

HNCO

Influence of the learning rate on the performance of PBIL

November 1, 2017

Abstract

PBIL is applied many times to the same collection of fitness functions (bit vector size $n = 100$), each time with a different learning rate taken from a finite set of values. All learning rates are ranked according to their median fitness over 20 independent runs, first for each fitness function, then across the entire collection of fitness functions. The mean and standard deviation of fitness are also plotted as a function of the learning rate.

Contents

1	Plan	2
2	Rankings	3
3	Function one-max	3
4	Function leading-ones	4
5	Function jmp-5	5
6	Function nk	6
7	Function max-sat	7
8	Function labs	8
9	Function ep	9
10	Function cancel	10
11	Function walsh2	11
12	Default parameters	13

1 Plan

```
{
  "exec": "hnco",
  "opt": "-s 100 --map 1 --map-random -i 0 -b 200000 --print-performance",
  "num_runs": 20,
  "results": "results",
  "graphics": "graphics",
  "report": "report",
  "parameter": {
    "id": "learning-rate",
    "values": [ 1e-2, 2e-2, 5e-2, 1e-1, 2e-1, 5e-1, 1 ],
    "logscale": true,
    "boxwidth": "$1 * 0.3"
  },
  "functions": [
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      "id": "one-max",
      "opt": "-F 0 --stop-on-maximum",
      "col": ">{\nprounddigits{0}}N{3}{0}"
    },
    {
      "id": "leading-ones",
      "opt": "-F 10 --stop-on-maximum",
      "col": ">{\nprounddigits{0}}N{3}{0}"
    },
    {
      "id": "jmp-5",
      "opt": "-F 30 --stop-on-maximum -t 5",
      "col": ">{\nprounddigits{0}}N{3}{0}"
    },
    {
      "id": "nk",
      "opt": "-F 60 -p instances/nk.100.4",
      "col": ">{\nprounddigits{2}}N{1}{2}"
    },
    {
      "id": "max-sat",
      "opt": "-F 70 -p instances/ms.100.3.1000 --cache",
      "col": ">{\nprounddigits{0}}N{3}{0}"
    },
    {
      "id": "labs",
      "opt": "-F 80",
      "col": ">{\nprounddigits{2}}N{1}{2}"
    },
    {
      "id": "ep",
      "opt": "-F 90 -p instances/ep.100",
      "reverse": true,
      "logscale": true,
      "col": ">{\nprounddigits{1}}N{1}{1}"
    },
    {
      "id": "cancel",
      "opt": "-F 100 -s 99",
      "reverse": true,
      "col": ">{\nprounddigits{2}}N{1}{2}"
    },
    {
      "id": "walsh2",
      "opt": "-F 162 -p instances/walsh2.100 --cache",
      "col": ">{\nprounddigits{2}}N{3}{2}"
    }
  ]
}
```

```

    }
  ],
  "algorithms": [
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      "id": "pbil",
      "opt": "-A 500 -x 10 -y 1"
    }
  ]
}

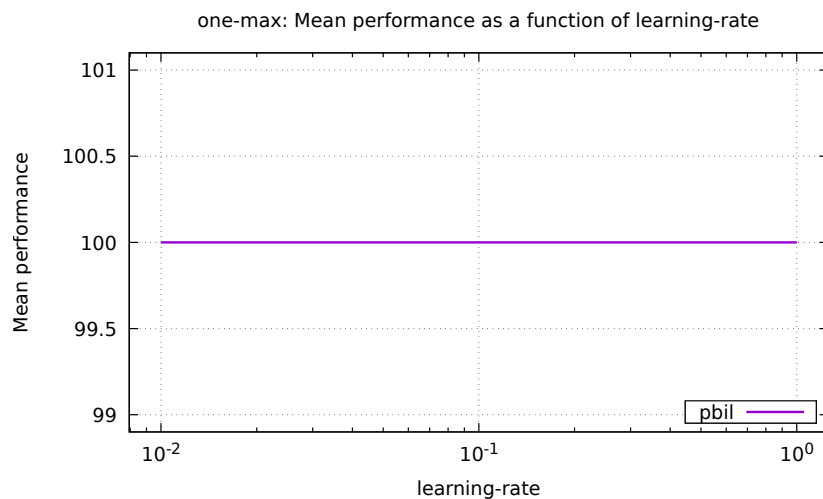
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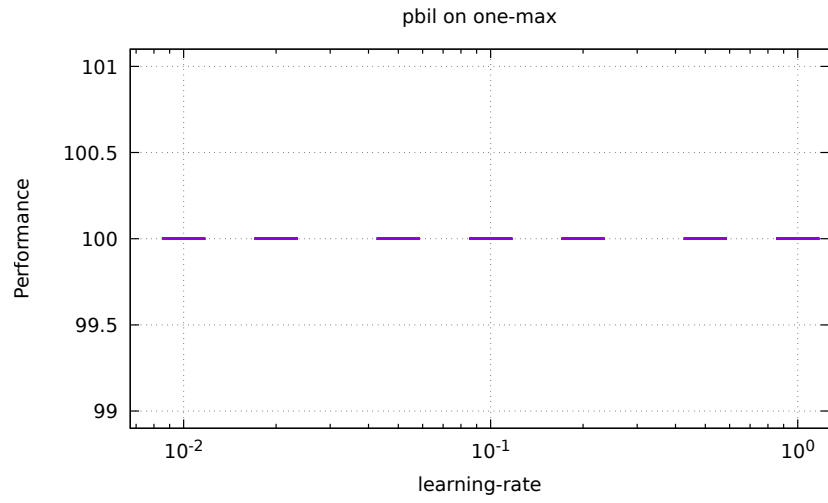
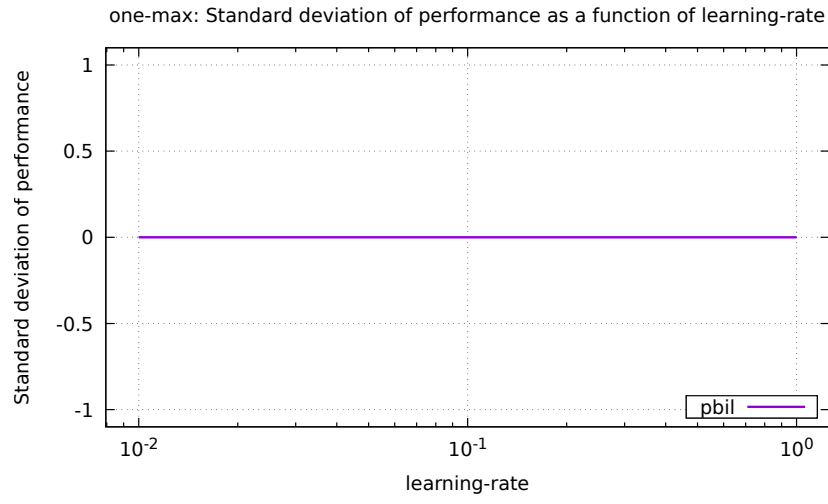
2 Rankings

algorithm	learning-rate	rank distribution						
		1	2	3	4	5	6	7
pbil	1	7	0	0	1	0	1	0
pbil	0.01	4	2	0	2	1	0	0
pbil	0.02	3	2	2	1	1	0	0
pbil	0.05	3	0	1	1	2	2	0
pbil	0.5	2	2	2	1	0	1	1
pbil	0.2	2	0	1	0	1	2	3
pbil	0.1	2	0	0	1	2	2	2

3 Function one-max

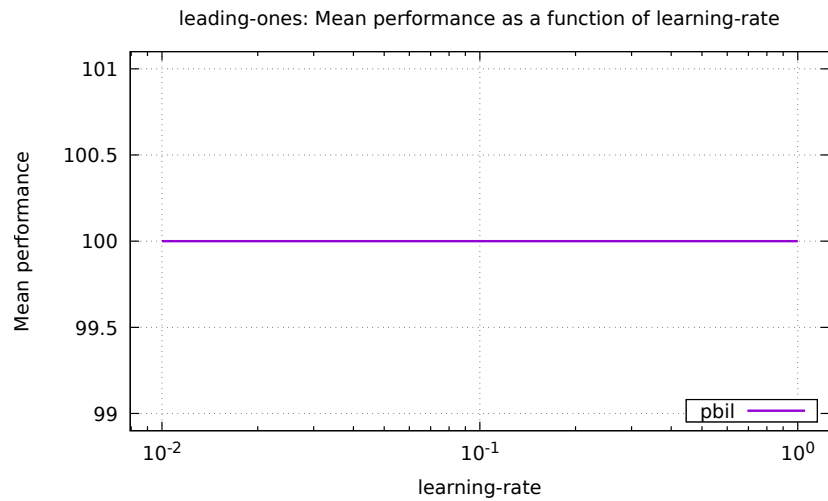
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	100	100	100	100	100	1
pbil	0.02	100	100	100	100	100	1
pbil	0.05	100	100	100	100	100	1
pbil	0.1	100	100	100	100	100	1
pbil	0.2	100	100	100	100	100	1
pbil	0.5	100	100	100	100	100	1
pbil	1	100	100	100	100	100	1

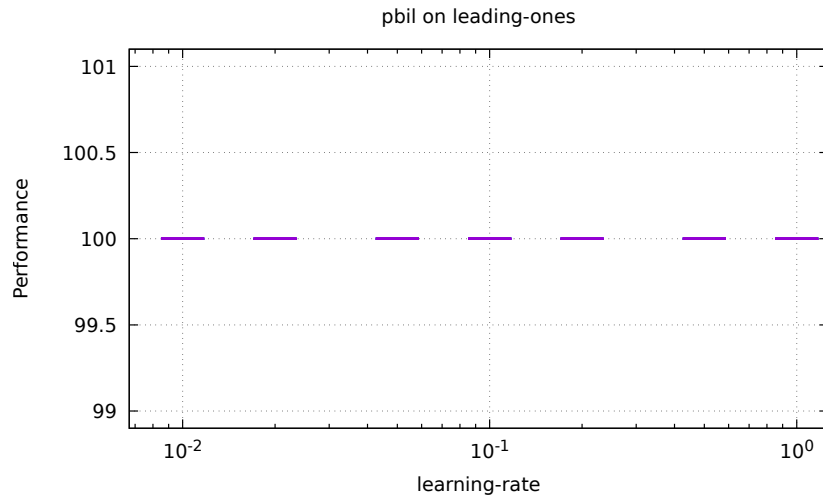
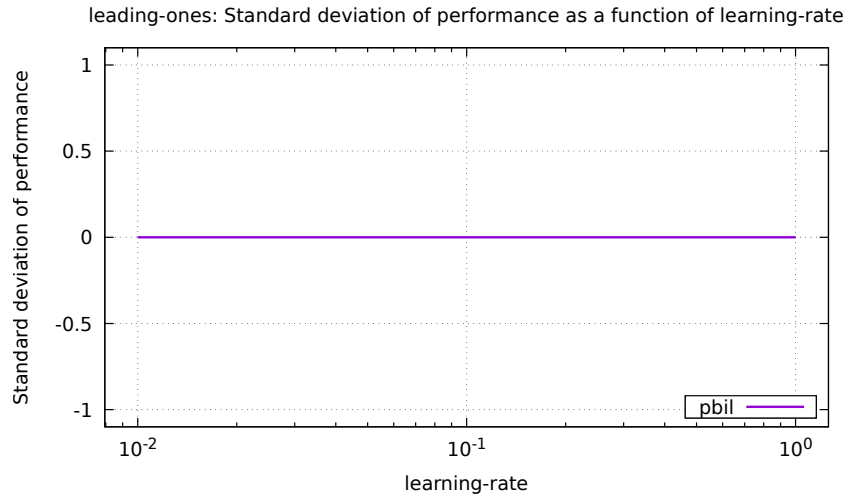




4 Function leading-ones

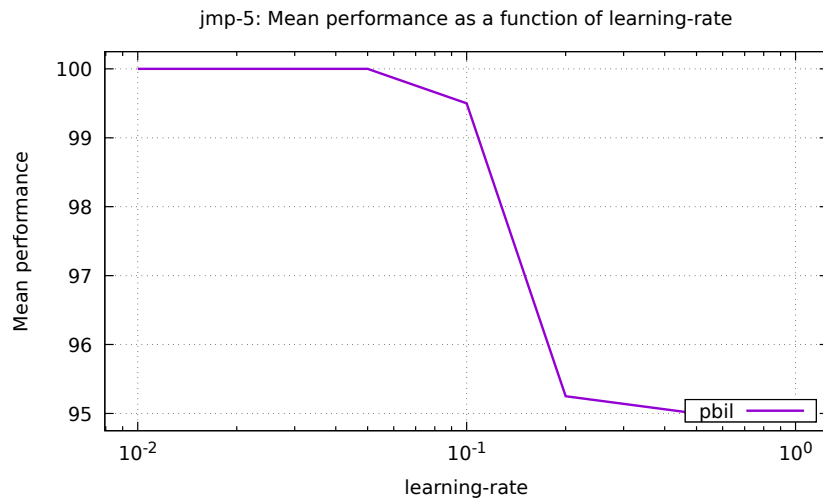
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	100	100	100	100	100	1
pbil	0.02	100	100	100	100	100	1
pbil	0.05	100	100	100	100	100	1
pbil	0.1	100	100	100	100	100	1
pbil	0.2	100	100	100	100	100	1
pbil	0.5	100	100	100	100	100	1
pbil	1	100	100	100	100	100	1

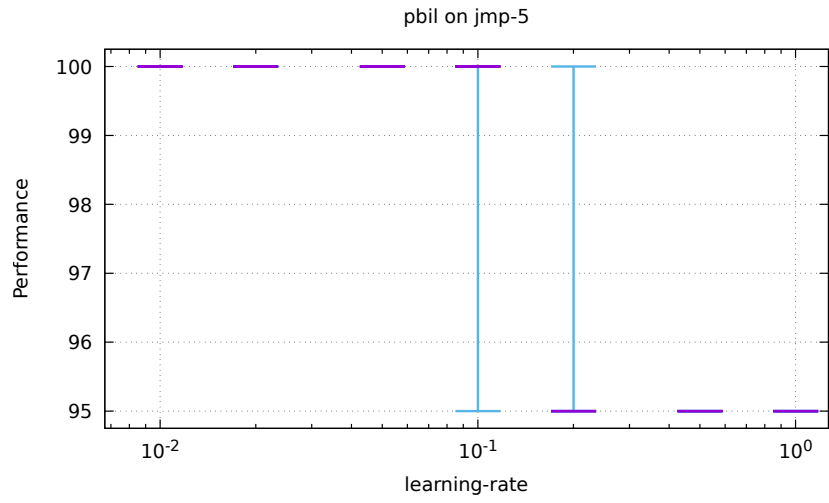
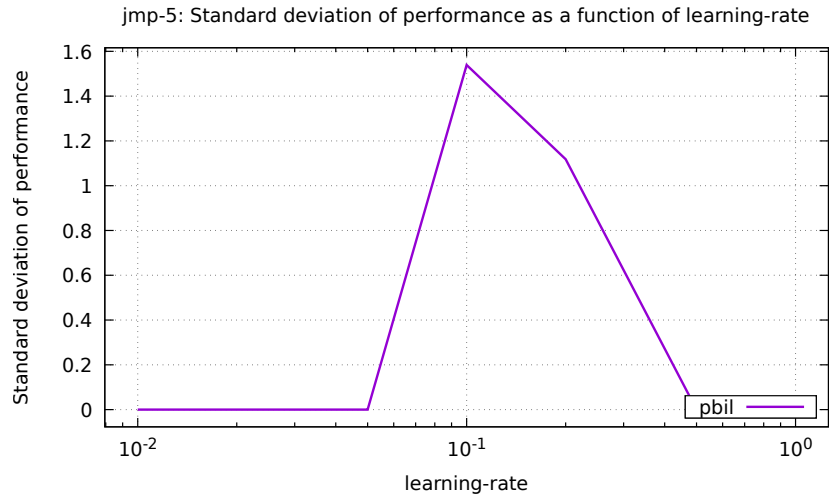




5 Function jmp-5

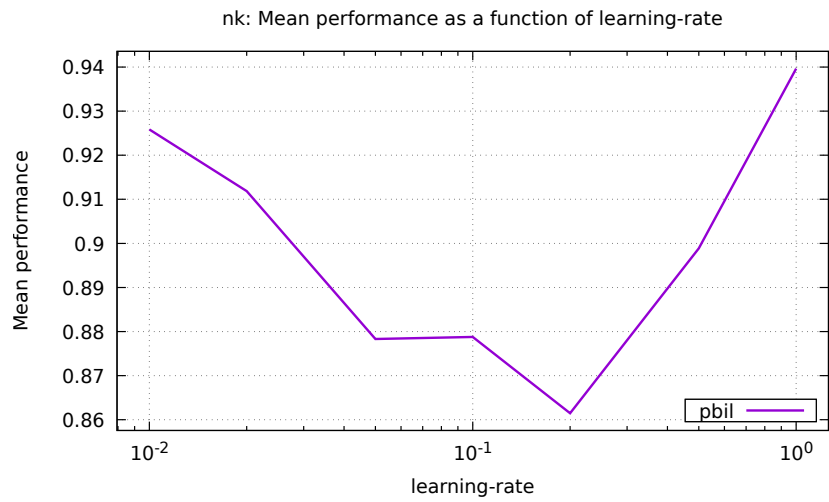
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	100	100	100	100	100	1
pbil	0.02	100	100	100	100	100	1
pbil	0.05	100	100	100	100	100	1
pbil	0.1	95	100	100	100	100	4
pbil	0.2	95	95	95	95	100	5
pbil	0.5	95	95	95	95	95	6
pbil	1	95	95	95	95	95	6

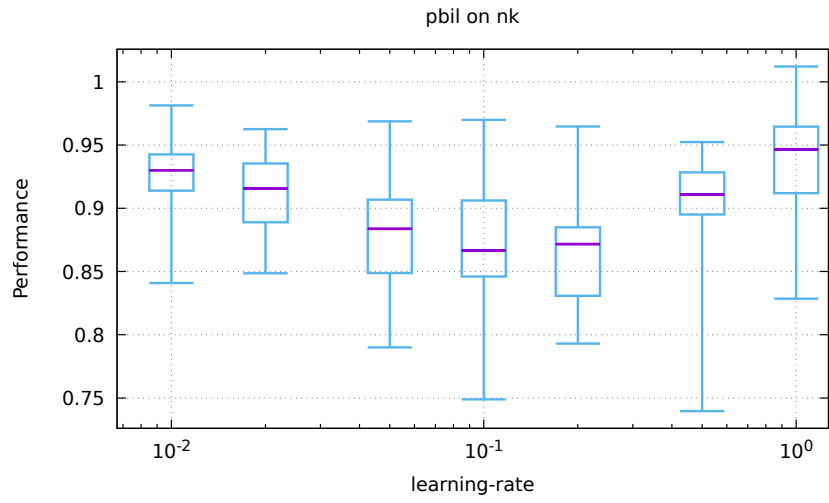
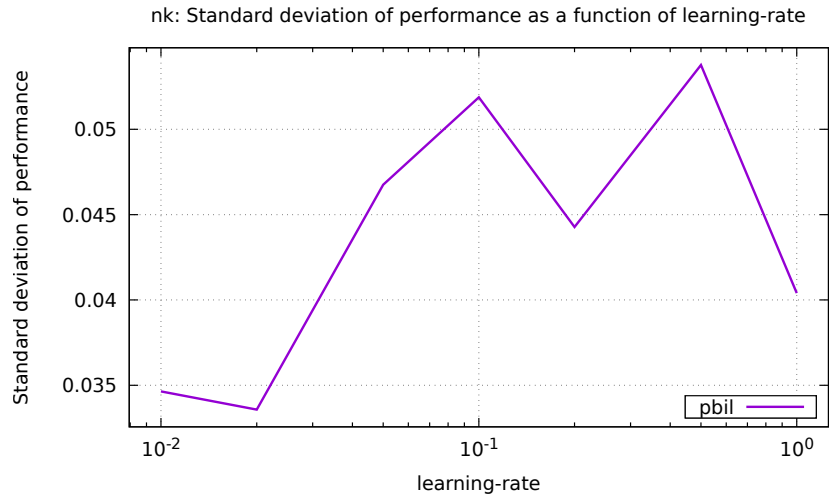




6 Function nk

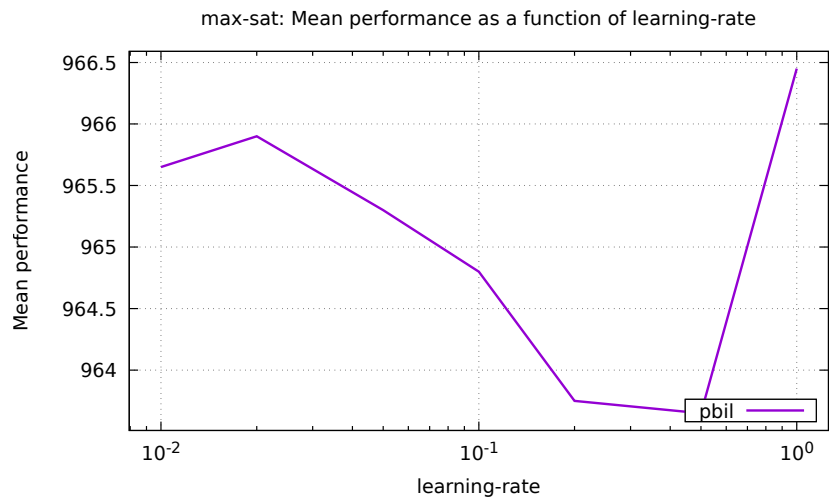
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	0.84	0.91	0.93	0.94	0.98	2
pbil	0.02	0.85	0.89	0.92	0.94	0.96	3
pbil	0.05	0.79	0.85	0.88	0.91	0.97	5
pbil	0.1	0.75	0.85	0.87	0.91	0.97	7
pbil	0.2	0.79	0.83	0.87	0.88	0.96	6
pbil	0.5	0.74	0.90	0.91	0.93	0.95	4
pbil	1	0.83	0.91	0.95	0.96	1.01	1

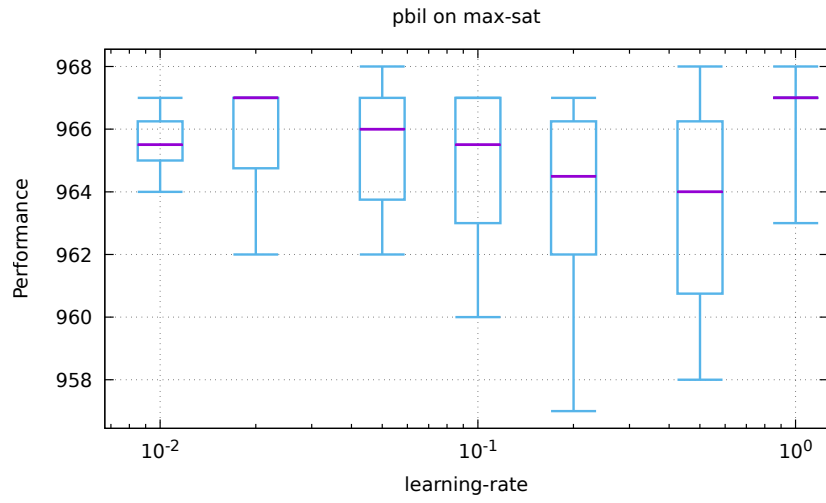
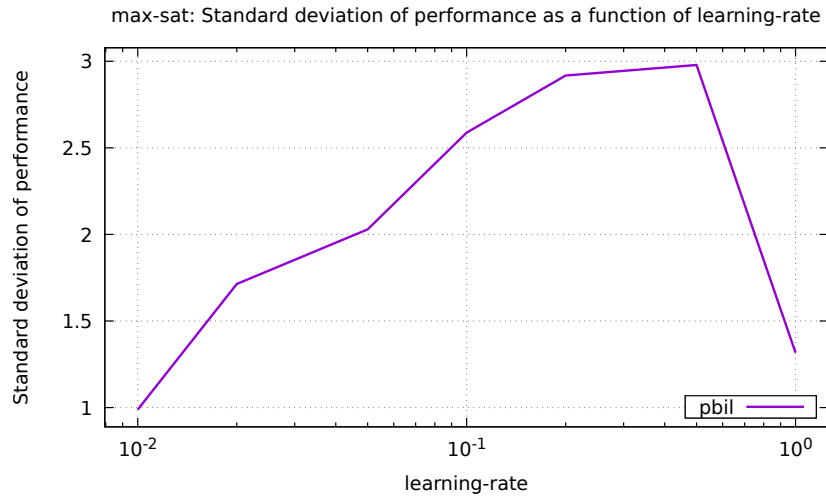




7 Function max-sat

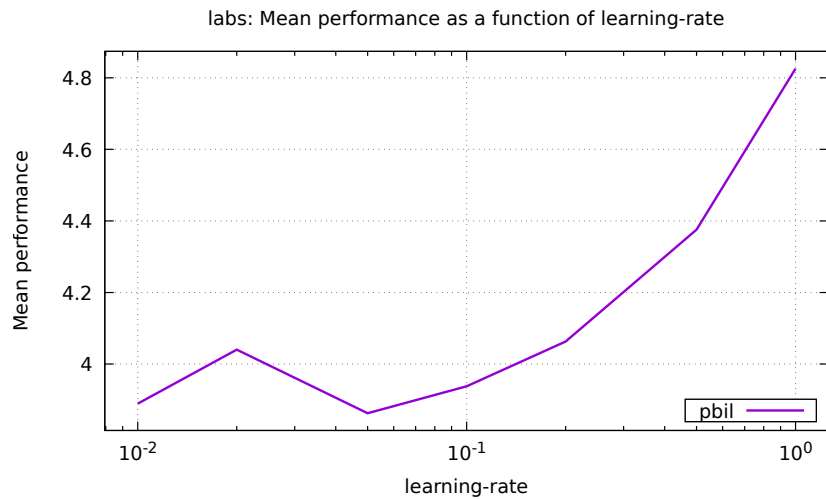
algorithm	learning-rate	min	Q ₁	med.	Q ₃	max	rk
pbil	0.01	964	965	966	966	967	4
pbil	0.02	962	965	967	967	967	2
pbil	0.05	962	964	966	967	968	3
pbil	0.1	960	963	966	967	967	5
pbil	0.2	957	962	965	966	967	6
pbil	0.5	958	961	964	966	968	7
pbil	1	963	967	967	967	968	1

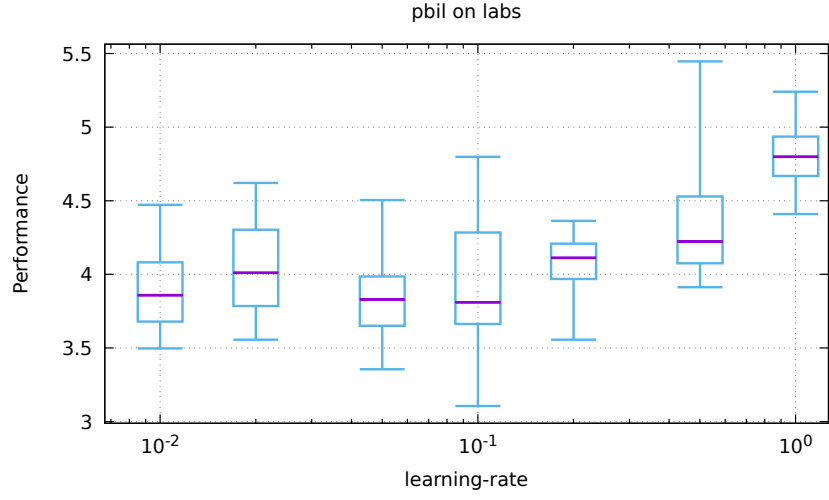
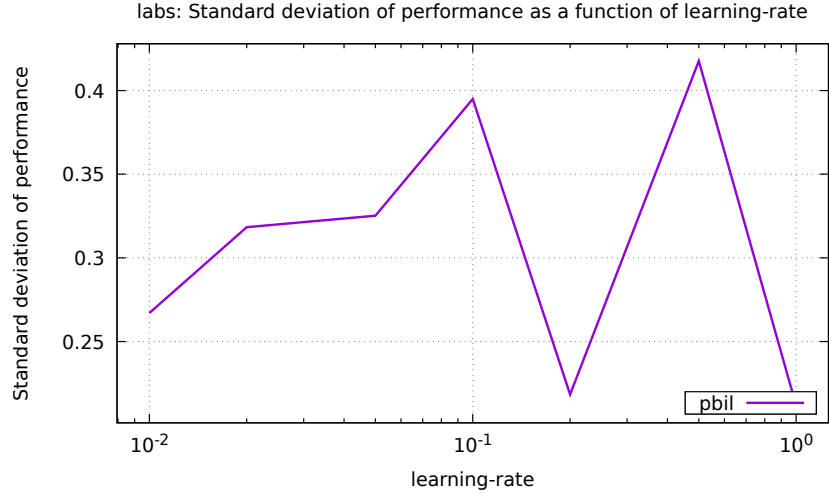




8 Function labs

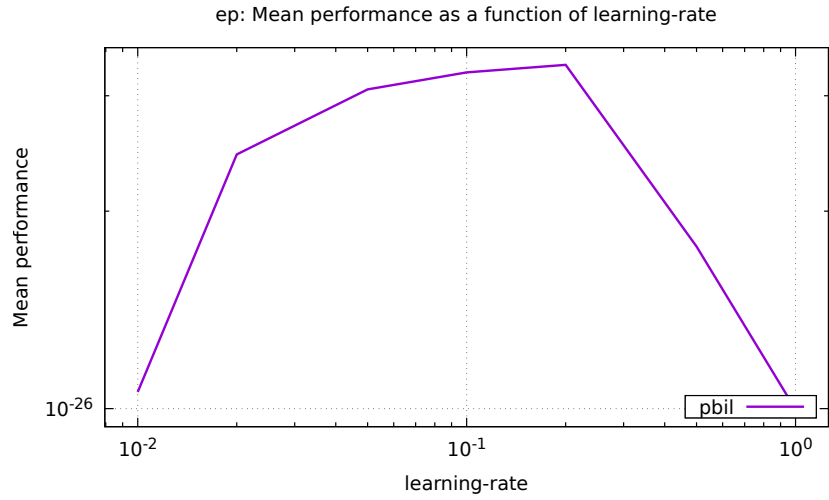
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	3.50	3.68	3.86	4.08	4.47	5
pbil	0.02	3.56	3.79	4.01	4.30	4.62	4
pbil	0.05	3.36	3.65	3.83	3.99	4.50	6
pbil	0.1	3.11	3.66	3.81	4.28	4.80	7
pbil	0.2	3.56	3.97	4.11	4.21	4.36	3
pbil	0.5	3.91	4.07	4.22	4.53	5.45	2
pbil	1	4.41	4.67	4.80	4.94	5.24	1

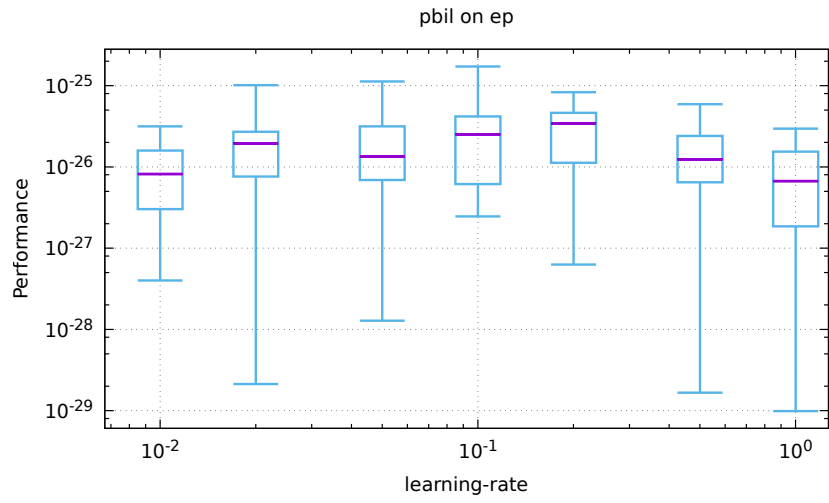
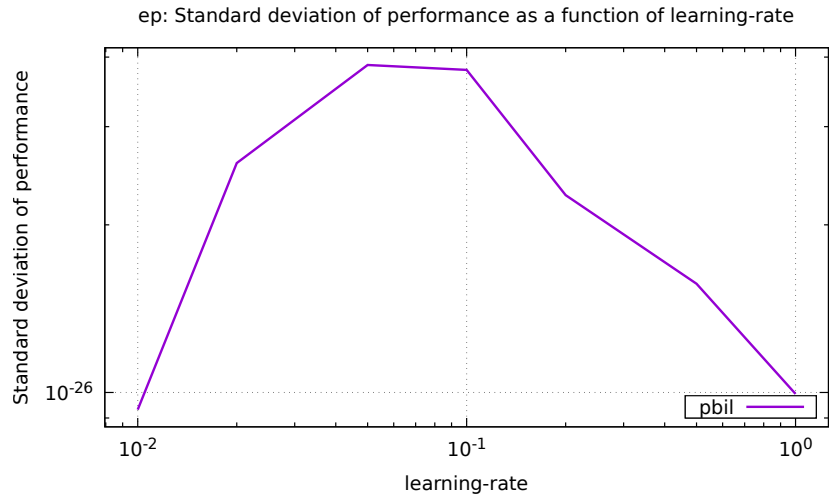




9 Function ep

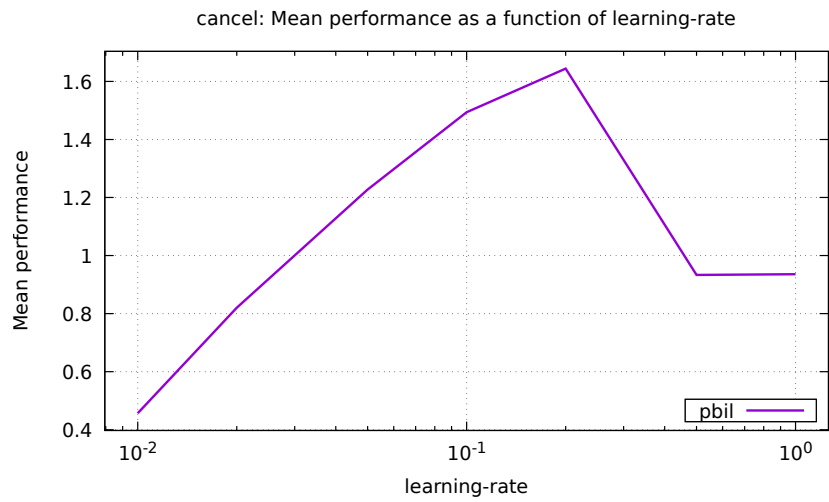
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	4.0×10^{-28}	3.0×10^{-27}	8.2×10^{-27}	1.6×10^{-26}	3.2×10^{-26}	2
pbil	0.02	2.1×10^{-29}	7.6×10^{-27}	1.9×10^{-26}	2.7×10^{-26}	1.0×10^{-25}	5
pbil	0.05	1.3×10^{-28}	6.9×10^{-27}	1.3×10^{-26}	3.2×10^{-26}	1.1×10^{-25}	4
pbil	0.1	2.5×10^{-27}	6.1×10^{-27}	2.5×10^{-26}	4.2×10^{-26}	1.7×10^{-25}	6
pbil	0.2	6.3×10^{-28}	1.1×10^{-26}	3.4×10^{-26}	4.6×10^{-26}	8.3×10^{-26}	7
pbil	0.5	1.7×10^{-29}	6.5×10^{-27}	1.2×10^{-26}	2.4×10^{-26}	5.9×10^{-26}	3
pbil	1	9.9×10^{-30}	1.9×10^{-27}	6.7×10^{-27}	1.5×10^{-26}	3.0×10^{-26}	1

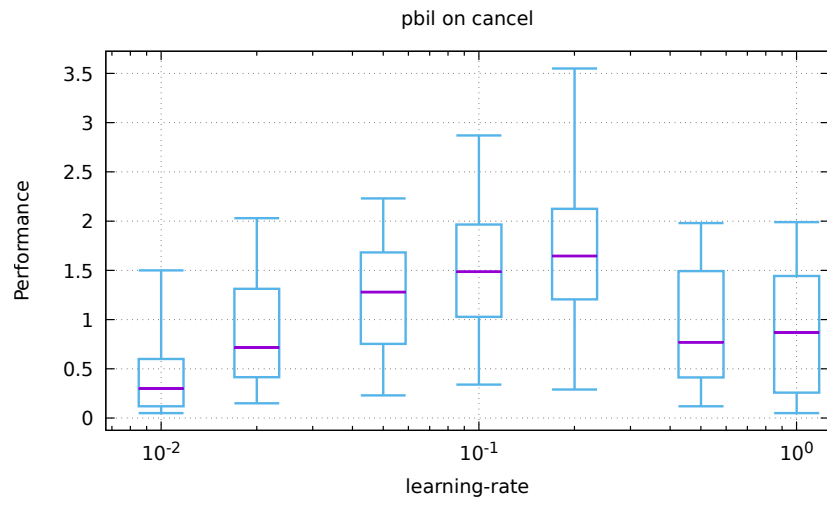
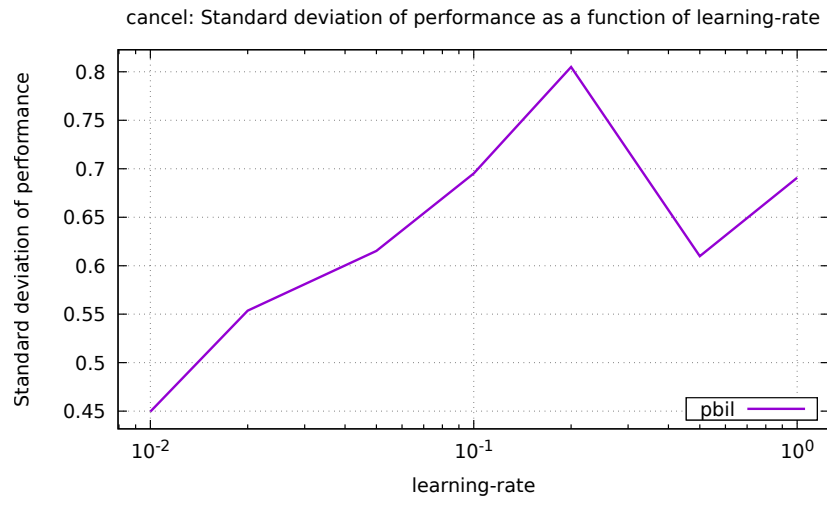




10 Function cancel

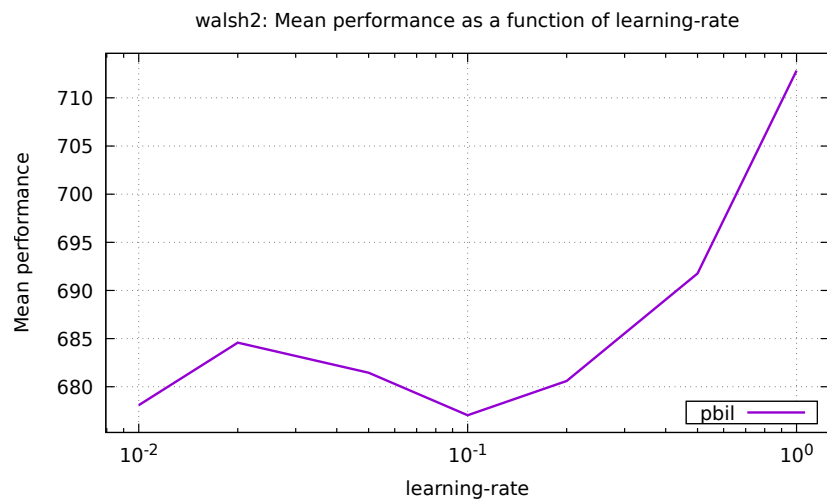
algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	0.05	0.12	0.30	0.60	1.50	1
pbil	0.02	0.15	0.42	0.72	1.31	2.03	2
pbil	0.05	0.23	0.75	1.28	1.68	2.23	5
pbil	0.1	0.34	1.03	1.49	1.97	2.87	6
pbil	0.2	0.29	1.21	1.65	2.13	3.55	7
pbil	0.5	0.12	0.41	0.77	1.49	1.98	3
pbil	1	0.05	0.26	0.87	1.44	1.99	4

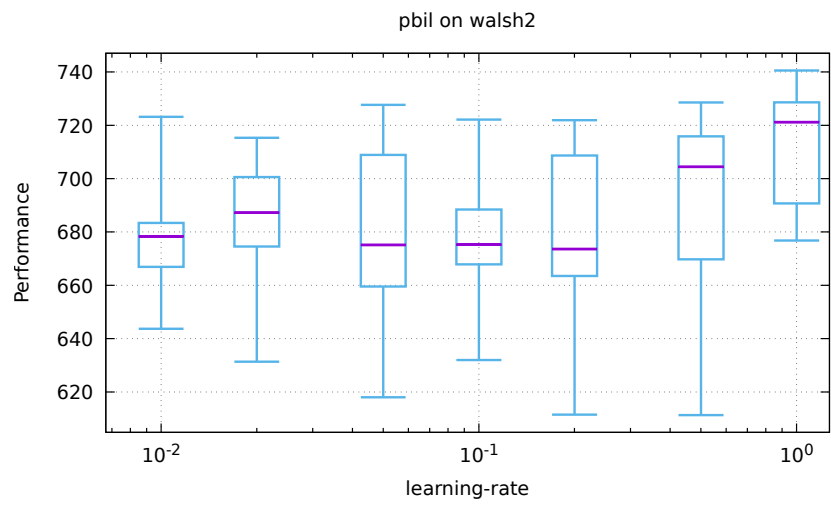
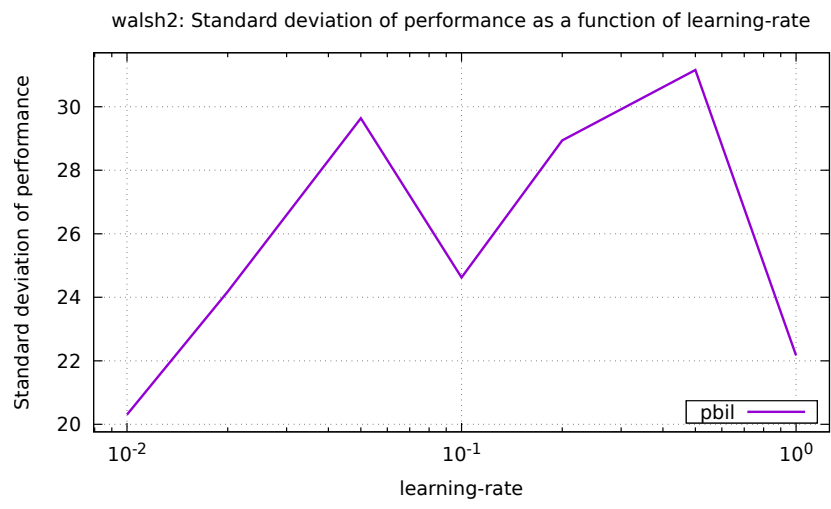




11 Function walsh2

algorithm	learning-rate	min	Q_1	med.	Q_3	max	rk
pbil	0.01	643.68	666.90	678.34	683.40	723.16	4
pbil	0.02	631.35	674.53	687.20	700.56	715.33	3
pbil	0.05	618.02	659.54	675.12	708.89	727.67	6
pbil	0.1	631.98	667.83	675.26	688.39	722.11	5
pbil	0.2	611.50	663.49	673.61	708.69	721.90	7
pbil	0.5	611.32	669.75	704.39	715.85	728.55	2
pbil	1	676.79	690.69	721.20	728.62	740.55	1





12 Default parameters

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