HNCO
Comparison of various black box optimization algorithms

February 21, 2019

Contents

1 Ranking

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

Per function rankings (ex-eaquo are grouped in parentheses):

one-max (ea-1c10, sa, hc, ea-1p10, umda, ea-10p1, rls, ea-1p1, pbil, ga)

lin (sa, hc, ea-1c10, ga, ea-1p1, pbil, ea-10p1, rls, ea-1p10, umda)

leading-ones (ea-1c10, sa, hc, ea-1p10, umda, ea-10p1, rls, ea-1p1, pbil), ga

ridge (hc, sa, ea-1p1, ea-1p10, umda, ea-10p1), pbil, ea-1c10, rls, ga

jmp-5 (pbil, umda), ga, (ea-1p1, ea-1p10, ea-10p1, rls, sa, hc, ea-1c10)

jmp-10 pbil, (ea-1p1, ga, ea-1p10, umda, rls, ea-10p1, hc, sa, ea-1c10)

djmp-5 (umda, pbil), ga, (ea-1p10, ea-10p1, rls, ea-1p1, ea-1c10, sa, hc)

djmp-10 pbil, (ea-1c10, sa, hc, umda, ea-1p10, ea-10p1, rls, ea-1p1, ga)

fp-5 (ea-1c10, ea-1p1, pbil, ea-10p1, rls, ea-1p10, umda), sa, ga, hc

fp-10 pbil, rls, ea-10p1, ea-1c10, umda, ga, ea-1p1, (ea-1p10, sa), hc

nk sa, ga, ea-1c10, hc, rls, ea-10p1, pbil, ea-1p1, ea-1p10, umda

max-sat sa, rls, ea-1c10, ga, ea-1p1, ea-10p1, ea-1p10, pbil, hc, umda

labs ga, ea-1c10, sa, hc, ea-10p1, rls, ea-1p10, ea-1p1, pbil, umda

ep rls, ga, pbil, hc, sa, ea-10p1, ea-1p10, ea-1c10, ea-1p1, umda

cancel pbil, ea-1p10, ga, ea-1p1, ea-1c10, ea-10p1, umda, rls, hc, sa

trap hc, rls, (sa, ea-1c10, ea-1p1, ga), (pbil, ea-1p10, umda, ea-10p1)

hiff ga, sa, ea-10p1, ea-1c10, pbil, umda, hc, ea-1p1, ea-1p10, rls

plateau sa, (ea-1p10, ea-1p1), (rls, ea-10p1, umda, ga, pbil, ea-1c10, hc)

walsh2 hc, sa, ga, rls, ea-1c10, ea-10p1, ea-1p10, pbil, umda, ea-1p1

2 Function one-max

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	100	100	100	100	100	1
hc	100	100	100	100	100	1
sa	100	100	100	100	100	1
ea-1p1	100	100	100	100	100	1
ea-1p10	100	100	100	100	100	1
ea-10p1	100	100	100	100	100	1
ea-1c10	100	100	100	100	100	1
ga	100	100	100	100	100	1
pbil	100	100	100	100	100	1
umda	100	100	100	100	100	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.00	0.00	0.00	0.00	0.00	0.00
hc	0.00	0.00	0.00	0.00	0.01	0.00
sa	0.01	0.00	0.01	0.00	0.02	0.00
ea-1p1	0.00	0.00	0.00	0.00	0.00	0.00
ea-1p10	0.00	0.00	0.00	0.00	0.00	0.00
ea-10p1	0.01	0.00	0.01	0.00	0.02	0.01
ea-1c10	0.00	0.00	0.00	0.00	0.00	0.00
ga	0.01	0.00	0.00	0.00	0.01	0.00
pbil	0.06	0.00	0.01	0.00	0.08	0.00
umda	0.00	0.00	0.00	0.00	0.01	0.00

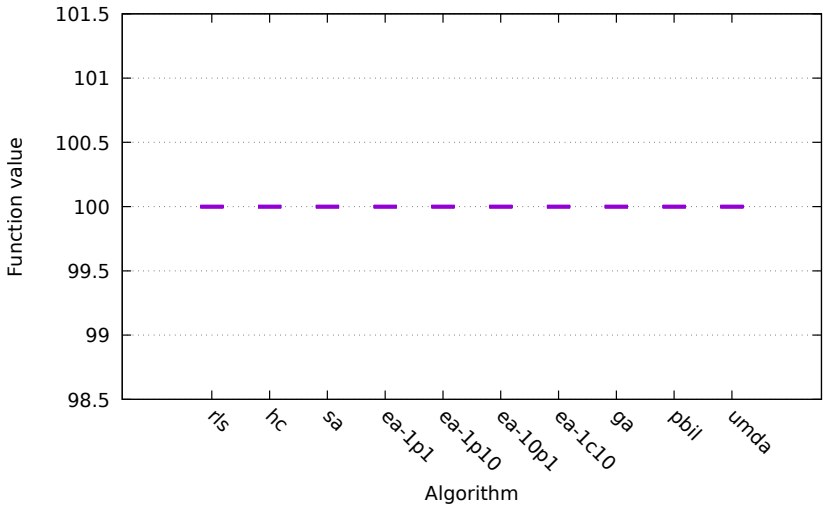

Figure 1: one-max

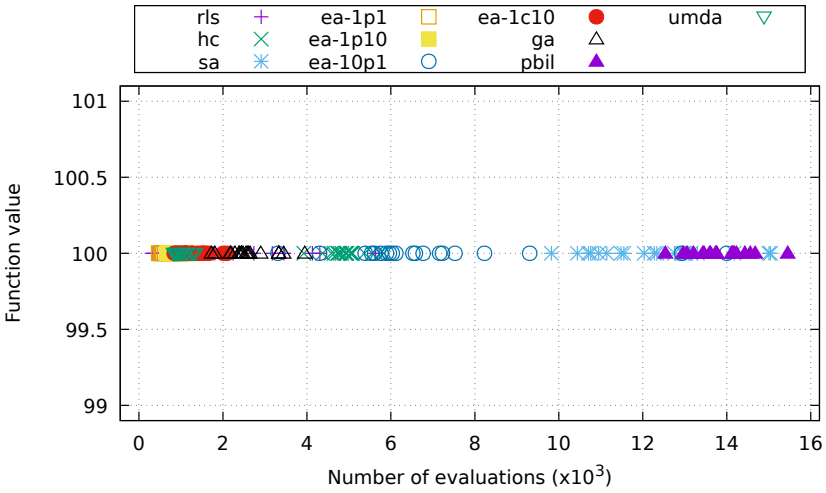

Figure 2: one-max

3 Function lin

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	45.03	45.03	45.03	45.03	45.03	1
hc	45.03	45.03	45.03	45.03	45.03	1
sa	45.03	45.03	45.03	45.03	45.03	1
ea-1p1	45.03	45.03	45.03	45.03	45.03	1
ea-1p10	45.03	45.03	45.03	45.03	45.03	1
ea-10p1	45.03	45.03	45.03	45.03	45.03	1
ea-1c10	45.03	45.03	45.03	45.03	45.03	1
ga	45.03	45.03	45.03	45.03	45.03	1
pbil	45.03	45.03	45.03	45.03	45.03	1
umda	45.03	45.03	45.03	45.03	45.03	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.00	0.00	0.00	0.00	0.00	0.00
hc	0.00	0.00	0.01	0.00	0.01	0.00
sa	0.01	0.00	0.02	0.00	0.04	0.01
ea-1p1	0.00	0.00	0.00	0.00	0.00	0.00
ea-1p10	0.00	0.00	0.00	0.00	0.00	0.00
ea-10p1	0.01	0.00	0.01	0.00	0.02	0.00
ea-1c10	0.00	0.00	0.00	0.00	0.00	0.00
ga	0.04	0.03	0.01	0.01	0.05	0.03
pbil	0.09	0.00	0.03	0.00	0.11	0.00
umda	0.01	0.00	0.00	0.00	0.01	0.00

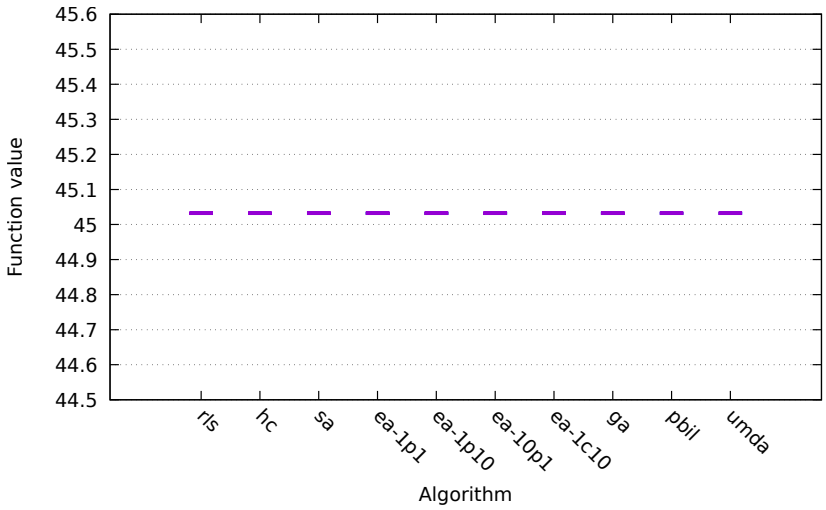

Figure 3: lin

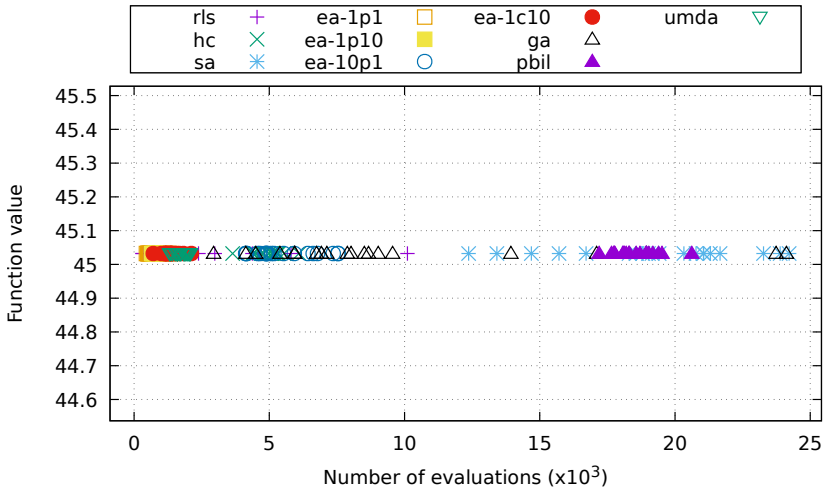

Figure 4: lin

4 Function leading-ones

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	100	100	100	100	100	1
hc	100	100	100	100	100	1
sa	100	100	100	100	100	1
ea-1p1	100	100	100	100	100	1
ea-1p10	100	100	100	100	100	1
ea-10p1	100	100	100	100	100	1
ea-1c10	100	100	100	100	100	1
ga	93	95	97	97	100	10
pbil	100	100	100	100	100	1
umda	100	100	100	100	100	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.02	0.01	0.02	0.02	0.04	0.03
hc	0.00	0.00	0.00	0.00	0.01	0.00
sa	0.01	0.01	0.01	0.02	0.02	0.03
ea-1p1	0.01	0.00	0.00	0.00	0.01	0.00
ea-1p10	0.01	0.00	0.00	0.00	0.01	0.00
ea-10p1	0.06	0.01	0.04	0.01	0.10	0.02
ea-1c10	0.01	0.00	0.01	0.00	0.02	0.00
ga	1.22	0.14	0.28	0.03	1.50	0.17
pbil	0.32	0.03	0.07	0.01	0.39	0.03
umda	0.06	0.01	0.01	0.00	0.07	0.01

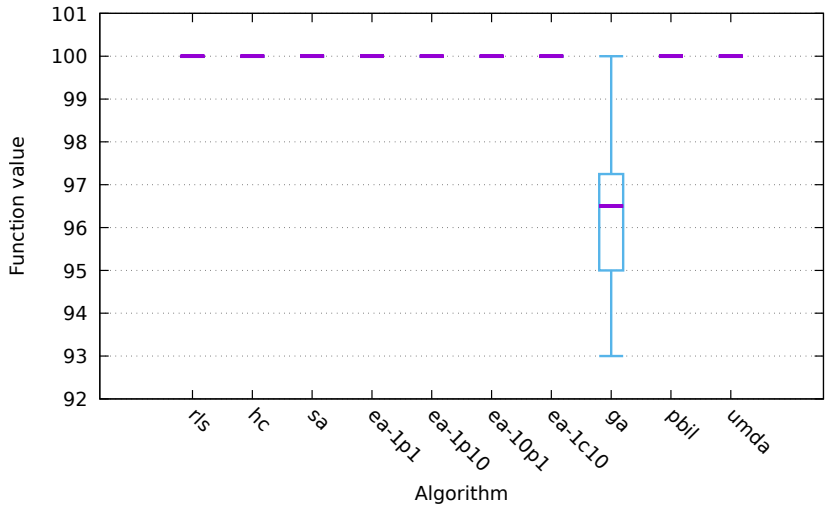

Figure 5: leading-ones

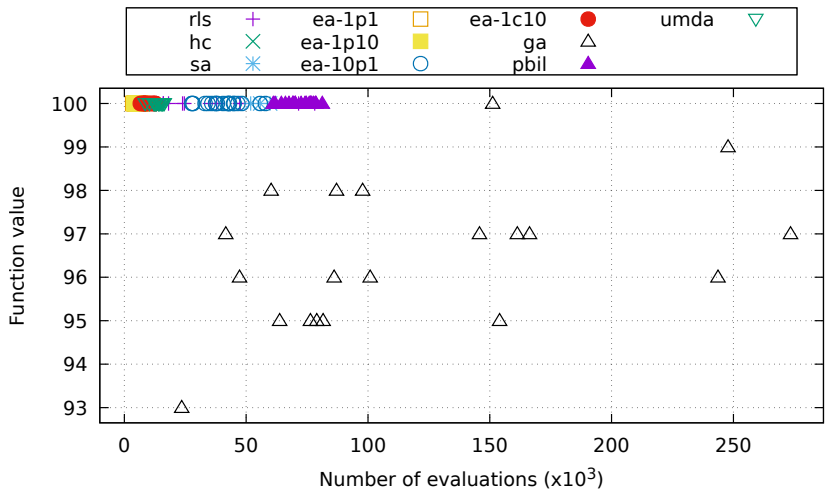

Figure 6: leading-ones

5 Function ridge

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	104	104	105	105	107	9
hc	200	200	200	200	200	1
sa	200	200	200	200	200	1
ea-1p1	200	200	200	200	200	1
ea-1p10	200	200	200	200	200	1
ea-10p1	200	200	200	200	200	1
ea-1c10	120	124	126	130	137	8
ga	102	102	103	103	103	10
pbil	153	154	155	155	157	7
umda	200	200	200	200	200	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	0.27	0.00	0.48	0.00
hc	0.01	0.00	0.01	0.00	0.02	0.00
sa	0.02	0.00	0.02	0.00	0.04	0.00
ea-1p1	0.02	0.00	0.02	0.00	0.04	0.00
ea-1p10	0.02	0.00	0.02	0.00	0.04	0.00
ea-10p1	0.26	0.03	0.17	0.02	0.43	0.05
ea-1c10	0.30	0.00	0.29	0.00	0.59	0.01
ga	1.24	0.00	0.29	0.00	1.53	0.01
pbil	1.26	0.00	0.29	0.00	1.55	0.00
umda	0.20	0.01	0.05	0.00	0.25	0.02

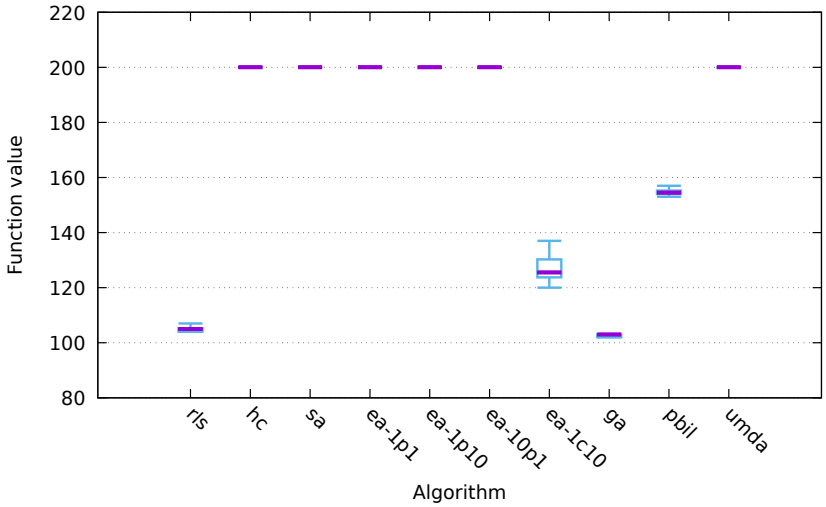

Figure 7: ridge

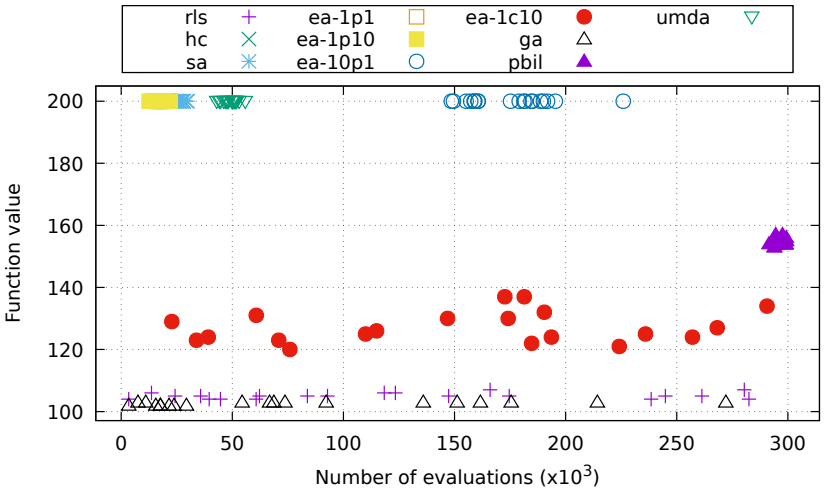

Figure 8: ridge

6 Function jmp-5

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	95	95	95	95	95	4
hc	95	95	95	95	95	4
sa	95	95	95	95	95	4
ea-1p1	95	95	95	95	95	4
ea-1p10	95	95	95	95	95	4
ea-10p1	95	95	95	95	95	4
ea-1c10	95	95	95	95	95	4
ga	95	100	100	100	100	3
pbil	100	100	100	100	100	1
umda	100	100	100	100	100	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.28	0.00	0.49	0.00
hc	0.19	0.00	0.28	0.00	0.46	0.00
sa	0.22	0.00	0.28	0.00	0.50	0.01
ea-1p1	0.32	0.00	0.28	0.01	0.60	0.01
ea-1p10	0.34	0.00	0.28	0.00	0.62	0.00
ea-10p1	0.45	0.01	0.28	0.00	0.73	0.01
ea-1c10	0.30	0.00	0.28	0.00	0.58	0.00
ga	0.46	0.45	0.10	0.10	0.57	0.55
pbil	0.07	0.00	0.01	0.00	0.08	0.00
umda	0.18	0.19	0.04	0.04	0.22	0.23

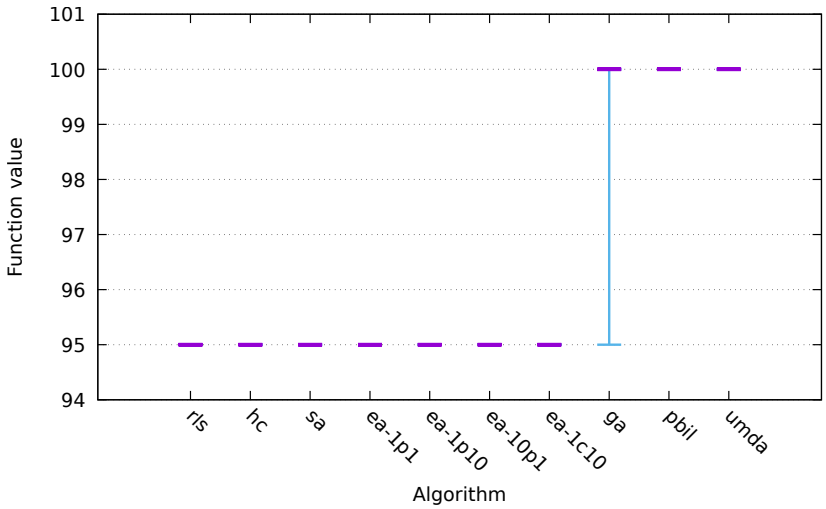

Figure 9: jmp-5

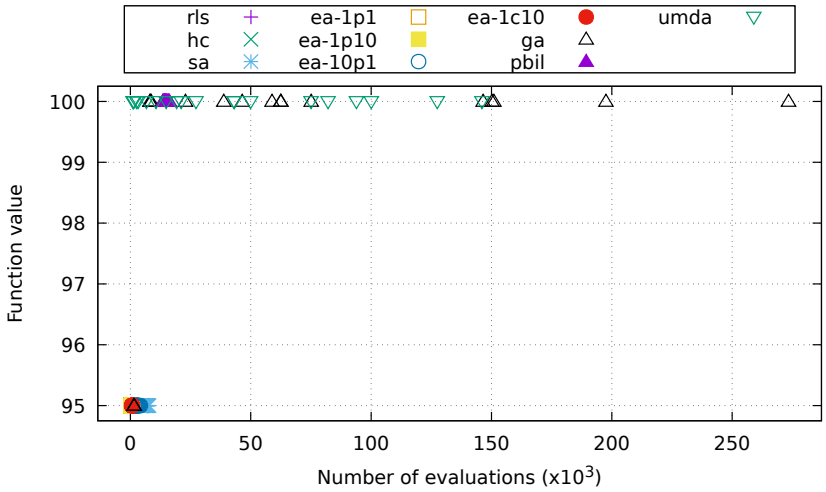

Figure 10: jmp-5

7 Function jmp-10

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	90	90	90	90	90	2
hc	90	90	90	90	90	2
sa	90	90	90	90	90	2
ea-1p1	90	90	90	90	90	2
ea-1p10	90	90	90	90	90	2
ea-10p1	90	90	90	90	90	2
ea-1c10	90	90	90	90	90	2
ga	90	90	90	90	90	2
pbil	90	90	90	93	100	1
umda	90	90	90	90	90	2

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.28	0.00	0.50	0.00
hc	0.19	0.00	0.28	0.00	0.46	0.00
sa	0.22	0.00	0.28	0.00	0.50	0.00
ea-1p1	0.32	0.00	0.28	0.00	0.60	0.01
ea-1p10	0.34	0.00	0.28	0.00	0.62	0.00
ea-10p1	0.44	0.01	0.28	0.01	0.72	0.01
ea-1c10	0.30	0.00	0.28	0.00	0.58	0.00
ga	1.25	0.00	0.28	0.00	1.53	0.00
pbil	1.05	0.48	0.22	0.10	1.27	0.58
umda	1.28	0.01	0.28	0.00	1.56	0.01

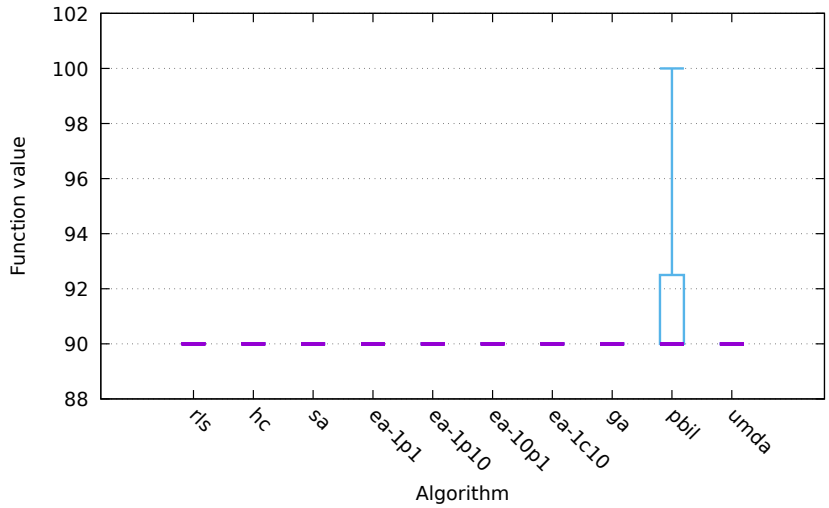

Figure 11: jmp-10

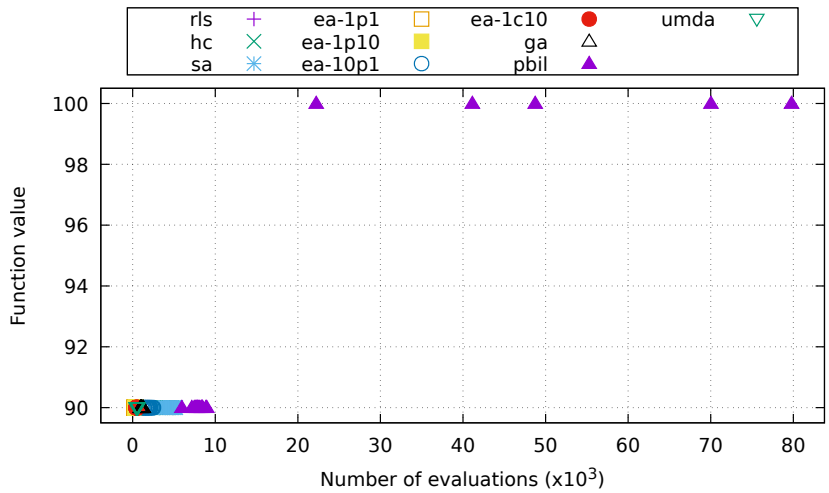

Figure 12: jmp-10

8 Function djmp-5

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	100	100	100	100	100	4
hc	100	100	100	100	100	4
sa	100	100	100	100	100	4
ea-1p1	100	100	100	100	100	4
ea-1p10	100	100	100	100	100	4
ea-10p1	100	100	100	100	100	4
ea-1c10	100	100	100	100	100	4
ga	100	105	105	105	105	3
pbil	105	105	105	105	105	1
umda	105	105	105	105	105	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	0.27	0.01	0.48	0.01
hc	0.18	0.00	0.27	0.00	0.45	0.00
sa	0.22	0.00	0.27	0.00	0.49	0.01
ea-1p1	0.32	0.01	0.27	0.00	0.60	0.01
ea-1p10	0.34	0.00	0.27	0.00	0.61	0.00
ea-10p1	0.44	0.01	0.28	0.01	0.72	0.01
ea-1c10	0.30	0.00	0.27	0.00	0.57	0.00
ga	0.43	0.36	0.09	0.08	0.52	0.44
pbil	0.07	0.00	0.01	0.00	0.08	0.00
umda	0.08	0.09	0.02	0.02	0.10	0.12

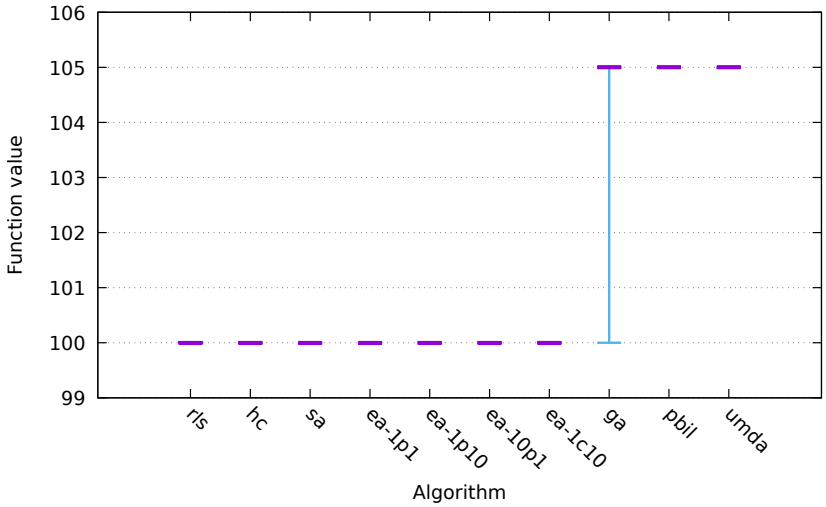

Figure 13: djmp-5

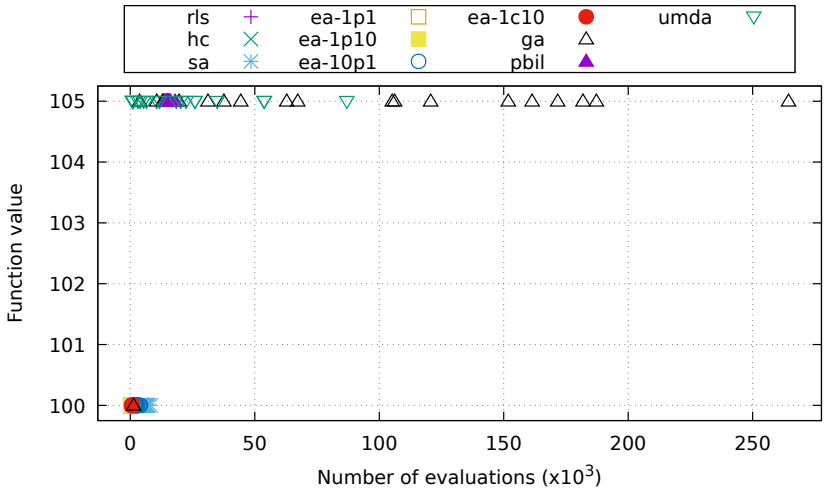

Figure 14: djmp-5

9 Function djmp-10

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	100	100	100	100	100	2
hc	100	100	100	100	100	2
sa	100	100	100	100	100	2
ea-1p1	100	100	100	100	100	2
ea-1p10	100	100	100	100	100	2
ea-10p1	100	100	100	100	100	2
ea-1c10	100	100	100	100	100	2
ga	100	100	100	100	100	2
pbil	100	100	110	110	110	1
umda	100	100	100	100	100	2

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.27	0.00	0.48	0.00
hc	0.18	0.00	0.27	0.00	0.45	0.00
sa	0.22	0.00	0.27	0.00	0.49	0.01
ea-1p1	0.32	0.00	0.28	0.00	0.60	0.01
ea-1p10	0.34	0.00	0.27	0.00	0.61	0.00
ea-10p1	0.44	0.01	0.28	0.00	0.72	0.01
ea-1c10	0.30	0.00	0.27	0.00	0.57	0.01
ga	1.24	0.00	0.28	0.00	1.52	0.00
pbil	0.62	0.58	0.13	0.12	0.75	0.71
umda	1.28	0.01	0.27	0.00	1.55	0.01

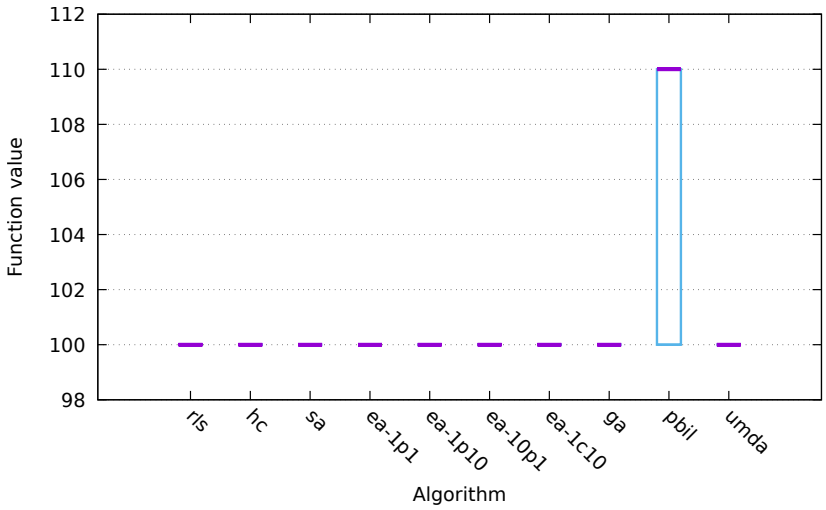

Figure 15: djmp-10

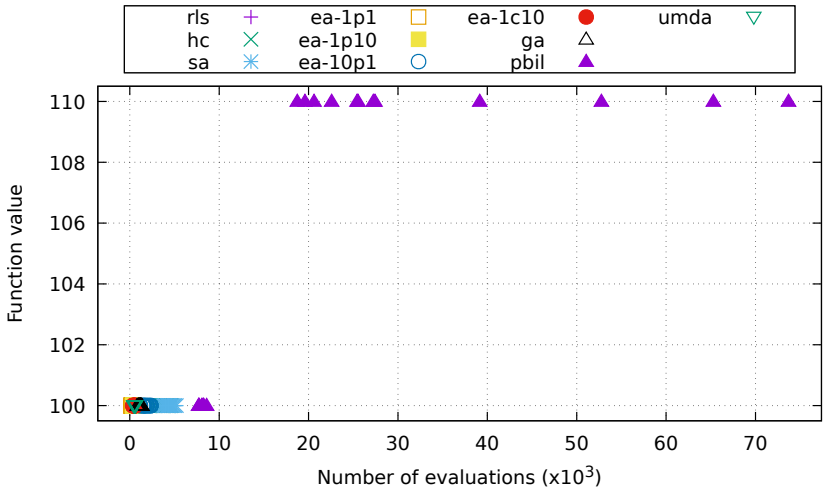

Figure 16: djmp-10

10 Function fp-5

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	194	194	194	194	194	1
hc	100	100	100	194	194	10
sa	159	194	194	194	194	8
ea-1p1	194	194	194	194	194	1
ea-1p10	194	194	194	194	194	1
ea-10p1	194	194	194	194	194	1
ea-1c10	194	194	194	194	194	1
ga	188	189	190	191	194	9
pbil	194	194	194	194	194	1
umda	194	194	194	194	194	1

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.01	0.01	0.02	0.02	0.03	0.03
hc	0.15	0.05	0.23	0.08	0.38	0.14
sa	0.01	0.04	0.02	0.06	0.03	0.10
ea-1p1	0.01	0.00	0.00	0.00	0.01	0.00
ea-1p10	0.01	0.00	0.00	0.00	0.01	0.00
ea-10p1	0.06	0.01	0.04	0.01	0.09	0.01
ea-1c10	0.01	0.01	0.01	0.01	0.03	0.02
ga	1.24	0.06	0.29	0.01	1.52	0.08
pbil	0.36	0.03	0.08	0.01	0.43	0.04
umda	0.05	0.01	0.01	0.00	0.06	0.01

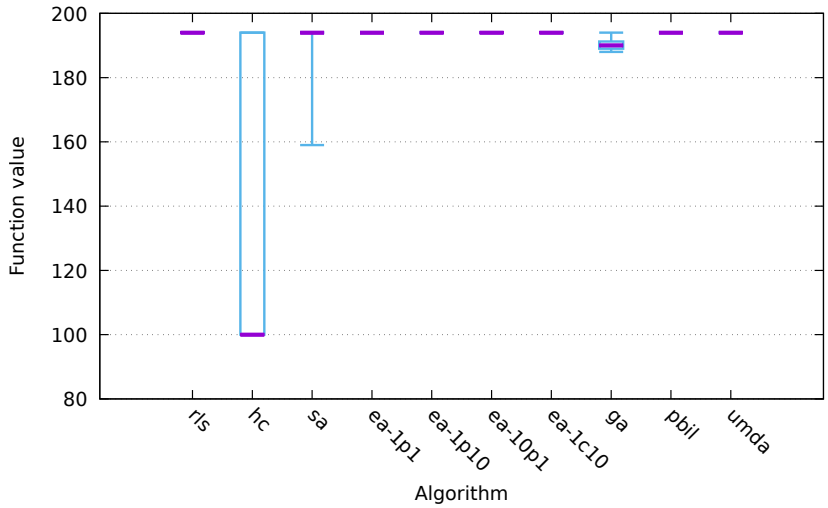

Figure 17: fp-5

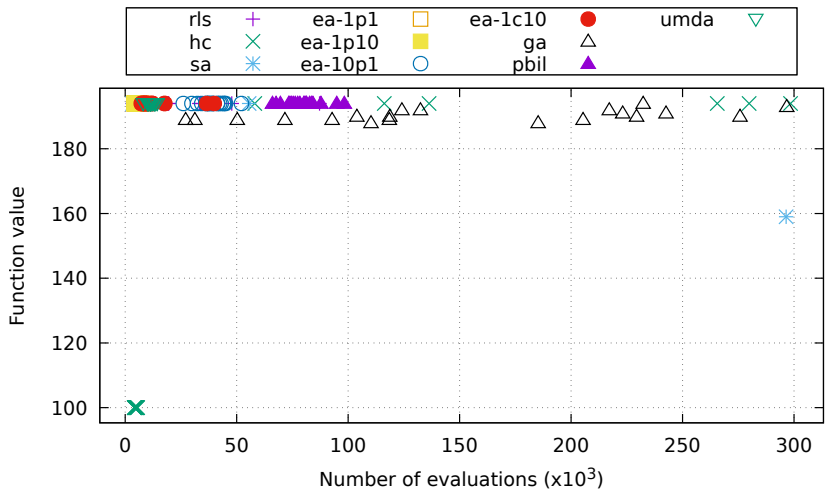

Figure 18: fp-5

11 Function fp-10

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	185	189	189	189	189	2
hc	100	100	100	100	100	10
sa	100	100	100	100	189	8
ea-1p1	100	100	100	189	189	7
ea-1p10	100	100	100	100	189	8
ea-10p1	100	189	189	189	189	3
ea-1c10	100	184	189	189	189	4
ga	182	184	185	186	189	6
pbil	189	189	189	189	189	1
umda	100	100	189	189	189	5

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.07	0.05	0.09	0.07	0.16	0.13
hc	0.18	0.00	0.27	0.00	0.45	0.00
sa	0.21	0.02	0.27	0.02	0.48	0.04
ea-1p1	0.18	0.16	0.16	0.14	0.34	0.30
ea-1p10	0.29	0.12	0.24	0.10	0.53	0.22
ea-10p1	0.14	0.16	0.09	0.10	0.23	0.26
ea-1c10	0.17	0.10	0.16	0.10	0.33	0.20
ga	1.21	0.12	0.28	0.03	1.50	0.15
pbil	0.33	0.03	0.07	0.01	0.40	0.04
umda	0.52	0.60	0.12	0.14	0.64	0.74

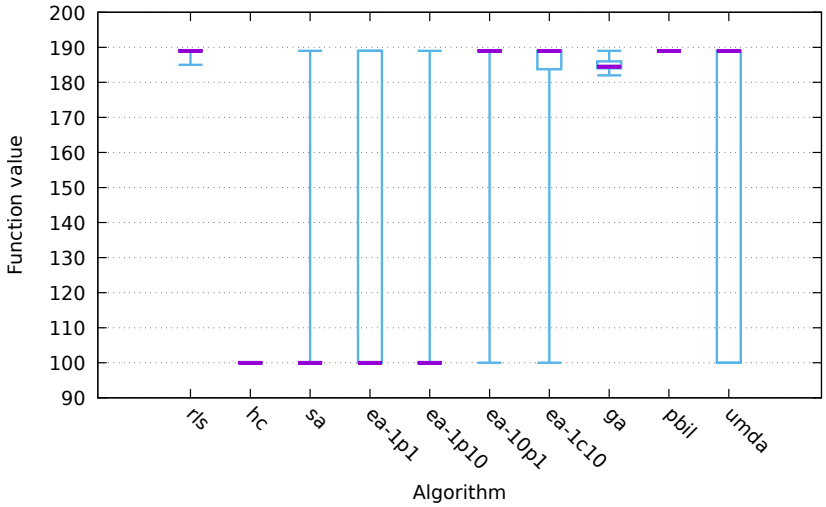

Figure 19: fp-10

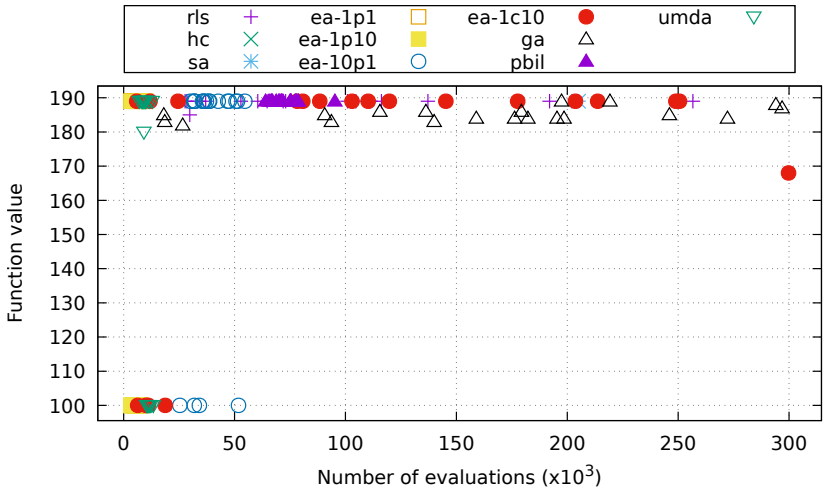

Figure 20: fp-10

12 Function nk

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.96	0.98	0.99	1.01	1.03	5
hc	0.96	0.98	1.00	1.01	1.04	4
sa	1.02	1.05	1.06	1.08	1.10	1
ea-1p1	0.82	0.90	0.95	0.98	1.01	8
ea-1p10	0.84	0.90	0.93	0.98	1.04	9
ea-10p1	0.84	0.95	0.99	1.00	1.10	6
ea-1c10	0.94	1.01	1.04	1.06	1.09	3
ga	0.98	1.02	1.04	1.06	1.07	2
pbil	0.95	0.97	0.98	1.00	1.02	7
umda	0.80	0.90	0.93	0.97	1.02	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.77	0.01	0.99	0.01
hc	0.18	0.00	0.73	0.01	0.91	0.01
sa	0.23	0.00	0.72	0.01	0.95	0.01
ea-1p1	0.33	0.01	0.76	0.01	1.09	0.02
ea-1p10	0.35	0.00	0.75	0.01	1.10	0.01
ea-10p1	0.46	0.01	0.78	0.01	1.25	0.02
ea-1c10	0.30	0.00	0.71	0.01	1.01	0.01
ga	1.25	0.00	0.86	0.01	2.12	0.01
pbil	1.27	0.00	0.77	0.01	2.05	0.01
umda	1.25	0.00	0.72	0.01	1.97	0.01

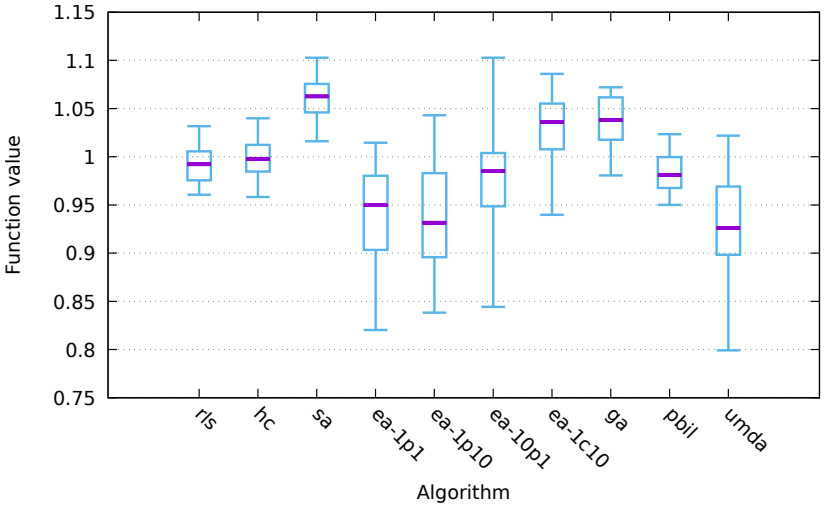

Figure 21: nk

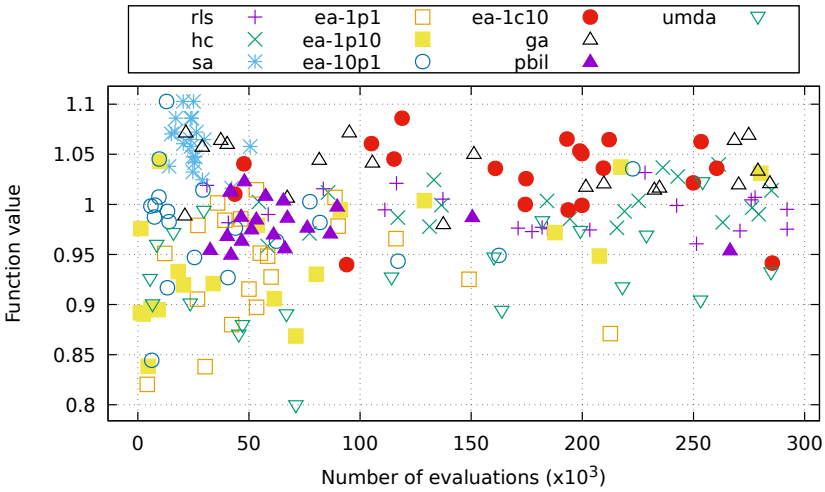

Figure 22: nk

13 Function max-sat

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	970	971	971	972	972	2
hc	962	965	967	968	970	9
sa	971	972	972	972	972	1
ea-1p1	961	965	968	971	972	5
ea-1p10	956	964	968	970	972	7
ea-10p1	960	965	968	968	972	6
ea-1c10	964	969	971	971	972	3
ga	965	968	971	972	972	4
pbil	964	966	967	967	969	8
umda	959	964	967	968	972	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	3.72	0.03	3.94	0.03
hc	0.19	0.00	3.33	0.02	3.52	0.02
sa	0.23	0.00	3.17	0.03	3.40	0.03
ea-1p1	0.34	0.01	3.39	0.11	3.73	0.11
ea-1p10	0.36	0.00	3.37	0.08	3.73	0.08
ea-10p1	0.47	0.01	4.15	0.09	4.61	0.09
ea-1c10	0.31	0.00	2.94	0.06	3.25	0.06
ga	1.26	0.00	4.49	0.06	5.75	0.06
pbil	1.32	0.01	3.43	0.09	4.75	0.10
umda	1.27	0.00	3.24	0.08	4.51	0.08

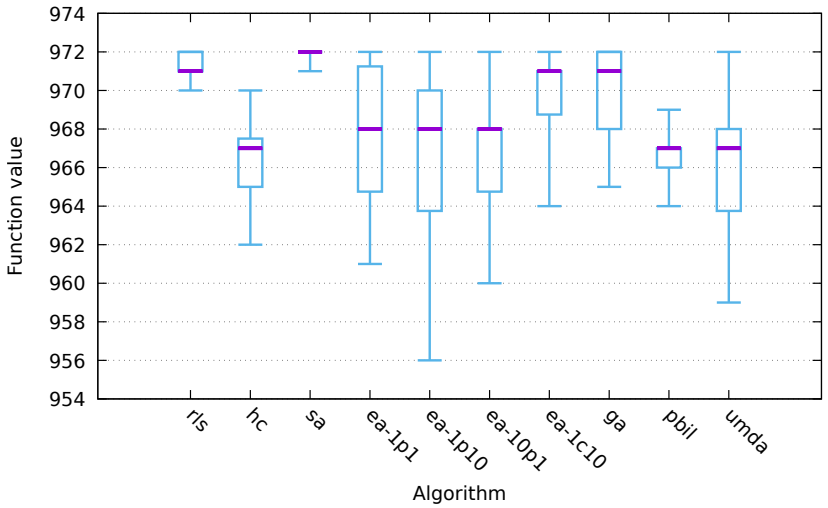

Figure 23: max-sat

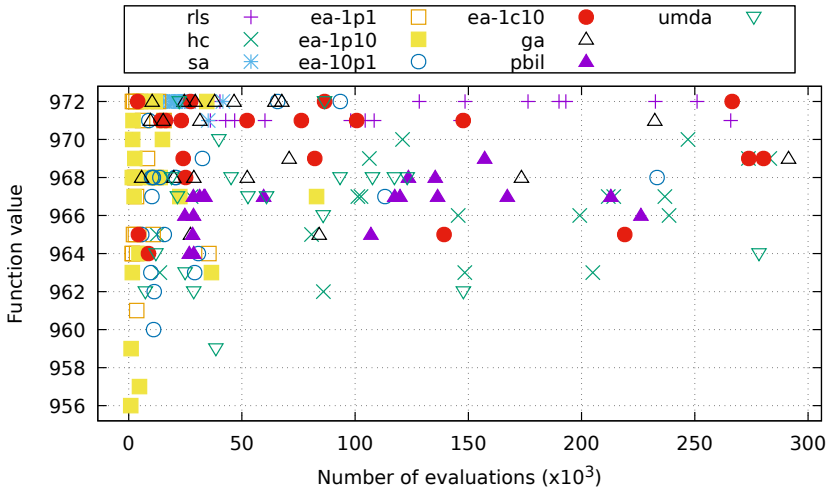

Figure 24: max-sat

14 Function labs

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	4.27	4.41	4.46	4.63	4.84	6
hc	4.44	4.60	4.72	4.82	5.09	4
sa	4.27	4.63	4.76	4.88	5.31	3
ea-1p1	3.25	3.87	4.07	4.23	4.60	8
ea-1p10	3.67	3.94	4.14	4.26	4.67	7
ea-10p1	4.11	4.44	4.54	4.68	4.97	5
ea-1c10	4.55	4.79	4.94	5.05	5.42	2
ga	4.59	4.92	5.05	5.16	5.54	1
pbil	3.22	3.68	3.91	4.01	4.39	9
umda	3.45	3.77	3.91	4.04	4.36	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	3.30	0.03	3.51	0.03
hc	0.18	0.00	3.25	0.01	3.42	0.01
sa	0.22	0.01	3.25	0.01	3.47	0.01
ea-1p1	0.32	0.01	3.27	0.04	3.58	0.04
ea-1p10	0.34	0.01	3.25	0.02	3.58	0.02
ea-10p1	0.44	0.01	3.29	0.04	3.73	0.05
ea-1c10	0.29	0.00	3.28	0.04	3.57	0.04
ga	1.24	0.01	3.27	0.02	4.51	0.04
pbil	1.32	0.02	3.29	0.04	4.61	0.05
umda	1.23	0.01	3.26	0.04	4.49	0.05

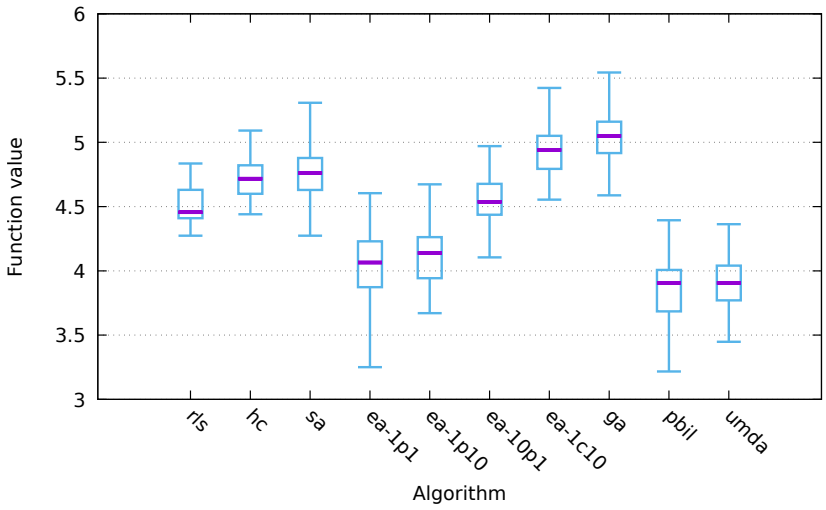

Figure 25: labs

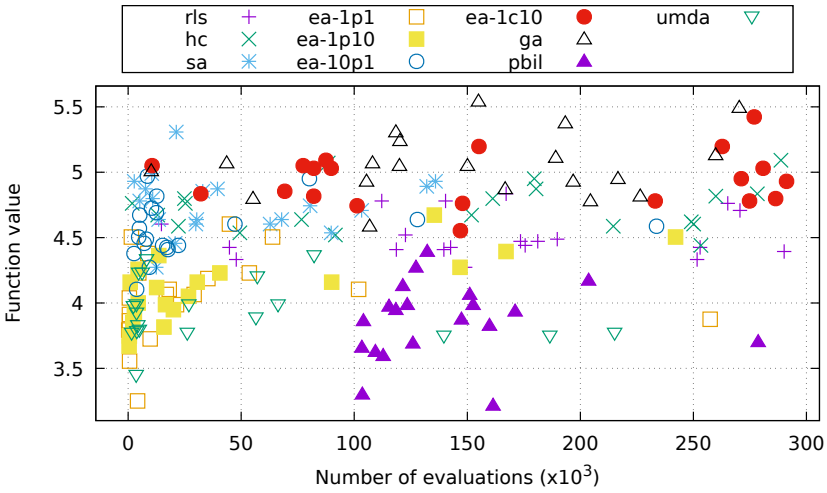

Figure 26: labs

15 Function ep

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	1.3×10^{-31}	1.1×10^{-30}	1.7×10^{-30}	3.7×10^{-30}	1.7×10^{-29}	1
hc	5.1×10^{-31}	1.4×10^{-30}	4.3×10^{-30}	6.0×10^{-30}	2.6×10^{-29}	4
sa	4.5×10^{-31}	2.8×10^{-30}	4.5×10^{-30}	9.8×10^{-30}	1.4×10^{-29}	5
ea-1p1	1.7×10^{-31}	8.1×10^{-30}	1.6×10^{-29}	3.0×10^{-29}	4.2×10^{-29}	9
ea-1p10	6.4×10^{-32}	3.0×10^{-30}	7.9×10^{-30}	3.0×10^{-29}	5.2×10^{-29}	7
ea-10p1	9.5×10^{-32}	2.6×10^{-30}	5.2×10^{-30}	1.2×10^{-29}	2.4×10^{-29}	6
ea-1c10	1.1×10^{-30}	3.5×10^{-30}	8.9×10^{-30}	1.2×10^{-29}	5.0×10^{-29}	8
ga	2.9×10^{-31}	1.1×10^{-30}	1.9×10^{-30}	5.3×10^{-30}	1.4×10^{-29}	2
pbil	2.7×10^{-31}	1.9×10^{-30}	2.8×10^{-30}	7.9×10^{-30}	3.2×10^{-29}	3
umda	1.0×10^{-31}	8.0×10^{-30}	2.8×10^{-29}	5.8×10^{-29}	1.6×10^{-28}	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.23	0.00	0.32	0.00	0.56	0.01
hc	0.19	0.00	0.32	0.00	0.51	0.00
sa	0.22	0.00	0.32	0.00	0.54	0.01
ea-1p1	0.32	0.01	0.32	0.00	0.64	0.00
ea-1p10	0.36	0.00	0.33	0.00	0.68	0.00
ea-10p1	0.45	0.01	0.34	0.01	0.80	0.01
ea-1c10	0.31	0.01	0.32	0.01	0.63	0.01
ga	1.27	0.02	0.40	0.01	1.67	0.02
pbil	1.41	0.02	0.40	0.01	1.81	0.03
umda	1.26	0.02	0.33	0.01	1.59	0.02

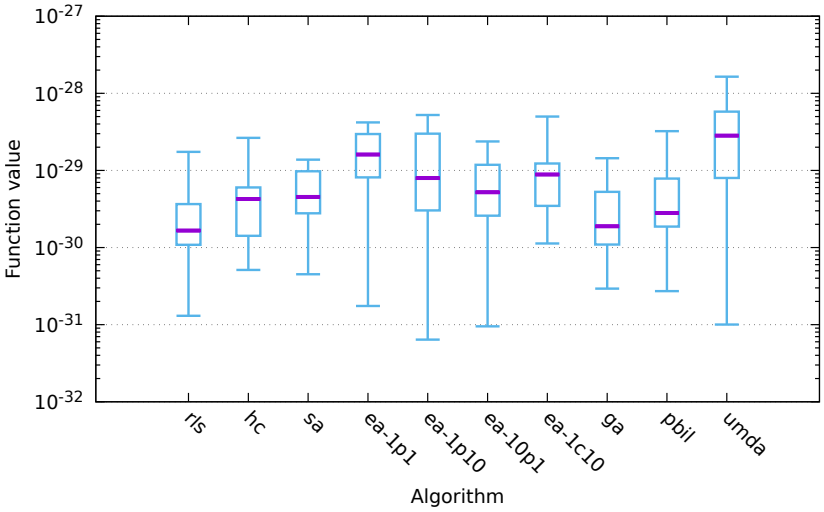

Figure 27: ep

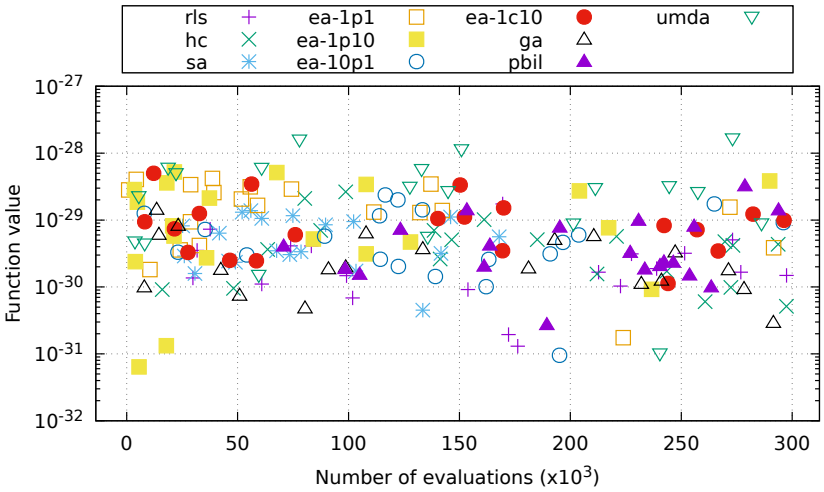

Figure 28: ep

16 Function cancel

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.30	1.32	1.53	1.81	2.40	8
hc	0.98	1.45	1.65	1.98	2.70	9
sa	1.31	1.52	2.62	3.29	5.83	10
ea-1p1	0.06	0.11	0.39	0.78	1.47	4
ea-1p10	0.04	0.14	0.22	0.39	1.35	2
ea-10p1	0.06	0.37	0.68	0.87	1.96	6
ea-1c10	0.06	0.11	0.41	0.72	2.00	5
ga	0.05	0.11	0.37	0.69	1.69	3
pbil	0.04	0.05	0.07	0.12	0.71	1
umda	0.10	0.43	0.80	1.17	2.79	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	0.32	0.00	0.53	0.00
hc	0.18	0.00	0.31	0.00	0.49	0.00
sa	0.22	0.00	0.31	0.00	0.53	0.01
ea-1p1	0.32	0.01	0.32	0.00	0.64	0.01
ea-1p10	0.35	0.00	0.33	0.00	0.68	0.01
ea-10p1	0.45	0.01	0.32	0.00	0.77	0.01
ea-1c10	0.31	0.00	0.32	0.00	0.63	0.00
ga	1.26	0.02	0.33	0.00	1.60	0.02
pbil	1.31	0.02	0.34	0.01	1.64	0.02
umda	1.25	0.02	0.32	0.01	1.57	0.03

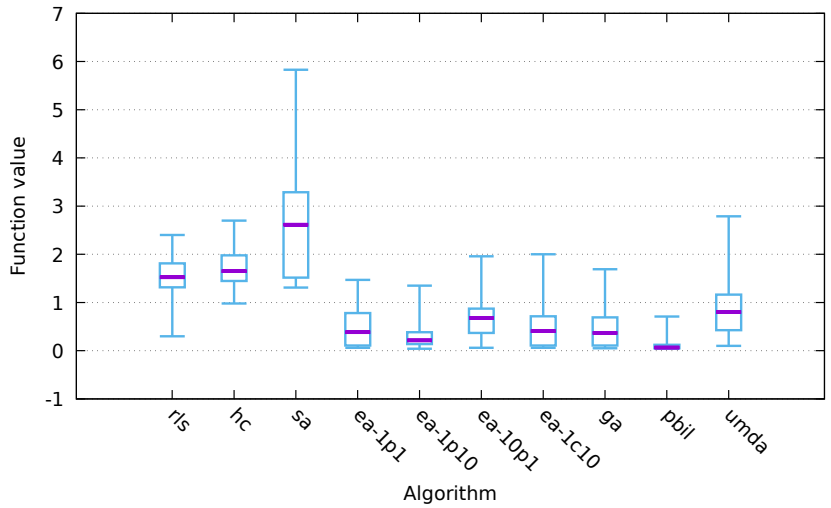

Figure 29: cancel

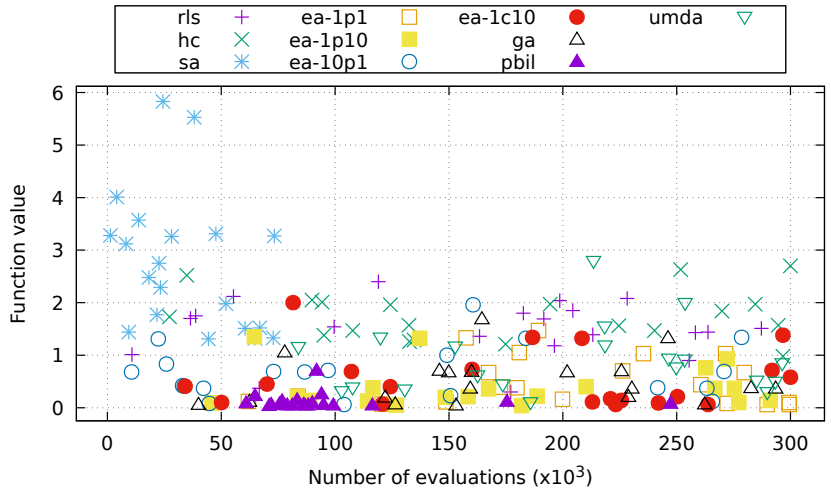

Figure 30: cancel

17 Function trap

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	90	91	91	91	92	2
hc	91	91	91	92	92	1
sa	90	90	90	90	91	3
ea-1p1	90	90	90	90	91	3
ea-1p10	90	90	90	90	90	7
ea-10p1	90	90	90	90	90	7
ea-1c10	90	90	90	90	91	3
ga	90	90	90	90	91	3
pbil	90	90	90	90	90	7
umda	90	90	90	90	90	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.32	0.01	0.54	0.01
hc	0.19	0.00	0.32	0.01	0.51	0.01
sa	0.23	0.00	0.33	0.00	0.56	0.01
ea-1p1	0.32	0.01	0.32	0.01	0.64	0.01
ea-1p10	0.35	0.00	0.33	0.00	0.68	0.01
ea-10p1	0.45	0.01	0.33	0.01	0.77	0.02
ea-1c10	0.31	0.01	0.33	0.01	0.63	0.01
ga	1.42	0.15	0.37	0.04	1.78	0.19
pbil	1.31	0.00	0.33	0.00	1.63	0.00
umda	1.28	0.00	0.33	0.00	1.61	0.00

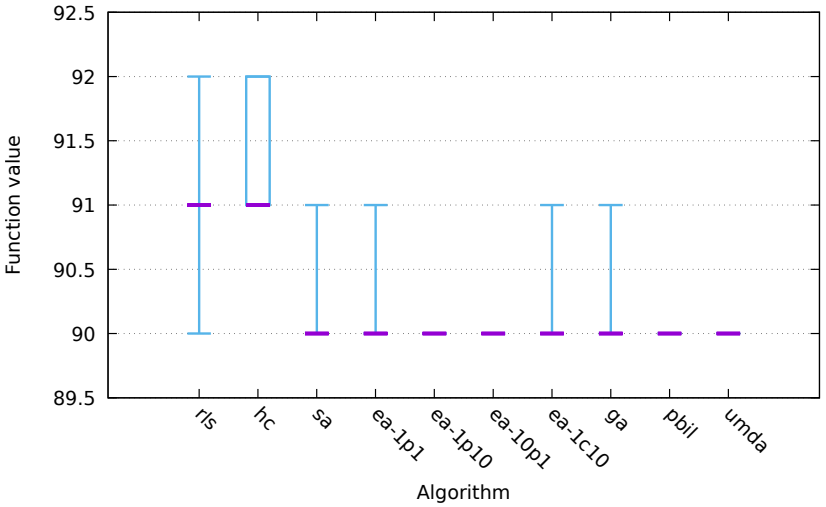

Figure 31: trap

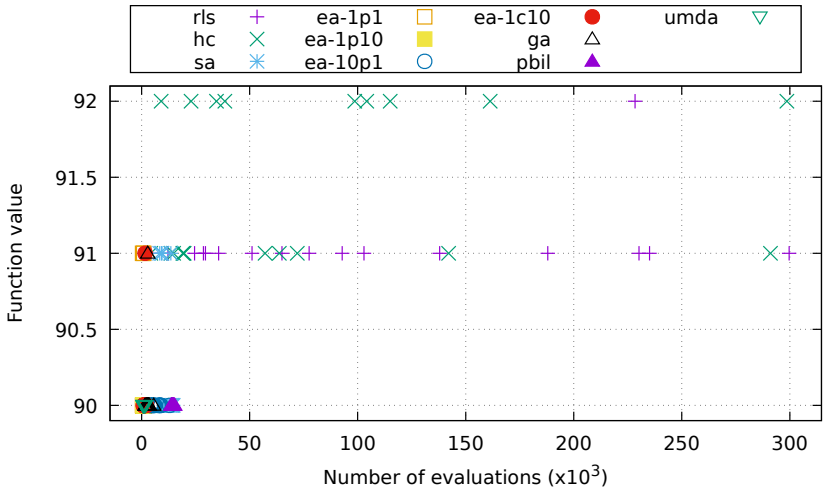

Figure 32: trap

18 Function hiff

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	404	415	424	428	448	10
hc	464	492	500	508	564	7
sa	672	696	704	776	832	2
ea-1p1	464	472	496	512	608	8
ea-1p10	416	452	480	490	592	9
ea-10p1	576	656	692	708	1,024	3
ea-1c10	620	654	670	687	772	4
ga	672	770	772	800	832	1
pbil	482	527	552	568	616	5
umda	432	489	510	544	588	6

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.23	0.00	0.65	0.01	0.88	0.01
hc	0.19	0.00	0.66	0.00	0.85	0.00
sa	0.23	0.00	0.77	0.01	1.01	0.01
ea-1p1	0.33	0.00	0.72	0.01	1.05	0.01
ea-1p10	0.35	0.00	0.72	0.02	1.07	0.02
ea-10p1	0.45	0.04	0.77	0.07	1.22	0.11
ea-1c10	0.31	0.00	0.74	0.01	1.05	0.01
ga	1.46	0.01	0.81	0.01	2.28	0.01
pbil	1.62	0.00	0.74	0.01	2.36	0.01
umda	1.58	0.01	0.72	0.02	2.30	0.02

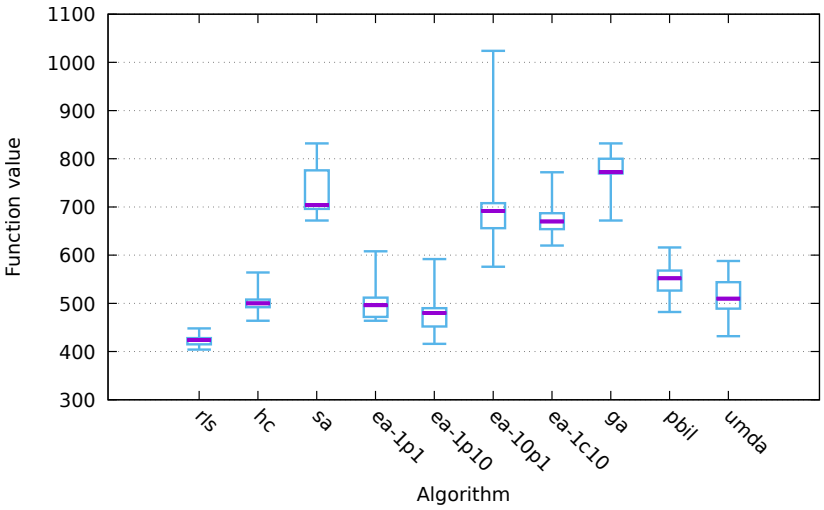

Figure 33: hiff

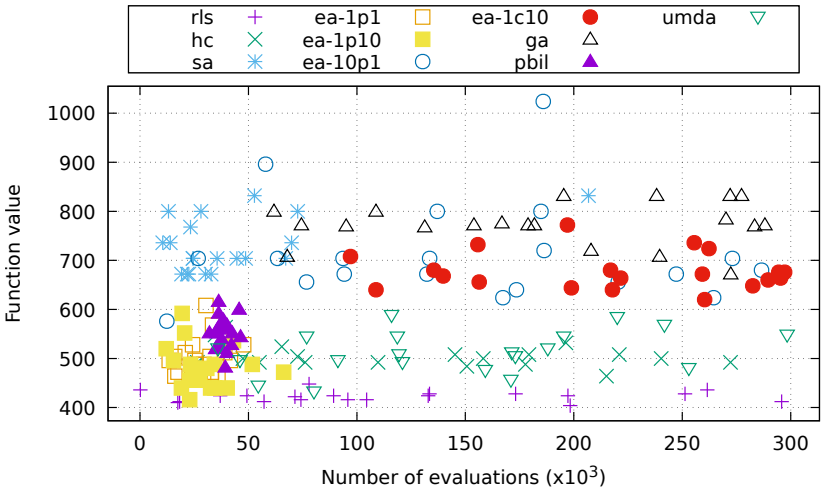

Figure 34: hiff

19 Function plateau

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	101	101	101	101	101	4
hc	101	101	101	101	101	4
sa	101	101	101	102	102	1
ea-1p1	101	101	101	101	102	2
ea-1p10	101	101	101	101	102	2
ea-10p1	101	101	101	101	101	4
ea-1c10	101	101	101	101	101	4
ga	101	101	101	101	101	4
pbil	101	101	101	101	101	4
umda	101	101	101	101	101	4

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	0.28	0.00	0.50	0.01
hc	0.19	0.00	0.28	0.01	0.47	0.01
sa	0.20	0.04	0.27	0.05	0.47	0.09
ea-1p1	0.32	0.04	0.29	0.03	0.61	0.07
ea-1p10	0.33	0.06	0.28	0.05	0.61	0.12
ea-10p1	0.46	0.01	0.30	0.00	0.75	0.01
ea-1c10	0.31	0.00	0.30	0.00	0.60	0.00
ga	1.28	0.00	0.30	0.00	1.58	0.00
pbil	1.30	0.00	0.30	0.00	1.60	0.00
umda	1.28	0.00	0.30	0.00	1.58	0.01

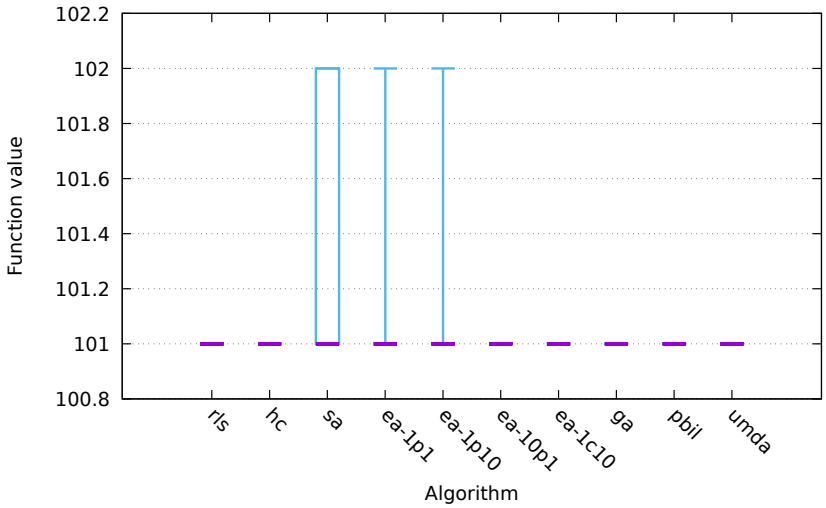

Figure 35: plateau

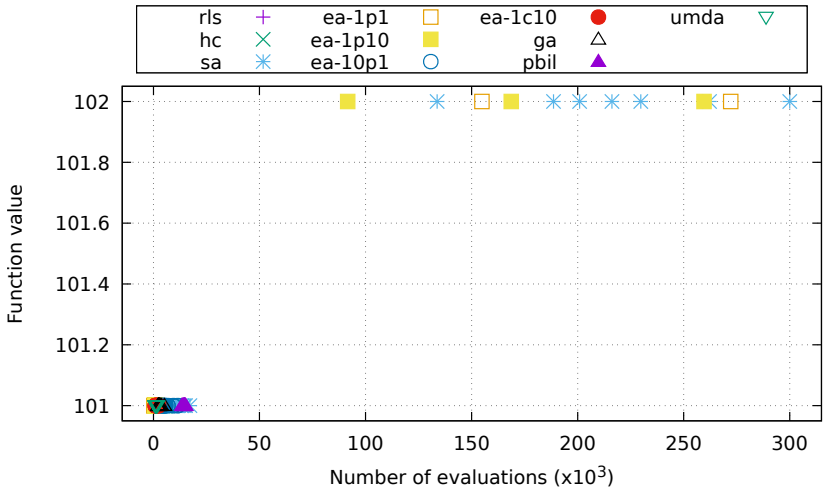

Figure 36: plateau

20 Function walsh2

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	694.42	700.46	706.71	712.18	721.22	4
hc	700.40	709.61	718.31	720.39	721.22	1
sa	702.16	712.50	714.46	720.24	721.22	2
ea-1p1	599.44	650.74	662.40	685.04	705.92	10
ea-1p10	624.57	661.96	681.60	692.68	706.39	7
ea-10p1	657.99	686.99	698.57	707.34	721.22	6
ea-1c10	672.51	698.68	701.97	709.09	721.22	5
ga	686.97	702.06	713.69	720.24	720.85	3
pbil	645.99	663.30	675.65	689.06	707.56	8
umda	618.61	643.83	662.76	680.41	694.27	9

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.23	0.00	3.24	0.01	3.47	0.01
hc	0.20	0.01	3.31	0.09	3.52	0.10
sa	0.24	0.01	3.20	0.05	3.44	0.05
ea-1p1	0.36	0.01	3.35	0.12	3.70	0.13
ea-1p10	0.38	0.02	3.38	0.17	3.76	0.18
ea-10p1	0.49	0.02	3.57	0.17	4.06	0.19
ea-1c10	0.33	0.01	3.14	0.10	3.46	0.10
ga	1.31	0.02	3.76	0.08	5.07	0.10
pbil	1.35	0.03	3.35	0.08	4.70	0.10
umda	1.31	0.04	3.15	0.11	4.46	0.15

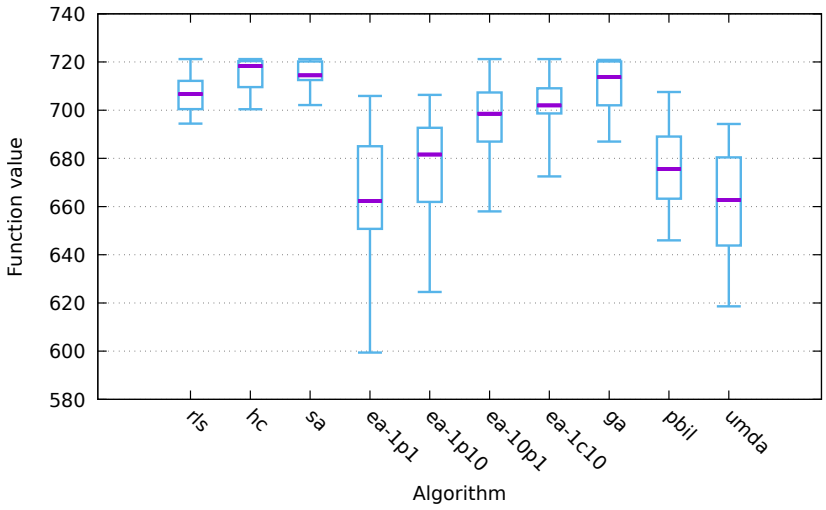

Figure 37: walsh2

A Plan

```
{
    "exec": "hnco",
    "opt": "--print-results --map 1 --map-random -s 100",
    "budget": 300000,
    "num_runs": 20,
    "parallel": true,
    "functions": [
        {
            "id": "one-max",
```

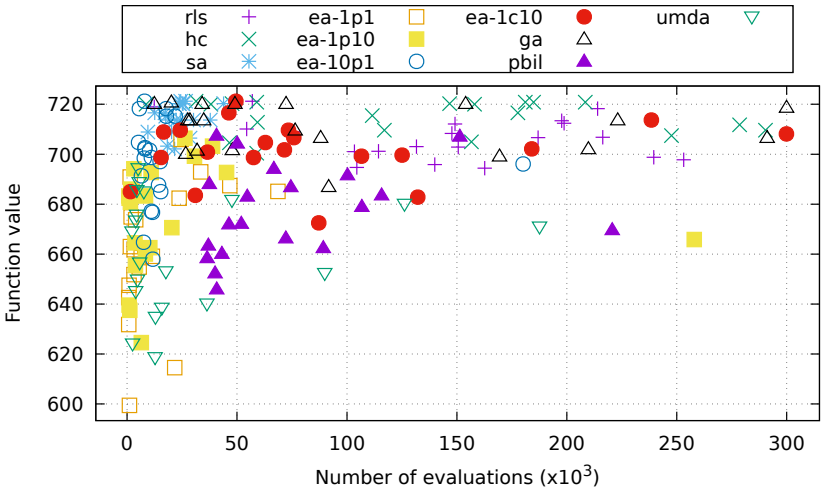

Figure 38: walsh2

```
    "opt": "-F 0 --stop-on-maximum",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "lin",
    "opt": "-F 1 --stop-on-maximum -p instances/lin.100",
    "rounding": {
        "value": { "before": 2, "after": 2 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "leading-ones",
    "opt": "-F 10 --stop-on-maximum",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "ridge",
    "opt": "-F 11 --stop-on-maximum",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "jmp-5",
    "opt": "-F 30 --stop-on-maximum -t 5",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "jmp-10",
    "opt": "-F 30 --stop-on-maximum -t 10",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "djmp-5",
```

```
    "opt": "-F 31 --stop-on-maximum -t 5",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "djmp-10",
    "opt": "-F 31 --stop-on-maximum -t 10",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "fp-5",
    "opt": "-F 40 --stop-on-maximum -t 5",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "fp-10",
    "opt": "-F 40 --stop-on-maximum -t 10",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "nk",
    "opt": "-F 60 -p instances/nk.100.4",
    "rounding": {
        "value": { "before": 1, "after": 2 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "max-sat",
    "opt": "-F 70 -p instances/ms.100.3.1000",
    "rounding": {
        "value": { "before": 3, "after": 0 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "labs",
    "opt": "-F 81",
    "rounding": {
        "value": { "before": 1, "after": 2 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "ep",
    "opt": "-F 90 -p instances/ep.100",
    "reverse": true,
    "logscale": true,
    "rounding": {
        "value": { "before": 1, "after": 1 },
        "time": { "before": 1, "after": 2 } }
},
{
    "id": "cancel",
    "opt": "-F 100 -s 99",
    "reverse": true,
    "rounding": {
        "value": { "before": 1, "after": 2 },
        "time": { "before": 1, "after": 2 } }
```

```
    },
    {
        "id": "trap",
        "opt": "-F 110 --stop-on-maximum --fn-num-traps 10",
        "rounding": {
            "value": { "before": 3, "after": 0 },
            "time": { "before": 1, "after": 2 } }
    },
    {
        "id": "hiff",
        "opt": "-F 120 --stop-on-maximum -s 128",
        "rounding": {
            "value": { "before": 4, "after": 0 },
            "time": { "before": 1, "after": 2 } }
    },
    {
        "id": "plateau",
        "opt": "-F 130 --stop-on-maximum",
        "rounding": {
            "value": { "before": 3, "after": 0 },
            "time": { "before": 1, "after": 2 } }
    },
    {
        "id": "walsh2",
        "opt": "-F 162 -p instances/walsh2.100",
        "rounding": {
            "value": { "before": 3, "after": 2 },
            "time": { "before": 1, "after": 2 } }
    }
],
"algorithms": [
    {
        "id": "rls",
        "opt": "-A 100 --restart"
    },
    {
        "id": "hc",
        "opt": "-A 150 --restart"
    },
    {
        "id": "sa",
        "opt": "-A 200 --sa-beta-ratio 1.05 --sa-num-trials 10"
    },
    {
        "id": "ea-1p1",
        "opt": "-A 300"
    },
    {
        "id": "ea-1p10",
        "opt": "-A 310 --ea-mu 1 --ea-lambda 10"
    },
    {
        "id": "ea-10p1",
        "opt": "-A 310 --ea-mu 10 --ea-lambda 1"
    },
    {
        "id": "ea-1c10",
        "opt": "-A 320 --ea-mu 1 --ea-lambda 10 --allow-stay"
    },
    {
        "id": "ga",
        "opt": "-A 400 --ea-mu 100"
    },
```

```
        {
            "id": "pbil",
            "opt": "-A 500 -r 5e-3"
        },
        {
            "id": "umda",
            "opt": "-A 600 -x 100 -y 10"
        }
    ]
}
```

B 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
# fn_name = noname
# fn_num_traps = 10
# fn_prefix_length = 2
# fn_threshold = 10
# function = 0
# ga_crossover_bias = 0.5
# ga_crossover_probability = 0.5
# ga_tournament_size = 10
# hea_bit_herding = 0
# hea_num_seq_updates = 100
# hea_reset_period = 0
# hea_sampling_method = 0
# hea_weight = 1
# learning_rate = 0.001
# map = 0
# map_input_size = 100
# map_path = nopath
# mutation_probability = 1
# neighborhood = 0
# neighborhood_iterator = 0
# noise_stddev = 1
# num_iterations = 0
# num_threads = 1
# path = nopath
# pn_mutation_probability = 1
# pn_neighborhood = 0
# pn_radius = 2
# population_size = 10
# pv_log_num_components = 5
# radius = 2
# results_path = results.json
# rls_patience = 50
# sa_beta_ratio = 1.2
# sa_initial_acceptance_probability = 0.6
# sa_num_transitions = 50
# sa_num_trials = 100
# seed = 0
# selection_size = 1
# target = 100
# print_defaults
```

```
# last_parameter
# exec_name = hnco
# version = 0.11
# Generated from hnco.json
```