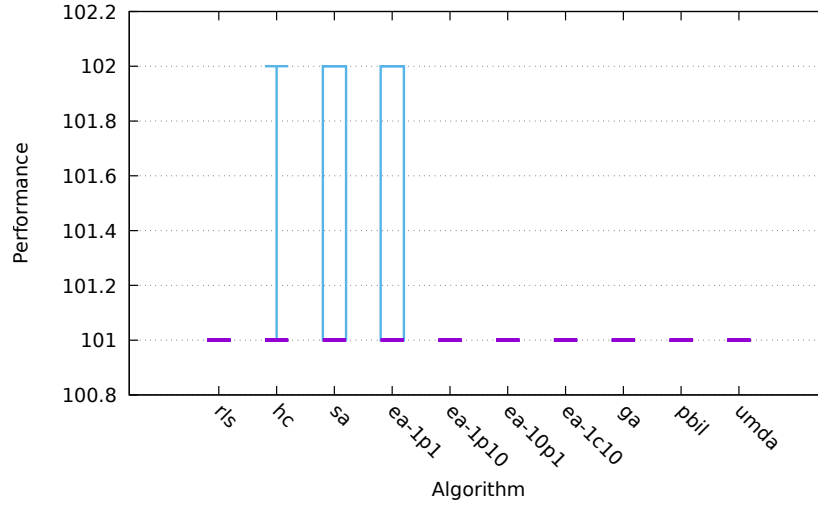


Figure 35: plateau

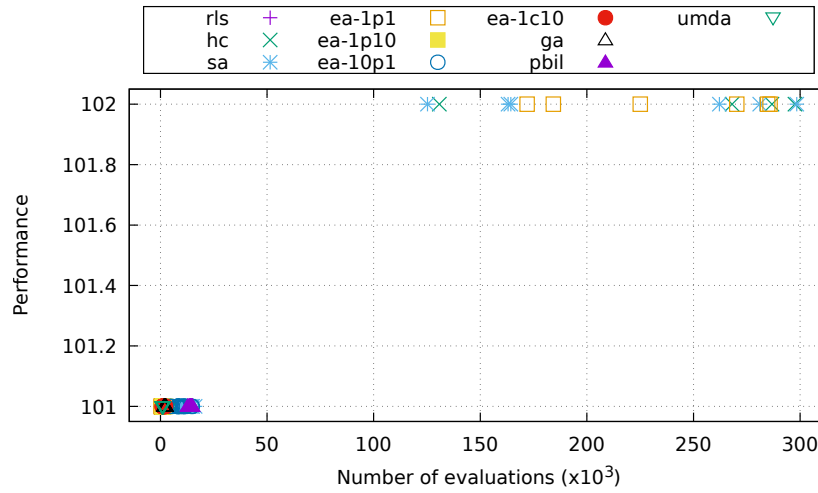


Figure 36: plateau

21 Function walsh2

algorithm	performance						time (s)	
	min	Q_1	med.	Q_3	max	rk	mean	dev.
rls	689.69	698.49	705.55	710.63	720.04	3	2.334	0.033
hc	698.13	710.00	712.91	718.70	720.85	2	2.438	0.007
sa	216.06	702.96	713.69	720.24	721.22	1	0.486	0.065
ea-1p1	627.06	671.14	681.92	692.93	713.69	6	0.680	0.042
ea-1p10	639.00	653.20	666.42	695.50	706.62	9	0.907	0.026
ea-10p1	667.90	686.93	701.73	716.57	721.22	4	1.221	0.019
ea-1c10	657.70	691.84	700.92	712.93	720.85	5	1.192	0.081
ga	628.70	651.78	676.12	691.27	713.69	7	1.439	0.027
pbil	643.65	655.26	665.80	673.95	700.30	10	1.298	0.041
umda	619.07	648.52	672.61	684.04	704.96	8	0.940	0.022

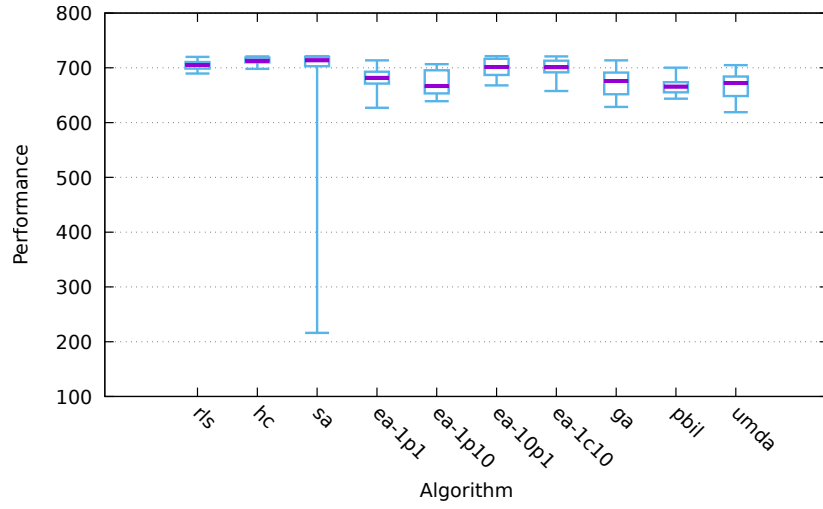


Figure 37: walsh2

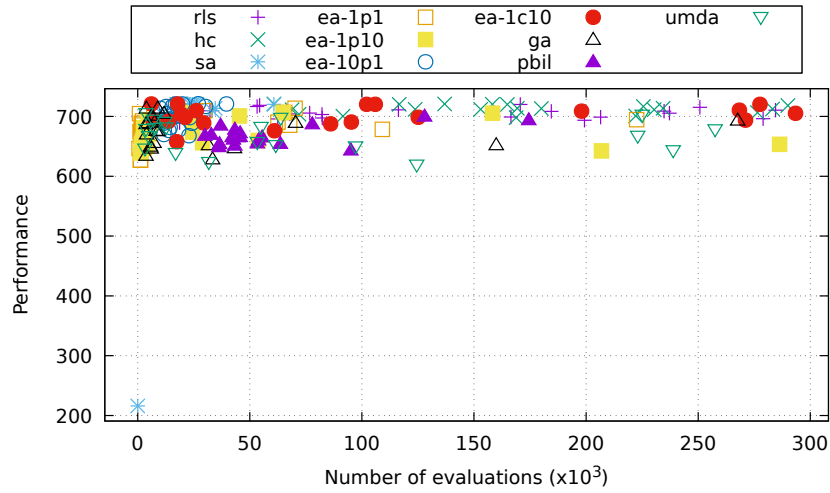


Figure 38: walsh2

22 Default parameters

```
# algorithm = 100
# bm_mc_reset_strategy = 1
# bm_num_gs_cycles = 1
# bm_num_gs_steps = 100
# bm_sampling = 1
# budget = 10000
# bv_size = 100
# ea_lambda = 100
# ea_mu = 10
# fun_name = noname
# fun_num_traps = 10
# fun_prefix_length = 2
# fun_threshold = 10
# function = 0
# ga_crossover_probability = 0.5
# ga_tournament_size = 10
# hea_binary_dynamics = 0
# hea_delay = 10000
# hea_num_par_updates = 1
# hea_num_seq_updates = 100
# hea_rate_strategy = 0
# hea_reset_period = 0
# hea_sampling_method = 0
# hea_time_constant = 1000
# hea_weight = 1
# learning_rate = 0.001
# map = 0
# map_input_size = 100
# map_path = nopath
# neighborhood = 0
# neighborhood_iterator = 0
# noise_stddev = 1
# num_iterations = 0
# num_threads = 1
# path = nopath
# population_size = 10
# pv_log_num_components = 5
# radius = 2
# rls_patience = 50
# sa_initial_acceptance_probability = 0.6
# sa_num_transitions = 50
# sa_num_trials = 100
# sa_rate = 1.2
# scaled_mutation_probability = 1
# seed = 0
# selection_size = 1
# target = 100
# print_default_parameters
# last_parameter
# exec_name = hnco
# version = 0.7
# Generated from hnco.json
```