HNCO
Comparison of various black box optimization algorithms

November 3, 2018

Contents

1 Ranking

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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	0.07	0.00	0.01	0.00	0.08	0.00
umda	0.00	0.00	0.00	0.00	0.01	0.00

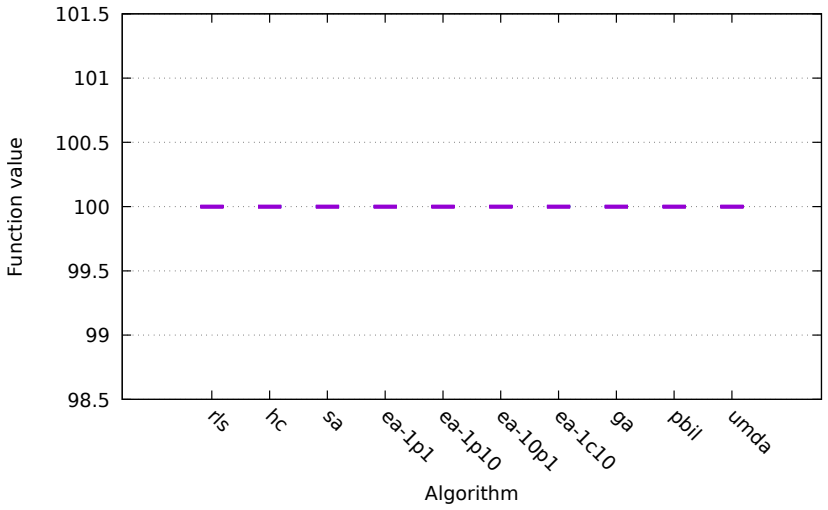

Figure 1: one-max

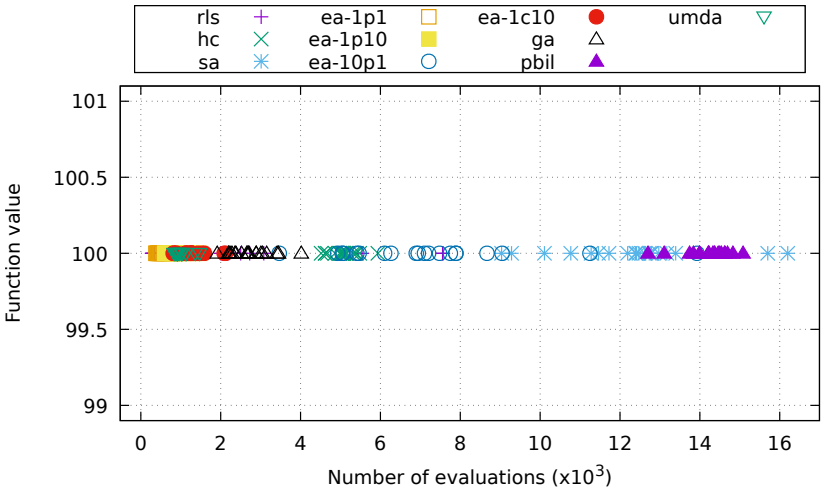

Figure 2: one-max

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	0.21	0.00	0.32	0.00	0.52	0.00
hc	0.17	0.00	0.31	0.00	0.49	0.00
sa	0.21	0.00	0.30	0.00	0.52	0.01
ea-1p1	0.31	0.01	0.30	0.00	0.61	0.01
ea-1p10	0.33	0.00	0.30	0.00	0.64	0.00
ea-10p1	0.39	0.01	0.31	0.00	0.70	0.01
ea-1c10	0.29	0.00	0.30	0.00	0.59	0.00
ga	1.21	0.00	0.32	0.00	1.53	0.00
pbil	1.26	0.00	0.31	0.00	1.57	0.00
umda	1.24	0.01	0.31	0.00	1.55	0.01

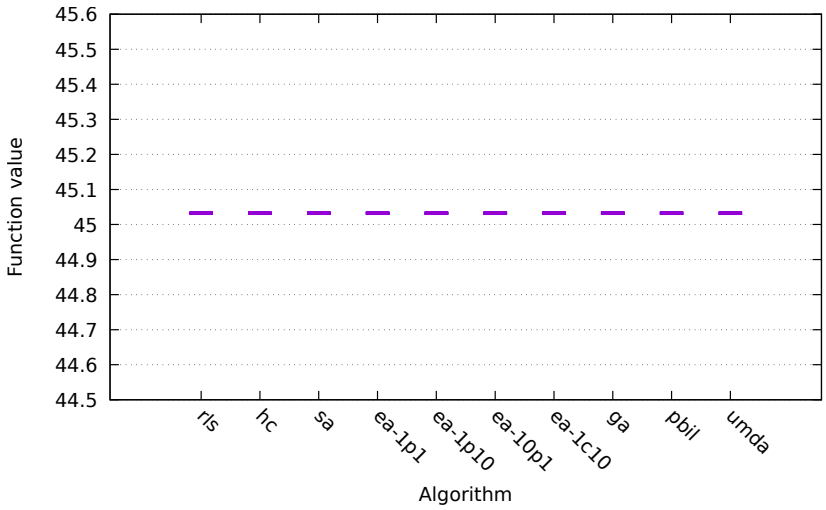

Figure 3: lin

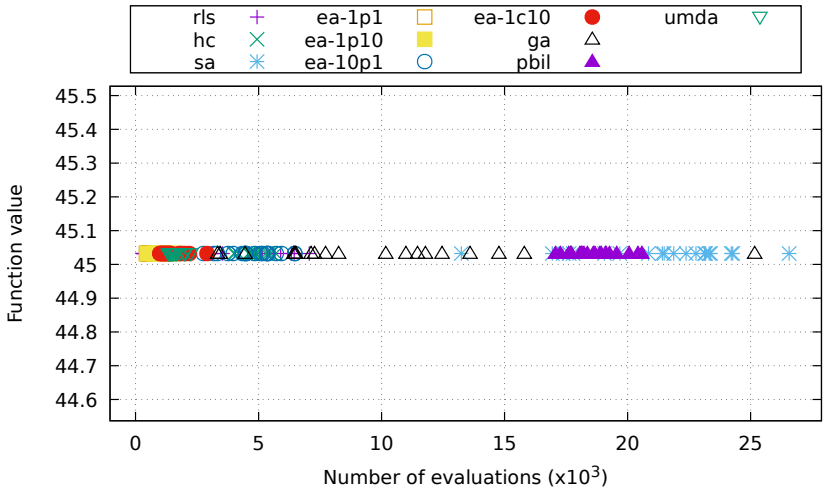

Figure 4: lin

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	94	95	95	97	99	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	0.00	0.00	0.00	0.00	0.01	0.00
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	0.05	0.01	0.04	0.01	0.09	0.02
ea-1c10	0.01	0.00	0.01	0.00	0.02	0.01
ga	1.21	0.00	0.28	0.00	1.49	0.00
pbil	0.33	0.02	0.07	0.00	0.40	0.02
umda	0.05	0.01	0.01	0.00	0.06	0.01

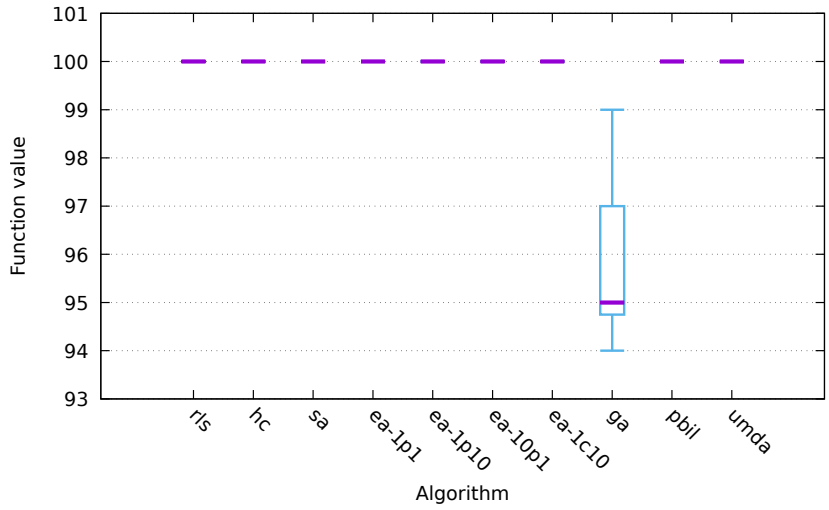

Figure 5: leading-ones

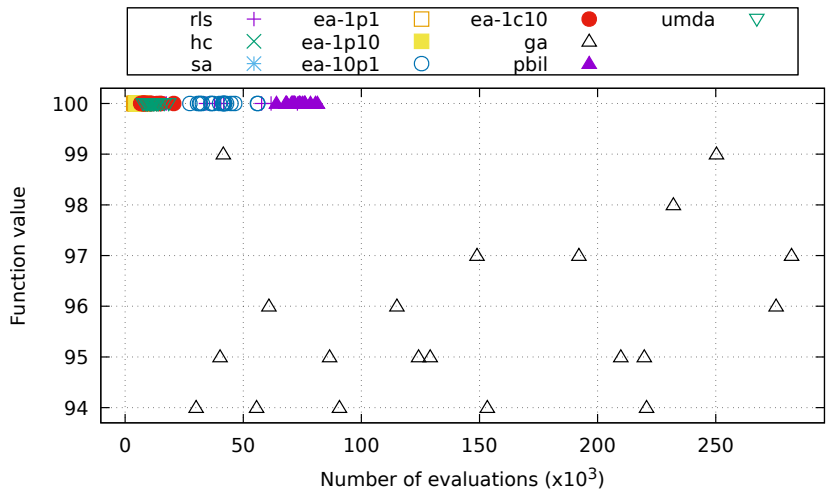

Figure 6: leading-ones

5 Function ridge

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	103	105	106	106	108	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	119	122	125	130	138	8
ga	102	103	103	103	104	10
pbil	153	154	155	156	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	0.01
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	0.03	0.00
ea-1p10	0.02	0.00	0.02	0.00	0.04	0.00
ea-10p1	0.23	0.02	0.17	0.02	0.40	0.04
ea-1c10	0.29	0.00	0.28	0.00	0.57	0.00
ga	1.20	0.00	0.29	0.00	1.48	0.01
pbil	1.26	0.00	0.29	0.00	1.55	0.00
umda	0.20	0.02	0.05	0.00	0.25	0.02

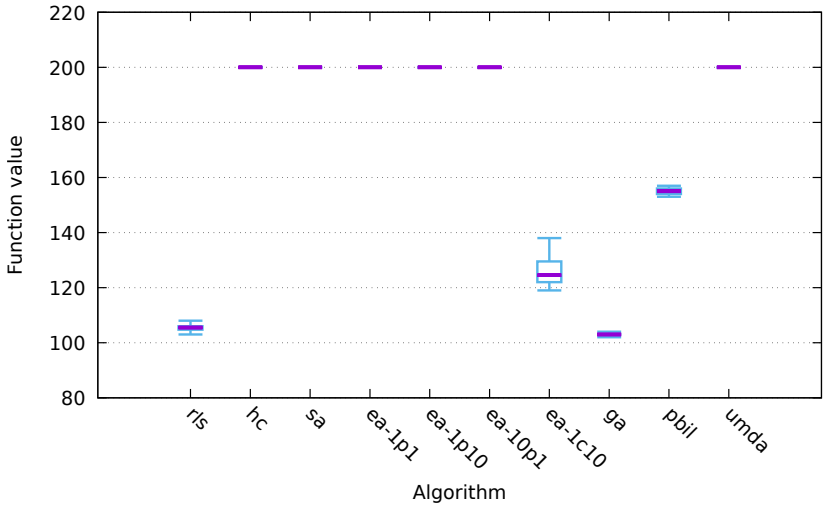

Figure 7: ridge

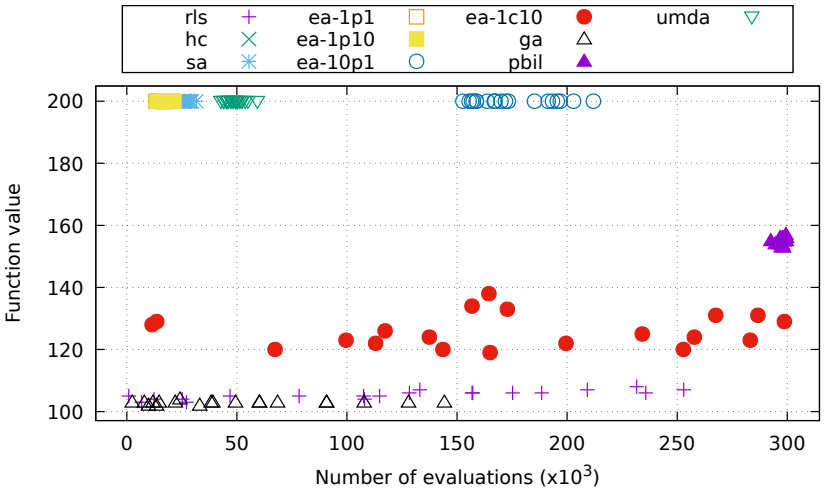

Figure 8: ridge

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	0.21	0.00	0.26	0.00	0.47	0.00
hc	0.18	0.00	0.26	0.00	0.44	0.00
sa	0.21	0.01	0.27	0.00	0.48	0.01
ea-1p1	0.31	0.01	0.27	0.00	0.58	0.01
ea-1p10	0.33	0.00	0.27	0.00	0.60	0.00
ea-10p1	0.40	0.01	0.27	0.01	0.67	0.01
ea-1c10	0.29	0.00	0.27	0.00	0.56	0.00
ga	0.35	0.37	0.08	0.09	0.43	0.46
pbil	0.07	0.00	0.01	0.00	0.08	0.01
umda	0.13	0.18	0.03	0.04	0.15	0.22

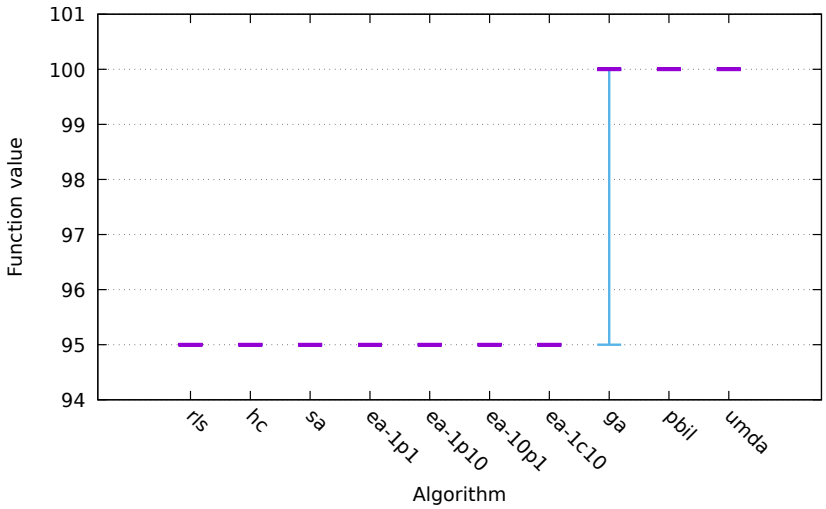

Figure 9: jmp-5

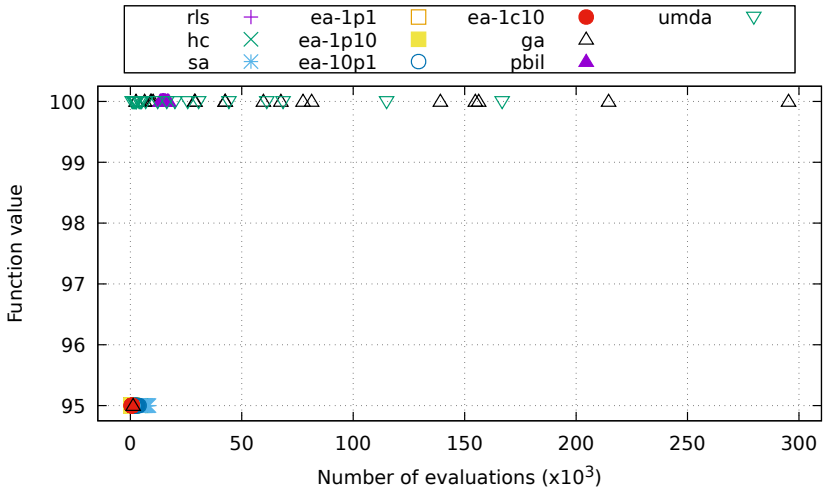

Figure 10: jmp-5

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	100	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	0.21	0.00	0.26	0.00	0.47	0.00
hc	0.18	0.00	0.26	0.00	0.44	0.00
sa	0.21	0.00	0.26	0.00	0.48	0.00
ea-1p1	0.31	0.00	0.26	0.00	0.58	0.00
ea-1p10	0.33	0.00	0.27	0.00	0.60	0.00
ea-10p1	0.40	0.01	0.27	0.00	0.67	0.02
ea-1c10	0.29	0.00	0.27	0.00	0.56	0.00
ga	1.20	0.00	0.27	0.00	1.47	0.01
pbil	0.89	0.55	0.18	0.12	1.07	0.67
umda	1.29	0.01	0.27	0.00	1.56	0.01

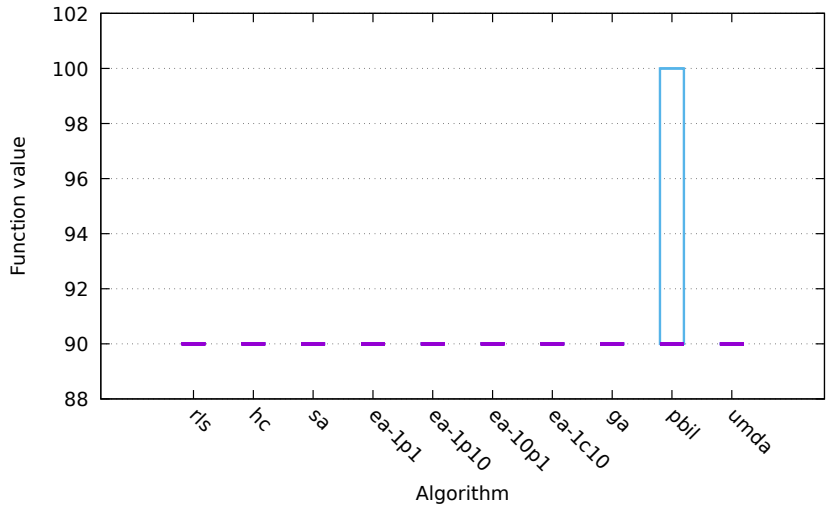

Figure 11: jmp-10

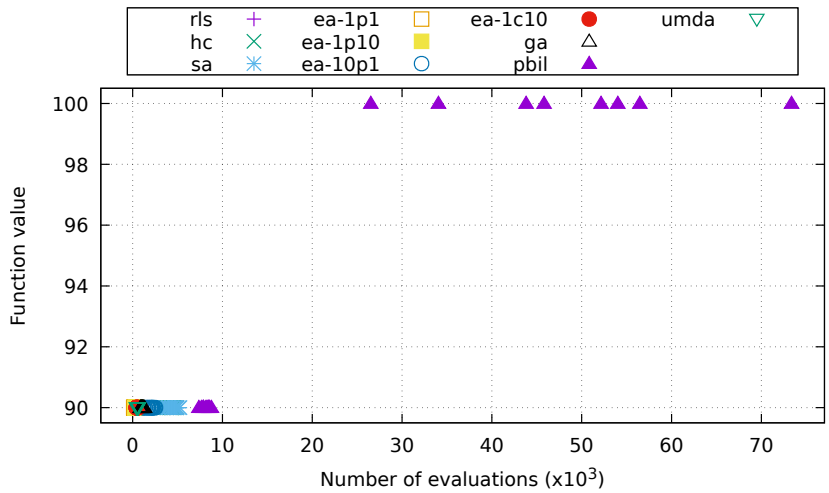

Figure 12: jmp-10

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	0.26	0.00	0.47	0.01
hc	0.18	0.00	0.26	0.00	0.44	0.00
sa	0.21	0.00	0.26	0.00	0.48	0.00
ea-1p1	0.31	0.00	0.27	0.00	0.58	0.00
ea-1p10	0.33	0.00	0.27	0.00	0.60	0.00
ea-10p1	0.40	0.01	0.27	0.00	0.67	0.01
ea-1c10	0.29	0.00	0.27	0.00	0.55	0.00
ga	0.49	0.32	0.11	0.07	0.60	0.40
pbil	0.07	0.00	0.01	0.00	0.09	0.01
umda	0.14	0.13	0.03	0.03	0.17	0.16

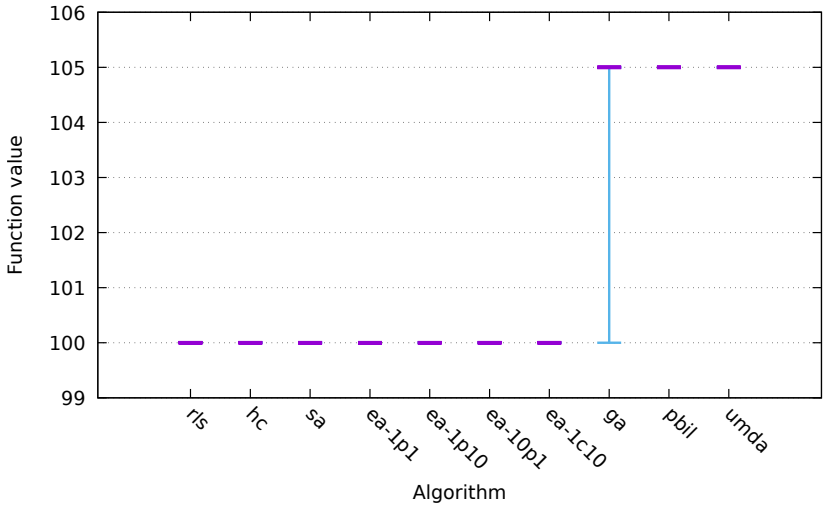

Figure 13: djmp-5

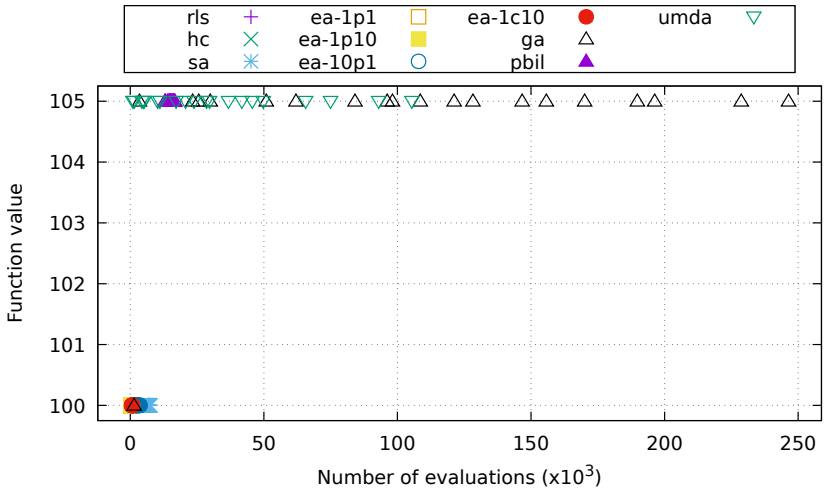

Figure 14: djmp-5

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	100	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	0.21	0.00	0.26	0.00	0.48	0.01
hc	0.18	0.00	0.26	0.00	0.44	0.01
sa	0.21	0.00	0.26	0.00	0.48	0.00
ea-1p1	0.31	0.00	0.27	0.00	0.58	0.01
ea-1p10	0.33	0.00	0.27	0.00	0.60	0.00
ea-10p1	0.40	0.01	0.27	0.00	0.67	0.01
ea-1c10	0.29	0.00	0.27	0.00	0.56	0.00
ga	1.20	0.00	0.27	0.00	1.47	0.01
pbil	0.87	0.59	0.18	0.12	1.04	0.71
umda	1.29	0.01	0.27	0.00	1.57	0.01

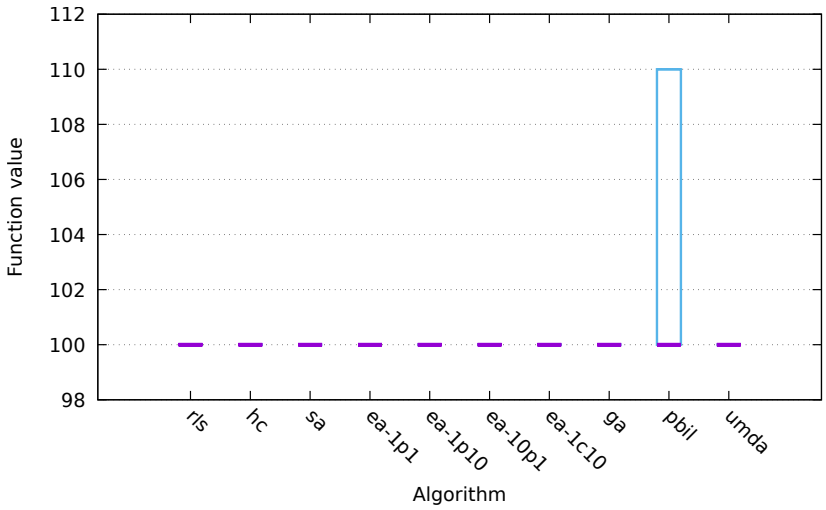

Figure 15: djmp-10

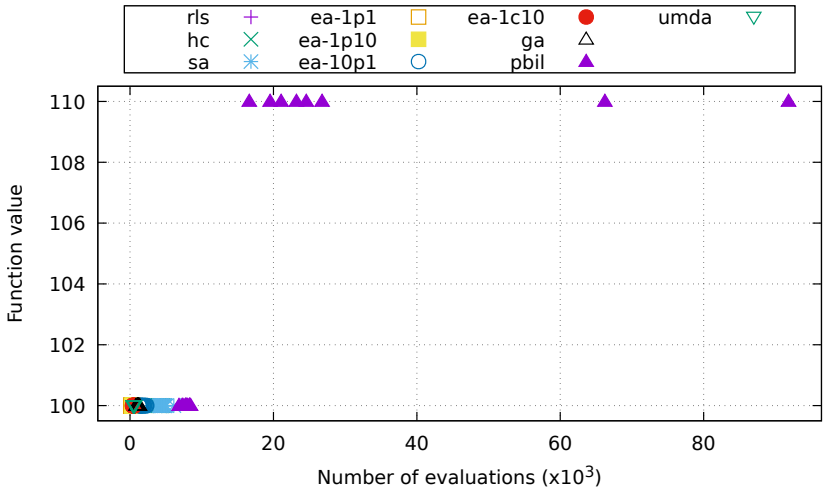

Figure 16: djmp-10

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	147	194	194	10
sa	100	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	187	189	190	191	194	9
pbil	194	194	194	194	194	1
umda	111	194	194	194	194	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.02	0.02	0.03	0.03	0.05	0.05
hc	0.13	0.07	0.19	0.10	0.32	0.17
sa	0.02	0.05	0.02	0.06	0.04	0.11
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	0.05	0.01	0.04	0.01	0.09	0.02
ea-1c10	0.01	0.01	0.01	0.01	0.02	0.01
ga	1.12	0.28	0.27	0.06	1.38	0.34
pbil	0.38	0.04	0.08	0.01	0.46	0.05
umda	0.16	0.36	0.04	0.09	0.20	0.45

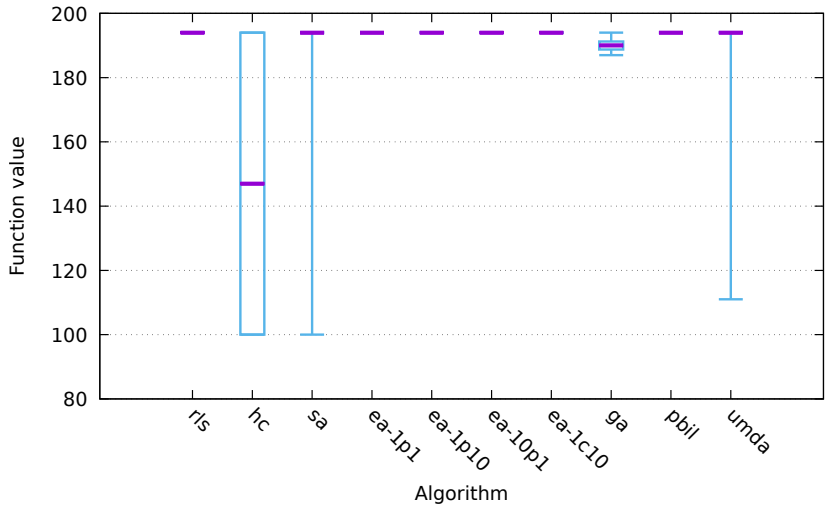

Figure 17: fp-5

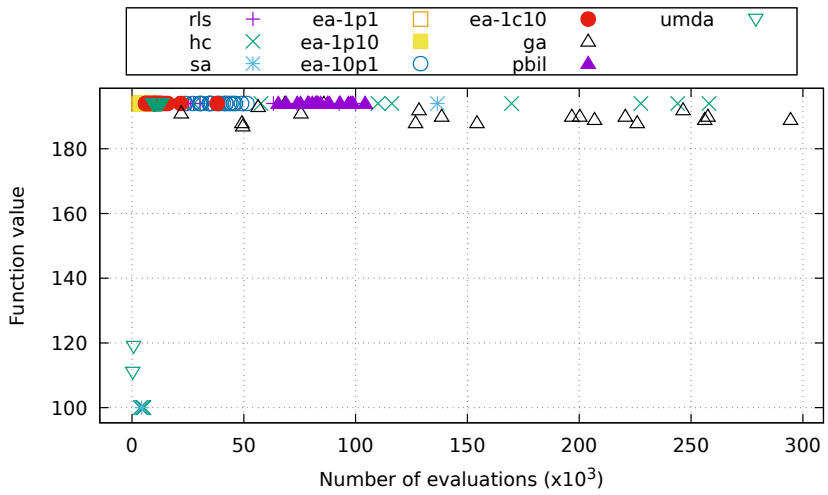

Figure 18: fp-5

11 Function fp-10

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	187	189	189	189	189	2
hc	100	100	100	100	100	10
sa	100	100	100	189	189	7
ea-1p1	100	100	100	100	189	8
ea-1p10	100	100	100	100	189	8
ea-10p1	100	189	189	189	189	3
ea-1c10	100	189	189	189	189	3
ga	183	184	185	188	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	0.06	0.10	0.08	0.18	0.15
hc	0.18	0.00	0.27	0.00	0.45	0.00
sa	0.14	0.09	0.19	0.12	0.34	0.21
ea-1p1	0.27	0.11	0.24	0.10	0.50	0.21
ea-1p10	0.27	0.13	0.22	0.11	0.49	0.24
ea-10p1	0.09	0.11	0.06	0.07	0.15	0.18
ea-1c10	0.12	0.11	0.11	0.11	0.23	0.22
ga	1.13	0.19	0.27	0.05	1.40	0.24
pbil	0.33	0.06	0.07	0.01	0.40	0.07
umda	0.47	0.58	0.11	0.14	0.58	0.72

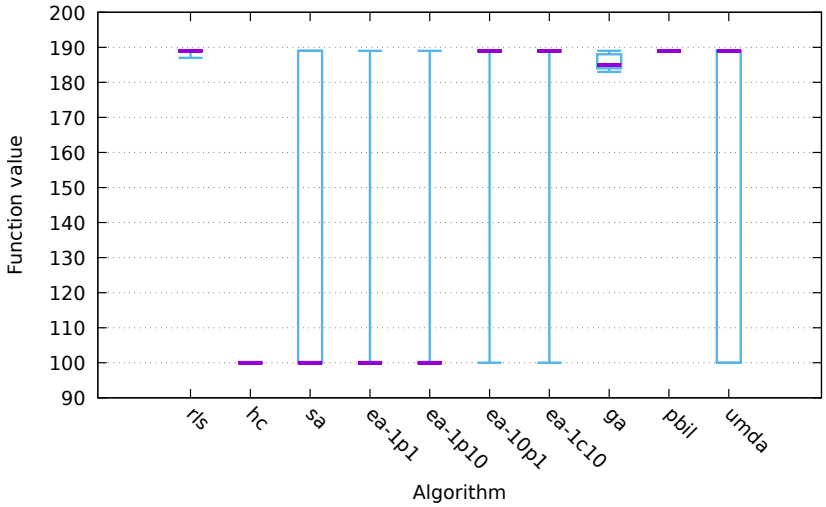

Figure 19: fp-10

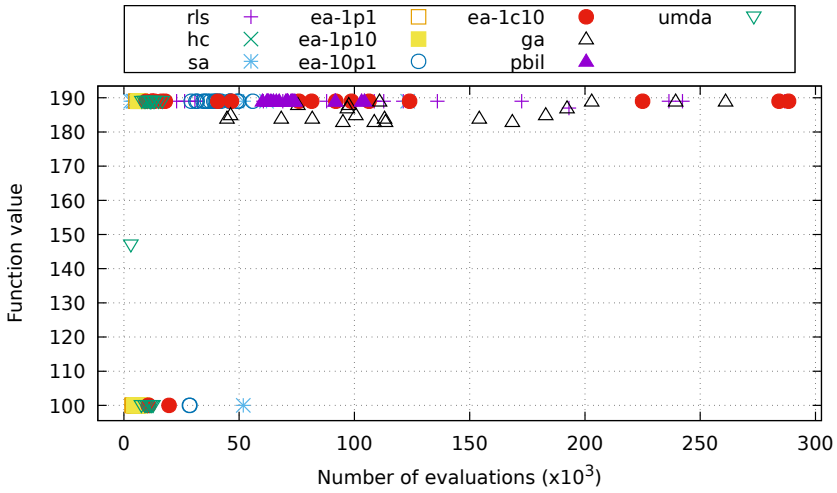

Figure 20: fp-10

12 Function nk

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.97	0.98	0.99	1.01	1.05	6
hc	0.97	0.99	1.00	1.01	1.07	5
sa	1.02	1.05	1.06	1.08	1.10	1
ea-1p1	0.89	0.90	0.92	0.96	1.05	10
ea-1p10	0.83	0.93	0.97	1.01	1.05	8
ea-10p1	0.94	0.96	0.99	1.00	1.06	7
ea-1c10	0.96	0.99	1.00	1.04	1.07	3
ga	0.98	1.01	1.03	1.06	1.10	2
pbil	0.96	0.97	1.00	1.02	1.03	4
umda	0.87	0.92	0.94	0.96	1.02	9

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	0.76	0.01	0.98	0.01
hc	0.18	0.00	0.72	0.00	0.91	0.00
sa	0.22	0.00	0.72	0.01	0.94	0.01
ea-1p1	0.33	0.01	0.75	0.01	1.08	0.01
ea-1p10	0.34	0.00	0.75	0.01	1.09	0.01
ea-10p1	0.41	0.01	0.78	0.01	1.19	0.02
ea-1c10	0.30	0.00	0.71	0.01	1.01	0.01
ga	1.21	0.00	0.87	0.01	2.08	0.01
pbil	1.28	0.00	0.77	0.01	2.05	0.01
umda	1.25	0.00	0.72	0.01	1.97	0.01

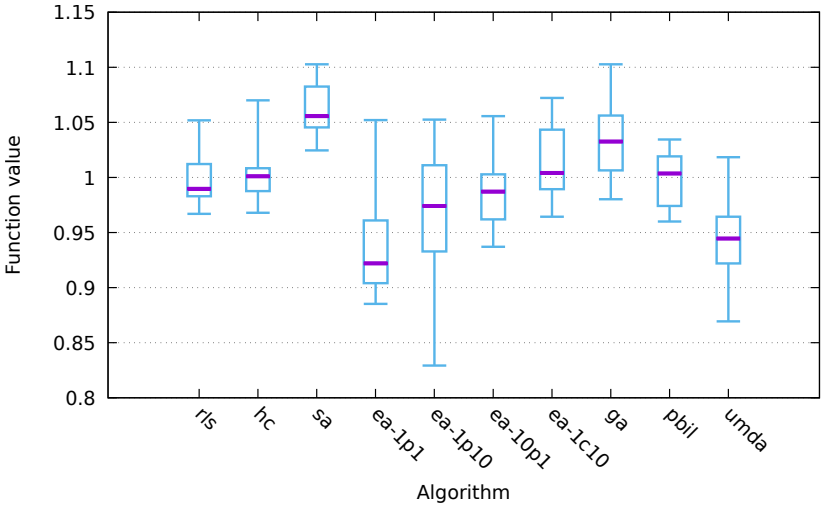

Figure 21: nk

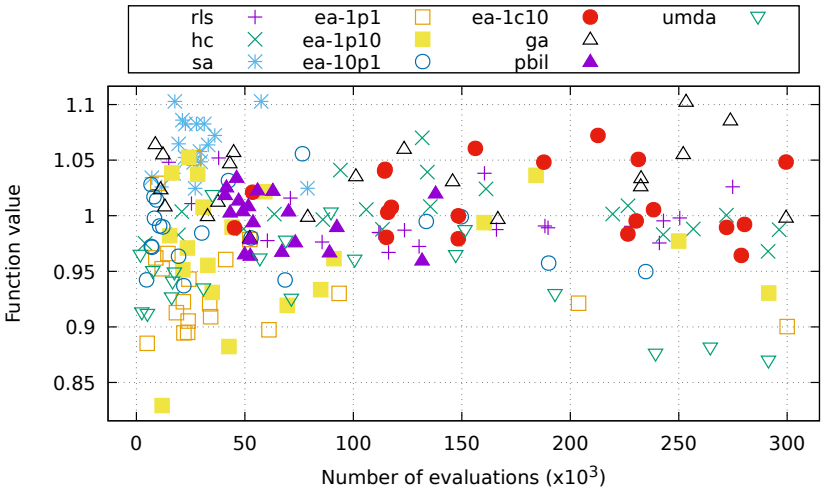

Figure 22: nk

13 Function max-sat

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	970	971	972	972	972	2
hc	963	965	966	967	971	10
sa	969	972	972	972	972	1
ea-1p1	960	965	967	971	972	8
ea-1p10	961	964	968	970	972	6
ea-10p1	961	964	968	972	972	5
ea-1c10	965	969	971	972	972	3
ga	965	968	970	972	972	4
pbil	964	966	967	967	968	7
umda	961	963	967	969	972	9

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	3.90	0.08	4.12	0.08
hc	0.19	0.00	3.54	0.05	3.73	0.05
sa	0.23	0.00	3.36	0.08	3.59	0.08
ea-1p1	0.34	0.01	3.62	0.14	3.96	0.14
ea-1p10	0.35	0.00	3.56	0.15	3.91	0.15
ea-10p1	0.42	0.01	4.35	0.12	4.77	0.12
ea-1c10	0.31	0.00	3.17	0.07	3.48	0.07
ga	1.22	0.00	4.65	0.07	5.86	0.07
pbil	1.34	0.01	3.63	0.12	4.96	0.12
umda	1.27	0.01	3.27	0.20	4.54	0.20

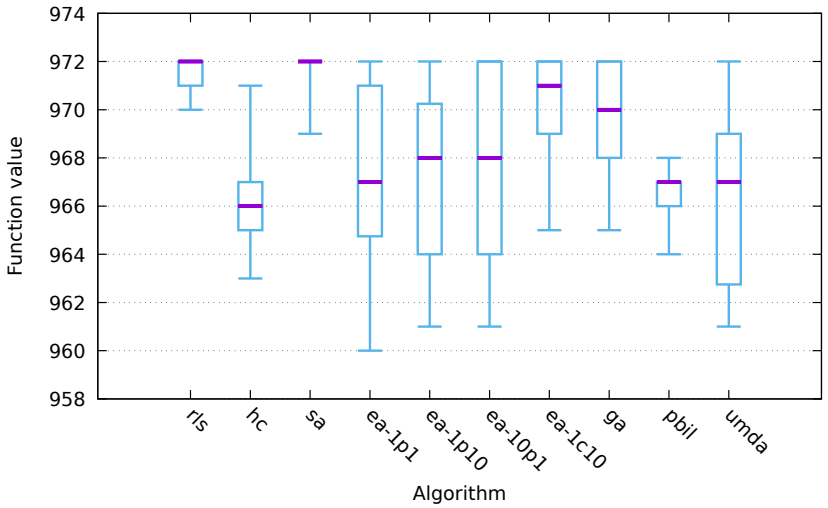

Figure 23: max-sat

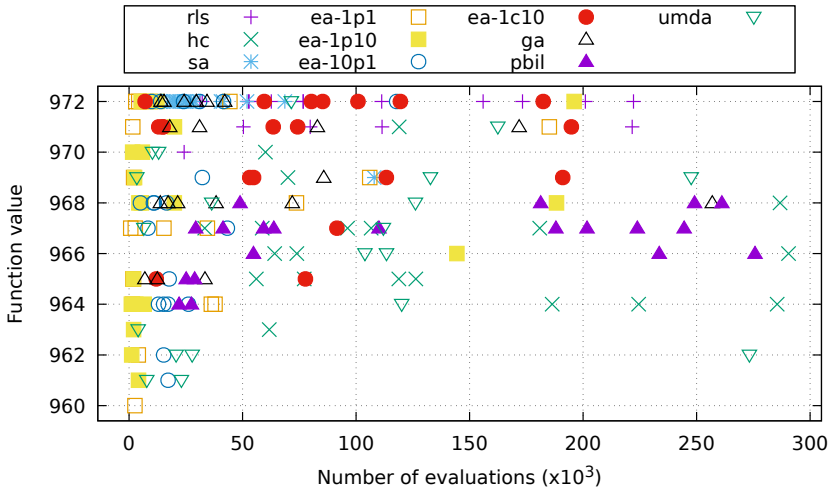

Figure 24: max-sat

14 Function labs

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	4.24	4.34	4.41	4.50	4.84	6
hc	4.59	4.72	4.77	4.86	5.01	3
sa	4.39	4.62	4.70	4.94	5.45	4
ea-1p1	3.67	3.83	3.96	4.03	5.01	8
ea-1p10	3.69	3.86	4.11	4.41	4.82	7
ea-10p1	4.16	4.54	4.66	4.82	5.38	5
ea-1c10	4.57	4.79	4.86	5.07	5.29	2
ga	4.69	4.85	4.96	5.20	5.35	1
pbil	3.48	3.62	3.86	4.06	4.23	10
umda	3.22	3.65	3.90	4.07	4.29	9

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	3.26	0.01	3.46	0.01
hc	0.17	0.00	3.25	0.00	3.43	0.00
sa	0.21	0.00	3.25	0.01	3.46	0.01
ea-1p1	0.31	0.01	3.25	0.01	3.55	0.01
ea-1p10	0.33	0.00	3.25	0.00	3.58	0.01
ea-10p1	0.38	0.01	3.25	0.01	3.63	0.02
ea-1c10	0.28	0.00	3.25	0.00	3.53	0.00
ga	1.19	0.00	3.26	0.00	4.45	0.01
pbil	1.30	0.01	3.26	0.00	4.56	0.01
umda	1.23	0.00	3.25	0.02	4.48	0.03

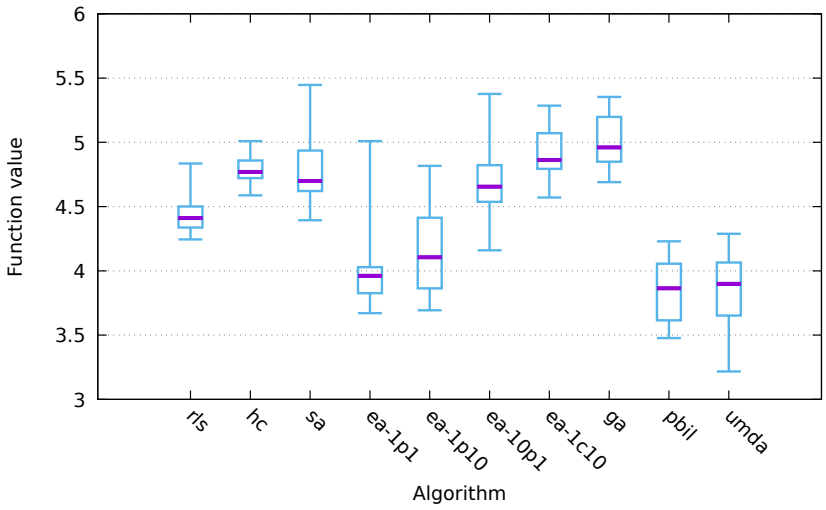

Figure 25: labs

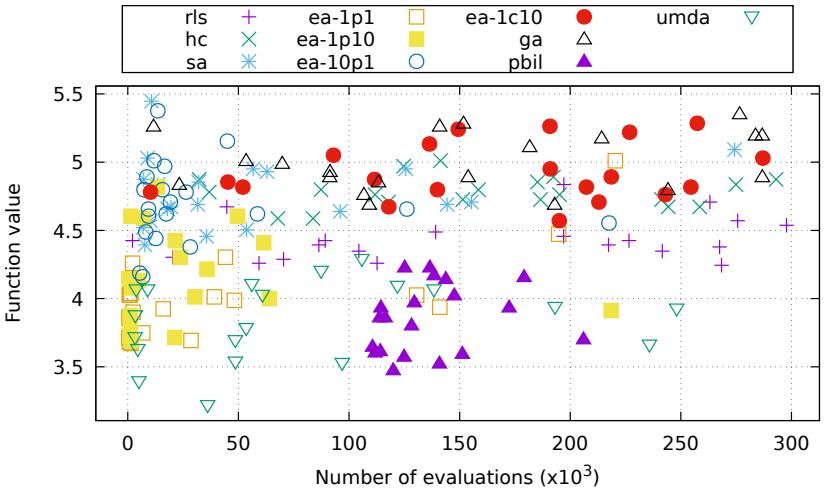

Figure 26: labs

15 Function ep

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	4.1×10^{-32}	1.4×10^{-30}	3.2×10^{-30}	6.9×10^{-30}	1.4×10^{-29}	3
hc	4.5×10^{-31}	2.9×10^{-30}	4.8×10^{-30}	6.3×10^{-30}	1.4×10^{-29}	4
sa	2.0×10^{-31}	2.4×10^{-30}	5.2×10^{-30}	8.2×10^{-30}	2.6×10^{-29}	5
ea-1p1	1.2×10^{-30}	5.9×10^{-30}	1.3×10^{-29}	2.0×10^{-29}	1.4×10^{-28}	9
ea-1p10	5.5×10^{-34}	1.8×10^{-30}	9.4×10^{-30}	2.0×10^{-29}	1.2×10^{-28}	8
ea-10p1	3.9×10^{-31}	2.4×10^{-30}	5.9×10^{-30}	1.1×10^{-29}	2.8×10^{-29}	6
ea-1c10	4.3×10^{-32}	2.0×10^{-30}	6.7×10^{-30}	2.1×10^{-29}	4.8×10^{-29}	7
ga	1.4×10^{-31}	1.4×10^{-30}	1.9×10^{-30}	3.0×10^{-30}	2.2×10^{-29}	1
pbil	8.4×10^{-31}	1.7×10^{-30}	3.0×10^{-30}	5.7×10^{-30}	2.1×10^{-29}	2
umda	4.4×10^{-31}	2.0×10^{-29}	2.8×10^{-29}	5.3×10^{-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	0.54	0.01
hc	0.18	0.00	0.31	0.00	0.49	0.00
sa	0.21	0.00	0.31	0.00	0.52	0.00
ea-1p1	0.31	0.00	0.31	0.00	0.62	0.00
ea-1p10	0.33	0.00	0.31	0.00	0.65	0.00
ea-10p1	0.40	0.01	0.33	0.01	0.73	0.01
ea-1c10	0.29	0.00	0.31	0.00	0.60	0.00
ga	1.21	0.00	0.39	0.00	1.60	0.00
pbil	1.39	0.01	0.39	0.01	1.78	0.02
umda	1.25	0.00	0.32	0.00	1.56	0.01

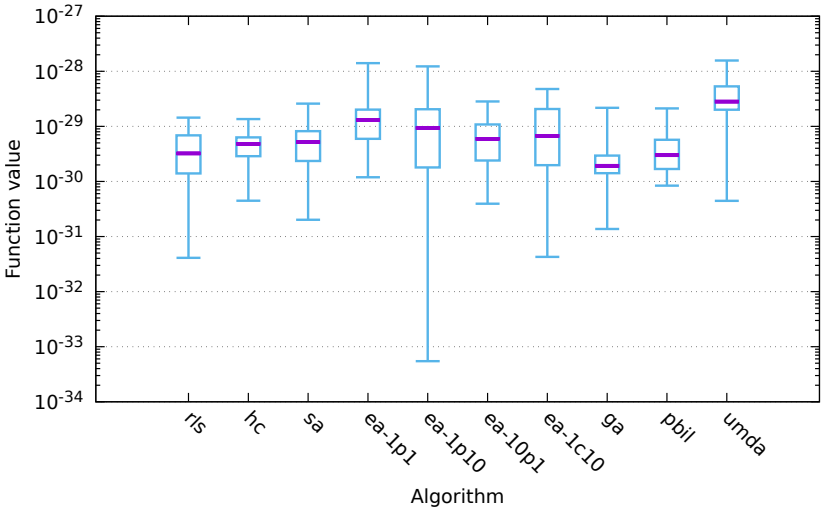

Figure 27: ep

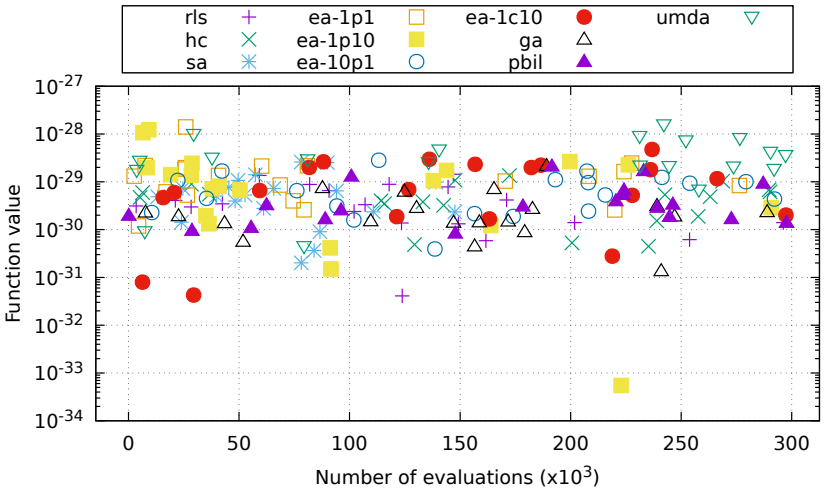

Figure 28: ep

16 Function cancel

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.41	1.58	1.80	1.97	2.21	8
hc	0.90	1.71	1.92	2.21	2.85	10
sa	0.46	1.28	1.81	2.39	3.60	9
ea-1p1	0.04	0.32	0.56	1.32	2.31	4
ea-1p10	0.04	0.41	0.81	1.37	2.74	5
ea-10p1	0.05	0.11	0.24	0.74	2.29	2
ea-1c10	0.08	0.38	1.10	1.52	2.72	6
ga	0.05	0.06	0.36	0.79	2.03	3
pbil	0.04	0.05	0.07	0.22	1.32	1
umda	0.14	0.44	1.18	1.73	2.26	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.20	0.00	0.31	0.00	0.52	0.01
hc	0.18	0.00	0.31	0.00	0.48	0.00
sa	0.21	0.00	0.31	0.01	0.52	0.00
ea-1p1	0.31	0.00	0.31	0.00	0.62	0.00
ea-1p10	0.33	0.00	0.31	0.00	0.64	0.00
ea-10p1	0.39	0.01	0.31	0.00	0.70	0.01
ea-1c10	0.29	0.00	0.31	0.00	0.60	0.01
ga	1.20	0.00	0.32	0.00	1.52	0.01
pbil	1.29	0.00	0.33	0.00	1.62	0.01
umda	1.24	0.01	0.31	0.00	1.55	0.01

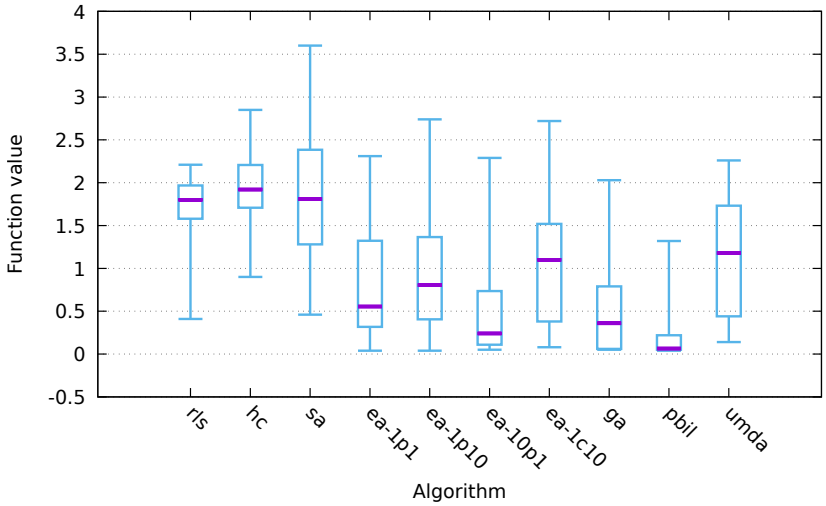

Figure 29: cancel

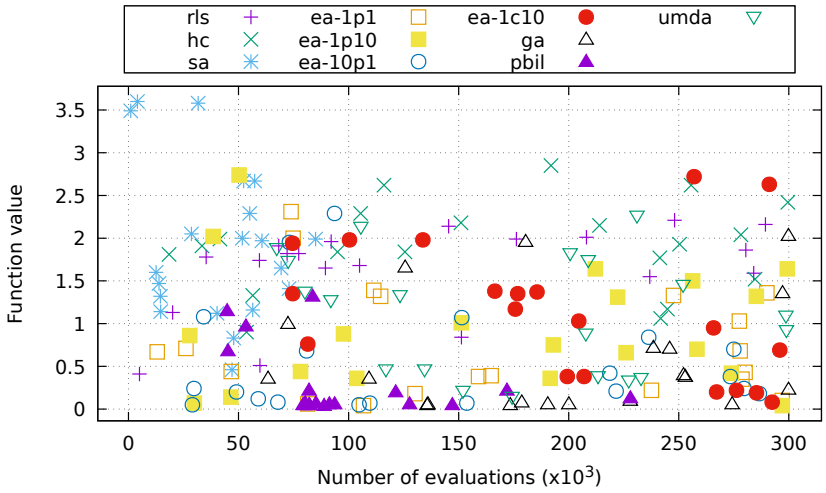

Figure 30: cancel

17 Function trap

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	90	91	91	91	91	2
hc	91	91	91	91	92	1
sa	90	90	90	90	91	3
ea-1p1	90	90	90	90	91	3
ea-1p10	90	90	90	90	91	3
ea-10p1	90	90	90	90	91	3
ea-1c10	90	90	90	90	91	3
ga	90	90	90	90	91	3
pbil	90	90	90	90	90	9
umda	90	90	90	90	90	9

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.20	0.00	0.30	0.00	0.51	0.00
hc	0.18	0.00	0.30	0.00	0.48	0.00
sa	0.21	0.00	0.30	0.00	0.52	0.00
ea-1p1	0.31	0.00	0.31	0.00	0.62	0.01
ea-1p10	0.33	0.00	0.31	0.01	0.64	0.00
ea-10p1	0.40	0.01	0.31	0.00	0.71	0.01
ea-1c10	0.29	0.00	0.31	0.00	0.59	0.00
ga	1.20	0.00	0.31	0.00	1.51	0.01
pbil	1.26	0.00	0.31	0.00	1.57	0.00
umda	1.24	0.00	0.31	0.00	1.55	0.00

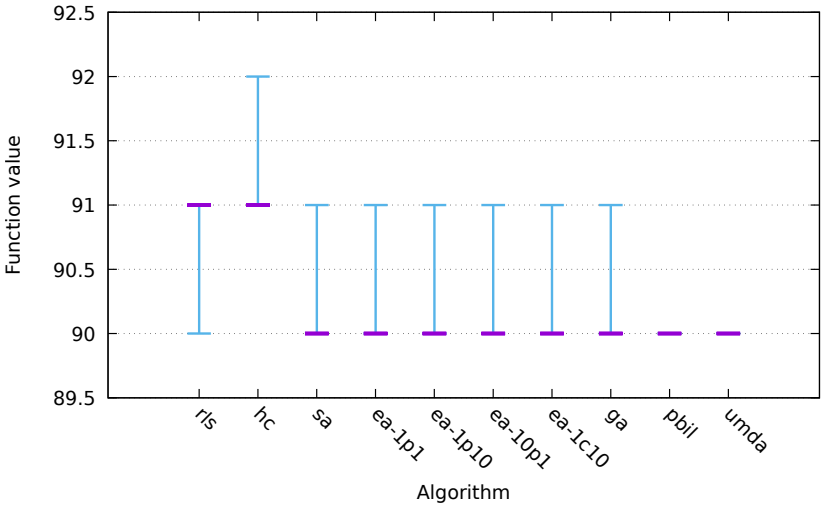

Figure 31: trap

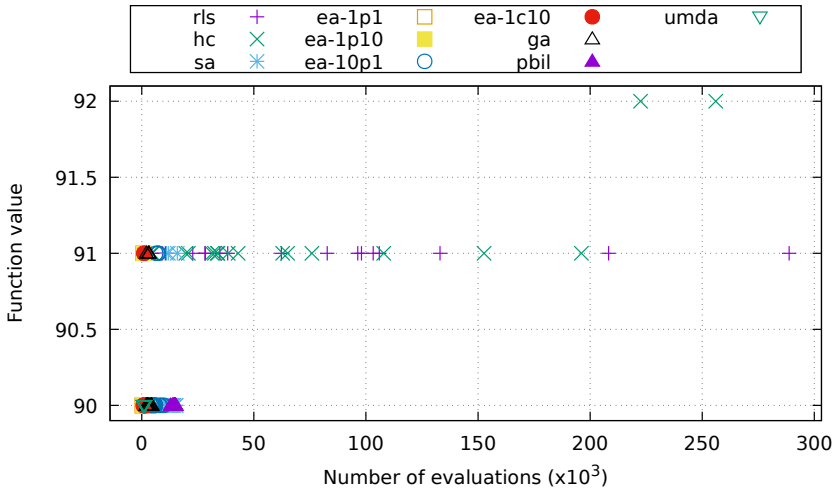

Figure 32: trap

18 Function hiff

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	402	406	417	432	454	10
hc	476	499	508	521	540	7
sa	348	672	704	744	1,024	2
ea-1p1	432	464	484	496	528	9
ea-1p10	440	470	504	512	552	8
ea-10p1	576	636	672	708	800	3
ea-1c10	596	629	648	688	760	4
ga	708	736	769	773	800	1
pbil	488	520	544	584	608	5
umda	460	476	512	548	608	6

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.21	0.00	0.62	0.00	0.83	0.00
hc	0.18	0.00	0.63	0.00	0.80	0.00
sa	0.20	0.05	0.68	0.16	0.89	0.20
ea-1p1	0.31	0.00	0.67	0.01	0.98	0.01
ea-1p10	0.33	0.00	0.68	0.01	1.01	0.01
ea-10p1	0.39	0.01	0.74	0.02	1.13	0.02
ea-1c10	0.29	0.00	0.70	0.01	0.99	0.01
ga	1.37	0.00	0.77	0.01	2.14	0.01
pbil	1.57	0.01	0.71	0.01	2.28	0.02
umda	1.54	0.01	0.70	0.02	2.23	0.02

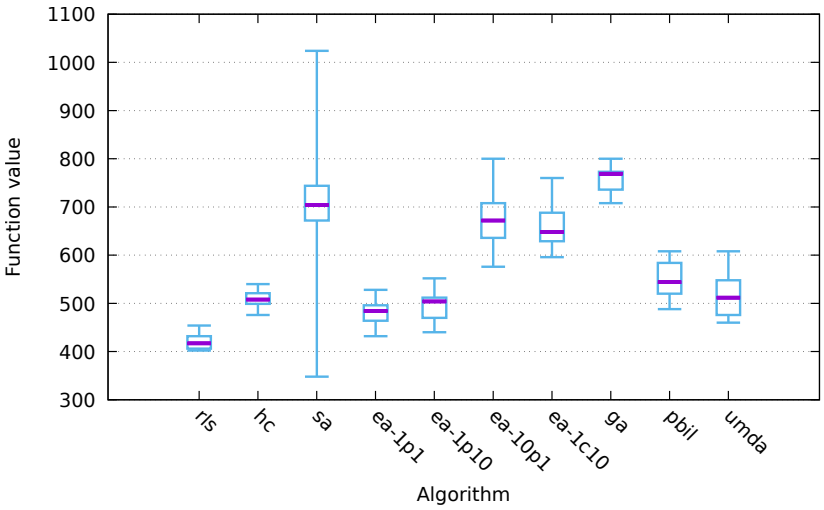

Figure 33: hiff

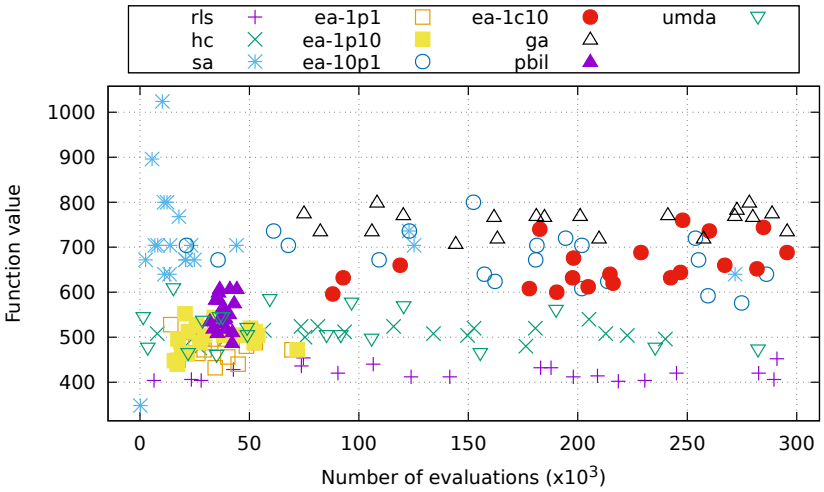

Figure 34: hiff

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	102	102	102	1
ea-1p1	101	101	101	101	102	2
ea-1p10	101	101	101	101	102	3
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	0.21	0.00	0.27	0.00	0.48	0.00
hc	0.18	0.00	0.27	0.00	0.44	0.00
sa	0.17	0.06	0.22	0.07	0.38	0.13
ea-1p1	0.30	0.02	0.27	0.02	0.57	0.04
ea-1p10	0.31	0.06	0.27	0.05	0.58	0.10
ea-10p1	0.40	0.01	0.28	0.00	0.68	0.01
ea-1c10	0.29	0.00	0.28	0.00	0.57	0.00
ga	1.20	0.00	0.29	0.00	1.48	0.00
pbil	1.26	0.00	0.29	0.00	1.55	0.00
umda	1.24	0.00	0.29	0.00	1.53	0.01

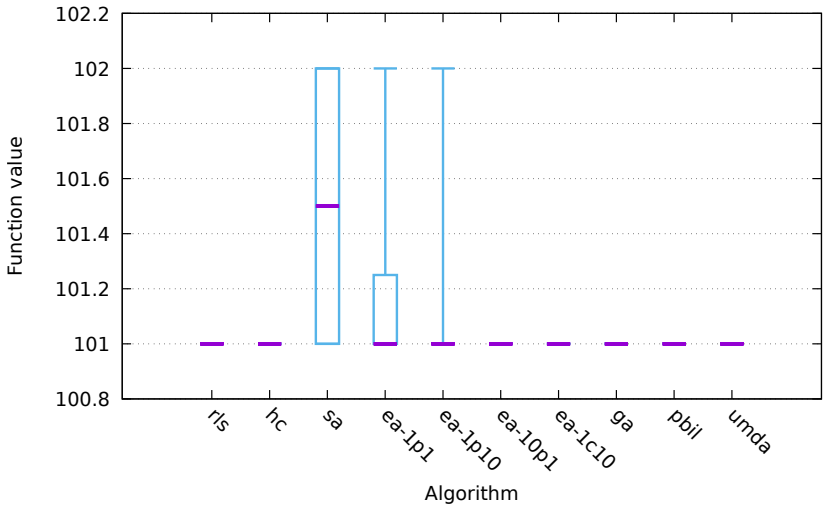

Figure 35: plateau

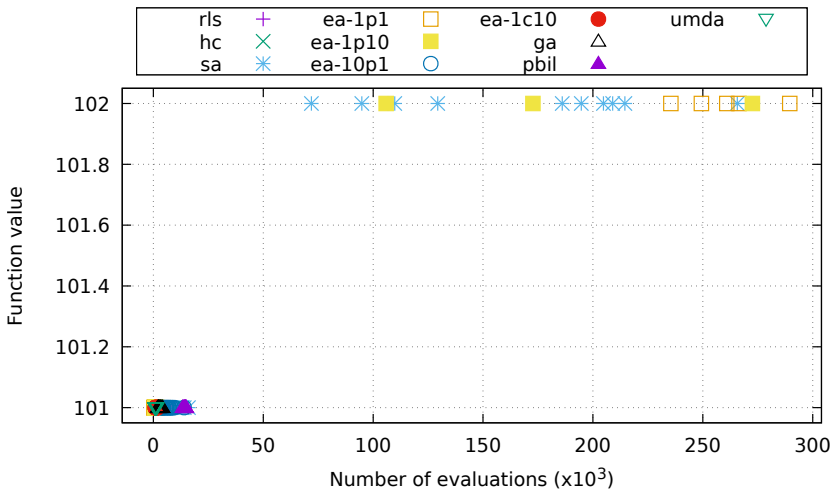

Figure 36: plateau

20 Function walsh2

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	690.10	700.31	707.49	712.21	720.85	4
hc	694.94	705.84	713.34	716.57	720.85	2
sa	693.71	713.69	718.41	720.24	721.22	1
ea-1p1	622.71	648.61	666.72	680.57	716.57	8
ea-1p10	611.04	658.21	668.66	680.24	701.41	7
ea-10p1	647.81	674.07	685.69	701.99	718.26	6
ea-1c10	659.35	696.33	705.57	710.83	720.85	5
ga	683.58	701.58	709.26	716.57	721.22	3
pbil	610.12	643.60	662.56	683.65	720.85	9
umda	624.91	651.69	662.20	680.92	716.57	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.22	0.00	3.12	0.01	3.34	0.01
hc	0.19	0.00	3.06	0.01	3.25	0.01
sa	0.23	0.00	3.11	0.05	3.34	0.05
ea-1p1	0.34	0.01	3.18	0.06	3.52	0.06
ea-1p10	0.35	0.00	3.16	0.09	3.51	0.09
ea-10p1	0.42	0.01	3.33	0.08	3.75	0.08
ea-1c10	0.31	0.00	3.08	0.07	3.39	0.08
ga	1.22	0.00	3.55	0.07	4.77	0.08
pbil	1.29	0.01	3.16	0.05	4.45	0.05
umda	1.25	0.04	3.02	0.10	4.27	0.13

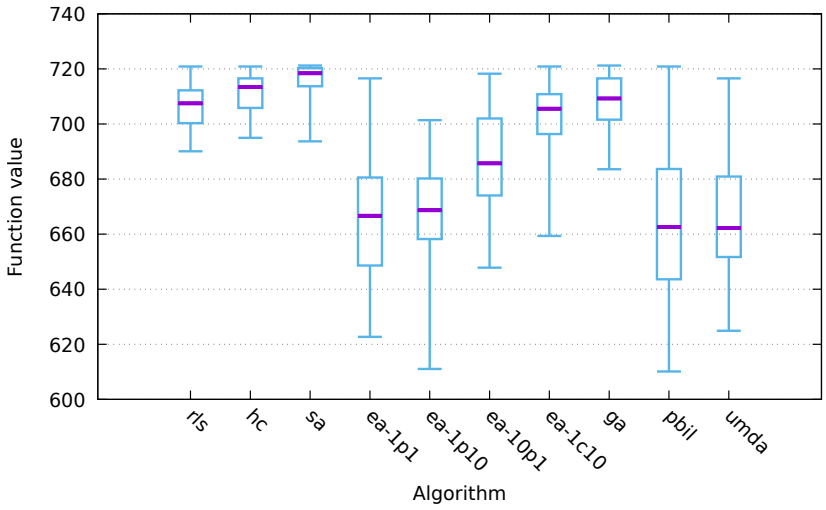

Figure 37: walsh2

A Plan

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

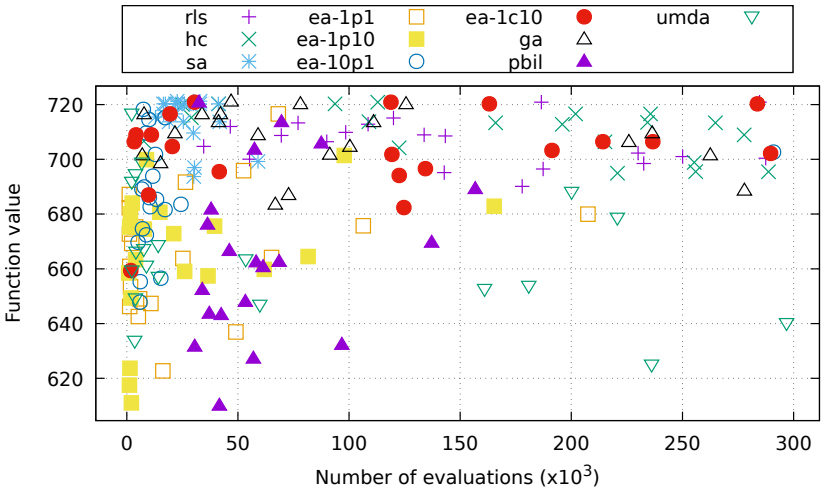

Figure 38: walsh2

```
    "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
```