HNCO
Fixed-budget analysis

August 15, 2021

Contents

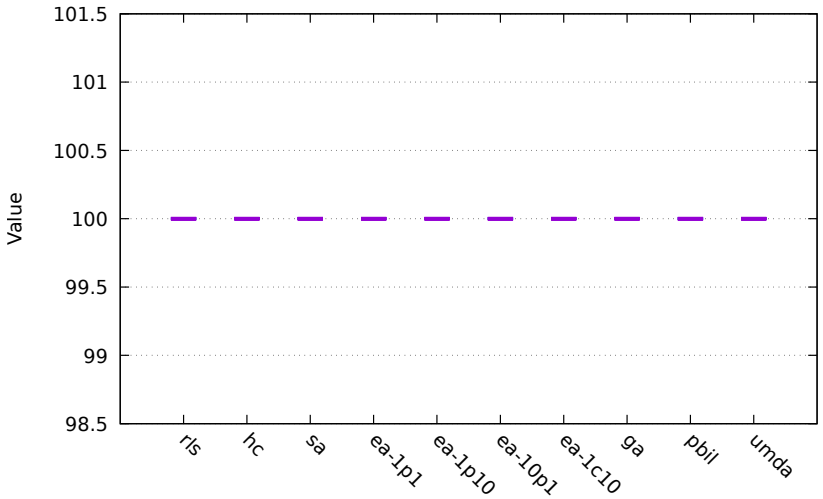
1 Global results

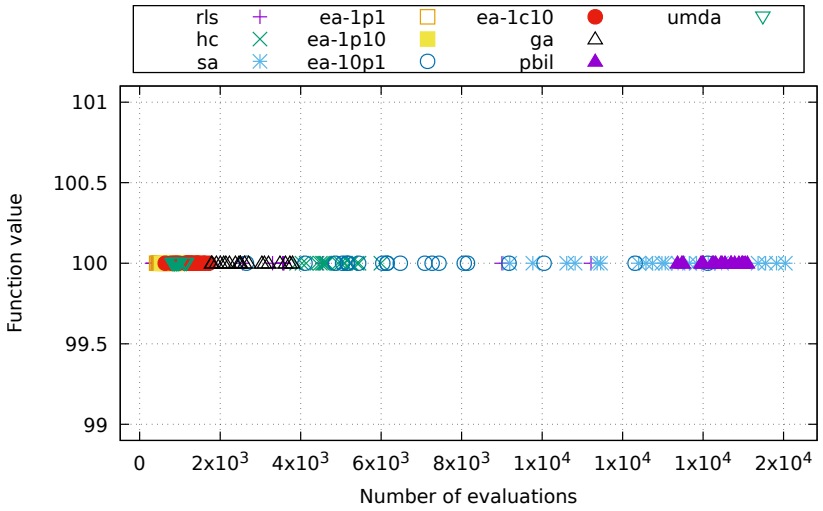
Algorithm	Rank				
	min	Q_1	med.	Q_3	max
pbil	1	1	1	6	10
sa	1	1	2	4	10
ea-10p1	1	1	3	4	8
hc	1	1	3	6	10
ea-1c10	1	2	3	4	8
ga	1	2	3	5	10
umda	1	1	4	7	10
rls	1	1	4	4	10
ea-1p10	1	1	4	7	9
ea-1p1	1	2	4	7	10

2 Function one-max

Algorithm	Value				
	min	Q_1	med.	Q_3	max
rls	**100**	**100**	**100**	**100**	**100**
hc	**100**	**100**	**100**	**100**	**100**
sa	**100**	**100**	**100**	**100**	**100**
ea-1p1	**100**	**100**	**100**	**100**	**100**
ea-1p10	**100**	**100**	**100**	**100**	**100**
ea-10p1	**100**	**100**	**100**	**100**	**100**
ea-1c10	**100**	**100**	**100**	**100**	**100**
ga	**100**	**100**	**100**	**100**	**100**
pbil	**100**	**100**	**100**	**100**	**100**
umda	**100**	**100**	**100**	**100**	**100**

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
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-1c10	0.00	0.00	0.00	0.00	0.00	0.00
rls	0.00	0.00	0.00	0.00	0.00	0.00
hc	0.00	0.00	0.00	0.00	0.00	0.00
umda	0.00	0.00	0.00	0.00	0.00	0.00
ea-10p1	0.00	0.00	0.00	0.00	0.01	0.00
sa	0.00	0.00	0.01	0.00	0.01	0.00
ga	0.01	0.00	0.00	0.00	0.01	0.00
pbil	0.04	0.00	0.01	0.00	0.04	0.00

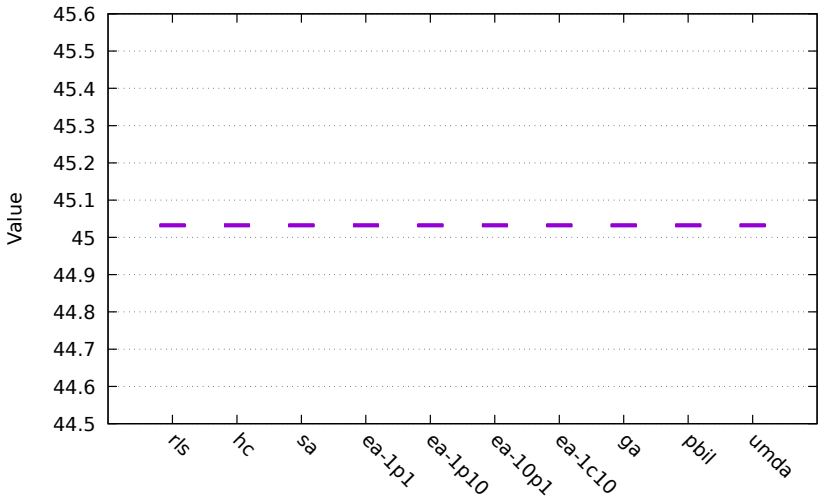


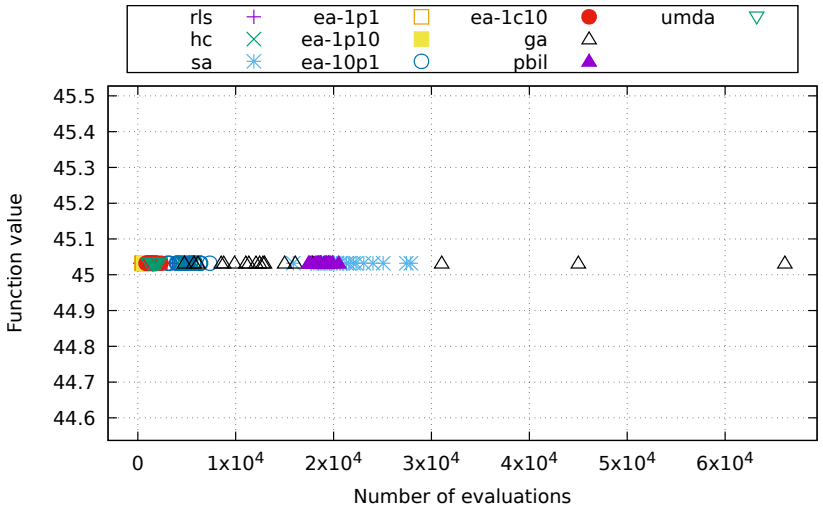

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
101
100.5
100
99.5
99
Function value
0
2x10^3
4x10^3
6x10^3
8x10^3
1x10^4
1x10^4
1x10^4
2x10^4
Number of evaluations

3 Function lin

Algorithm	Value				
	min	Q_1	med.	Q_3	max
rls	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
hc	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
sa	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
ea-1p1	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
ea-1p10	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
ea-10p1	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
ea-1c10	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
ga	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
pbil	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**
umda	**45.03**	**45.03**	**45.03**	**45.03**	**45.03**

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
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
rls	0.00	0.00	0.00	0.00	0.00	0.00
ea-1c10	0.00	0.00	0.00	0.00	0.00	0.00
hc	0.00	0.00	0.00	0.00	0.00	0.00
ea-10p1	0.00	0.00	0.00	0.00	0.01	0.00
umda	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
ga	0.03	0.03	0.01	0.01	0.04	0.04
pbil	0.05	0.00	0.01	0.00	0.06	0.00

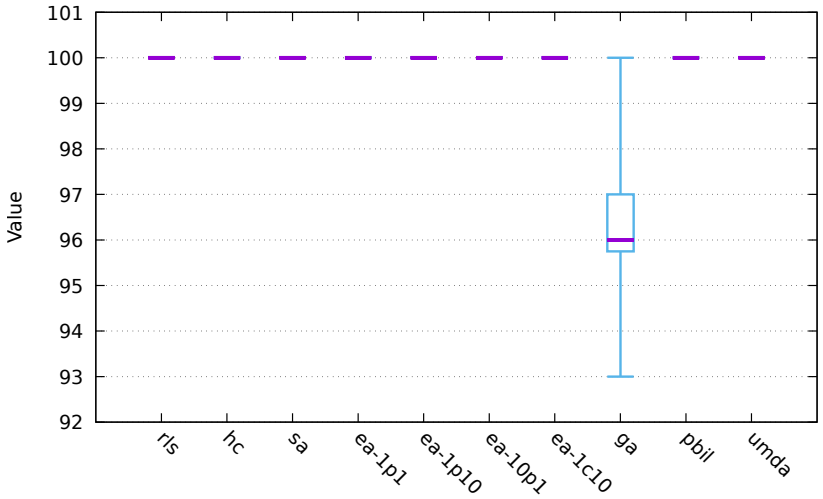


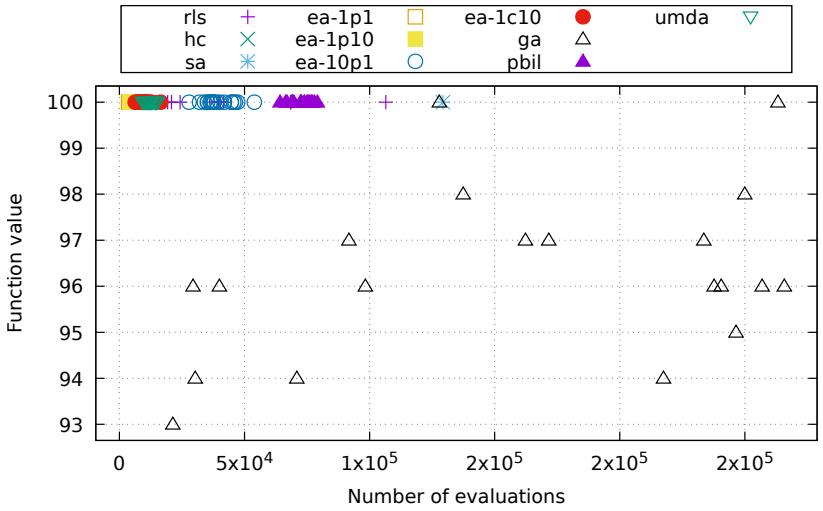

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
45.5
45.4
45.3
45.2
45.1
45
44.9
44.8
44.7
44.6
0
1x10^4
2x10^4
3x10^4
4x10^4
5x10^4
6x10^4
Number of evaluations

4 Function leading-ones

Algorithm	Value				
	min	Q_1	med.	Q_3	max
rls	**100**	**100**	**100**	**100**	**100**
hc	**100**	**100**	**100**	**100**	**100**
sa	**100**	**100**	**100**	**100**	**100**
ea-1p1	**100**	**100**	**100**	**100**	**100**
ea-1p10	**100**	**100**	**100**	**100**	**100**
ea-10p1	**100**	**100**	**100**	**100**	**100**
ea-1c10	**100**	**100**	**100**	**100**	**100**
pbil	**100**	**100**	**100**	**100**	**100**
umda	**100**	**100**	**100**	**100**	**100**
ga	93	96	96	97	**100**

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	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-1p1	0.00	0.00	0.00	0.00	0.01	0.00
sa	0.00	0.01	0.00	0.01	0.01	0.02
ea-1c10	0.00	0.00	0.00	0.00	0.01	0.00
rls	0.01	0.01	0.01	0.01	0.02	0.02
ea-10p1	0.02	0.00	0.02	0.00	0.04	0.01
umda	0.03	0.00	0.00	0.00	0.03	0.00
pbil	0.18	0.01	0.03	0.00	0.21	0.01
ga	0.59	0.08	0.12	0.02	0.71	0.10

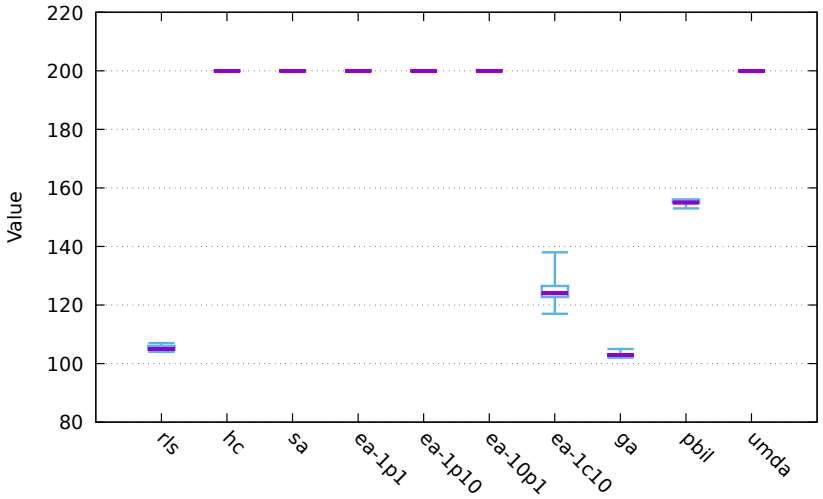


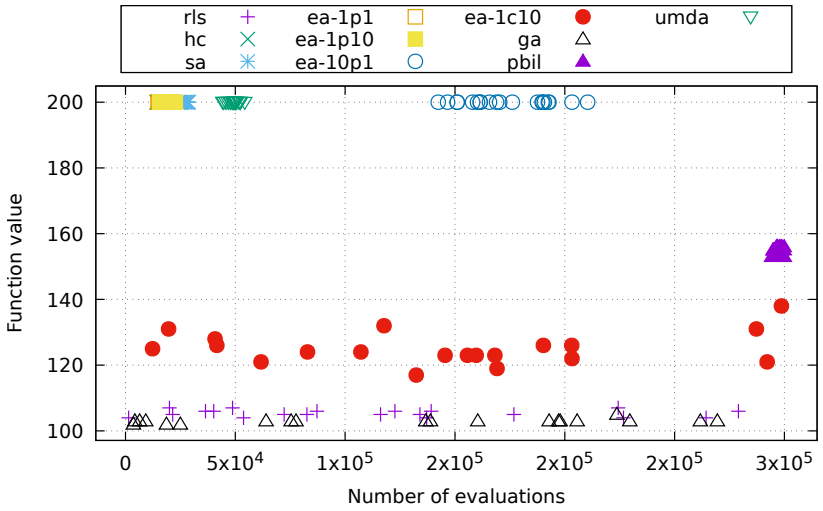

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
100
99
98
97
96
95
94
93
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
Number of evaluations

5 Function ridge

Algorithm	Value				
	min	Q_1	med.	Q_3	max
hc	**200**	**200**	**200**	**200**	**200**
sa	**200**	**200**	**200**	**200**	**200**
ea-1p1	**200**	**200**	**200**	**200**	**200**
ea-1p10	**200**	**200**	**200**	**200**	**200**
ea-10p1	**200**	**200**	**200**	**200**	**200**
umda	**200**	**200**	**200**	**200**	**200**
pbil	153	155	155	156	156
ea-1c10	117	123	124	127	138
rls	104	105	105	106	107
ga	102	103	103	103	105

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.00	0.00	0.01	0.00	0.01	0.00
sa	0.01	0.00	0.01	0.00	0.02	0.00
ea-1p1	0.01	0.00	0.01	0.00	0.02	0.00
ea-1p10	0.01	0.00	0.01	0.00	0.02	0.00
rls	0.09	0.00	0.12	0.00	0.21	0.00
ea-10p1	0.10	0.01	0.07	0.01	0.18	0.02
umda	0.11	0.01	0.02	0.00	0.13	0.01
ea-1c10	0.13	0.00	0.12	0.00	0.25	0.00
ga	0.60	0.01	0.12	0.00	0.73	0.01
pbil	0.66	0.01	0.13	0.00	0.78	0.01

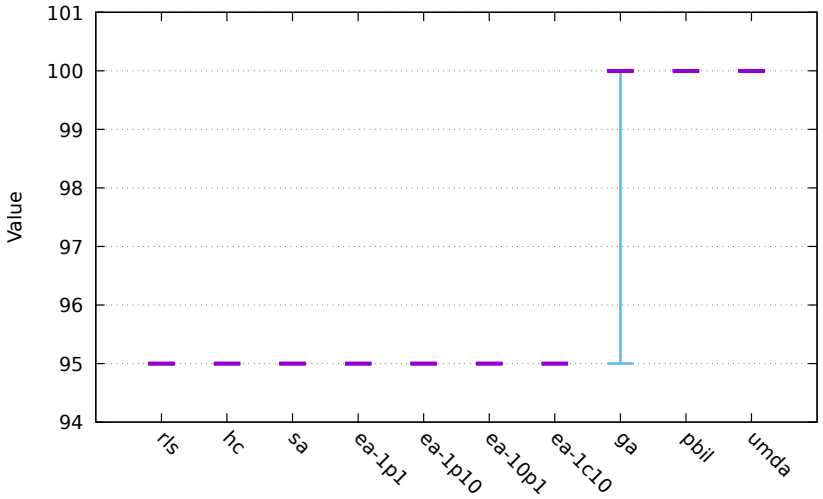


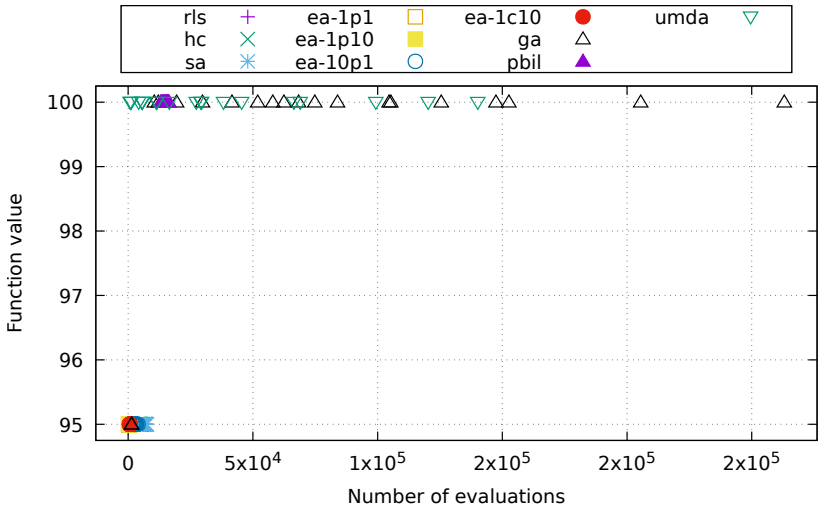

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
200
180
160
140
120
100
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

6 Function jmp-5

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	**100**	**100**	**100**	**100**	**100**
umda	**100**	**100**	**100**	**100**	**100**
ga	95	**100**	**100**	**100**	**100**
rls	95	95	95	95	95
hc	95	95	95	95	95
sa	95	95	95	95	95
ea-1p1	95	95	95	95	95
ea-1p10	95	95	95	95	95
ea-10p1	95	95	95	95	95
ea-1c10	95	95	95	95	95

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
pbil	0.04	0.00	0.01	0.00	0.05	0.00
umda	0.08	0.09	0.01	0.02	0.10	0.11
hc	0.08	0.00	0.11	0.00	0.19	0.00
rls	0.09	0.00	0.12	0.00	0.21	0.01
sa	0.10	0.00	0.12	0.00	0.21	0.01
ea-1c10	0.13	0.00	0.12	0.00	0.24	0.00
ea-1p1	0.14	0.00	0.12	0.00	0.26	0.01
ea-1p10	0.14	0.00	0.12	0.00	0.26	0.01
ea-10p1	0.17	0.00	0.12	0.00	0.29	0.00
ga	0.22	0.18	0.04	0.04	0.27	0.22

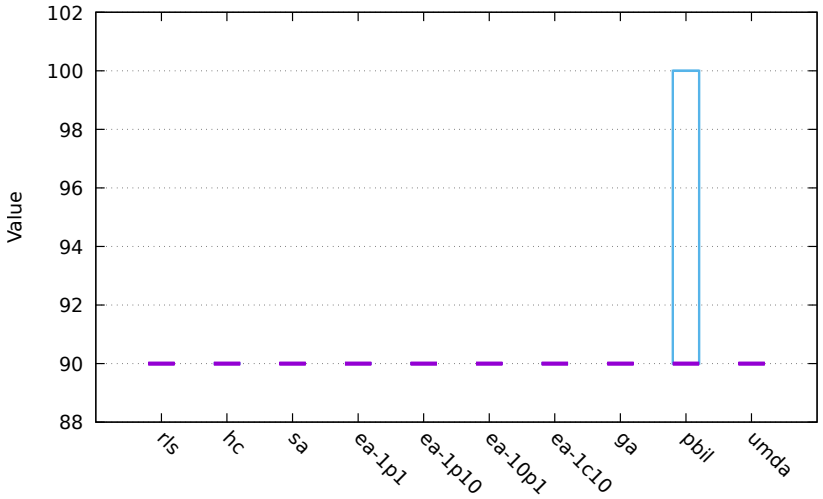


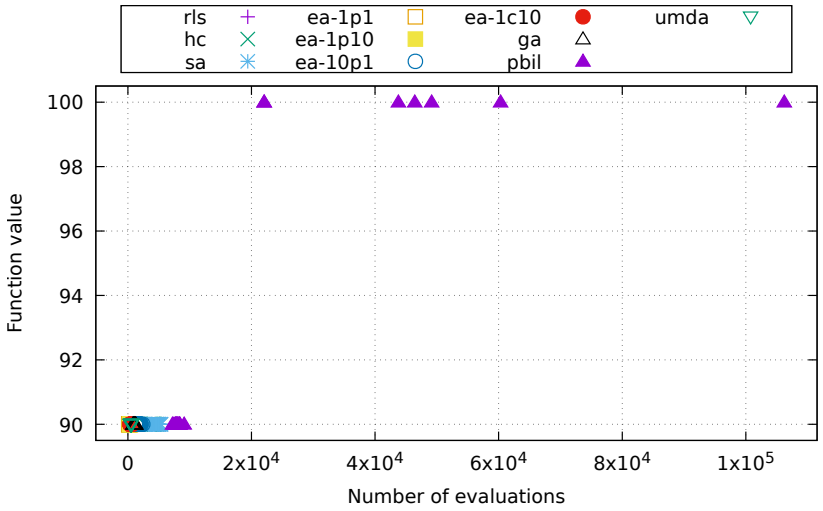

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
100
99
98
97
96
95
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
Number of evaluations

7 Function jmp-10

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	**90**	**90**	**90**	**100**	**100**
rls	**90**	**90**	**90**	90	90
hc	**90**	**90**	**90**	90	90
sa	**90**	**90**	**90**	90	90
ea-1p1	**90**	**90**	**90**	90	90
ea-1p10	**90**	**90**	**90**	90	90
ea-10p1	**90**	**90**	**90**	90	90
ea-1c10	**90**	**90**	**90**	90	90
ga	**90**	**90**	**90**	90	90
umda	**90**	**90**	**90**	90	90

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.12	0.00	0.20	0.01
rls	0.09	0.00	0.12	0.00	0.21	0.01
sa	0.10	0.00	0.12	0.00	0.21	0.00
ea-1c10	0.13	0.00	0.12	0.00	0.24	0.01
ea-1p1	0.14	0.00	0.12	0.00	0.25	0.01
ea-1p10	0.15	0.01	0.12	0.00	0.26	0.01
ea-10p1	0.17	0.00	0.12	0.00	0.29	0.01
pbil	0.50	0.28	0.08	0.05	0.58	0.33
ga	0.60	0.01	0.12	0.00	0.72	0.01
umda	0.67	0.01	0.12	0.00	0.79	0.01

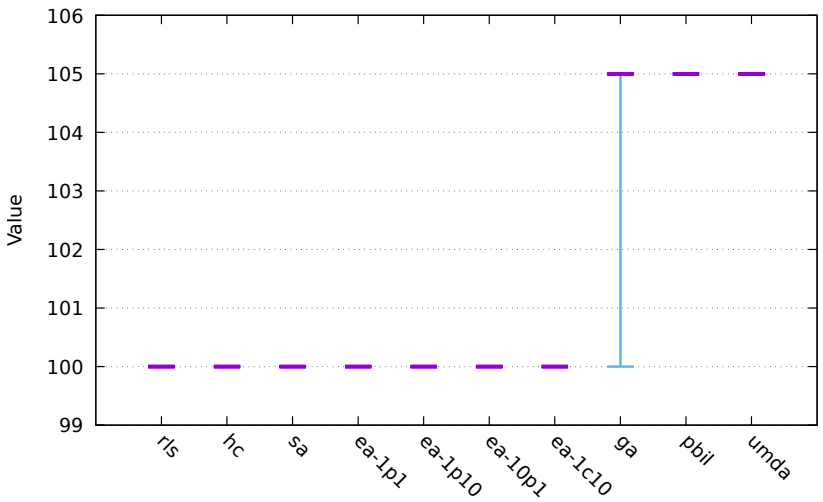


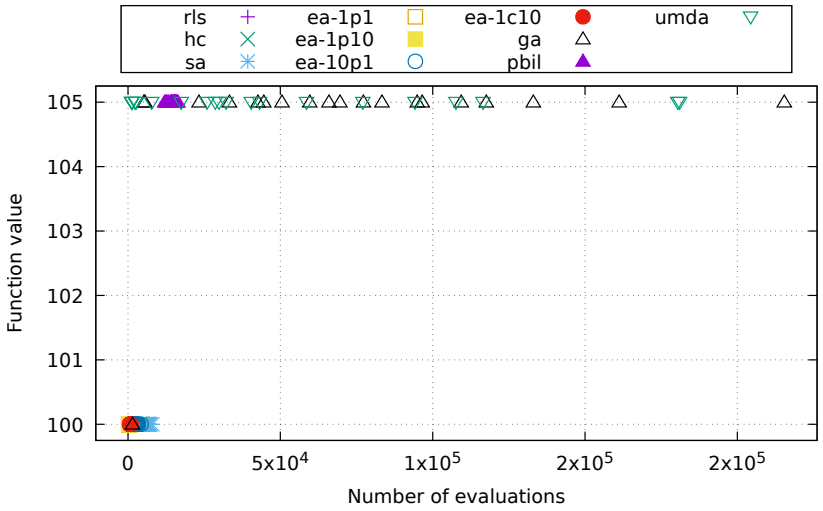

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
100
98
96
94
92
90
0
2x10^4
4x10^4
6x10^4
8x10^4
1x10^5
Number of evaluations

8 Function djmp-5

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	**105**	**105**	**105**	**105**	**105**
umda	**105**	**105**	**105**	**105**	**105**
ga	100	**105**	**105**	**105**	**105**
rls	100	100	100	100	100
hc	100	100	100	100	100
sa	100	100	100	100	100
ea-1p1	100	100	100	100	100
ea-1p10	100	100	100	100	100
ea-10p1	100	100	100	100	100
ea-1c10	100	100	100	100	100

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
pbil	0.04	0.00	0.01	0.00	0.04	0.00
hc	0.08	0.00	0.11	0.00	0.20	0.00
rls	0.09	0.00	0.12	0.00	0.21	0.01
sa	0.10	0.00	0.11	0.00	0.21	0.00
umda	0.12	0.13	0.02	0.02	0.14	0.15
ea-1c10	0.13	0.00	0.12	0.00	0.24	0.01
ea-1p1	0.14	0.00	0.12	0.00	0.25	0.01
ea-1p10	0.14	0.00	0.12	0.00	0.26	0.00
ea-10p1	0.17	0.01	0.12	0.00	0.29	0.01
ga	0.18	0.14	0.03	0.03	0.21	0.17

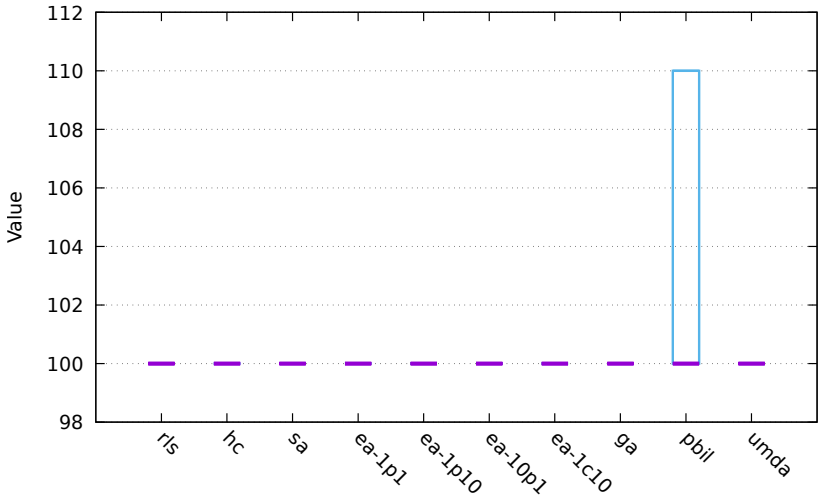


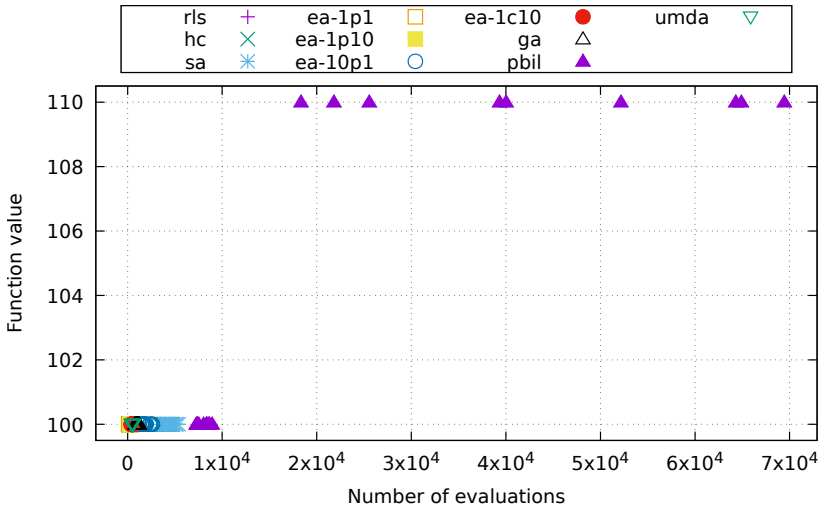

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
105
104
103
102
101
100
Function value
0
5x10^4
1x10^5
2x10^5
2x10^5
Number of evaluations

9 Function djmp-10

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	**100**	**100**	**100**	**110**	**110**
rls	**100**	**100**	**100**	100	100
hc	**100**	**100**	**100**	100	100
sa	**100**	**100**	**100**	100	100
ea-1p1	**100**	**100**	**100**	100	100
ea-1p10	**100**	**100**	**100**	100	100
ea-10p1	**100**	**100**	**100**	100	100
ea-1c10	**100**	**100**	**100**	100	100
ga	**100**	**100**	**100**	100	100
umda	**100**	**100**	**100**	100	100

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.11	0.00	0.20	0.00
rls	0.09	0.00	0.12	0.00	0.21	0.00
sa	0.10	0.00	0.12	0.00	0.21	0.01
ea-1c10	0.13	0.00	0.12	0.00	0.24	0.01
ea-1p1	0.14	0.00	0.12	0.00	0.25	0.00
ea-1p10	0.14	0.00	0.11	0.00	0.26	0.00
ea-10p1	0.17	0.00	0.12	0.00	0.29	0.01
pbil	0.44	0.30	0.07	0.05	0.51	0.35
ga	0.61	0.01	0.12	0.00	0.72	0.01
umda	0.67	0.01	0.12	0.00	0.79	0.01

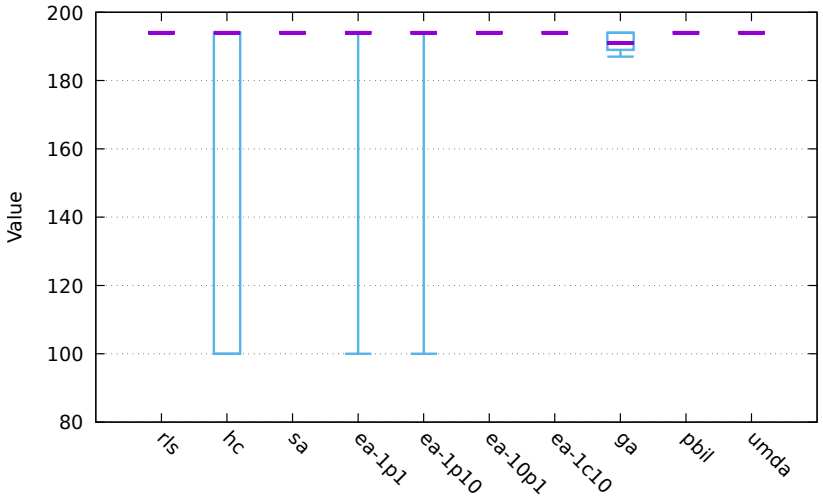


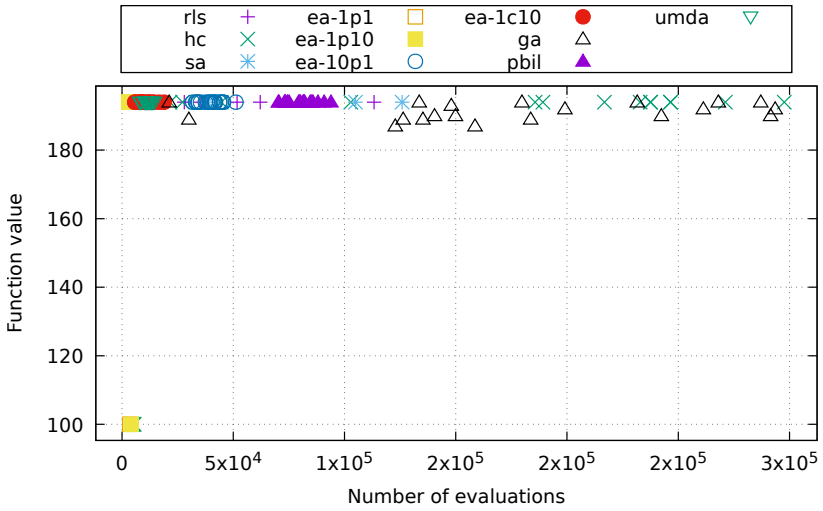

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
110
108
106
104
102
100
0
1x10^4
2x10^4
3x10^4
4x10^4
5x10^4
6x10^4
7x10^4
Number of evaluations

10 Function fp-5

Algorithm	Value				
	min	Q_1	med.	Q_3	max
rls	**194**	**194**	**194**	**194**	**194**
sa	**194**	**194**	**194**	**194**	**194**
ea-10p1	**194**	**194**	**194**	**194**	**194**
ea-1c10	**194**	**194**	**194**	**194**	**194**
pbil	**194**	**194**	**194**	**194**	**194**
umda	**194**	**194**	**194**	**194**	**194**
ea-1p1	100	**194**	**194**	**194**	**194**
ea-1p10	100	**194**	**194**	**194**	**194**
hc	100	100	**194**	**194**	**194**
ga	187	189	191	**194**	**194**

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
ea-1c10	0.00	0.00	0.00	0.00	0.01	0.00
sa	0.01	0.01	0.01	0.01	0.01	0.02
rls	0.01	0.01	0.01	0.01	0.02	0.02
ea-1p1	0.01	0.03	0.01	0.03	0.02	0.06
ea-1p10	0.01	0.03	0.01	0.03	0.02	0.06
ea-10p1	0.02	0.00	0.02	0.00	0.04	0.01
umda	0.03	0.00	0.00	0.00	0.03	0.00
hc	0.06	0.03	0.09	0.04	0.15	0.06
pbil	0.20	0.02	0.03	0.00	0.23	0.02
ga	0.54	0.15	0.11	0.03	0.65	0.18

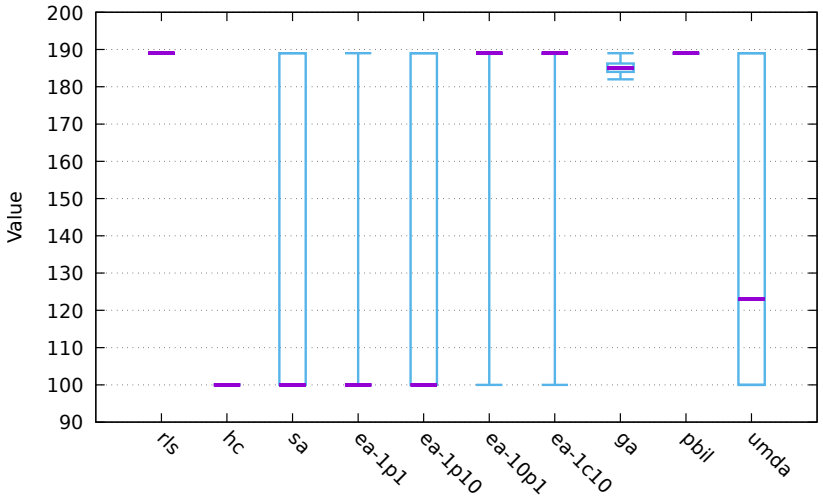


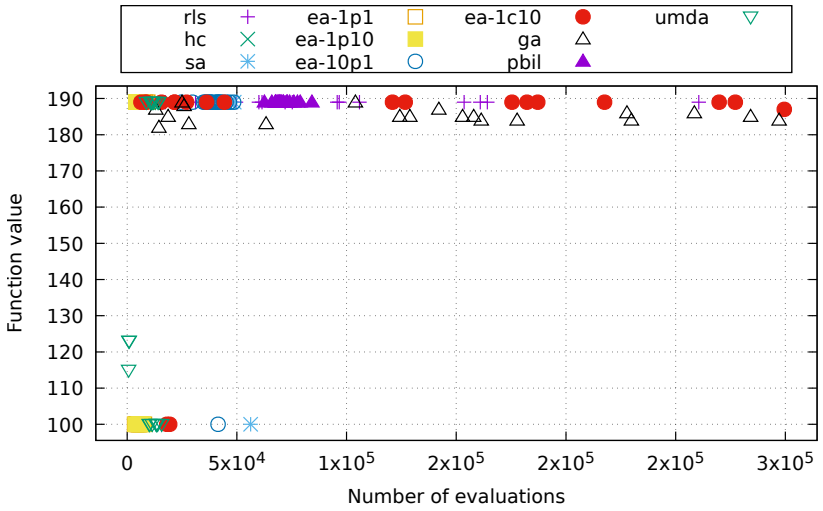

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
180
160
140
120
100
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

11 Function fp-10

Algorithm	Value				
	min	Q_1	med.	Q_3	max
rls	**189**	**189**	**189**	**189**	**189**
pbil	**189**	**189**	**189**	**189**	**189**
ea-10p1	100	**189**	**189**	**189**	**189**
ea-1c10	100	**189**	**189**	**189**	**189**
ga	182	184	185	186	**189**
umda	100	100	123	**189**	**189**
sa	100	100	100	**189**	**189**
ea-1p10	100	100	100	**189**	**189**
ea-1p1	100	100	100	100	**189**
hc	100	100	100	100	100

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
rls	0.02	0.02	0.03	0.03	0.06	0.05
ea-10p1	0.03	0.03	0.02	0.02	0.05	0.06
ea-1c10	0.06	0.05	0.06	0.05	0.11	0.10
sa	0.07	0.04	0.09	0.05	0.16	0.09
hc	0.08	0.00	0.12	0.00	0.20	0.01
ea-1p10	0.09	0.07	0.08	0.06	0.18	0.13
ea-1p1	0.11	0.06	0.10	0.05	0.21	0.10
pbil	0.17	0.01	0.03	0.00	0.20	0.01
umda	0.37	0.32	0.07	0.06	0.44	0.38
ga	0.56	0.15	0.12	0.03	0.67	0.18

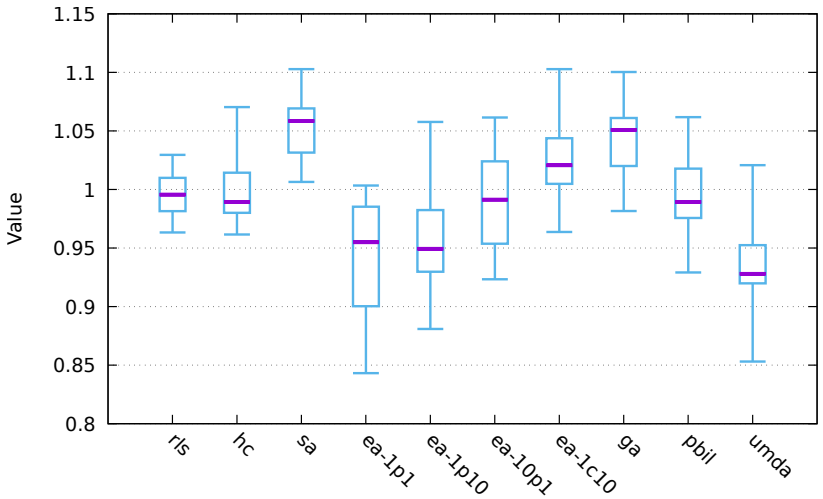


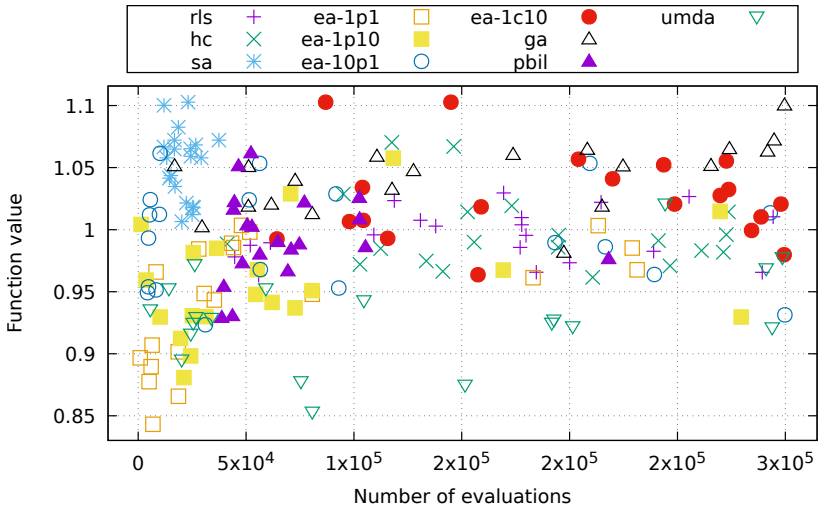

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
190
180
170
160
150
140
130
120
110
100
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

12 Function nk

Algorithm	Value				
	min	Q_1	med.	Q_3	max
sa	**1.01**	**1.03**	**1.06**	**1.07**	**1.10**
ga	0.98	1.02	1.05	1.06	1.10
ea-1c10	0.96	1.00	1.02	1.04	**1.10**
rls	0.96	0.98	1.00	1.01	1.03
ea-10p1	0.92	0.95	0.99	1.02	1.06
pbil	0.93	0.98	0.99	1.02	1.06
hc	0.96	0.98	0.99	1.01	1.07
ea-1p1	0.84	0.90	0.95	0.99	1.00
ea-1p10	0.88	0.93	0.95	0.98	1.06
umda	0.85	0.92	0.93	0.95	1.02

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.43	0.01	0.52	0.01
rls	0.10	0.00	0.45	0.01	0.55	0.01
sa	0.10	0.00	0.40	0.01	0.51	0.01
ea-1c10	0.13	0.00	0.41	0.01	0.54	0.01
ea-1p1	0.14	0.00	0.43	0.01	0.57	0.01
ea-1p10	0.15	0.00	0.44	0.01	0.58	0.01
ea-10p1	0.18	0.00	0.46	0.01	0.64	0.01
ga	0.61	0.01	0.52	0.01	1.13	0.01
umda	0.65	0.01	0.42	0.01	1.07	0.02
pbil	0.67	0.01	0.47	0.01	1.13	0.01

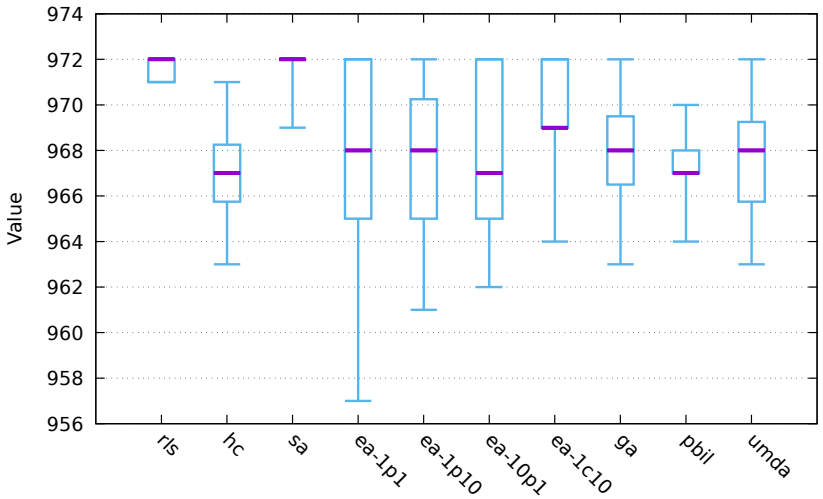


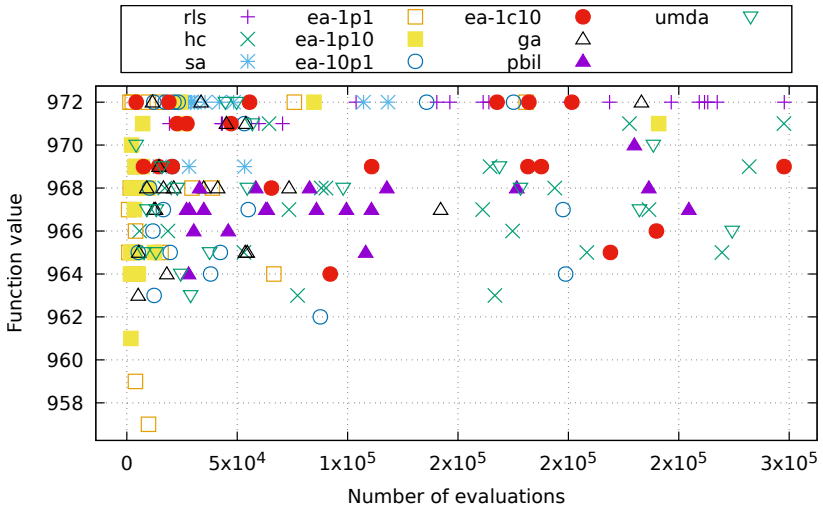

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
1.1
1.05
1
0.95
0.9
0.85
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

13 Function max-sat

Algorithm	Value				
	min	Q_1	med.	Q_3	max
sa	969	**972**	**972**	**972**	**972**
rls	**971**	971	**972**	**972**	**972**
ea-1c10	964	969	969	**972**	**972**
ea-1p1	957	965	968	**972**	**972**
ea-1p10	961	965	968	970	**972**
ga	963	967	968	970	**972**
umda	963	966	968	969	**972**
ea-10p1	962	965	967	**972**	**972**
hc	963	966	967	968	971
pbil	964	967	967	968	970

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.01	1.88	0.10	1.96	0.11
rls	0.10	0.00	1.94	0.07	2.03	0.07
sa	0.10	0.01	1.78	0.10	1.88	0.10
ea-1c10	0.13	0.00	1.75	0.07	1.88	0.07
ea-1p1	0.15	0.00	1.91	0.05	2.06	0.05
ea-1p10	0.15	0.00	1.91	0.05	2.06	0.05
ea-10p1	0.19	0.00	2.22	0.07	2.40	0.07
ga	0.61	0.00	2.35	0.07	2.97	0.07
umda	0.66	0.01	1.77	0.05	2.42	0.05
pbil	0.68	0.01	1.99	0.05	2.67	0.05

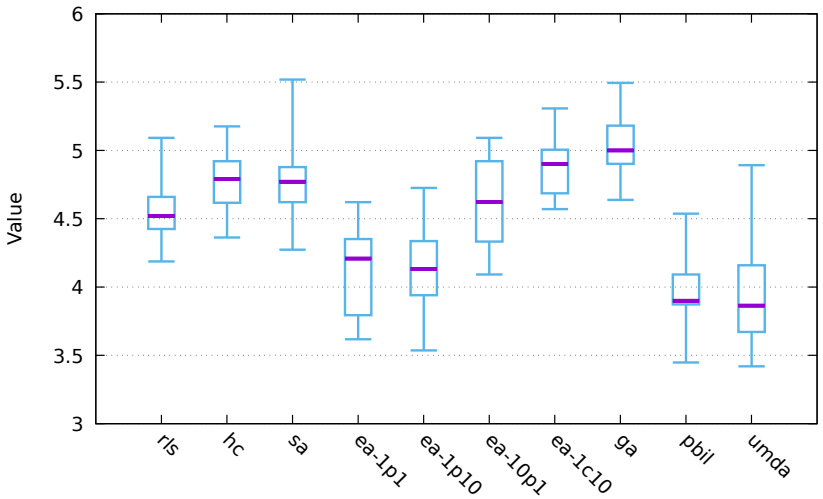


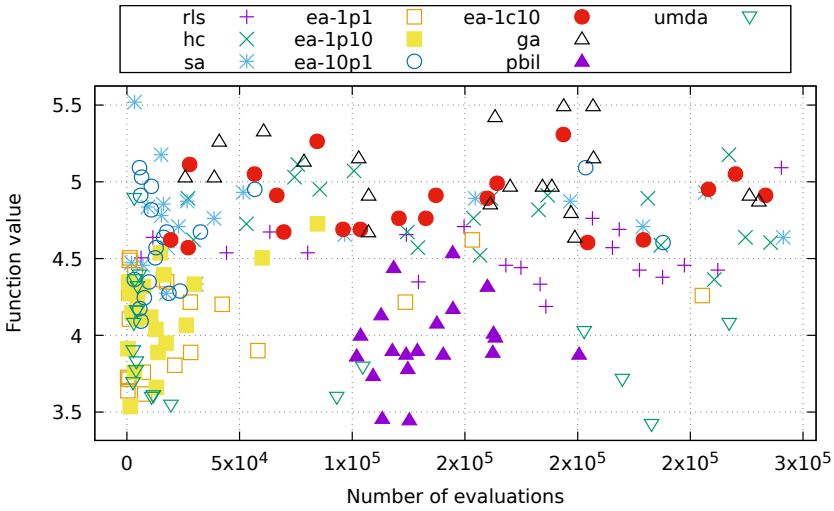

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
972
970
968
966
964
962
960
958
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

14 Function labs

Algorithm	Value				
	min	Q_1	med.	Q_3	max
ga	**4.64**	**4.90**	**5.00**	**5.18**	5.49
ea-1c10	4.57	4.69	4.90	5.01	5.31
hc	4.36	4.62	4.79	4.92	5.18
sa	4.27	4.62	4.77	4.88	**5.52**
ea-10p1	4.09	4.33	4.62	4.92	5.09
rls	4.19	4.42	4.52	4.66	5.09
ea-1p1	3.62	3.79	4.21	4.35	4.62
ea-1p10	3.54	3.94	4.13	4.34	4.73
pbil	3.45	3.87	3.90	4.09	4.54
umda	3.42	3.67	3.86	4.16	4.89

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	1.93	0.03	2.02	0.03
rls	0.10	0.00	1.93	0.03	2.03	0.03
sa	0.10	0.00	1.94	0.03	2.04	0.03
ea-1c10	0.13	0.00	1.94	0.02	2.07	0.02
ea-1p1	0.14	0.00	1.93	0.02	2.08	0.02
ea-1p10	0.15	0.00	1.93	0.03	2.08	0.03
ea-10p1	0.18	0.00	1.95	0.03	2.12	0.03
ga	0.61	0.01	1.94	0.02	2.55	0.02
umda	0.65	0.01	1.94	0.02	2.59	0.02
pbil	0.71	0.01	1.95	0.02	2.65	0.02

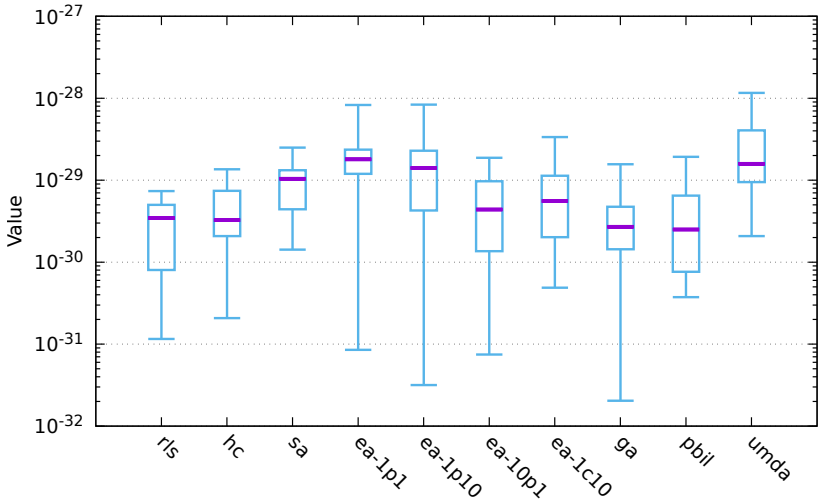


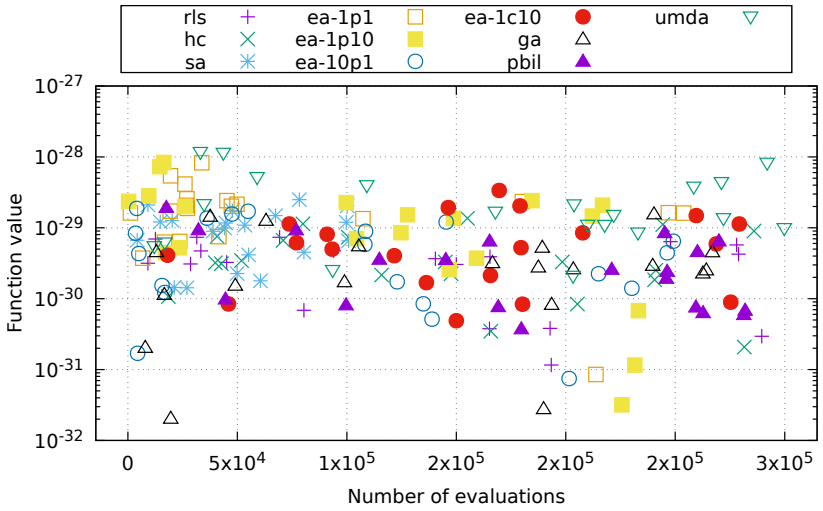

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
5.5
5
4.5
4
3.5
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

15 Function ep

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	3.7×10^{-31}	$\mathbf{7.6 \times 10^{-31}}$	$\mathbf{2.5 \times 10^{-30}}$	6.5×10^{-30}	1.9×10^{-29}
ga	$\mathbf{2.0 \times 10^{-32}}$	1.4×10^{-30}	2.7×10^{-30}	$\mathbf{4.7 \times 10^{-30}}$	1.6×10^{-29}
hc	2.1×10^{-31}	2.1×10^{-30}	3.3×10^{-30}	7.4×10^{-30}	1.4×10^{-29}
rls	1.2×10^{-31}	8.0×10^{-31}	3.5×10^{-30}	5.0×10^{-30}	$\mathbf{7.4 \times 10^{-30}}$
ea-10p1	7.5×10^{-32}	1.4×10^{-30}	4.4×10^{-30}	9.7×10^{-30}	1.9×10^{-29}
ea-1c10	4.9×10^{-31}	2.0×10^{-30}	5.6×10^{-30}	1.1×10^{-29}	3.4×10^{-29}
sa	1.4×10^{-30}	4.4×10^{-30}	1.0×10^{-29}	1.3×10^{-29}	2.5×10^{-29}
ea-1p10	3.2×10^{-32}	4.3×10^{-30}	1.4×10^{-29}	2.3×10^{-29}	8.3×10^{-29}
umda	2.1×10^{-30}	9.5×10^{-30}	1.6×10^{-29}	4.1×10^{-29}	1.2×10^{-28}
ea-1p1	8.5×10^{-32}	1.2×10^{-29}	1.8×10^{-29}	2.4×10^{-29}	8.3×10^{-29}

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.15	0.00	0.23	0.00
rls	0.09	0.00	0.16	0.00	0.25	0.01
sa	0.10	0.00	0.15	0.00	0.25	0.00
ea-1c10	0.13	0.00	0.15	0.00	0.28	0.00
ea-1p1	0.14	0.00	0.15	0.00	0.29	0.01
ea-1p10	0.14	0.00	0.15	0.00	0.30	0.00
ea-10p1	0.17	0.00	0.17	0.00	0.34	0.01
ga	0.61	0.01	0.20	0.00	0.80	0.01
umda	0.65	0.01	0.15	0.00	0.80	0.01
pbil	0.76	0.01	0.21	0.00	0.96	0.01

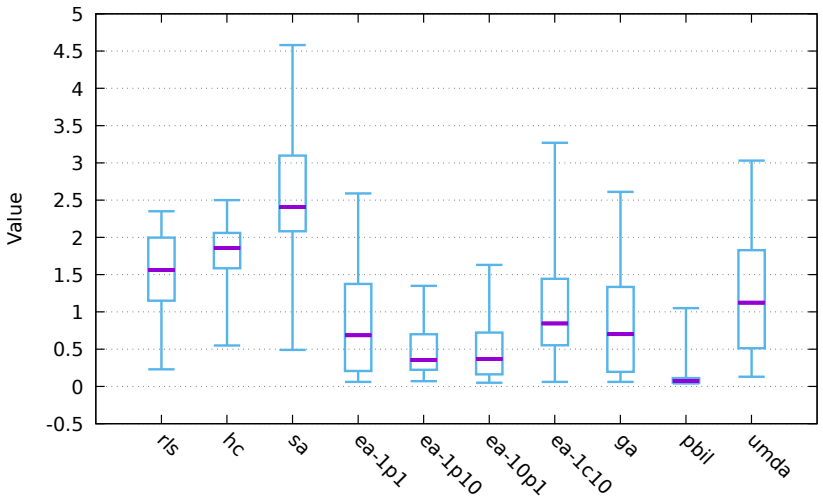


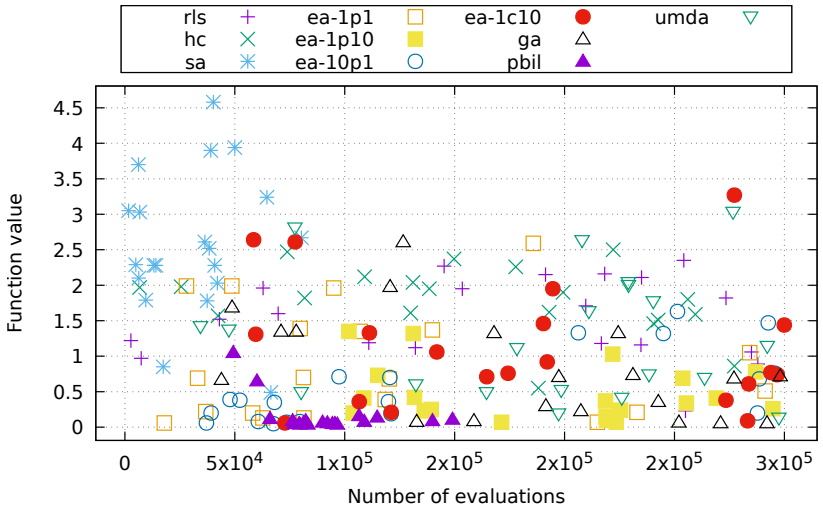

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
10-27
10-28
10-29
10-30
10-31
10-32
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

16 Function cancel

Algorithm	Value				
	min	Q_1	med.	Q_3	max
pbil	**0.04**	**0.05**	**0.08**	**0.11**	**1.05**
ea-1p10	0.07	0.22	0.36	0.70	1.35
ea-10p1	0.05	0.16	0.37	0.72	1.63
ea-1p1	0.06	0.21	0.69	1.38	2.59
ga	0.06	0.20	0.70	1.34	2.61
ea-1c10	0.06	0.55	0.85	1.45	3.27
umda	0.13	0.51	1.13	1.83	3.03
rls	0.23	1.15	1.56	2.00	2.35
hc	0.55	1.59	1.86	2.06	2.50
sa	0.49	2.08	2.41	3.10	4.58

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.14	0.00	0.22	0.00
rls	0.09	0.00	0.15	0.00	0.24	0.01
sa	0.10	0.00	0.14	0.00	0.24	0.01
ea-1c10	0.13	0.00	0.14	0.00	0.27	0.01
ea-1p1	0.14	0.00	0.15	0.00	0.28	0.01
ea-1p10	0.14	0.00	0.14	0.00	0.29	0.01
ea-10p1	0.17	0.01	0.15	0.00	0.32	0.01
ga	0.60	0.01	0.15	0.00	0.75	0.01
umda	0.64	0.01	0.14	0.00	0.78	0.01
pbil	0.68	0.01	0.16	0.00	0.83	0.01

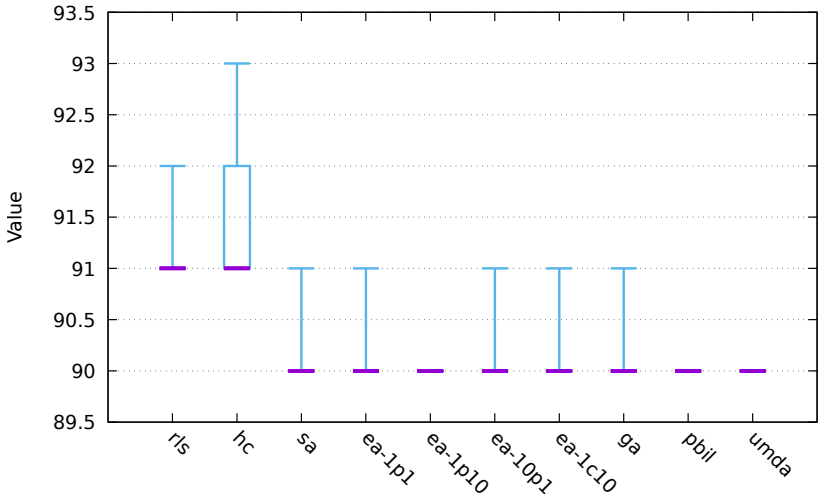


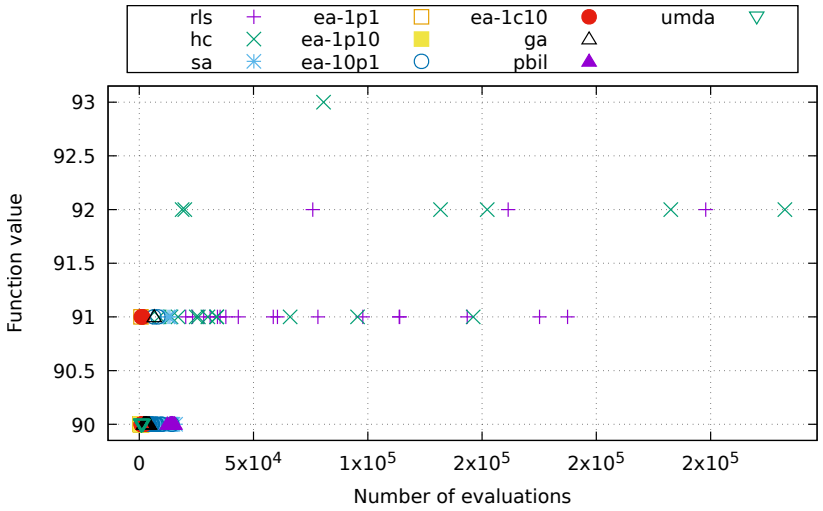

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

17 Function trap

Algorithm	Value				
	min	Q_1	med.	Q_3	max
hc	**91**	**91**	**91**	**92**	**93**
rls	**91**	**91**	**91**	91	92
sa	90	90	90	90	91
ea-1p1	90	90	90	90	91
ea-10p1	90	90	90	90	91
ea-1c10	90	90	90	90	91
ga	90	90	90	90	91
ea-1p10	90	90	90	90	90
pbil	90	90	90	90	90
umda	90	90	90	90	90

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.13	0.00	0.21	0.00
rls	0.09	0.00	0.13	0.00	0.22	0.01
sa	0.10	0.00	0.13	0.00	0.23	0.01
ea-1c10	0.13	0.00	0.13	0.00	0.26	0.01
ea-1p1	0.14	0.00	0.13	0.00	0.27	0.01
ea-1p10	0.15	0.00	0.13	0.00	0.28	0.01
ea-10p1	0.17	0.00	0.13	0.00	0.31	0.01
ga	0.60	0.01	0.13	0.00	0.73	0.01
umda	0.64	0.01	0.13	0.00	0.77	0.01
pbil	0.65	0.01	0.13	0.00	0.79	0.01

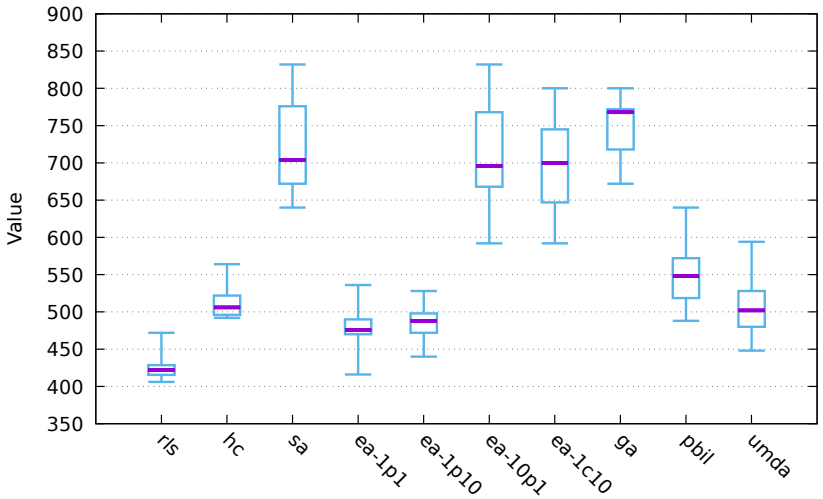


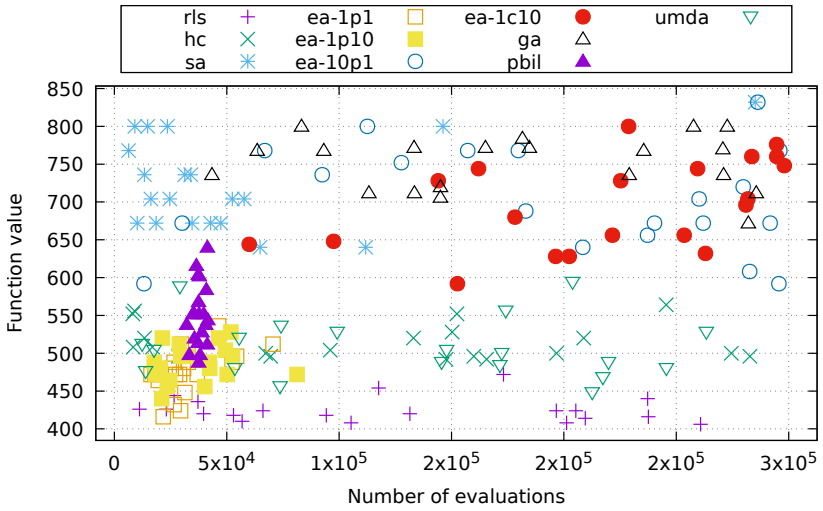

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
93
92.5
92
91.5
91
90.5
90
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
Number of evaluations

18 Function hiff

Algorithm	Value				
	min	Q_1	med.	Q_3	max
ga	**672**	**718**	**768**	772	800
sa	640	672	704	**776**	**832**
ea-1c10	592	647	700	745	800
ea-10p1	592	668	696	768	**832**
pbil	488	519	548	572	640
hc	492	496	506	522	564
umda	448	480	502	528	594
ea-1p10	440	472	488	498	528
ea-1p1	416	470	476	490	536
rls	406	416	422	429	472

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.35	0.01	0.44	0.01
rls	0.10	0.00	0.36	0.02	0.45	0.02
sa	0.10	0.00	0.41	0.01	0.51	0.01
ea-1c10	0.13	0.00	0.39	0.01	0.52	0.01
ea-1p1	0.14	0.00	0.37	0.01	0.51	0.01
ea-1p10	0.15	0.00	0.38	0.01	0.52	0.01
ea-10p1	0.18	0.01	0.42	0.01	0.59	0.01
ga	0.71	0.01	0.44	0.01	1.15	0.01
umda	0.80	0.01	0.38	0.02	1.17	0.02
pbil	0.82	0.02	0.40	0.01	1.22	0.02

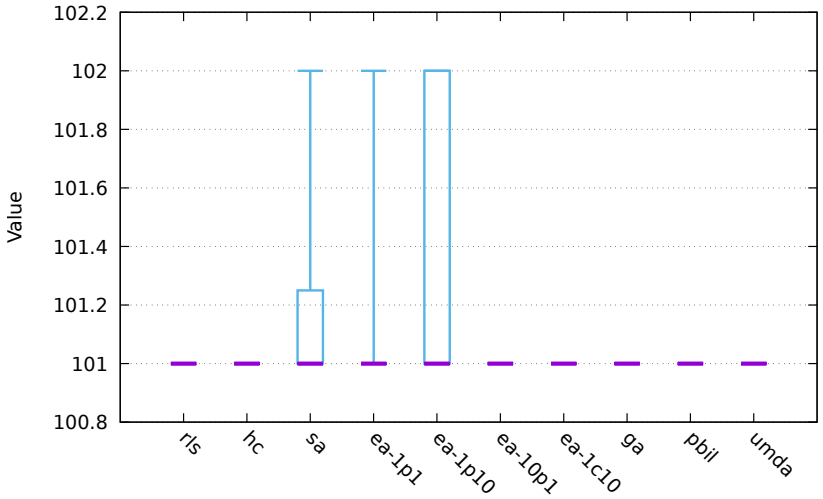


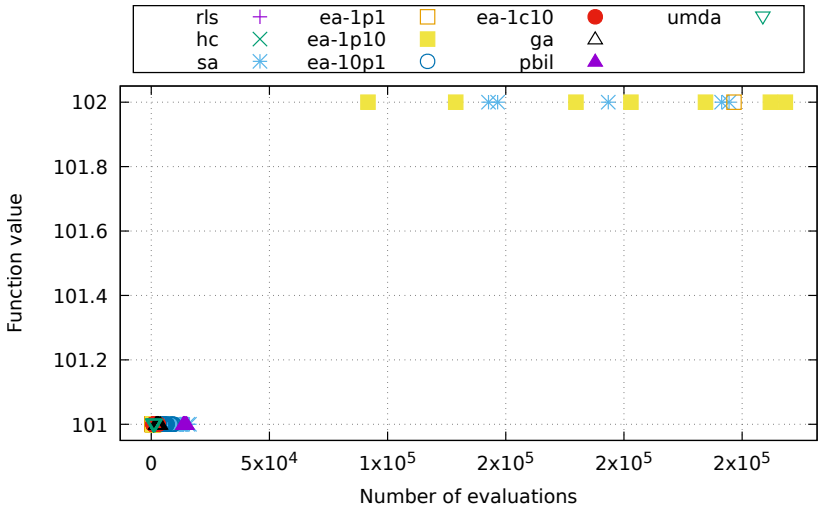

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
850
800
750
700
650
600
550
500
450
400
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
3x10^5
Number of evaluations

19 Function plateau

Algorithm	Value				
	min	Q_1	med.	Q_3	max
ea-1p10	**101**	**101**	**101**	**102**	**102**
sa	**101**	**101**	**101**	101	**102**
ea-1p1	**101**	**101**	**101**	101	**102**
rls	**101**	**101**	**101**	101	101
hc	**101**	**101**	**101**	101	101
ea-10p1	**101**	**101**	**101**	101	101
ea-1c10	**101**	**101**	**101**	101	101
ga	**101**	**101**	**101**	101	101
pbil	**101**	**101**	**101**	101	101
umda	**101**	**101**	**101**	101	101

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	0.12	0.00	0.20	0.01
sa	0.09	0.02	0.11	0.02	0.20	0.04
rls	0.09	0.00	0.12	0.00	0.21	0.01
ea-1c10	0.13	0.00	0.12	0.00	0.25	0.01
ea-1p10	0.13	0.03	0.11	0.03	0.24	0.06
ea-1p1	0.14	0.01	0.13	0.01	0.26	0.01
ea-10p1	0.17	0.00	0.13	0.00	0.30	0.01
ga	0.61	0.01	0.12	0.00	0.73	0.01
umda	0.65	0.01	0.13	0.00	0.77	0.01
pbil	0.66	0.01	0.13	0.00	0.78	0.01

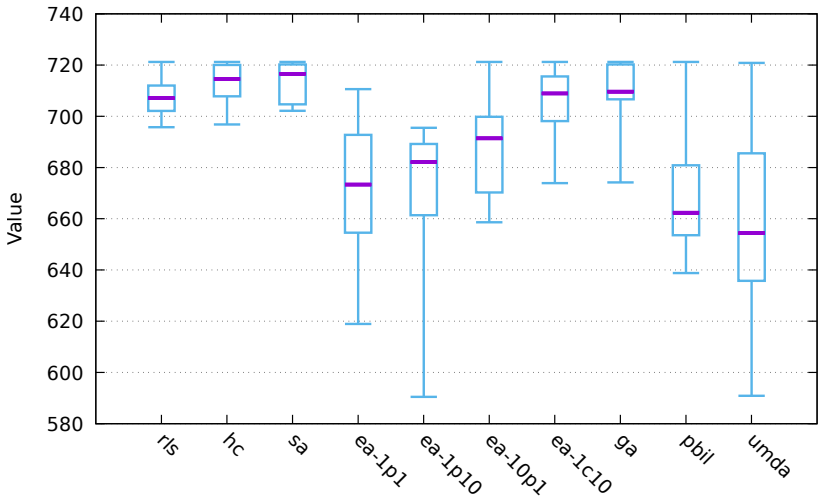


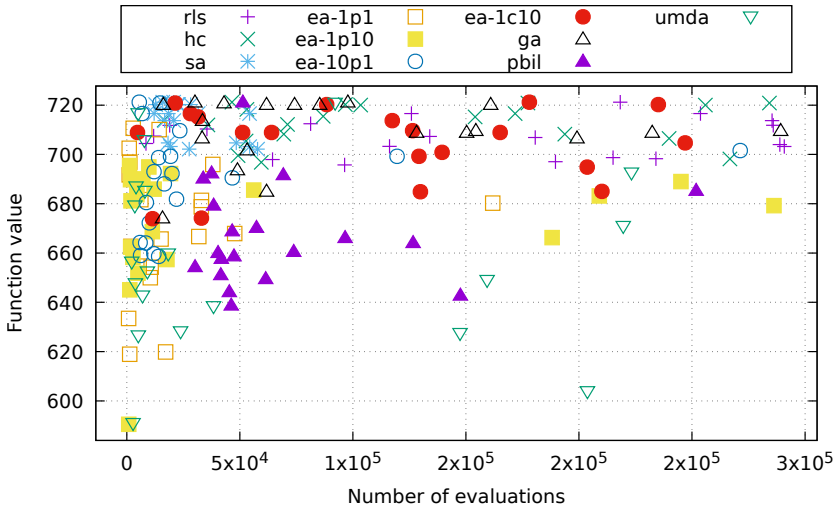

rls
hc
sa
ea-1p1
ea-1p10
ea-10p1
ea-1c10
ga
pbil
umda
Function value
102
101.8
101.6
101.4
101.2
101
0
5x10^4
1x10^5
2x10^5
2x10^5
2x10^5
Number of evaluations

20 Function walsh2

Algorithm	Value				
	min	Q_1	med.	Q_3	max
sa	**702.16**	704.68	**716.57**	**720.24**	**721.22**
hc	696.79	**707.78**	714.58	720.04	**721.22**
ga	674.19	706.62	709.61	**720.24**	**721.22**
ea-1c10	673.92	698.14	708.91	715.57	**721.22**
rls	695.72	702.11	707.10	711.99	**721.22**
ea-10p1	658.63	670.24	691.37	699.82	**721.22**
ea-1p10	590.49	661.37	682.15	689.19	695.51
ea-1p1	618.94	654.57	673.32	692.76	710.62
pbil	638.81	653.58	662.35	680.85	**721.22**
umda	590.89	635.77	654.40	685.54	720.85

Algorithm	Time (s)					
	algorithm		evaluation		total	
	mean	dev.	mean	dev.	mean	dev.
hc	0.08	0.00	1.92	0.04	2.01	0.04
rls	0.10	0.00	1.95	0.03	2.05	0.03
sa	0.11	0.00	1.91	0.03	2.01	0.03
ea-1c10	0.13	0.00	1.89	0.04	2.02	0.04
ea-1p1	0.15	0.00	1.97	0.04	2.12	0.04
ea-1p10	0.15	0.00	1.98	0.04	2.13	0.04
ea-10p1	0.18	0.01	2.10	0.10	2.28	0.11
ga	0.61	0.01	2.25	0.03	2.86	0.03
umda	0.65	0.01	1.88	0.05	2.53	0.05
pbil	0.68	0.01	2.02	0.05	2.70	0.05





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 },
        "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-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_precision = 0.01
# 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
# rep_categorical_representation = 0
# 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 = 0.18
# Generated from hnco.json
```