HNCO
Comparison of various black box optimization algorithms

August 7, 2020

Contents

1 Ranking

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

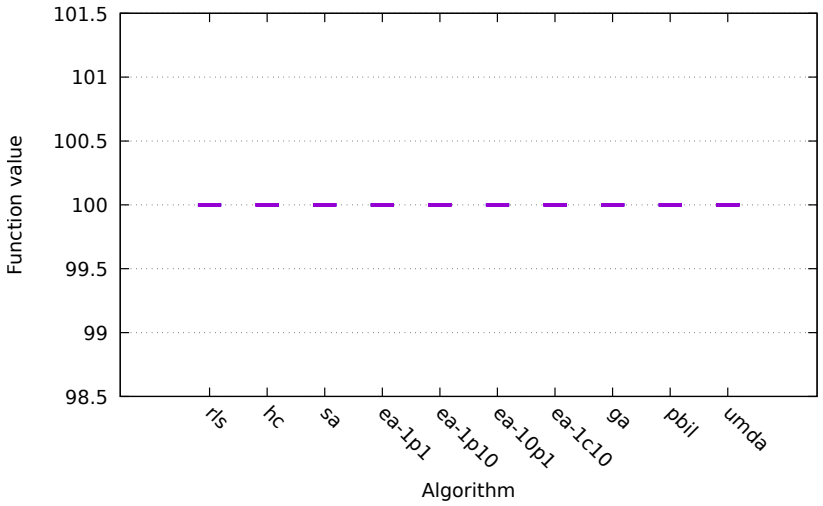
plateau (sa, ea-1p10, ea-1p1), (hc, ea-10p1, rls, pbil, ga, ea-1c10, umda)

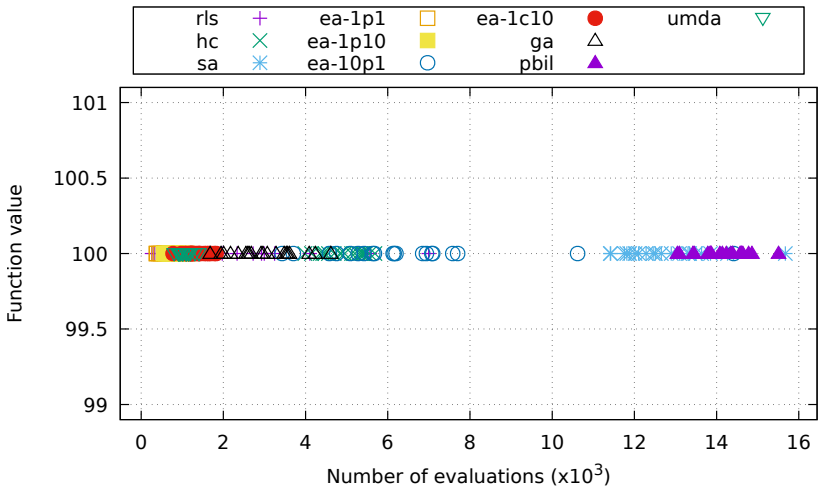
walsh2 sa, hc, ga, rls, ea-10p1, ea-1c10, ea-1p1, pbil, ea-1p10, umda

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	0.01	0.00	0.01	0.00
sa	0.01	0.00	0.01	0.00	0.03	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	0.02	0.00
pbil	0.08	0.00	0.02	0.00	0.09	0.00
umda	0.01	0.00	0.00	0.00	0.01	0.00

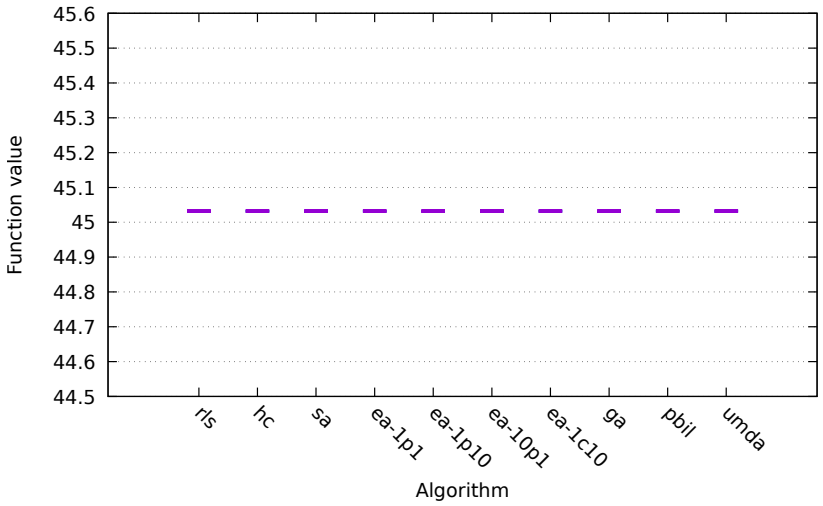


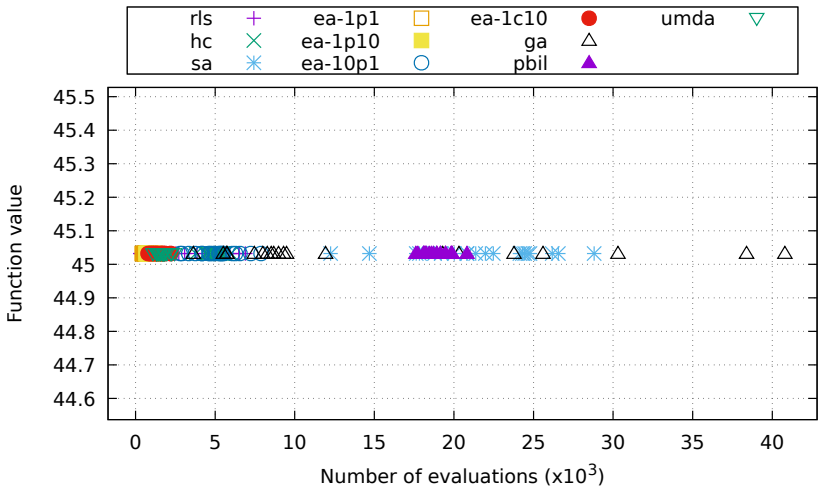


3 Function lin

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	0.01	0.01
hc	0.00	0.00	0.01	0.00	0.01	0.00
sa	0.03	0.00	0.03	0.01	0.05	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	0.07	0.05	0.02	0.01	0.09	0.07
pbil	0.11	0.00	0.03	0.00	0.14	0.01
umda	0.01	0.00	0.00	0.00	0.01	0.00

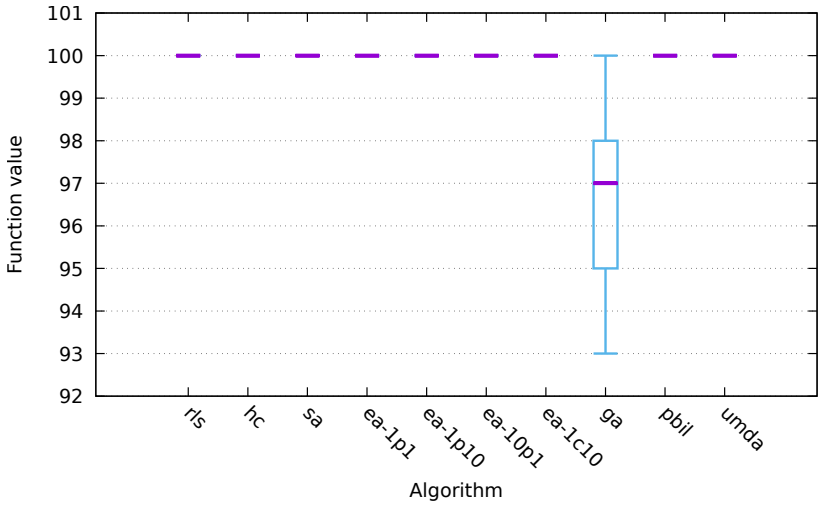


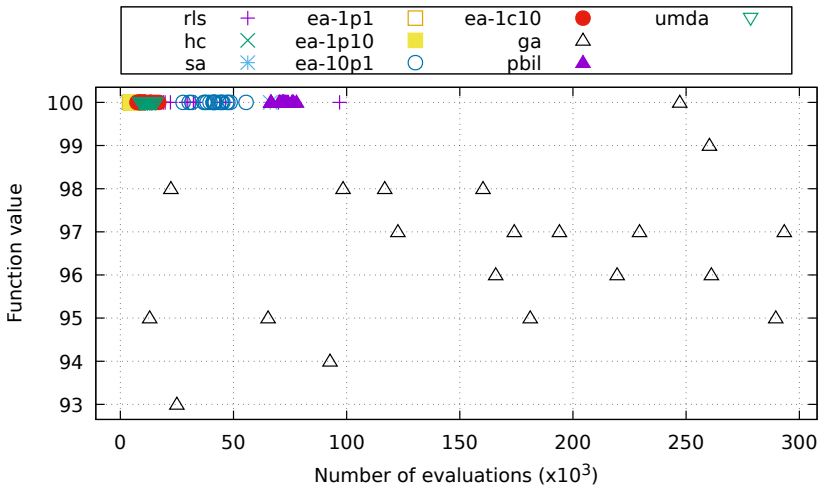


4 Function leading-ones

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	98	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	0.03	0.02	0.03	0.03	0.06	0.05
hc	0.00	0.00	0.01	0.00	0.01	0.00
sa	0.01	0.01	0.01	0.01	0.02	0.03
ea-1p1	0.01	0.00	0.01	0.00	0.01	0.00
ea-1p10	0.01	0.00	0.01	0.00	0.01	0.00
ea-10p1	0.07	0.01	0.05	0.01	0.12	0.02
ea-1c10	0.01	0.00	0.01	0.00	0.03	0.01
ga	1.59	0.09	0.39	0.02	1.98	0.12
pbil	0.45	0.02	0.09	0.00	0.54	0.03
umda	0.07	0.01	0.02	0.00	0.09	0.02

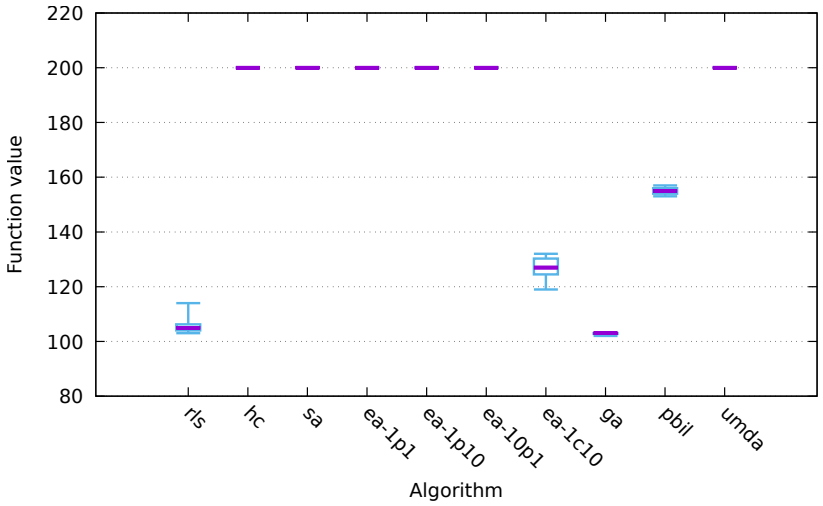


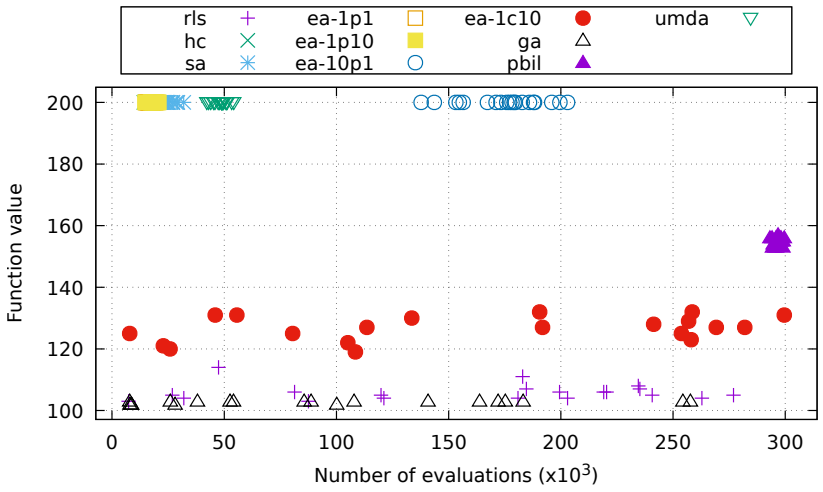


5 Function ridge

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	103	104	105	106	114	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	125	127	130	132	8
ga	102	103	103	103	103	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	0.37	0.00	0.43	0.01	0.80	0.01
hc	0.02	0.00	0.02	0.00	0.04	0.00
sa	0.03	0.00	0.04	0.00	0.07	0.01
ea-1p1	0.03	0.00	0.02	0.00	0.05	0.01
ea-1p10	0.03	0.00	0.03	0.00	0.05	0.00
ea-10p1	0.33	0.04	0.26	0.03	0.59	0.06
ea-1c10	0.45	0.00	0.44	0.01	0.89	0.01
ga	1.67	0.03	0.42	0.01	2.09	0.04
pbil	1.86	0.03	0.44	0.01	2.30	0.04
umda	0.30	0.03	0.07	0.01	0.37	0.04

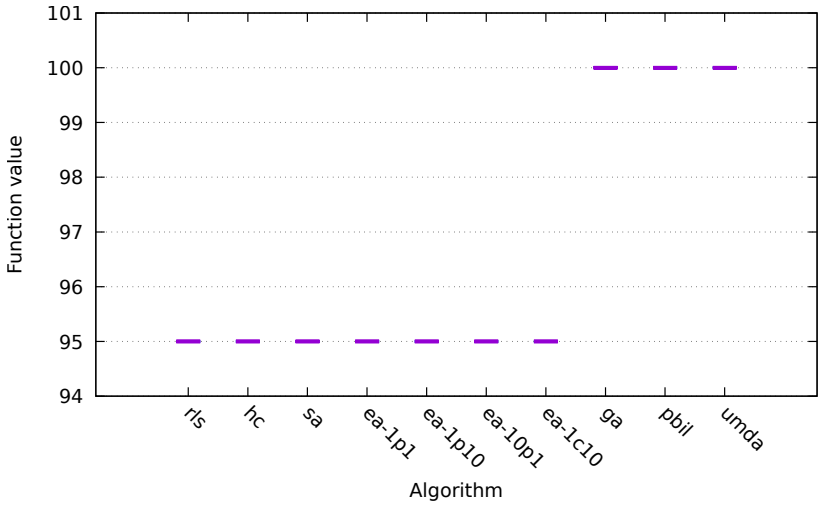


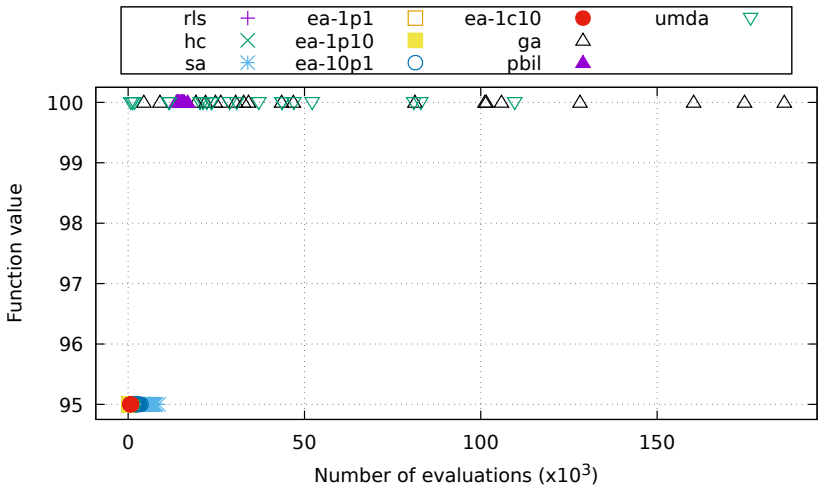


6 Function jmp-5

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	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	0.37	0.00	0.42	0.01	0.79	0.01
hc	0.33	0.01	0.42	0.01	0.75	0.01
sa	0.37	0.01	0.43	0.01	0.79	0.01
ea-1p1	0.47	0.01	0.42	0.01	0.89	0.01
ea-1p10	0.50	0.02	0.42	0.02	0.92	0.03
ea-10p1	0.57	0.02	0.42	0.01	0.99	0.02
ea-1c10	0.45	0.00	0.42	0.01	0.87	0.01
ga	0.39	0.34	0.09	0.08	0.48	0.42
pbil	0.11	0.01	0.02	0.00	0.13	0.01
umda	0.21	0.18	0.05	0.04	0.26	0.22

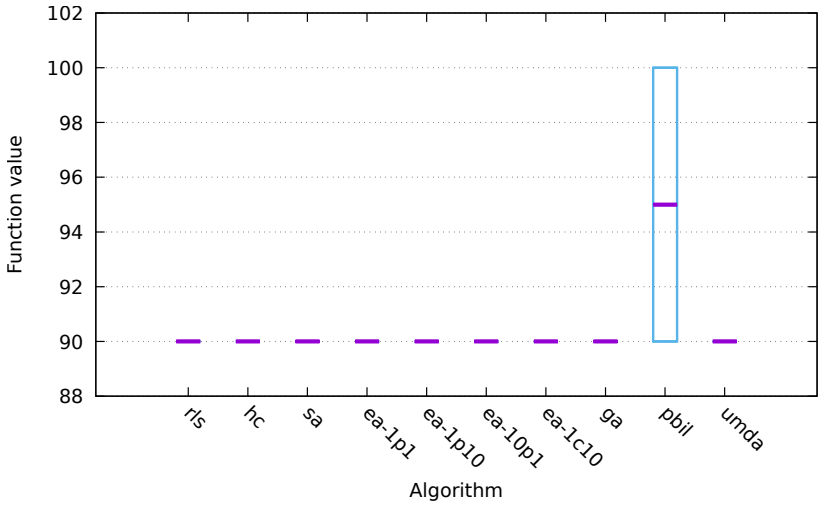


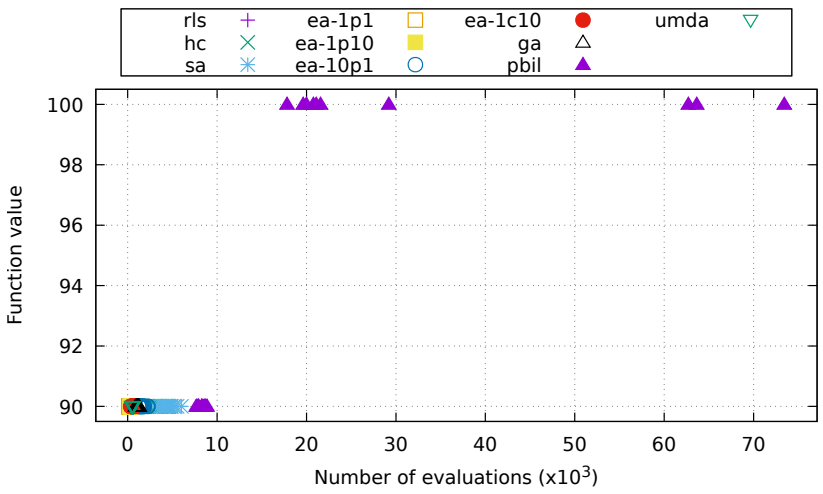


7 Function jmp-10

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	95	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	0.39	0.02	0.45	0.02	0.83	0.04
hc	0.33	0.00	0.42	0.01	0.75	0.01
sa	0.36	0.01	0.43	0.01	0.79	0.01
ea-1p1	0.48	0.02	0.43	0.02	0.91	0.04
ea-1p10	0.51	0.02	0.44	0.02	0.95	0.04
ea-10p1	0.59	0.03	0.43	0.02	1.02	0.04
ea-1c10	0.46	0.02	0.42	0.02	0.89	0.03
ga	1.73	0.02	0.42	0.01	2.15	0.02
pbil	1.09	0.88	0.23	0.19	1.32	1.07
umda	1.89	0.03	0.41	0.01	2.30	0.04

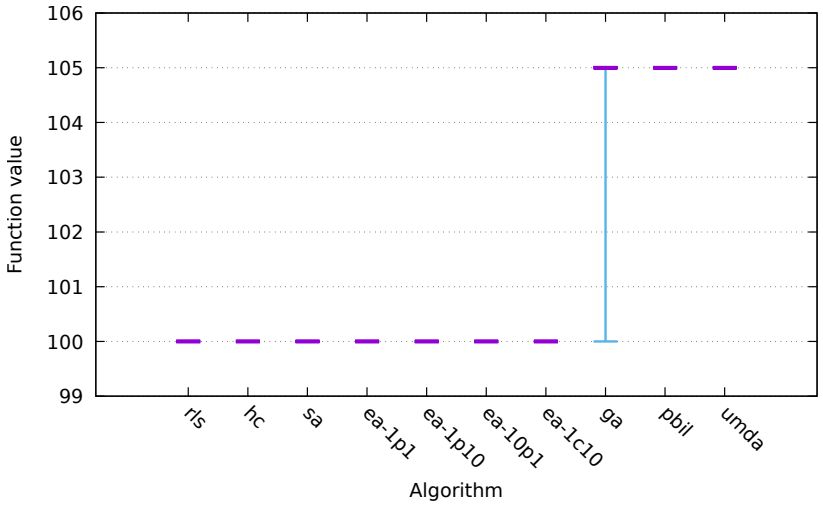


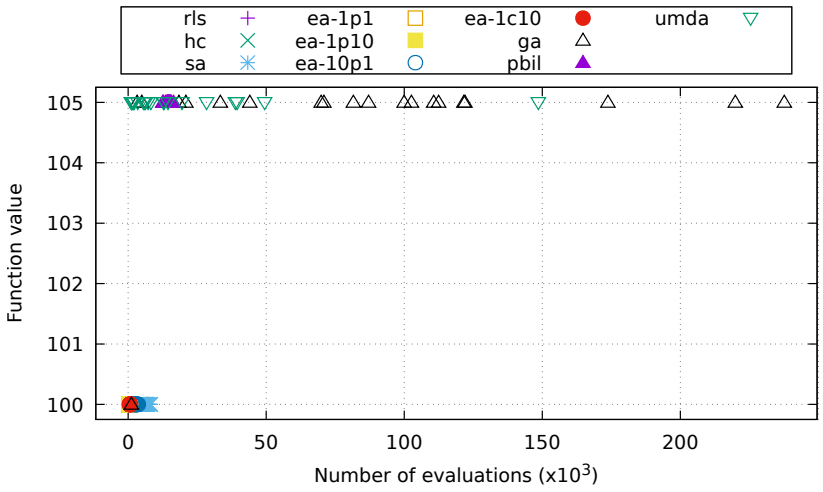


8 Function djmp-5

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	0.36	0.01	0.42	0.01	0.79	0.02
hc	0.33	0.00	0.42	0.01	0.75	0.01
sa	0.36	0.00	0.43	0.01	0.79	0.00
ea-1p1	0.48	0.02	0.43	0.02	0.91	0.03
ea-1p10	0.50	0.02	0.43	0.02	0.93	0.04
ea-10p1	0.61	0.02	0.44	0.02	1.05	0.04
ea-1c10	0.46	0.02	0.42	0.02	0.88	0.03
ga	0.59	0.47	0.14	0.11	0.73	0.58
pbil	0.10	0.01	0.02	0.00	0.12	0.01
umda	0.14	0.22	0.03	0.05	0.16	0.27

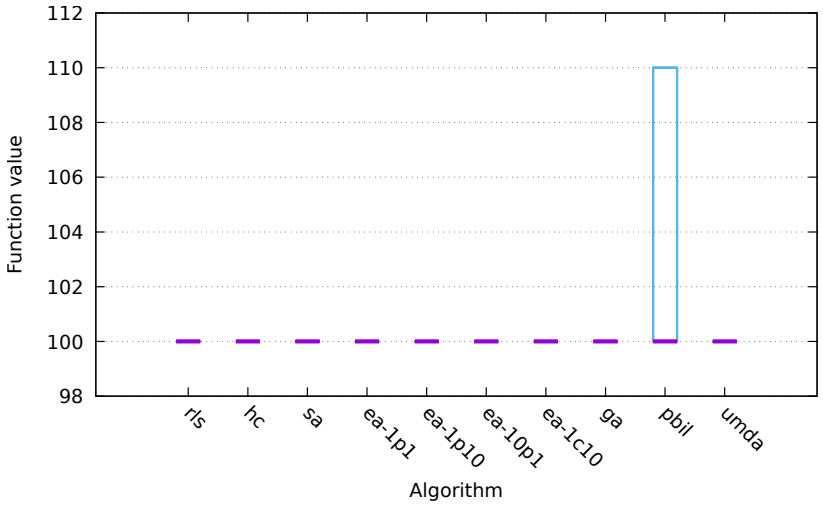


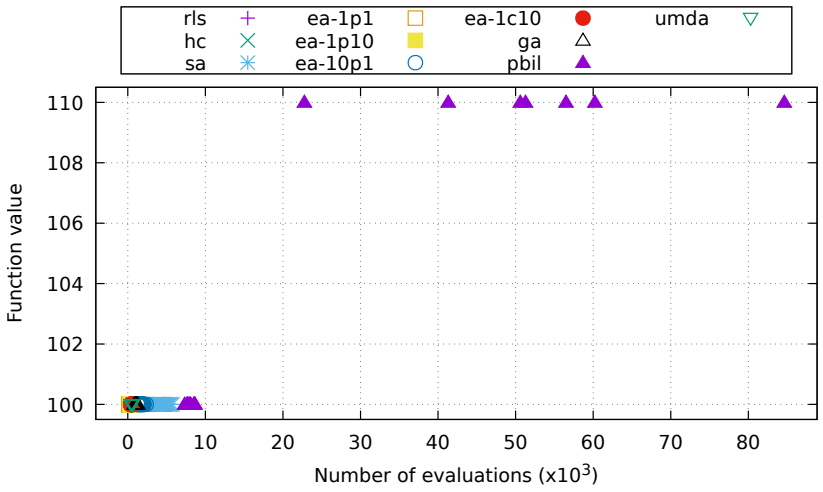


9 Function djmp-10

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	0.38	0.02	0.44	0.02	0.82	0.04
hc	0.34	0.01	0.44	0.02	0.78	0.03
sa	0.38	0.02	0.45	0.02	0.84	0.04
ea-1p1	0.48	0.02	0.43	0.02	0.91	0.04
ea-1p10	0.51	0.02	0.43	0.02	0.94	0.04
ea-10p1	0.59	0.03	0.43	0.02	1.02	0.06
ea-1c10	0.47	0.03	0.44	0.02	0.91	0.05
ga	1.73	0.01	0.43	0.02	2.16	0.02
pbil	1.39	0.78	0.30	0.17	1.69	0.95
umda	1.93	0.05	0.42	0.01	2.34	0.07

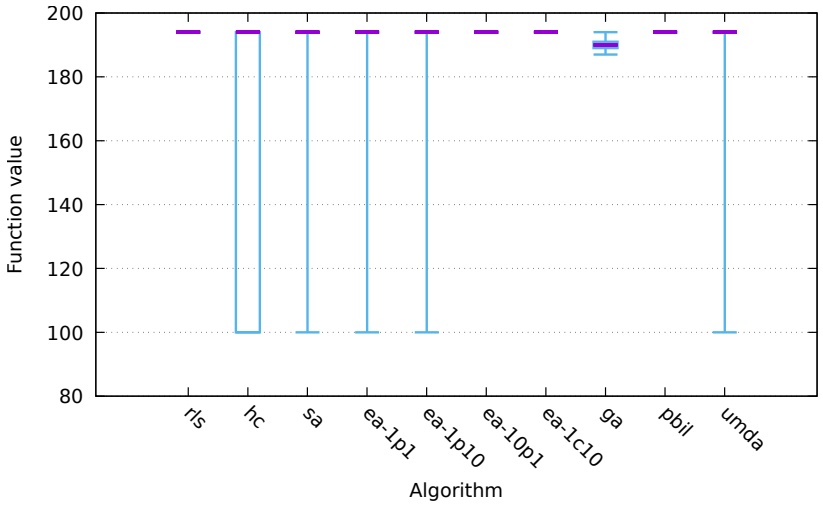


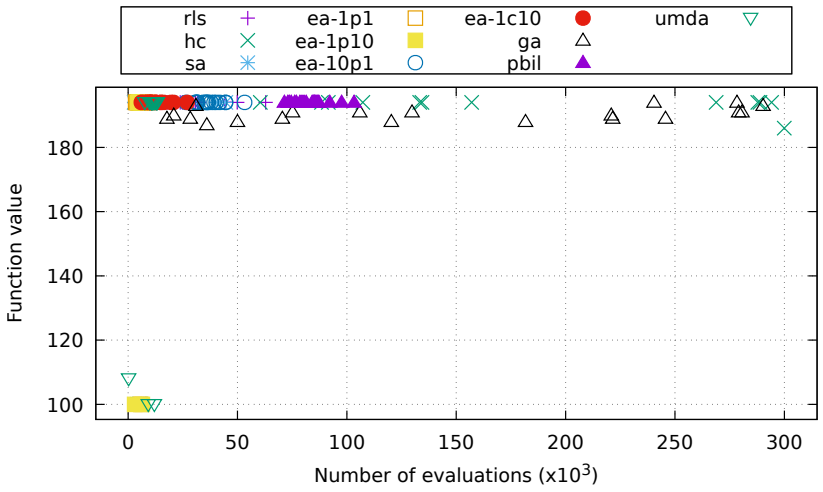


10 Function fp-5

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	194	194	194	194	194	1
hc	100	100	194	194	194	9
sa	100	194	194	194	194	5
ea-1p1	100	194	194	194	194	5
ea-1p10	100	194	194	194	194	5
ea-10p1	194	194	194	194	194	1
ea-1c10	194	194	194	194	194	1
ga	187	189	190	191	194	10
pbil	194	194	194	194	194	1
umda	100	194	194	194	194	5

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.03	0.02	0.04	0.02	0.06	0.04
hc	0.24	0.11	0.31	0.15	0.54	0.26
sa	0.03	0.07	0.03	0.09	0.06	0.16
ea-1p1	0.03	0.10	0.03	0.09	0.06	0.19
ea-1p10	0.06	0.14	0.05	0.13	0.11	0.27
ea-10p1	0.07	0.01	0.05	0.01	0.12	0.02
ea-1c10	0.02	0.01	0.02	0.01	0.04	0.02
ga	1.71	0.08	0.43	0.02	2.14	0.10
pbil	0.55	0.05	0.12	0.01	0.67	0.06
umda	0.34	0.66	0.08	0.15	0.42	0.82

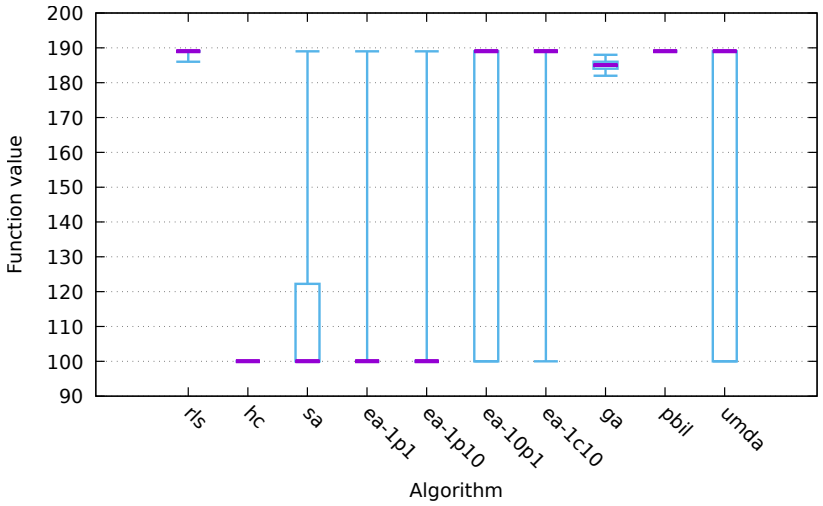


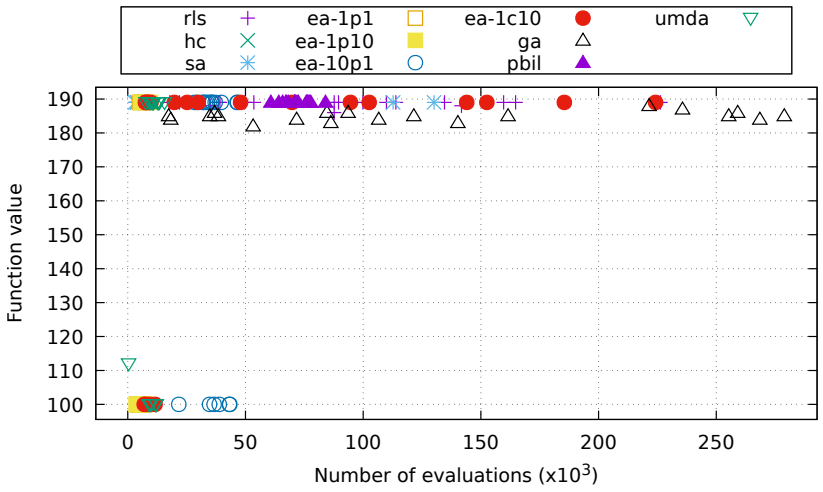


11 Function fp-10

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	186	189	189	189	189	2
hc	100	100	100	100	100	10
sa	100	100	100	122	189	7
ea-1p1	100	100	100	100	189	8
ea-1p10	100	100	100	100	189	8
ea-10p1	100	100	189	189	189	4
ea-1c10	100	189	189	189	189	3
ga	182	184	185	186	188	6
pbil	189	189	189	189	189	1
umda	100	100	189	189	189	4

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.13	0.11	0.16	0.14	0.30	0.26
hc	0.35	0.01	0.46	0.02	0.80	0.03
sa	0.30	0.15	0.36	0.18	0.66	0.32
ea-1p1	0.42	0.18	0.39	0.16	0.81	0.34
ea-1p10	0.44	0.18	0.38	0.16	0.82	0.34
ea-10p1	0.23	0.25	0.17	0.19	0.41	0.44
ea-1c10	0.19	0.18	0.18	0.17	0.36	0.35
ga	1.73	0.01	0.43	0.01	2.16	0.01
pbil	0.48	0.04	0.10	0.01	0.59	0.05
umda	0.70	0.89	0.16	0.21	0.87	1.09

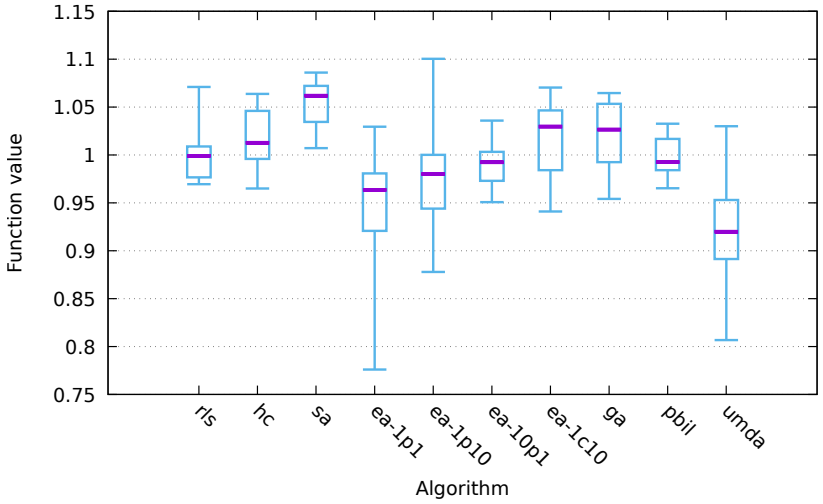


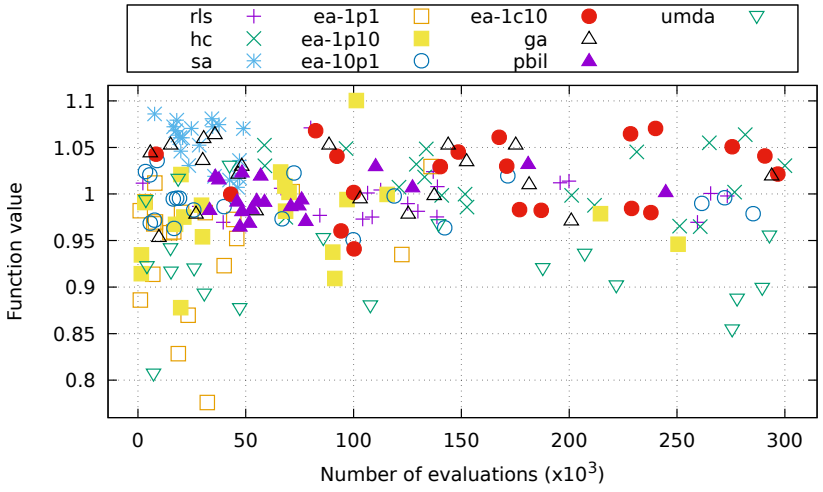


12 Function nk

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.97	0.98	1.00	1.01	1.07	5
hc	0.96	1.00	1.01	1.05	1.06	4
sa	1.01	1.03	1.06	1.07	1.09	1
ea-1p1	0.78	0.92	0.96	0.98	1.03	9
ea-1p10	0.88	0.94	0.98	1.00	1.10	8
ea-10p1	0.95	0.97	0.99	1.00	1.04	7
ea-1c10	0.94	0.98	1.03	1.05	1.07	2
ga	0.95	0.99	1.03	1.05	1.06	3
pbil	0.97	0.98	0.99	1.02	1.03	6
umda	0.81	0.89	0.92	0.95	1.03	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.36	0.01	1.10	0.02	1.46	0.03
hc	0.32	0.01	1.05	0.02	1.37	0.03
sa	0.37	0.01	1.02	0.03	1.39	0.03
ea-1p1	0.48	0.01	1.08	0.02	1.55	0.02
ea-1p10	0.49	0.01	1.06	0.02	1.56	0.02
ea-10p1	0.59	0.02	1.11	0.02	1.69	0.03
ea-1c10	0.45	0.01	1.00	0.03	1.45	0.03
ga	1.72	0.03	1.21	0.02	2.93	0.05
pbil	1.87	0.02	1.06	0.02	2.92	0.04
umda	1.84	0.02	0.98	0.02	2.81	0.03

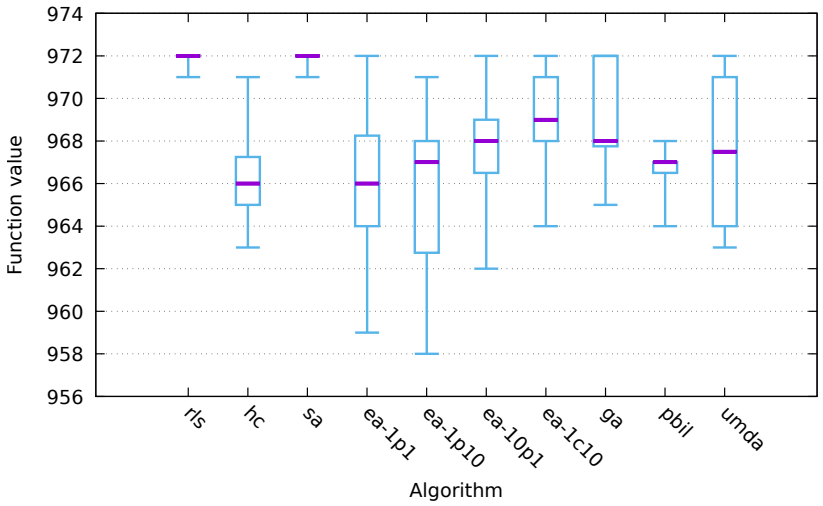


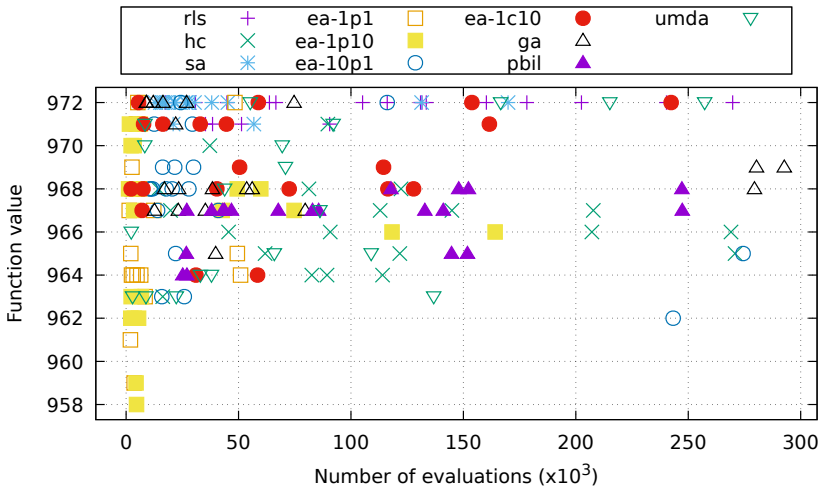


13 Function max-sat

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	971	972	972	972	972	1
hc	963	965	966	967	971	9
sa	971	972	972	972	972	1
ea-1p1	959	964	966	968	972	10
ea-1p10	958	963	967	968	971	8
ea-10p1	962	967	968	969	972	5
ea-1c10	964	968	969	971	972	3
ga	965	968	968	972	972	4
pbil	964	967	967	967	968	7
umda	963	964	968	971	972	6

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.34	0.01	4.73	0.07	5.07	0.07
hc	0.31	0.00	4.28	0.05	4.59	0.05
sa	0.36	0.01	4.10	0.09	4.46	0.10
ea-1p1	0.47	0.01	4.31	0.19	4.77	0.19
ea-1p10	0.49	0.01	4.32	0.18	4.81	0.18
ea-10p1	0.58	0.01	5.13	0.11	5.70	0.11
ea-1c10	0.45	0.01	3.81	0.07	4.26	0.07
ga	1.68	0.01	5.56	0.08	7.24	0.09
pbil	1.86	0.01	4.31	0.13	6.17	0.14
umda	1.82	0.01	3.99	0.14	5.81	0.15

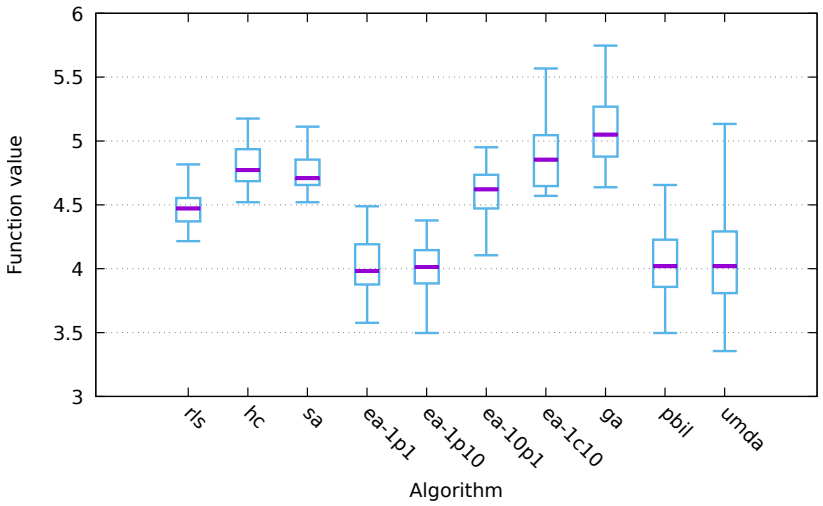


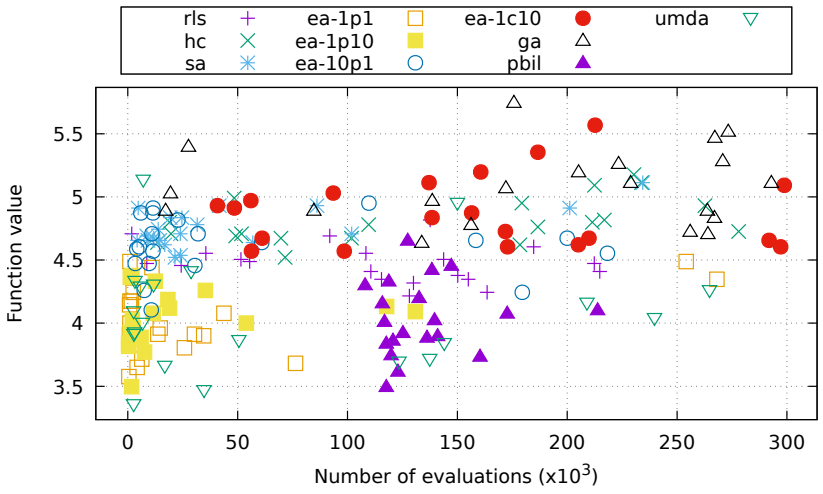


14 Function labs

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	4.22	4.37	4.47	4.55	4.82	6
hc	4.52	4.69	4.77	4.94	5.18	3
sa	4.52	4.66	4.71	4.85	5.11	4
ea-1p1	3.58	3.88	3.98	4.19	4.49	10
ea-1p10	3.50	3.89	4.01	4.15	4.38	9
ea-10p1	4.11	4.47	4.62	4.74	4.95	5
ea-1c10	4.57	4.65	4.85	5.05	5.57	2
ga	4.64	4.88	5.05	5.27	5.75	1
pbil	3.50	3.86	4.02	4.23	4.66	8
umda	3.36	3.81	4.02	4.29	5.13	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.40	0.01	5.06	0.18	5.46	0.19
hc	0.36	0.01	5.09	0.09	5.45	0.10
sa	0.31	0.02	3.88	0.31	4.19	0.34
ea-1p1	0.42	0.01	4.12	0.04	4.54	0.05
ea-1p10	0.45	0.00	4.15	0.04	4.60	0.04
ea-10p1	0.52	0.02	4.17	0.03	4.69	0.04
ea-1c10	0.41	0.01	4.16	0.03	4.57	0.03
ga	1.65	0.01	4.16	0.00	5.81	0.01
pbil	1.84	0.01	4.15	0.01	5.99	0.01
umda	1.78	0.05	4.17	0.08	5.94	0.13

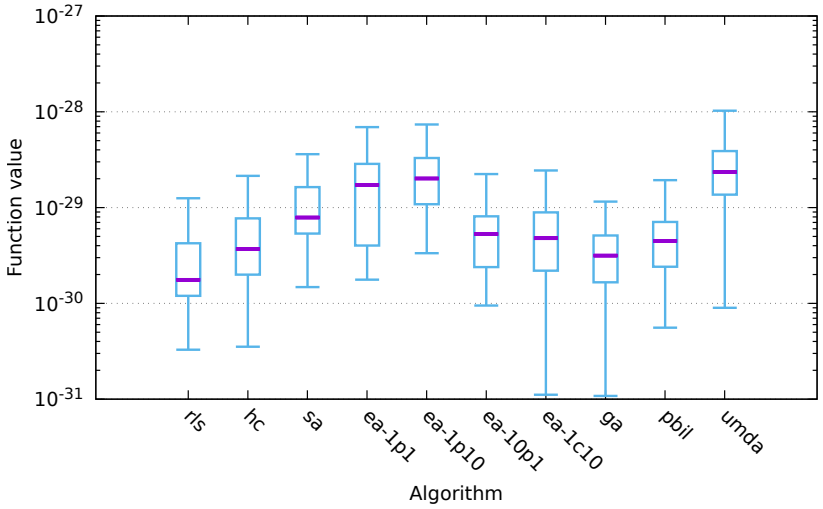


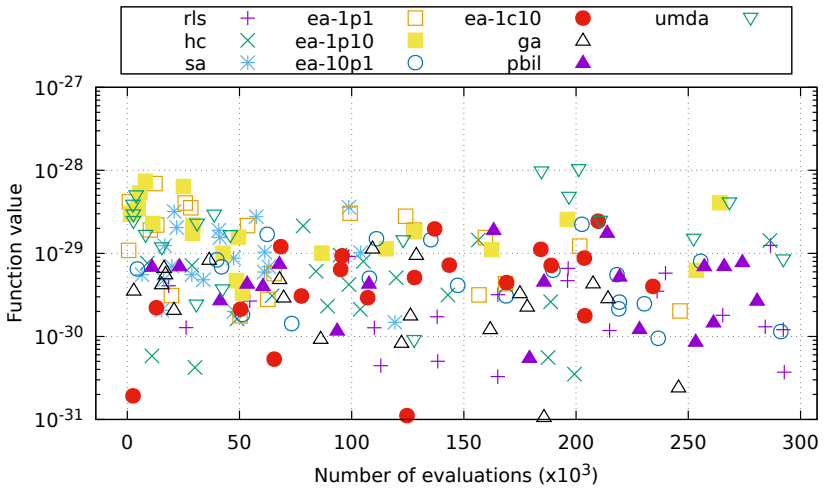


15 Function ep

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	3.3×10^{-31}	1.2×10^{-30}	1.8×10^{-30}	4.2×10^{-30}	1.3×10^{-29}	1
hc	3.5×10^{-31}	2.0×10^{-30}	3.7×10^{-30}	7.7×10^{-30}	2.1×10^{-29}	3
sa	1.5×10^{-30}	5.4×10^{-30}	7.9×10^{-30}	1.6×10^{-29}	3.6×10^{-29}	7
ea-1p1	1.8×10^{-30}	4.0×10^{-30}	1.7×10^{-29}	2.9×10^{-29}	6.9×10^{-29}	8
ea-1p10	3.3×10^{-30}	1.1×10^{-29}	2.0×10^{-29}	3.3×10^{-29}	7.4×10^{-29}	9
ea-10p1	9.5×10^{-31}	2.4×10^{-30}	5.3×10^{-30}	8.1×10^{-30}	2.2×10^{-29}	6
ea-1c10	1.1×10^{-31}	2.2×10^{-30}	4.8×10^{-30}	8.9×10^{-30}	2.4×10^{-29}	5
ga	1.1×10^{-31}	1.7×10^{-30}	3.2×10^{-30}	5.1×10^{-30}	1.2×10^{-29}	2
pbil	5.6×10^{-31}	2.4×10^{-30}	4.5×10^{-30}	7.1×10^{-30}	1.9×10^{-29}	4
umda	9.0×10^{-31}	1.4×10^{-29}	2.3×10^{-29}	3.9×10^{-29}	1.0×10^{-28}	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.37	0.03	0.50	0.04	0.87	0.07
hc	0.33	0.01	0.53	0.02	0.86	0.03
sa	0.37	0.01	0.51	0.02	0.88	0.03
ea-1p1	0.48	0.02	0.52	0.02	1.00	0.04
ea-1p10	0.50	0.01	0.51	0.01	1.01	0.02
ea-10p1	0.58	0.02	0.53	0.02	1.11	0.04
ea-1c10	0.47	0.02	0.52	0.02	0.98	0.04
ga	1.72	0.01	0.57	0.01	2.29	0.02
pbil	2.00	0.03	0.58	0.01	2.58	0.04
umda	1.85	0.02	0.48	0.01	2.34	0.02

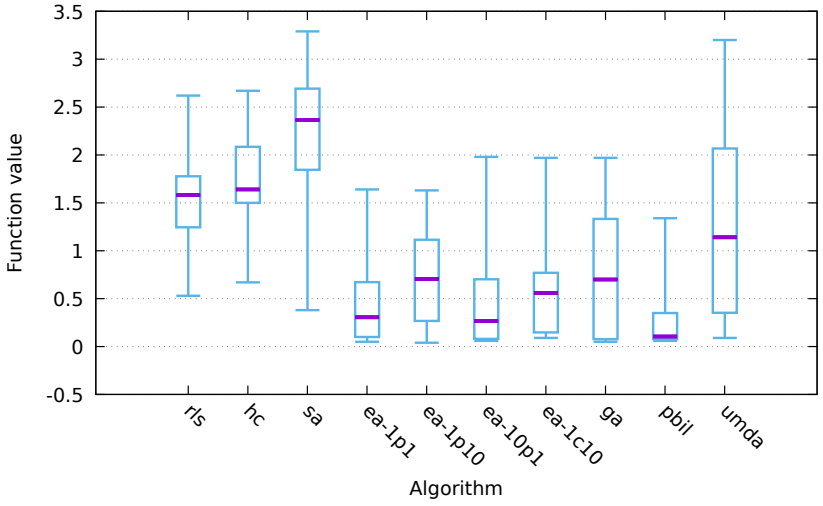


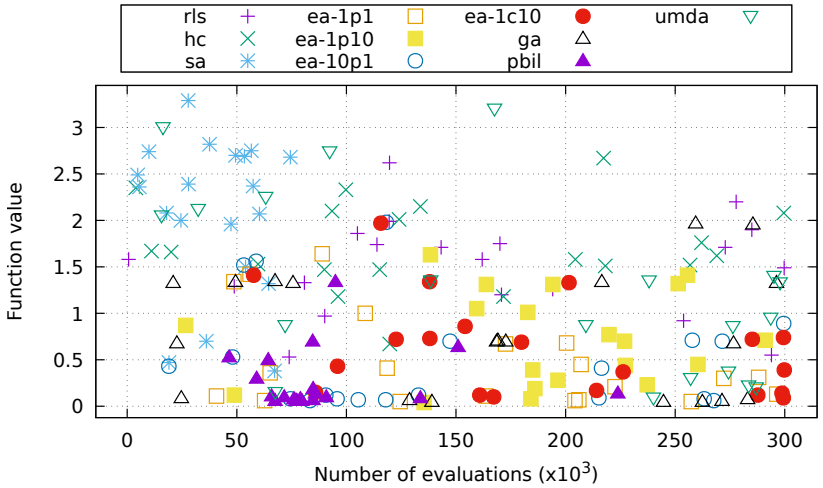


16 Function cancel

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	0.53	1.25	1.58	1.78	2.62	8
hc	0.67	1.50	1.64	2.09	2.67	9
sa	0.38	1.85	2.37	2.69	3.29	10
ea-1p1	0.05	0.10	0.31	0.67	1.64	3
ea-1p10	0.04	0.27	0.71	1.12	1.63	6
ea-10p1	0.06	0.08	0.27	0.70	1.98	2
ea-1c10	0.09	0.15	0.56	0.77	1.97	4
ga	0.05	0.08	0.70	1.33	1.97	5
pbil	0.06	0.08	0.11	0.35	1.34	1
umda	0.09	0.35	1.14	2.07	3.20	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.36	0.02	0.53	0.02	0.88	0.04
hc	0.31	0.01	0.51	0.02	0.82	0.04
sa	0.36	0.02	0.49	0.02	0.85	0.04
ea-1p1	0.48	0.01	0.52	0.01	1.00	0.02
ea-1p10	0.50	0.02	0.51	0.02	1.00	0.04
ea-10p1	0.59	0.03	0.51	0.02	1.10	0.05
ea-1c10	0.46	0.01	0.51	0.01	0.96	0.02
ga	1.72	0.01	0.49	0.01	2.21	0.02
pbil	1.88	0.02	0.50	0.01	2.38	0.03
umda	1.83	0.01	0.48	0.01	2.32	0.02

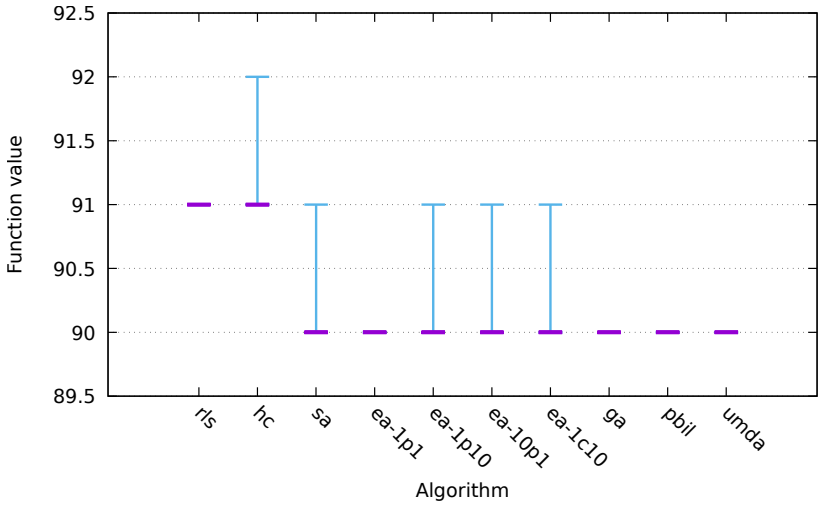


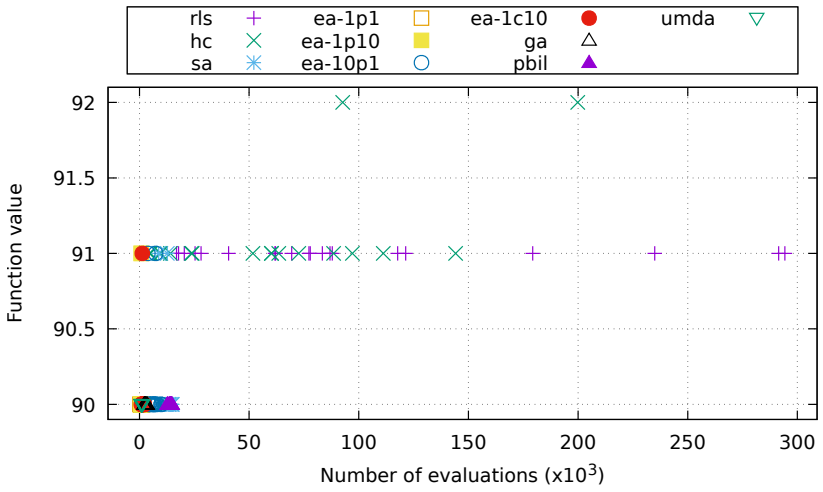


17 Function trap

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	91	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	90	7
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	90	7
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	0.37	0.02	0.48	0.02	0.85	0.04
hc	0.34	0.02	0.50	0.02	0.84	0.04
sa	0.38	0.02	0.49	0.02	0.87	0.04
ea-1p1	0.49	0.02	0.49	0.02	0.98	0.04
ea-1p10	0.51	0.02	0.50	0.02	1.01	0.03
ea-10p1	0.60	0.02	0.48	0.02	1.08	0.04
ea-1c10	0.46	0.02	0.49	0.02	0.96	0.04
ga	1.73	0.01	0.47	0.01	2.20	0.02
pbil	1.88	0.02	0.46	0.01	2.34	0.02
umda	1.85	0.02	0.47	0.01	2.32	0.02

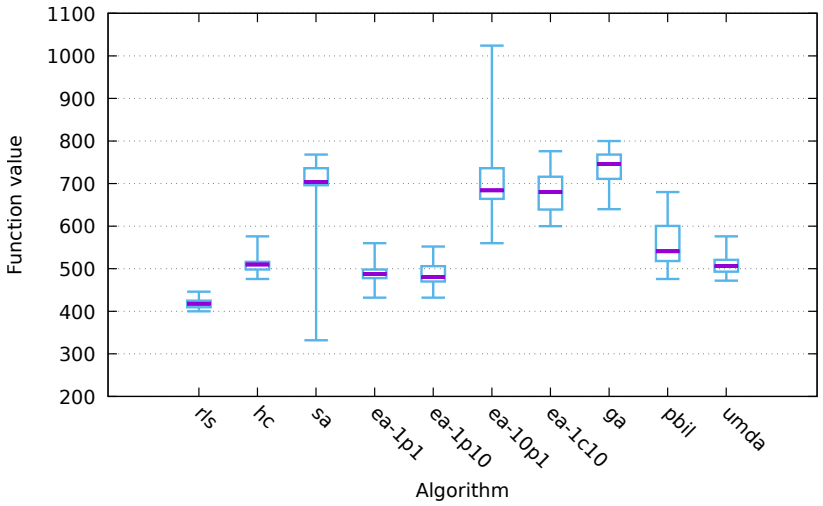


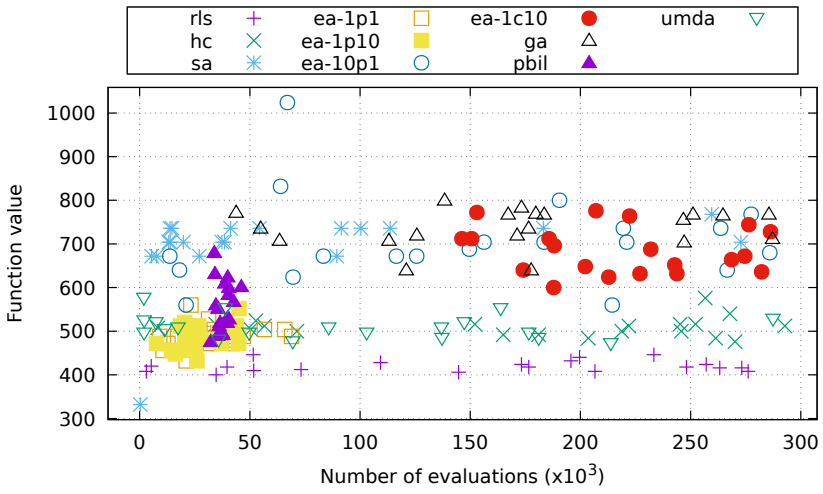


18 Function hiff

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	400	410	418	425	446	10
hc	476	498	510	516	576	6
sa	332	696	704	736	768	2
ea-1p1	432	478	488	498	560	8
ea-1p10	432	470	480	506	552	9
ea-10p1	560	664	684	736	1,024	3
ea-1c10	600	639	680	716	776	4
ga	640	711	746	768	800	1
pbil	476	518	541	601	680	5
umda	472	493	506	521	576	7

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.37	0.01	0.93	0.03	1.31	0.04
hc	0.33	0.01	0.95	0.02	1.28	0.03
sa	0.37	0.01	1.04	0.04	1.40	0.05
ea-1p1	0.47	0.01	0.97	0.03	1.45	0.04
ea-1p10	0.49	0.01	0.97	0.02	1.46	0.03
ea-10p1	0.56	0.10	1.01	0.18	1.57	0.28
ea-1c10	0.46	0.01	1.01	0.03	1.46	0.04
ga	1.95	0.03	1.05	0.02	3.00	0.04
pbil	2.27	0.03	0.96	0.02	3.23	0.05
umda	2.26	0.02	0.93	0.02	3.19	0.04

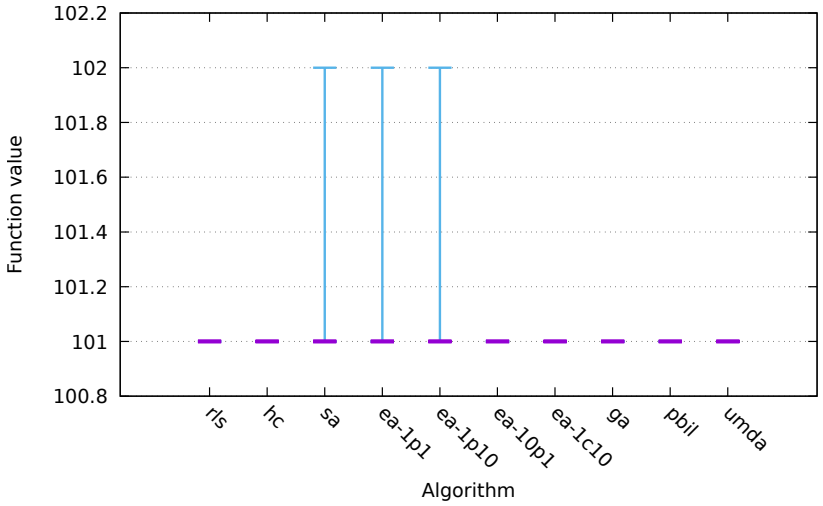


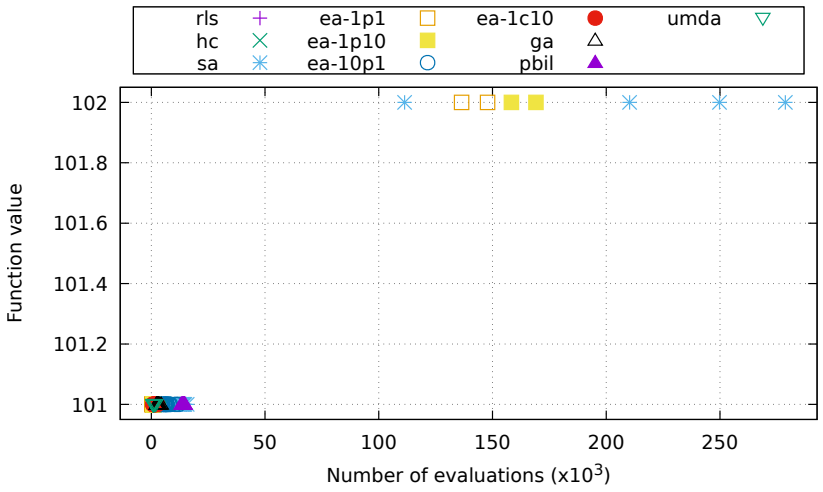


19 Function plateau

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	101	102	1
ea-1p1	101	101	101	101	102	1
ea-1p10	101	101	101	101	102	1
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	0.39	0.01	0.46	0.02	0.84	0.03
hc	0.35	0.01	0.46	0.02	0.80	0.04
sa	0.37	0.06	0.45	0.08	0.81	0.14
ea-1p1	0.47	0.08	0.44	0.08	0.92	0.16
ea-1p10	0.49	0.08	0.45	0.07	0.94	0.15
ea-10p1	0.60	0.02	0.46	0.02	1.06	0.04
ea-1c10	0.47	0.01	0.47	0.01	0.94	0.03
ga	1.73	0.01	0.44	0.01	2.17	0.01
pbil	1.88	0.03	0.45	0.01	2.33	0.04
umda	1.85	0.02	0.44	0.01	2.29	0.03

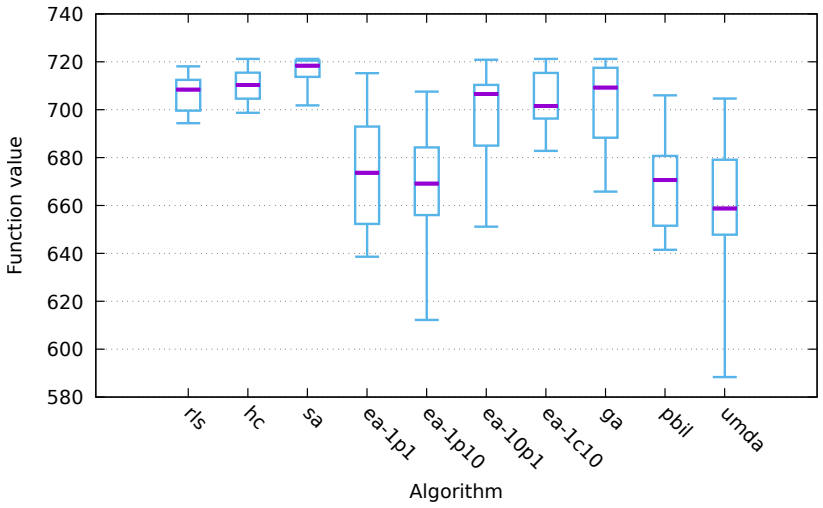


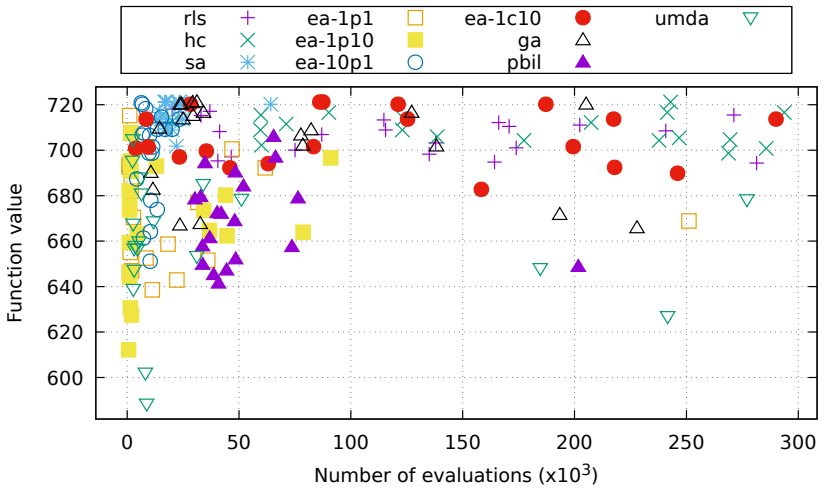


20 Function walsh2

algorithm	function value					
	min	Q_1	med.	Q_3	max	rk
rls	694.37	699.58	708.39	712.45	718.08	4
hc	698.68	704.61	710.23	715.46	721.22	2
sa	701.78	713.69	718.41	720.48	721.22	1
ea-1p1	638.59	652.28	673.71	692.95	715.23	7
ea-1p10	612.19	656.00	669.13	684.24	707.56	9
ea-10p1	651.16	685.00	706.54	710.34	720.85	5
ea-1c10	682.78	696.32	701.56	715.33	721.22	6
ga	665.79	688.29	709.26	717.49	721.22	3
pbil	641.48	651.53	670.55	680.69	705.98	8
umda	588.37	647.80	658.76	679.08	704.66	10

algorithm	algo. time (s)		eval. time (s)		total time (s)	
	mean	dev.	mean	dev.	mean	dev.
rls	0.35	0.01	3.75	0.05	4.10	0.06
hc	0.37	0.01	4.35	0.09	4.72	0.10
sa	0.44	0.01	4.40	0.02	4.84	0.02
ea-1p1	0.57	0.01	4.63	0.04	5.19	0.04
ea-1p10	0.59	0.01	4.62	0.03	5.21	0.04
ea-10p1	0.60	0.09	4.20	0.68	4.80	0.77
ea-1c10	0.44	0.01	3.53	0.01	3.98	0.01
ga	1.68	0.01	4.42	0.05	6.10	0.06
pbil	2.07	0.18	4.22	0.36	6.29	0.53
umda	2.19	0.07	4.30	0.12	6.49	0.18





A Plan


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

```
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},
{
    "id": "fp-5",
    "opt": "-F 40 --stop-on-maximum -t 5",
    "rounding": {
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        "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-no-mutation"
        },
        {
            "id": "ga",
            "opt": "-A 400 --ea-mu 100"
        },
        {
            "id": "pbil",
            "opt": "-A 500 -l 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
# description_path = description.txt
# ea_lambda = 100
# ea_mu = 10
# expression = x
# fn_name = noname
# fn_num_traps = 10
# fn_prefix_length = 2
# fn_threshold = 10
# fp_expression = (1-x)^2+100*(y-x^2)^2
# fp_lower_bound = -2
# fp_num_bits = 8
# fp_upper_bound = 2
# 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 = map.txt
# map_ts_length = 10
# map_ts_sampling_mode = 0
# mutation_rate = 1
# neighborhood = 0
# neighborhood_iterator = 0
# noise_stddev = 1
# num_iterations = 0
# num_threads = 1
# path = function.txt
# pn_mutation_rate = 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
# solution_path = solution.txt
# target = 100
# print_defaults
# last_parameter
# exec_name = hnco
# version = 0.15
```

```
# Generated from hnco.json
```