

Report of Experiment ExpD. k-Symmetry: Training Neural Networks. GAs or DE?

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Abstract

In this experiment we compare the training of feedforward neural networks with topology $(k, 2k, k, 1)$ for k -symmetry problems ($k \in 2, \dots, 6$) for a genetic algorithm and a differential evolution algorithm.

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5 C xega

Description of Experiment

The purpose of this computational experiment is to find out which algorithm performs better, genetic algorithms or differential evolution for the training of a feed-forward neural network for k-symmetry problems.

The **problem environment** is the k-symmetry problem: Finding a boolean expression (with and, or, and not) which is TRUE for symmetric k-bit strings.

The **solution method** is grammar-based genetic programming (options `algorithm="sga"` and `algorithm="sgde"` of `xegaRun`).

The **solver** used is `xegaRun` from the R-package `xega`.

The experiment consists of 10 treatments, 2 algorithms for 5 problem sizes $k \in 2, \dots, 6$.

Description of Experiment

The control variable in this experiment is:

- The algorithm used for training the feed-forward neural network:
 - "sga": A simple binary genetic algorithm.
 - "sgde": A differential evolution algorithm.

Both algorithms use a plain-vanilla standard parameter configuration.

Common Parameters of Experiment ExpD

	Parameter Value
Experiment	EB
Optimize	Minimize!
Trials	92
Max.Depth.of.DTs	7
Grammar	NULL
Replay	0
Evaluation.Method	Deterministic
Execution.Model	MultiCore
Verbose	1
Semantics	byValue
Report.Eval.Errors	TRUE
Termination.Condition	NoTermination
Termination.Eps	0.01
Init.Gene	InitGene
Codons	25

Table: Common Parameters of Experiment ExpD (Part 1)

Common Parameters of Experiment ExpD

	Parameter Value
Codon.Precision	LCM
Population.Size	200
Max.Generations	500
Crossover.Rate	0.2
Mutation.Rate	0.4
IV.Crossover.Rate	Const
Crossover.Rate.2	0.4
IV.Mutation.Rate	Const
Mutation.Rate.2	0.8

Table: Common Parameters of Experiment ExpD (Part 2)

Parameters of Treatments of Experiment ExpD

	Treatment	Problem	Environment	Algorithm	Worst Fitness	Gene Map
1	NNtop1sga2k	2-Symmetry	Problem NN	sga	-4	Bin2Dec
2	NNtop1sga3k	3-Symmetry	Problem NN	sga	-8	Bin2Dec
3	NNtop1sga4k	4-Symmetry	Problem NN	sga	-16	Bin2Dec
4	NNtop1sga5k	5-Symmetry	Problem NN	sga	-32	Bin2Dec
5	NNtop1sga6k	6-Symmetry	Problem NN	sga	-64	Bin2Dec
6	NNtop1sgde2k	2-Symmetry	Problem NN	sgde	-4	Identity
7	NNtop1sgde3k	3-Symmetry	Problem NN	sgde	-8	Identity
8	NNtop1sgde4k	4-Symmetry	Problem NN	sgde	-16	Identity
9	NNtop1sgde5k	5-Symmetry	Problem NN	sgde	-32	Identity
10	NNtop1sgde6k	6-Symmetry	Problem NN	sgde	-64	Identity

Table: Parameters of Treatments of Experiment ExpD

How long to find an optimal solution?

Matrix of Mean of Seconds. Rows: $k=2, 3, 4, 5, 6$)

	sga	sgde
1	6.24	2.40
2	20.65	10.96
3	141.28	59.21
4	277.99	106.60
5	468.15	272.94

Table: Matrix of Mean of Seconds. Rows: $k=2, 3, 4, 5, 6$)

How long to find an optimal solution?

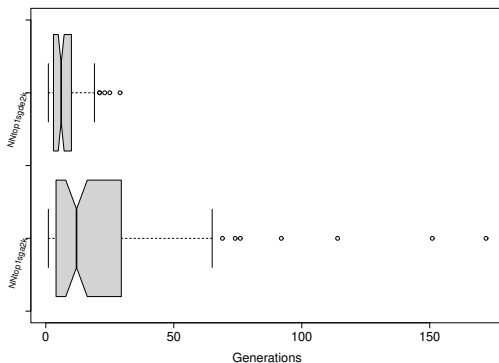
Matrix of Mean of Generations. Rows: $k=2, 3, 4, 5, 6$)

	sga	sgde
1	23.14	7.59
2	57.26	28.74
3	270.91	185.75
4	388.70	258.61
5	500.00	473.53

Table: Matrix of Mean of Generations. Rows: $k=2, 3, 4, 5, 6$)

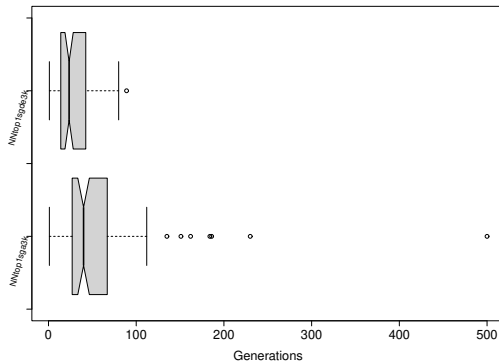
How long to find an optimal solution?

Distribution of Number of Generations for k-symmetry problem 2k



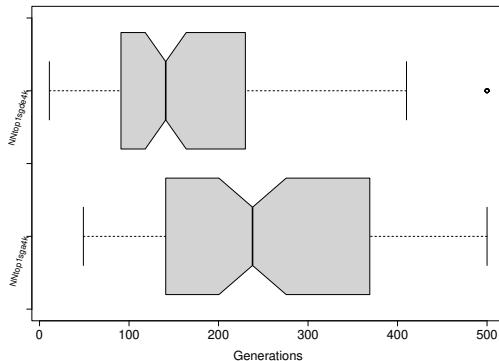
How long to find an optimal solution?

Distribution of Number of Generations for k-symmetry problem 3k



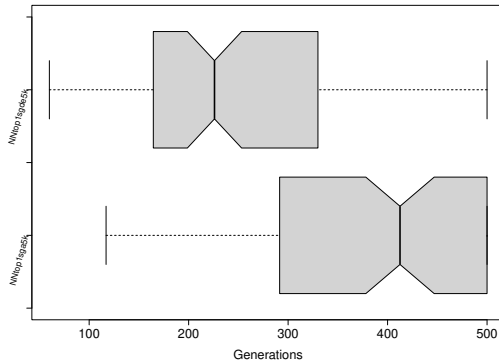
How long to find an optimal solution?

Distribution of Number of Generations for k-symmetry problem 4k



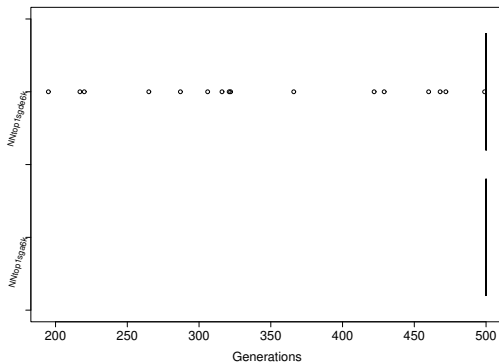
How long to find an optimal solution?

Distribution of Number of Generations for k-symmetry problem 5k



How long to find an optimal solution?

Distribution of Number of Generations for k-symmetry problem 6k



Result of Experiment

For the 2, 3, 4, and 5-symmetry problems, **differential evolution** needs **statistically significant fewer** generations (non-overlapping notches in all Box-plots) than a **genetic algorithm**.

Differential evolution should be preferred.

For $k = 6$ (and beyond) the parameter generation should be increased considerably for both algorithms.

Suggestions for Further Experiments

- The fitness function of the NN and the error rate do not correspond. The reporting mechanism of the experiment should be adapted to report both performance measures.
- The convexity of the NN loss function has not been exploited. Experiments with fitness scaling (genetic algorithms) and selection functions (differential evolution) should be performed.
- Repeat the experiment with optimal parameters for both algorithms. Find optimal hyper-parameters for both algorithms first!
- Study the balance between population size and number of generations needed!

Summary of statistics of experiment ExpD.

	Treatment	Trials	Variable	min	mean	sd	
4	NNtop1sga2k	92	Evaluations	200.00	9113.04	12193.25	6880
8	NNtop1sga3k	92	Evaluations	400.00	22721.74	24949.81	20000
12	NNtop1sga4k	92	Evaluations	19600.00	106719.57	58361.19	20000
16	NNtop1sga5k	92	Evaluations	26400.00	154765.22	49031.68	20000
20	NNtop1sga6k	92	Evaluations	100000.00	197826.09	14662.96	20000
24	NNtop1sgde2k	92	Evaluations	200.00	3019.57	2457.03	1160
28	NNtop1sgde3k	92	Evaluations	400.00	11336.96	7869.09	3560
32	NNtop1sgde4k	92	Evaluations	4400.00	73082.61	50943.88	20000
36	NNtop1sgde5k	92	Evaluations	24000.00	102526.09	48628.58	20000
40	NNtop1sgde6k	92	Evaluations	78000.00	187239.13	31130.55	20000
1	NNtop1sga2k	92	Fitness	0.16	0.53	0.15	
5	NNtop1sga3k	92	Fitness	0.28	0.82	0.21	
9	NNtop1sga4k	92	Fitness	0.34	0.88	0.26	
13	NNtop1sga5k	92	Fitness	0.79	1.88	0.67	
17	NNtop1sga6k	92	Fitness	1.68	3.93	1.03	

Table: Summary of statistics of experiment ExpD. (Part 1)

Summary of statistics of experiment ExpD.

	Treatment	Trials	Variable	min	mean	sd	max
21	NNtop1sgde2k	92	Fitness	0.08	0.42	0.14	0.71
25	NNtop1sgde3k	92	Fitness	0.06	0.59	0.27	1.36
29	NNtop1sgde4k	92	Fitness	0.18	0.70	0.32	1.56
33	NNtop1sgde5k	92	Fitness	0.23	1.21	0.59	4.01
37	NNtop1sgde6k	92	Fitness	0.28	3.21	1.45	6.13
3	NNtop1sga2k	92	Generations	1.00	23.14	30.78	172.00
7	NNtop1sga3k	92	Generations	1.00	57.26	62.23	500.00
11	NNtop1sga4k	92	Generations	49.00	270.91	146.64	500.00
15	NNtop1sga5k	92	Generations	117.00	388.70	118.69	500.00
19	NNtop1sga6k	92	Generations	500.00	500.00	0.00	500.00
23	NNtop1sgde2k	92	Generations	1.00	7.59	6.12	29.00
27	NNtop1sgde3k	92	Generations	1.00	28.74	19.65	89.00
31	NNtop1sgde4k	92	Generations	11.00	185.75	131.06	500.00
35	NNtop1sgde5k	92	Generations	60.00	258.61	119.77	500.00
39	NNtop1sgde6k	92	Generations	195.00	473.53	70.74	500.00

Table: Summary of statistics of experiment ExpD. (Part 2)

Summary of statistics of experiment ExpD.

	Treatment	Trials	Variable	min	mean	sd	max
2	NNtop1sga2k	92	Seconds	0.19	6.24	8.57	52.63
6	NNtop1sga3k	92	Seconds	0.73	20.65	21.20	149.44
10	NNtop1sga4k	92	Seconds	27.18	141.28	81.33	295.25
14	NNtop1sga5k	92	Seconds	25.81	277.99	104.43	386.47
18	NNtop1sga6k	92	Seconds	124.23	468.15	90.36	521.27
22	NNtop1sgde2k	92	Seconds	0.14	2.40	1.84	9.09
26	NNtop1sgde3k	92	Seconds	0.60	10.96	8.17	43.51
30	NNtop1sgde4k	92	Seconds	3.22	59.21	59.39	330.53
34	NNtop1sgde5k	92	Seconds	20.45	106.60	61.28	323.39
38	NNtop1sgde6k	92	Seconds	96.96	272.94	143.68	905.69

Table: Summary of statistics of experiment ExpD. (Part 3)

Treatment NNtop1sga2k

Parameters of treatment: NNtop1sga2k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sga2k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sga2k

Parameters of treatment NNtop1sga2k passed to xegaRun

Parameter Values	
penv	2-Symmetry Problem NN
replay	0
algorithm	sga
max	FALSE
worstFitness	-4
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Bin2Dec

Table: Parameters of treatment NNtop1sga2k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sga2k passed to xegaRun

Parameter Values	
initgene	InitGene
selection	SUS
mateselection	SUS
replication	Kid2
crossover	Cross2Gene
mutation	MutateGene
accept	All
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sga2k passed to xegaRun (Part 2)

Treatment NNtop1sga2k

Treatment: NNtop1sga2k

	Treatment	Trials	Variable	min	mean	sd	max
4	NNtop1sga2k	92	Evaluations	200.00	9113.04	12193.25	68800.00
1	NNtop1sga2k	92	Fitness	0.16	0.53	0.15	0.84
3	NNtop1sga2k	92	Generations	1.00	23.14	30.78	172.00
2	NNtop1sga2k	92	Seconds	0.19	6.24	8.57	52.63

Table: Treatment: NNtop1sga2k

Treatment NNtop1sga2k

Solution of treatment NNtop1sga2k

	Fitness	Errors
1	-0.72	0

Table: Solution of treatment NNtop1sga2k

Treatment NNtop1sga2k

Cases of treatment NNtop1sga2k

	1	2	Activation	Predicted	Actual	Error
1	0.00	0.00	0.50	TRUE	1.00	FALSE
2	0.00	1.00	0.44	FALSE	0.00	FALSE
3	1.00	0.00	0.40	FALSE	0.00	FALSE
4	1.00	1.00	0.65	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sga2k

Treatment NNtop1sga2k

Layer: 1 Neurons: 2 $(b|W)^T$:

	V1	V2	V3	V4
1	0.40	-0.13	0.85	-0.20
2	-0.57	-0.81	0.23	0.26
3	0.71	0.65	0.77	-0.50

Table: Layer: 1 Neurons: 2 $(b|W)^T$:

Treatment NNtop1sga2k

Layer: 2 Neurons: 4 $(b|W)^T$:

	V1	V2
1	-0.50	0.46
2	0.68	-0.28
3	0.15	0.73
4	-0.95	-0.13
5	0.08	0.56

Table: Layer: 2 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sga2k

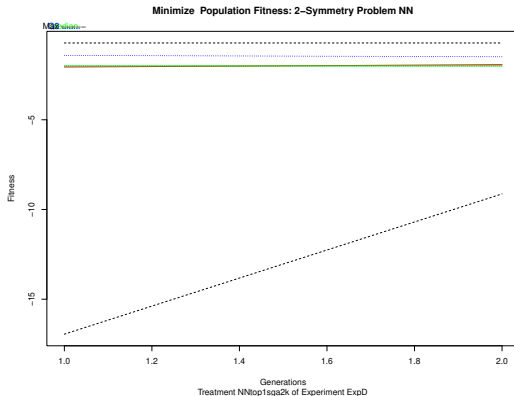
Layer: 3 Neurons: 2 $(b|W)^T$:

	V1
1	0.70
2	0.23
3	-0.86

Table: Layer: 3 Neurons: 2 $(b|W)^T$:

Treatment NNtop1sga2k

Plot of last xegaRun for Treatment NNtop1sga2k of Experiment ExpD



Treatment NNtop1sga3k

Parameters of treatment: NNtop1sga3k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sga3k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sga3k

Treatment NNtop1sga3k

Parameters of treatment NNtop1sga3k passed to xegaRun

Parameter Values	
penv	3-Symmetry Problem NN
replay	0
algorithm	sga
max	FALSE
worstFitness	-8
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Bin2Dec

Table: Parameters of treatment NNtop1sga3k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sga3k passed to xegaRun

Parameter Values	
initgene	InitGene
selection	SUS
mateselection	SUS
replication	Kid2
crossover	Cross2Gene
mutation	MutateGene
accept	All
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sga3k passed to xegaRun (Part 2)

Treatment NNtop1sga3k

Treatment: NNtop1sga3k

	Treatment	Trials	Variable	min	mean	sd	max
8	NNtop1sga3k	92	Evaluations	400.00	22721.74	24949.81	200000.00
5	NNtop1sga3k	92	Fitness	0.28	0.82	0.21	1.30
7	NNtop1sga3k	92	Generations	1.00	57.26	62.23	500.00
6	NNtop1sga3k	92	Seconds	0.73	20.65	21.20	149.44

Table: Treatment: NNtop1sga3k

Treatment NNtop1sga3k

Solution of treatment NNtop1sga3k

	Fitness	Errors
1	-1.24	0

Table: Solution of treatment NNtop1sga3k

Treatment NNtop1sga3k

Cases of treatment NNtop1sga3k

	1	2	3	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.60	TRUE	1.00	FALSE
2	0.00	0.00	1.00	0.23	FALSE	0.00	FALSE
3	0.00	1.00	0.00	0.59	TRUE	1.00	FALSE
4	0.00	1.00	1.00	0.36	FALSE	0.00	FALSE
5	1.00	0.00	0.00	0.48	FALSE	0.00	FALSE
6	1.00	0.00	1.00	0.51	TRUE	1.00	FALSE
7	1.00	1.00	0.00	0.37	FALSE	0.00	FALSE
8	1.00	1.00	1.00	0.62	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sga3k

Treatment NNtop1sga3k

Layer: 1 Neurons: 3 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6
1	-0.11	-0.19	-0.70	0.28	0.01	0.88
2	-0.64	-0.61	0.46	0.20	-0.83	-0.42
3	-0.27	0.26	-0.79	-0.00	-0.95	-0.42
4	0.87	-0.62	-0.52	-0.42	0.31	0.75

Table: Layer: 1 Neurons: 3 $(b|W)^T$:

Treatment NNtop1sga3k

Layer: 2 Neurons: 6 $(b|W)^T$:

	V1	V2	V3
1	-0.03	0.11	0.72
2	-0.68	0.83	-0.04
3	0.11	0.98	0.89
4	-0.76	0.88	-0.73
5	0.91	-0.04	0.63
6	-0.03	-0.42	0.19
7	-0.45	0.41	-0.78

Table: Layer: 2 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sga3k

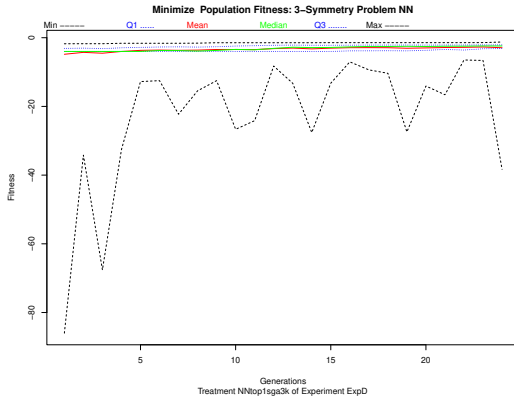
Layer: 3 Neurons: 3 $(b|W)^T$:

	V1
1	0.85
2	-0.83
3	-0.49
4	-0.11

Table: Layer: 3 Neurons: 3 $(b|W)^T$:

Treatment NNtop1sga3k

Plot of last xegaRun for Treatment NNtop1sga3k of Experiment ExpD



Treatment NNtop1sga4k

Parameters of treatment: NNtop1sga4k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sga4k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sga4k

Treatment NNtop1sga4k

Parameters of treatment NNtop1sga4k passed to xegaRun

Parameter Values	
penv	4-Symmetry Problem NN
replay	0
algorithm	sga
max	FALSE
worstFitness	-16
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Bin2Dec

Table: Parameters of treatment NNtop1sga4k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sga4k passed to xegaRun

Parameter Values	
initgene	InitGene
selection	SUS
mateselection	SUS
replication	Kid2
crossover	Cross2Gene
mutation	MutateGene
accept	All
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sga4k passed to xegaRun (Part 2)

Treatment NNtop1sga4k

Treatment: NNtop1sga4k

	Treatment	Trials	Variable	min	mean	sd	m
12	NNtop1sga4k	92	Evaluations	19600.00	106719.57	58361.19	200000.
9	NNtop1sga4k	92	Fitness	0.34	0.88	0.26	1.
11	NNtop1sga4k	92	Generations	49.00	270.91	146.64	500.
10	NNtop1sga4k	92	Seconds	27.18	141.28	81.33	295.

Table: Treatment: NNtop1sga4k

Treatment NNtop1sga4k

Solution of treatment NNtop1sga4k

	Fitness	Errors
1	-0.76	0

Table: Solution of treatment NNtop1sga4k

Treatment NNtop1sga4k

Cases of treatment NNtop1sga4k

	1	2	3	4	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.00	0.70	TRUE	1.00	FALSE
2	0.00	0.00	0.00	1.00	0.40	FALSE	0.00	FALSE
3	0.00	0.00	1.00	0.00	0.09	FALSE	0.00	FALSE
4	0.00	0.00	1.00	1.00	0.09	FALSE	0.00	FALSE
5	0.00	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
6	0.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE
7	0.00	1.00	1.00	0.00	1.06	TRUE	1.00	FALSE
8	0.00	1.00	1.00	1.00	0.19	FALSE	0.00	FALSE
9	1.00	0.00	0.00	0.00	0.00	FALSE	0.00	FALSE
10	1.00	0.00	0.00	1.00	0.76	TRUE	1.00	FALSE
11	1.00	0.00	1.00	0.00	0.00	FALSE	0.00	FALSE
12	1.00	0.00	1.00	1.00	0.31	FALSE	0.00	FALSE
13	1.00	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
14	1.00	1.00	0.00	1.00	0.35	FALSE	0.00	FALSE
15	1.00	1.00	1.00	0.00	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga4k (Part 1)

Treatment NNtop1sga4k

Cases of treatment NNtop1sga4k

	1	2	3	4	Activation	Predicted	Actual	Error
16	1.00	1.00	1.00	1.00	0.57	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sga4k (Part 2)

Treatment NNtop1sga4k

Layer: 1 Neurons: 4 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8
1	-0.57	0.52	-0.40	-0.68	0.15	-0.14	-0.20	-0.91
2	-0.88	-0.14	0.87	-0.94	-0.33	-0.77	0.71	-0.24
3	0.38	-0.43	0.86	-0.84	-0.40	0.79	-0.10	0.92
4	0.68	-0.78	0.09	0.45	0.87	-0.66	0.31	0.79
5	-1.00	0.50	0.93	-0.61	0.47	0.43	-0.95	-0.65

Table: Layer: 1 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sga4k

Layer: 2 Neurons: 8 $(b|W)^T$:

	V1	V2	V3	V4
1	0.54	0.45	0.18	0.15
2	-0.91	0.42	-0.06	0.76
3	-0.05	0.54	-0.30	0.15
4	-0.96	0.50	0.24	-0.54
5	-0.31	-0.76	-0.97	0.47
6	-0.36	-0.68	-0.88	-0.37
7	0.33	-0.62	0.77	-0.06
8	-0.58	-0.76	0.83	-0.99
9	-0.99	0.10	0.12	0.97

Table: Layer: 2 Neurons: 8 $(b|W)^T$:

Treatment NNtop1sga4k

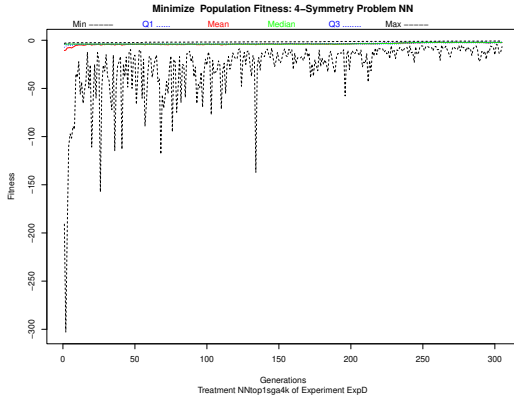
Layer: 3 Neurons: 4 $(b|W)^T$:

	V1
1	0.09
2	0.34
3	0.48
4	-0.63
5	0.93

Table: Layer: 3 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sga4k

Plot of last xegaRun for Treatment NNtop1sga4k of Experiment ExpD



Treatment NNtop1sga5k

Parameters of treatment: NNtop1sga5k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sga5k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sga5k

Treatment NNtop1sga5k

Parameters of treatment NNtop1sga5k passed to xegaRun

Parameter Values	
penv	5-Symmetry Problem NN
replay	0
algorithm	sga
max	FALSE
worstFitness	-32
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Bin2Dec

Table: Parameters of treatment NNtop1sga5k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sga5k passed to xegaRun

Parameter Values	
initgene	InitGene
selection	SUS
mateselection	SUS
replication	Kid2
crossover	Cross2Gene
mutation	MutateGene
accept	All
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sga5k passed to xegaRun (Part 2)

Treatment NNtop1sga5k

Treatment: NNtop1sga5k

	Treatment	Trials	Variable	min	mean	sd	m
16	NNtop1sga5k	92	Evaluations	26400.00	154765.22	49031.68	200000.
13	NNtop1sga5k	92	Fitness	0.79	1.88	0.67	4.
15	NNtop1sga5k	92	Generations	117.00	388.70	118.69	500.
14	NNtop1sga5k	92	Seconds	25.81	277.99	104.43	386.

Table: Treatment: NNtop1sga5k

Treatment NNtop1sga5k

Solution of treatment NNtop1sga5k

	Fitness	Errors
1	-1.46	0

Table: Solution of treatment NNtop1sga5k

Treatment NNtop1sga5k

Cases of treatment NNtop1sga5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.00	0.00	0.65	TRUE	1.00	FALSE
2	0.00	0.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
3	0.00	0.00	0.00	1.00	0.00	0.06	FALSE	0.00	FALSE
4	0.00	0.00	0.00	1.00	1.00	0.00	FALSE	0.00	FALSE
5	0.00	0.00	1.00	0.00	0.00	0.51	TRUE	1.00	FALSE
6	0.00	0.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE
7	0.00	0.00	1.00	1.00	0.00	0.10	FALSE	0.00	FALSE
8	0.00	0.00	1.00	1.00	1.00	0.00	FALSE	0.00	FALSE
9	0.00	1.00	0.00	0.00	0.00	0.02	FALSE	0.00	FALSE
10	0.00	1.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
11	0.00	1.00	0.00	1.00	0.00	0.63	TRUE	1.00	FALSE
12	0.00	1.00	0.00	1.00	1.00	0.00	FALSE	0.00	FALSE
13	0.00	1.00	1.00	0.00	0.00	0.36	FALSE	0.00	FALSE
14	0.00	1.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE
15	0.00	1.00	1.00	1.00	0.00	0.68	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sga5k (Part 1)

Treatment NNtop1sga5k

Cases of treatment NNtop1sga5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
16	0.00	1.00	1.00	1.00	1.00	0.00	FALSE	0.00	FALSE
17	1.00	0.00	0.00	0.00	0.00	0.10	FALSE	0.00	FALSE
18	1.00	0.00	0.00	0.00	1.00	0.70	TRUE	1.00	FALSE
19	1.00	0.00	0.00	1.00	0.00	0.00	FALSE	0.00	FALSE
20	1.00	0.00	0.00	1.00	1.00	0.05	FALSE	0.00	FALSE
21	1.00	0.00	1.00	0.00	0.00	0.16	FALSE	0.00	FALSE
22	1.00	0.00	1.00	0.00	1.00	0.64	TRUE	1.00	FALSE
23	1.00	0.00	1.00	1.00	0.00	0.00	FALSE	0.00	FALSE
24	1.00	0.00	1.00	1.00	1.00	0.21	FALSE	0.00	FALSE
25	1.00	1.00	0.00	0.00	0.00	0.22	FALSE	0.00	FALSE
26	1.00	1.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
27	1.00	1.00	0.00	1.00	0.00	0.00	FALSE	0.00	FALSE
28	1.00	1.00	0.00	1.00	1.00	0.56	TRUE	1.00	FALSE
29	1.00	1.00	1.00	0.00	0.00	0.29	FALSE	0.00	FALSE
30	1.00	1.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga5k (Part 2)

Treatment NNtop1sga5k

Cases of treatment NNtop1sga5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
31	1.00	1.00	1.00	1.00	0.00	0.00	FALSE	0.00	FALSE
32	1.00	1.00	1.00	1.00	1.00	0.70	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sga5k (Part 3)

Treatment NNtop1sga5k

Layer: 1 Neurons: 5 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	-0.52	0.15	-0.34	-0.19	-0.65	0.53	0.03	0.69	0.95	-0.37
2	0.78	-0.81	0.25	0.43	0.29	-0.76	0.98	0.19	0.62	-0.30
3	0.91	0.71	0.60	0.36	0.72	-0.64	-0.35	-0.15	-0.55	0.34
4	-0.60	-0.40	-0.22	0.43	-0.85	0.63	0.16	0.79	0.35	-0.65
5	0.06	-0.54	0.01	-0.45	-0.64	0.02	0.48	-0.73	0.35	-0.22
6	0.49	0.69	0.67	0.50	-0.78	0.77	-0.81	0.14	-0.46	0.95

Table: Layer: 1 Neurons: 5 $(b|W)^T$:

Treatment NNtop1sga5k

Layer: 2 Neurons: 10 $(b|W)^T$:

	V1	V2	V3	V4	V5
1	-0.81	-0.45	-0.60	-0.28	-0.07
2	0.61	-0.35	0.66	0.56	0.15
3	-0.74	-0.32	-0.01	0.19	0.87
4	0.59	0.81	-0.15	-0.57	0.54
5	0.34	-0.28	0.68	-0.90	-0.25
6	-0.02	0.90	0.12	0.83	0.84
7	0.09	0.53	0.49	-0.85	0.93
8	-0.99	0.44	-0.30	0.53	-0.79
9	-0.55	-0.89	-0.09	0.72	0.27
10	-0.40	0.55	-0.81	0.26	-0.72
11	0.21	-0.74	0.65	0.01	-0.58

Table: Layer: 2 Neurons: 10 $(b|W)^T$:

Treatment NNtop1sga5k

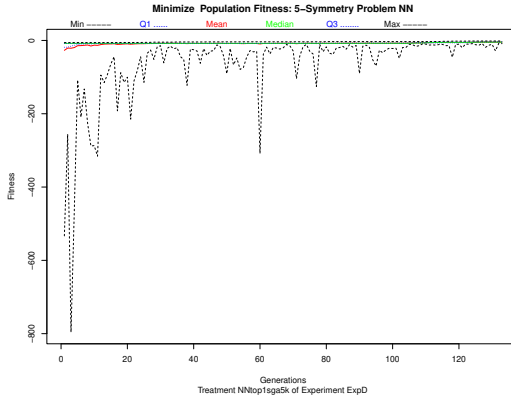
Layer: 3 Neurons: 5 $(b|W)^T$:

	V1
1	0.70
2	0.17
3	-0.82
4	-0.99
5	-0.48
6	-0.69

Table: Layer: 3 Neurons: 5 $(b|W)^T$:

Treatment NNtop1sga5k

Plot of last xegaRun for Treatment NNtop1sga5k of Experiment ExpD



Treatment NNtop1sga6k

Parameters of treatment: NNtop1sga6k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sga6k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sga6k

Parameters of treatment NNtop1sga6k passed to xegaRun

Parameter Values	
penv	6-Symmetry Problem NN
replay	0
algorithm	sga
max	FALSE
worstFitness	-64
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Bin2Dec

Table: Parameters of treatment NNtop1sga6k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sga6k passed to xegaRun

Parameter Values	
initgene	InitGene
selection	SUS
mateselection	SUS
replication	Kid2
crossover	Cross2Gene
mutation	MutateGene
accept	All
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sga6k passed to xegaRun (Part 2)

Treatment NNtop1sga6k

Treatment: NNtop1sga6k

	Treatment	Trials	Variable	min	mean	sd	n
20	NNtop1sga6k	92	Evaluations	100000.00	197826.09	14662.96	200000
17	NNtop1sga6k	92	Fitness	1.68	3.93	1.03	6
19	NNtop1sga6k	92	Generations	500.00	500.00	0.00	500
18	NNtop1sga6k	92	Seconds	124.23	468.15	90.36	521

Table: Treatment: NNtop1sga6k

Treatment NNtop1sga6k

Solution of treatment NNtop1sga6k

	Fitness	Errors
1	-5.27	6

Table: Solution of treatment NNtop1sga6k

Treatment NNtop1sga6k

Cases of treatment NNtop1sga6k

	Activation	Predicted	Actual	Error
1	0.30	FALSE	1.00	TRUE
2	0.09	FALSE	0.00	FALSE
3	0.13	FALSE	0.00	FALSE
4	0.11	FALSE	0.00	FALSE
5	0.11	FALSE	0.00	FALSE
6	0.11	FALSE	0.00	FALSE
7	0.12	FALSE	0.00	FALSE
8	0.13	FALSE	0.00	FALSE
9	0.19	FALSE	0.00	FALSE
10	0.10	FALSE	0.00	FALSE
11	0.29	FALSE	0.00	FALSE
12	0.11	FALSE	0.00	FALSE
13	0.63	TRUE	1.00	FALSE
14	0.11	FALSE	0.00	FALSE
15	0.43	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga6k (Part 1)

Treatment NNtop1sga6k

Cases of treatment NNtop1sga6k

	Activation	Predicted	Actual	Error
16	0.13	FALSE	0.00	FALSE
17	0.27	FALSE	0.00	FALSE
18	0.09	FALSE	0.00	FALSE
19	0.73	TRUE	1.00	FALSE
20	0.11	FALSE	0.00	FALSE
21	0.19	FALSE	0.00	FALSE
22	0.09	FALSE	0.00	FALSE
23	0.24	FALSE	0.00	FALSE
24	0.11	FALSE	0.00	FALSE
25	0.09	FALSE	0.00	FALSE
26	0.09	FALSE	0.00	FALSE
27	0.09	FALSE	0.00	FALSE
28	0.08	FALSE	0.00	FALSE
29	0.09	FALSE	0.00	FALSE
30	0.09	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga6k (Part 2)

Treatment NNtop1sga6k

Cases of treatment NNtop1sga6k

	Activation	Predicted	Actual	Error
31	0.24	FALSE	1.00	TRUE
32	0.09	FALSE	0.00	FALSE
33	0.11	FALSE	0.00	FALSE
34	0.11	FALSE	1.00	TRUE
35	0.00	FALSE	0.00	FALSE
36	0.03	FALSE	0.00	FALSE
37	0.10	FALSE	0.00	FALSE
38	0.13	FALSE	0.00	FALSE
39	0.01	FALSE	0.00	FALSE
40	0.08	FALSE	0.00	FALSE
41	0.08	FALSE	0.00	FALSE
42	0.11	FALSE	0.00	FALSE
43	0.00	FALSE	0.00	FALSE
44	0.05	FALSE	0.00	FALSE
45	0.09	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga6k (Part 3)

Treatment NNtop1sga6k

Cases of treatment NNtop1sga6k

	Activation	Predicted	Actual	Error
46	0.14	FALSE	1.00	TRUE
47	0.00	FALSE	0.00	FALSE
48	0.07	FALSE	0.00	FALSE
49	0.11	FALSE	0.00	FALSE
50	0.10	FALSE	0.00	FALSE
51	0.09	FALSE	0.00	FALSE
52	0.13	FALSE	1.00	TRUE
53	0.11	FALSE	0.00	FALSE
54	0.11	FALSE	0.00	FALSE
55	0.07	FALSE	0.00	FALSE
56	0.13	FALSE	0.00	FALSE
57	0.09	FALSE	0.00	FALSE
58	0.09	FALSE	0.00	FALSE
59	0.04	FALSE	0.00	FALSE
60	0.10	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sga6k (Part 4)

Treatment NNtop1sga6k

Cases of treatment NNtop1sga6k

	Activation	Predicted	Actual	Error
61	0.10	FALSE	0.00	FALSE
62	0.10	FALSE	0.00	FALSE
63	0.04	FALSE	0.00	FALSE
64	0.11	FALSE	1.00	TRUE

Table: Cases of treatment NNtop1sga6k (Part 5)

Treatment NNtop1sga6k

Layer: 1 Neurons: 6 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
1	0.78	0.41	-0.23	-0.28	-0.69	0.88	-0.30	-0.12	-0.22	-0.76	0.7
2	-0.73	0.32	0.96	0.58	0.88	-0.11	0.88	0.92	0.72	-0.97	0.5
3	0.55	0.11	-0.85	0.80	0.05	0.89	-0.06	-0.31	-0.31	0.96	-0.5
4	-0.76	-0.06	0.73	-0.42	0.86	-0.68	0.65	-0.67	0.46	-0.88	0.6
5	-0.68	0.49	0.37	-0.61	0.33	-0.32	-0.26	0.68	0.50	-0.70	0.4
6	0.59	0.58	-0.02	-0.06	-0.77	0.76	0.89	0.44	-0.18	0.59	0.0
7	-0.87	0.81	0.20	-0.20	0.95	0.87	-0.20	0.76	0.46	-0.98	0.6

Table: Layer: 1 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sga6k

Layer: 2 Neurons: 12 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6
1	0.10	-0.21	0.64	-0.86	0.09	-0.95
2	-0.92	0.32	0.56	0.58	0.29	0.60
3	-0.61	0.13	0.16	-0.01	0.91	0.54
4	-0.07	-0.23	0.99	-0.40	0.98	0.64
5	-0.14	-0.87	-0.71	-0.76	0.79	0.10
6	-0.63	-0.46	0.47	-0.26	-0.98	-0.98
7	-0.52	-0.83	-0.43	-0.43	-0.70	-0.15
8	-0.08	0.89	0.10	0.06	-0.20	-0.85
9	-0.11	0.55	-0.40	0.52	0.90	-0.98
10	0.57	0.22	-0.83	-0.11	-0.62	-0.66
11	-0.87	-0.09	0.25	-0.10	-0.30	0.87
12	-0.17	-0.05	0.04	-0.30	0.04	0.83
13	0.56	0.79	-0.43	-0.96	0.66	-0.41

Table: Layer: 2 Neurons: 12 $(b|W)^T$:

Treatment NNtop1sga6k

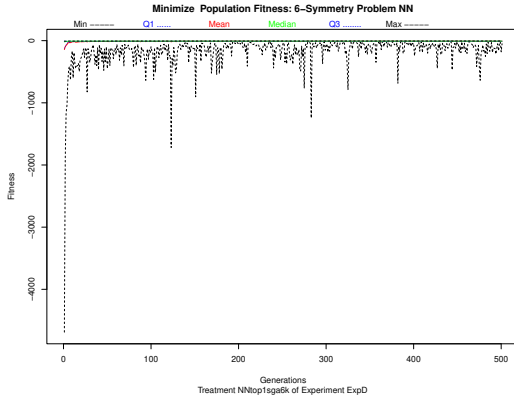
Layer: 3 Neurons: 6 $(b|W)^T$:

	V1
1	0.08
2	0.47
3	-0.13
4	0.01
5	0.19
6	0.02
7	0.87

Table: Layer: 3 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sga6k

Plot of last xegaRun for Treatment NNtop1sga6k of Experiment ExpD



Treatment NNtop1sgde2k

Parameters of treatment: NNtop1sgde2k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sgde2k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sgde2k

Parameters of treatment NNtop1sgde2k passed to xegaRun

Parameter Values	
penv	2-Symmetry Problem NN
replay	0
algorithm	sgde
max	FALSE
worstFitness	-4
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Identity

Table: Parameters of treatment NNtop1sgde2k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sgde2k passed to xegaRun

	Parameter Values
initgene	InitGene
selection	UniformP
mateselection	UniformP
replication	DE
crossover	UCrossGene
mutation	MutateGeneDE
accept	Best
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sgde2k passed to xegaRun (Part 2)

Treatment NNtop1sgde2k

Treatment: NNtop1sgde2k

	Treatment	Trials	Variable	min	mean	sd	max
24	NNtop1sgde2k	92	Evaluations	200.00	3019.57	2457.03	11600.00
21	NNtop1sgde2k	92	Fitness	0.08	0.42	0.14	0.71
23	NNtop1sgde2k	92	Generations	1.00	7.59	6.12	29.00
22	NNtop1sgde2k	92	Seconds	0.14	2.40	1.84	9.09

Table: Treatment: NNtop1sgde2k

Treatment NNtop1sgde2k

Solution of treatment NNtop1sgde2k

	Fitness	Errors
1	-0.29	0

Table: Solution of treatment NNtop1sgde2k

Treatment NNtop1sgde2k

Cases of treatment NNtop1sgde2k

	1	2	Activation	Predicted	Actual	Error
1	0.00	0.00	0.72	TRUE	1.00	FALSE
2	0.00	1.00	0.09	FALSE	0.00	FALSE
3	1.00	0.00	0.09	FALSE	0.00	FALSE
4	1.00	1.00	0.56	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde2k

Treatment NNtop1sgde2k

Layer: 1 Neurons: 2 $(b|W)^T$:

	V1	V2	V3	V4
1	-1.08	-0.20	0.40	-0.69
2	0.99	0.57	-0.74	1.34
3	-0.95	-0.31	0.68	-2.48

Table: Layer: 1 Neurons: 2 $(b|W)^T$:

Treatment NNtop1sgde2k

Layer: 2 Neurons: 4 $(b|W)^T$:

	V1	V2
1	0.56	-1.46
2	-0.61	1.74
3	-1.74	0.65
4	-0.67	-0.35
5	-0.96	-0.37

Table: Layer: 2 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sgde2k

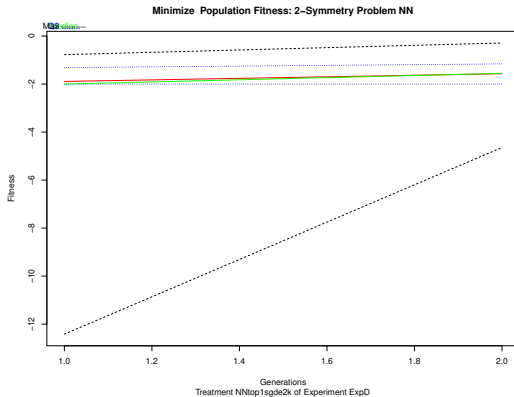
Layer: 3 Neurons: 2 $(b|W)^T$:

	V1
1	0.09
2	2.12
3	-1.33

Table: Layer: 3 Neurons: 2 $(b|W)^T$:

Treatment NNtop1sgde2k

Plot of last xegaRun for Treatment NNtop1sgde2k of Experiment ExpD



Treatment NNtop1sgde3k

Parameters of treatment: NNtop1sgde3k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sgde3k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sgde3k

Parameters of treatment NNtop1sgde3k passed to xegaRun

Parameter Values	
penv	3-Symmetry Problem NN
replay	0
algorithm	sgde
max	FALSE
worstFitness	-8
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Identity

Table: Parameters of treatment NNtop1sgde3k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sgde3k passed to xegaRun

	Parameter Values
initgene	InitGene
selection	UniformP
mateselection	UniformP
replication	DE
crossover	UCrossGene
mutation	MutateGeneDE
accept	Best
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sgde3k passed to xegaRun (Part 2)

Treatment NNtop1sgde3k

Treatment: NNtop1sgde3k

	Treatment	Trials	Variable	min	mean	sd	max
28	NNtop1sgde3k	92	Evaluations	400.00	11336.96	7869.09	35600.00
25	NNtop1sgde3k	92	Fitness	0.06	0.59	0.27	1.36
27	NNtop1sgde3k	92	Generations	1.00	28.74	19.65	89.00
26	NNtop1sgde3k	92	Seconds	0.60	10.96	8.17	43.51

Table: Treatment: NNtop1sgde3k

Treatment NNtop1sgde3k

Solution of treatment NNtop1sgde3k

	Fitness	Errors
1	-0.50	0

Table: Solution of treatment NNtop1sgde3k

Treatment NNtop1sgde3k

Cases of treatment NNtop1sgde3k

	1	2	3	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.61	TRUE	1.00	FALSE
2	0.00	0.00	1.00	0.23	FALSE	0.00	FALSE
3	0.00	1.00	0.00	0.95	TRUE	1.00	FALSE
4	0.00	1.00	1.00	0.21	FALSE	0.00	FALSE
5	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
6	1.00	0.00	1.00	0.57	TRUE	1.00	FALSE
7	1.00	1.00	0.00	0.00	FALSE	0.00	FALSE
8	1.00	1.00	1.00	0.74	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde3k

Treatment NNtop1sgde3k

Layer: 1 Neurons: 3 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6
1	-1.65	1.27	-0.21	-1.58	-0.01	-0.29
2	-0.18	1.22	1.29	-0.90	-0.97	-0.03
3	-1.04	-0.24	0.17	2.18	1.87	-0.03
4	0.80	-0.51	-0.60	0.76	2.61	0.12

Table: Layer: 1 Neurons: 3 $(b|W)^T$:

Treatment NNtop1sgde3k

Layer: 2 Neurons: 6 $(b|W)^T$:

	V1	V2	V3
1	0.08	0.27	-0.26
2	1.43	0.39	-0.30
3	0.72	0.45	1.30
4	-0.46	0.35	-0.98
5	0.64	-0.23	0.55
6	-0.58	-0.41	-0.25
7	2.22	-1.50	0.69

Table: Layer: 2 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sgde3k

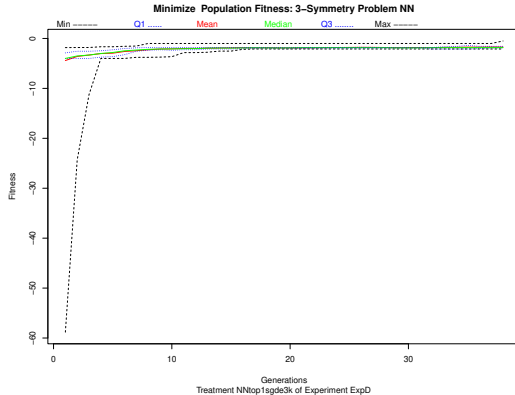
Layer: 3 Neurons: 3 $(b|W)^T$:

	V1
1	0.16
2	0.48
3	-1.30
4	0.76

Table: Layer: 3 Neurons: 3 $(b|W)^T$:

Treatment NNtop1sgde3k

Plot of last xegaRun for Treatment NNtop1sgde3k of Experiment ExpD



Treatment NNtop1sgde4k

Parameters of treatment: NNtop1sgde4k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sgde4k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sgde4k

Parameters of treatment NNtop1sgde4k passed to xegaRun

Parameter Values	
penv	4-Symmetry Problem NN
replay	0
algorithm	sgde
max	FALSE
worstFitness	-16
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Identity

Table: Parameters of treatment NNtop1sgde4k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sgde4k passed to xegaRun

	Parameter Values
initgene	InitGene
selection	UniformP
mateselection	UniformP
replication	DE
crossover	UCrossGene
mutation	MutateGeneDE
accept	Best
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sgde4k passed to xegaRun (Part 2)

Treatment NNtop1sgde4k

Treatment: NNtop1sgde4k

	Treatment	Trials	Variable	min	mean	sd	ma
32	NNtop1sgde4k	92	Evaluations	4400.00	73082.61	50943.88	200000.0
29	NNtop1sgde4k	92	Fitness	0.18	0.70	0.32	1.5
31	NNtop1sgde4k	92	Generations	11.00	185.75	131.06	500.0
30	NNtop1sgde4k	92	Seconds	3.22	59.21	59.39	330.5

Table: Treatment: NNtop1sgde4k

Treatment NNtop1sgde4k

Solution of treatment NNtop1sgde4k

	Fitness	Errors
1	-1.22	0

Table: Solution of treatment NNtop1sgde4k

Treatment NNtop1sgde4k

Cases of treatment NNtop1sgde4k

	1	2	3	4	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.00	0.56	TRUE	1.00	FALSE
2	0.00	0.00	0.00	1.00	0.15	FALSE	0.00	FALSE
3	0.00	0.00	1.00	0.00	0.32	FALSE	0.00	FALSE
4	0.00	0.00	1.00	1.00	0.05	FALSE	0.00	FALSE
5	0.00	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
6	0.00	1.00	0.00	1.00	0.05	FALSE	0.00	FALSE
7	0.00	1.00	1.00	0.00	0.75	TRUE	1.00	FALSE
8	0.00	1.00	1.00	1.00	0.05	FALSE	0.00	FALSE
9	1.00	0.00	0.00	0.00	0.39	FALSE	0.00	FALSE
10	1.00	0.00	0.00	1.00	0.54	TRUE	1.00	FALSE
11	1.00	0.00	1.00	0.00	0.05	FALSE	0.00	FALSE
12	1.00	0.00	1.00	1.00	0.45	FALSE	0.00	FALSE
13	1.00	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
14	1.00	1.00	0.00	1.00	0.05	FALSE	0.00	FALSE
15	1.00	1.00	1.00	0.00	0.36	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde4k (Part 1)

Treatment NNtop1sgde4k

Cases of treatment NNtop1sgde4k

	1	2	3	4	Activation	Predicted	Actual	Error
16	1.00	1.00	1.00	1.00	0.64	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde4k (Part 2)

Treatment NNtop1sgde4k

Layer: 1 Neurons: 4 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8
1	-0.78	-0.64	-0.64	0.13	-0.60	0.12	-0.11	-0.44
2	-0.16	2.46	-0.60	-1.06	-0.11	0.27	-0.17	-0.32
3	-1.96	0.24	0.27	-1.43	1.71	0.47	-1.53	0.63
4	-1.26	-0.41	0.34	-1.91	-1.76	0.56	0.48	0.83
5	0.37	2.09	-0.63	-1.47	-0.55	0.37	0.43	-0.77

Table: Layer: 1 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sgde4k

Layer: 2 Neurons: 8 $(b|W)^T$:

	V1	V2	V3	V4
1	-1.23	-1.54	0.79	-1.04
2	-0.47	0.10	-0.48	-0.81
3	-0.03	-0.11	0.01	0.39
4	-1.26	-0.40	0.77	0.10
5	1.52	1.05	0.28	0.25
6	-0.75	2.65	-0.41	-3.79
7	-0.44	-0.67	-0.80	0.30
8	1.50	-0.04	-0.80	-0.11
9	0.22	0.81	1.11	-1.56

Table: Layer: 2 Neurons: 8 $(b|W)^T$:

Treatment NNtop1sgde4k

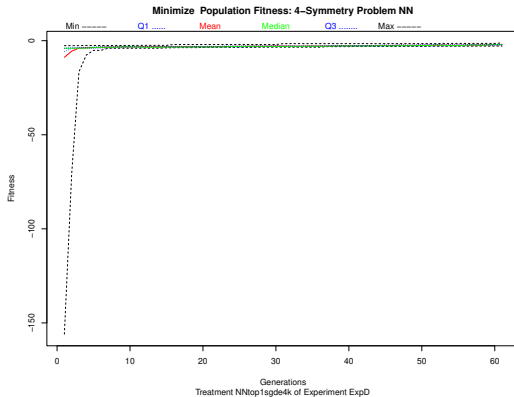
Layer: 3 Neurons: 4 $(b|W)^T$:

	V1
1	0.05
2	-0.35
3	-0.74
4	0.70
5	0.63

Table: Layer: 3 Neurons: 4 $(b|W)^T$:

Treatment NNtop1sgde4k

Plot of last xegaRun for Treatment NNtop1sgde4k of Experiment ExpD



Treatment NNtop1sgde5k

Parameters of treatment: NNtop1sgde5k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sgde5k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sgde5k

Parameters of treatment NNtop1sgde5k passed to xegaRun

Parameter Values	
penv	5-Symmetry Problem NN
replay	0
algorithm	sgde
max	FALSE
worstFitness	-32
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Identity

Table: Parameters of treatment NNtop1sgde5k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sgde5k passed to xegaRun

	Parameter Values
initgene	InitGene
selection	UniformP
mateselection	UniformP
replication	DE
crossover	UCrossGene
mutation	MutateGeneDE
accept	Best
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sgde5k passed to xegaRun (Part 2)

Treatment NNtop1sgde5k

Treatment: NNtop1sgde5k

	Treatment	Trials	Variable	min	mean	sd	n
36	NNtop1sgde5k	92	Evaluations	24000.00	102526.09	48628.58	200000
33	NNtop1sgde5k	92	Fitness	0.23	1.21	0.59	4
35	NNtop1sgde5k	92	Generations	60.00	258.61	119.77	500
34	NNtop1sgde5k	92	Seconds	20.45	106.60	61.28	323

Table: Treatment: NNtop1sgde5k

Treatment NNtop1sgde5k

Solution of treatment NNtop1sgde5k

	Fitness	Errors
1	-1.45	0

Table: Solution of treatment NNtop1sgde5k

Treatment NNtop1sgde5k

Cases of treatment NNtop1sgde5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
1	0.00	0.00	0.00	0.00	0.00	0.61	TRUE	1.00	FALSE
2	0.00	0.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
3	0.00	0.00	0.00	1.00	0.00	0.37	FALSE	0.00	FALSE
4	0.00	0.00	0.00	1.00	1.00	0.00	FALSE	0.00	FALSE
5	0.00	0.00	1.00	0.00	0.00	1.05	TRUE	1.00	FALSE
6	0.00	0.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE
7	0.00	0.00	1.00	1.00	0.00	0.41	FALSE	0.00	FALSE
8	0.00	0.00	1.00	1.00	1.00	0.00	FALSE	0.00	FALSE
9	0.00	1.00	0.00	0.00	0.00	0.00	FALSE	0.00	FALSE
10	0.00	1.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
11	0.00	1.00	0.00	1.00	0.00	0.75	TRUE	1.00	FALSE
12	0.00	1.00	0.00	1.00	1.00	0.00	FALSE	0.00	FALSE
13	0.00	1.00	1.00	0.00	0.00	0.00	FALSE	0.00	FALSE
14	0.00	1.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE
15	0.00	1.00	1.00	1.00	0.00	0.80	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde5k (Part 1)

Treatment NNtop1sgde5k

Cases of treatment NNtop1sgde5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
16	0.00	1.00	1.00	1.00	1.00	0.00	FALSE	0.00	FALSE
17	1.00	0.00	0.00	0.00	0.00	0.18	FALSE	0.00	FALSE
18	1.00	0.00	0.00	0.00	1.00	0.50	TRUE	1.00	FALSE
19	1.00	0.00	0.00	1.00	0.00	0.17	FALSE	0.00	FALSE
20	1.00	0.00	0.00	1.00	1.00	0.18	FALSE	0.00	FALSE
21	1.00	0.00	1.00	0.00	0.00	0.19	FALSE	0.00	FALSE
22	1.00	0.00	1.00	0.00	1.00	0.92	TRUE	1.00	FALSE
23	1.00	0.00	1.00	1.00	0.00	0.17	FALSE	0.00	FALSE
24	1.00	0.00	1.00	1.00	1.00	0.20	FALSE	0.00	FALSE
25	1.00	1.00	0.00	0.00	0.00	0.19	FALSE	0.00	FALSE
26	1.00	1.00	0.00	0.00	1.00	0.00	FALSE	0.00	FALSE
27	1.00	1.00	0.00	1.00	0.00	0.19	FALSE	0.00	FALSE
28	1.00	1.00	0.00	1.00	1.00	0.59	TRUE	1.00	FALSE
29	1.00	1.00	1.00	0.00	0.00	0.19	FALSE	0.00	FALSE
30	1.00	1.00	1.00	0.00	1.00	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde5k (Part 2)

Treatment NNtop1sgde5k

Cases of treatment NNtop1sgde5k

	1	2	3	4	5	Activation	Predicted	Actual	Error
31	1.00	1.00	1.00	1.00	0.00	0.19	FALSE	0.00	FALSE
32	1.00	1.00	1.00	1.00	1.00	0.64	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde5k (Part 3)

Treatment NNtop1sgde5k

Layer: 1 Neurons: 5 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	-0.08	0.57	-0.06	-0.10	-1.99	-1.56	0.84	0.43	-0.27	1.08
2	-1.28	1.29	-1.30	-0.68	-0.45	-0.55	-0.03	0.42	0.81	-0.77
3	-1.07	0.18	1.28	1.16	-0.49	-1.14	1.33	0.14	0.27	-0.03
4	2.01	-0.03	-0.07	0.16	-0.77	0.76	-0.23	0.06	0.34	0.34
5	-1.86	0.04	0.74	0.78	0.49	0.36	-1.57	0.34	-0.43	-1.09
6	0.73	-0.50	0.50	0.28	0.13	0.33	-0.33	-2.85	-2.92	0.84

Table: Layer: 1 Neurons: 5 $(b|W)^T$:

Treatment NNtop1sgde5k

Layer: 2 Neurons: 10 $(b|W)^T$:

	V1	V2	V3	V4	V5
1	-1.38	0.46	-0.93	-0.55	0.93
2	0.20	1.05	0.21	0.31	-0.96
3	-0.26	-0.59	-0.50	-0.54	0.43
4	0.39	0.68	0.45	-2.15	-0.83
5	-1.21	1.04	0.40	-0.06	-0.61
6	0.28	-0.28	-1.31	0.69	1.02
7	-0.74	0.88	-2.27	2.27	-1.52
8	-0.15	-0.47	0.27	-0.65	-0.36
9	-0.79	-0.63	-0.85	0.50	0.72
10	-0.58	-0.73	-0.03	-0.37	-1.04
11	0.15	-0.07	1.00	2.09	-0.09

Table: Layer: 2 Neurons: 10 $(b|W)^T$:

Treatment NNtop1sgde5k

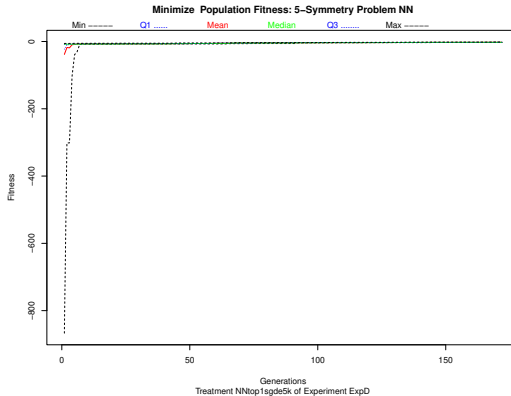
Layer: 3 Neurons: 5 $(b|W)^T$:

	V1
1	0.20
2	-0.72
3	0.23
4	-1.38
5	0.40
6	-0.01

Table: Layer: 3 Neurons: 5 $(b|W)^T$:

Treatment NNtop1sgde5k

Plot of last xegaRun for Treatment NNtop1sgde5k of Experiment ExpD



Treatment NNtop1sgde6k

Parameters of treatment: NNtop1sgde6k

Parameter Values	
tRNG	L'Ecuyer-CMRG Inversion Rejection
tReplay	0
experimentName	EB
treatmentName	NNtop1sgde6k
trials	2
everyK	10
outpath	data
batchPath	.
tVerbose	1

Table: Parameters of treatment: NNtop1sgde6k

Parameters of treatment NNtop1sgde6k passed to xegaRun

Parameter Values	
penv	6-Symmetry Problem NN
replay	0
algorithm	sgde
max	FALSE
worstFitness	-64
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
ivmutrate	Const
mutrate2	0.8
ivcrossrate	Const
crossrate2	0.4
scalefactor	Uniform
genemap	Identity

Table: Parameters of treatment NNtop1sgde6k passed to xegaRun (Part 1)

Parameters of treatment NNtop1sgde6k passed to xegaRun

	Parameter Values
initgene	InitGene
selection	UniformP
mateselection	UniformP
replication	DE
crossover	UCrossGene
mutation	MutateGeneDE
accept	Best
reportEvalErrors	TRUE
evalmethod	Deterministic
executionModel	MultiCore
verbose	1
early	TRUE
batch	FALSE
semantics	byValue
path	.

Table: Parameters of treatment NNtop1sgde6k passed to xegaRun (Part 2)

Treatment NNtop1sgde6k

Treatment: NNtop1sgde6k

	Treatment	Trials	Variable	min	mean	sd	n
40	NNtop1sgde6k	92	Evaluations	78000.00	187239.13	31130.55	200000
37	NNtop1sgde6k	92	Fitness	0.28	3.21	1.45	6
39	NNtop1sgde6k	92	Generations	195.00	473.53	70.74	500
38	NNtop1sgde6k	92	Seconds	96.96	272.94	143.68	905

Table: Treatment: NNtop1sgde6k

Treatment NNtop1sgde6k

Solution of treatment NNtop1sgde6k

	Fitness	Errors
1	-1.58	2

Table: Solution of treatment NNtop1sgde6k

Treatment NNtop1sgde6k

Cases of treatment NNtop1sgde6k

	Activation	Predicted	Actual	Error
1	0.99	TRUE	1.00	FALSE
2	0.00	FALSE	0.00	FALSE
3	0.00	FALSE	0.00	FALSE
4	0.00	FALSE	0.00	FALSE
5	0.00	FALSE	0.00	FALSE
6	0.00	FALSE	0.00	FALSE
7	0.00	FALSE	0.00	FALSE
8	0.00	FALSE	0.00	FALSE
9	0.00	FALSE	0.00	FALSE
10	0.00	FALSE	0.00	FALSE
11	0.00	FALSE	0.00	FALSE
12	0.00	FALSE	0.00	FALSE
13	0.97	TRUE	1.00	FALSE
14	0.00	FALSE	0.00	FALSE
15	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde6k (Part 1)

Treatment NNtop1sgde6k

Cases of treatment NNtop1sgde6k

	Activation	Predicted	Actual	Error
16	0.00	FALSE	0.00	FALSE
17	0.00	FALSE	0.00	FALSE
18	0.00	FALSE	0.00	FALSE
19	0.41	FALSE	1.00	TRUE
20	0.00	FALSE	0.00	FALSE
21	0.00	FALSE	0.00	FALSE
22	0.00	FALSE	0.00	FALSE
23	0.00	FALSE	0.00	FALSE
24	0.00	FALSE	0.00	FALSE
25	0.00	FALSE	0.00	FALSE
26	0.00	FALSE	0.00	FALSE
27	0.00	FALSE	0.00	FALSE
28	0.00	FALSE	0.00	FALSE
29	0.00	FALSE	0.00	FALSE
30	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde6k (Part 2)

Treatment NNtop1sgde6k

Cases of treatment NNtop1sgde6k

	Activation	Predicted	Actual	Error
31	0.00	FALSE	1.00	TRUE
32	0.00	FALSE	0.00	FALSE
33	0.00	FALSE	0.00	FALSE
34	1.03	TRUE	1.00	FALSE
35	0.00	FALSE	0.00	FALSE
36	0.00	FALSE	0.00	FALSE
37	0.00	FALSE	0.00	FALSE
38	0.00	FALSE	0.00	FALSE
39	0.00	FALSE	0.00	FALSE
40	0.00	FALSE	0.00	FALSE
41	0.00	FALSE	0.00	FALSE
42	0.00	FALSE	0.00	FALSE
43	0.00	FALSE	0.00	FALSE
44	0.00	FALSE	0.00	FALSE
45	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde6k (Part 3)

Treatment NNtop1sgde6k

Cases of treatment NNtop1sgde6k

	Activation	Predicted	Actual	Error
46	1.08	TRUE	1.00	FALSE
47	0.00	FALSE	0.00	FALSE
48	0.00	FALSE	0.00	FALSE
49	0.00	FALSE	0.00	FALSE
50	0.00	FALSE	0.00	FALSE
51	0.46	FALSE	0.00	FALSE
52	0.89	TRUE	1.00	FALSE
53	0.00	FALSE	0.00	FALSE
54	0.00	FALSE	0.00	FALSE
55	0.00	FALSE	0.00	FALSE
56	0.00	FALSE	0.00	FALSE
57	0.00	FALSE	0.00	FALSE
58	0.00	FALSE	0.00	FALSE
59	0.00	FALSE	0.00	FALSE
60	0.00	FALSE	0.00	FALSE

Table: Cases of treatment NNtop1sgde6k (Part 4)

Treatment NNtop1sgde6k

Cases of treatment NNtop1sgde6k

	Activation	Predicted	Actual	Error
61	0.00	FALSE	0.00	FALSE
62	0.00	FALSE	0.00	FALSE
63	0.00	FALSE	0.00	FALSE
64	0.95	TRUE	1.00	FALSE

Table: Cases of treatment NNtop1sgde6k (Part 5)

Treatment NNtop1sgde6k

Layer: 1 Neurons: 6 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
1	-0.22	0.19	-0.45	-1.04	-0.10	-0.74	-0.46	1.22	-1.02	0.00	0.00
2	-0.55	-0.49	-0.23	-1.71	0.89	1.45	-0.16	0.22	-0.74	0.72	0.30
3	-0.66	-0.95	-0.88	0.17	-0.23	-0.72	-0.52	-2.30	0.28	0.62	-2.20
4	0.33	1.58	0.22	1.22	-1.29	0.29	2.52	0.45	0.19	0.76	1.60
5	1.45	-2.34	-2.29	-0.16	1.76	0.23	-1.52	-0.82	-0.13	-0.24	-0.20
6	-1.68	-1.77	-3.53	0.45	-1.28	-0.85	0.98	0.42	-1.32	2.32	1.70
7	-0.98	-1.67	-1.47	0.92	-0.77	-0.72	-0.68	0.24	-2.06	0.27	1.10

Table: Layer: 1 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sgde6k

Layer: 2 Neurons: 12 $(b|W)^T$:

	V1	V2	V3	V4	V5	V6
1	-0.60	-0.01	-0.65	0.89	-0.01	-0.43
2	-0.67	0.38	0.49	-0.32	-0.58	-0.20
3	0.04	0.73	0.54	1.86	-1.52	-0.31
4	0.28	-0.99	0.35	-0.10	-1.45	0.94
5	-0.26	2.32	-0.24	3.04	2.62	-0.73
6	-0.28	0.57	-0.02	3.84	-0.04	0.24
7	-2.29	-0.89	-1.07	-0.65	-2.09	-0.12
8	-0.45	-5.76	-0.59	-0.15	-0.19	0.06
9	-0.26	-0.17	-2.21	0.81	0.09	-0.85
10	0.82	1.88	-2.00	1.01	1.00	0.69
11	-1.32	0.79	-0.96	-0.39	-0.18	0.21
12	0.62	0.51	-0.28	0.35	0.01	-0.57
13	1.55	-1.90	-3.09	-2.41	-1.09	0.87

Table: Layer: 2 Neurons: 12 $(b|W)^T$:

Treatment NNtop1sgde6k

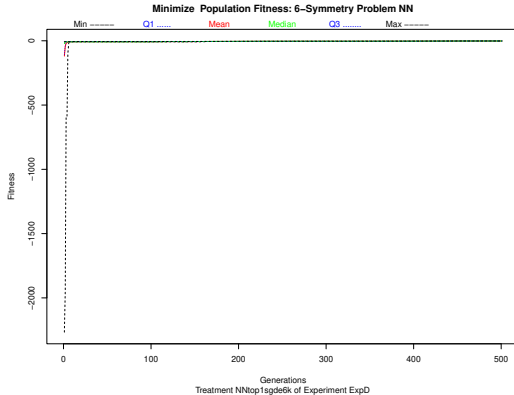
Layer: 3 Neurons: 6 $(b|W)^T$:

	V1
1	-0.08
2	0.83
3	0.27
4	-0.19
5	-1.12
6	-1.95
7	-0.68

Table: Layer: 3 Neurons: 6 $(b|W)^T$:

Treatment NNtop1sgde6k

Plot of last xegaRun for Treatment NNtop1sgde6k of Experiment ExpD



All parameters of xegaRun of treatment NNtop1sga2k

Parameter Values	
penv	2-Symmetry Problem NN
max	FALSE
algorithm	sga
popsiz	200
generations	500
crossrate	0.2
mutrate	0.4
elitist	TRUE
replay	0
maxdepth	7
maxtrials	5
codons	25
codonBits	0
codonPrecision	LCM
maxPBias	0.01

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 1)

All parameters of xegaRun of treatment NNtop1sga2k

	Parameter Values
evalmethod	Deterministic
evalrep	1
reportEvalErrors	TRUE
genemap	Bin2Dec
decoder	DecodeGene
crossrate2	0.4
ivcrossrate	Const
crossover	Cross2Gene
uCrossSwap	0.2
mincrossdepth	1
maxcrossdepth	7
ivmutrate	Const
mutrate2	0.8
bitmutrate	0.005
bitmutrate2	0.01

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 2)

All parameters of xegaRun of treatment NNtop1sga2k

	Parameter Values
maxmutdepth	3
minmutinsertiondepth	1
maxmutinsertiondepth	7
lambda	0.05
max2opt	100
scalefactor1	0.9
scalefactor2	0.3
scalefactor	Uniform
cutoffFit	0.5
mutation	MutateGene
replication	Kid2
initgene	InitGene
offset	1
eps	0.01
tournamentSize	2

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 3)

All parameters of xegaRun of treatment NNtop1sga2k

Parameter Values	
selectionBias	1.5
maxTSR	1.5
selection	SUS
mateselection	SUS
selectionContinuation	TRUE
scaling	NoScaling
scalingThreshold	0
scalingExp	1
scalingExp2	1
rdmWeight	1
drMax	2
drMin	0.5
dispersionMeasure	var
scalingDelay	1
accept	All

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 4)

All parameters of xegaRun of treatment NNtop1sga2k

Parameter Values		
alpha		0.99
beta		2
cooling	Exponential	Multiplicative
coolingPower		1
temp0		40
tempN		0.01
verbose		1
logevals		FALSE
allsolutions		FALSE
early		TRUE
terminationCondition	NoTermination	
terminationEps		0.01
terminationThreshold		0
worstFitness		-4
PACdelta		0.01

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 5)

All parameters of xegaRun of treatment NNtop1sga2k

Parameter Values	
fSpace	Hilbert
cores	16
executionModel	MultiCore
uParApply	NULL
Cluster	NULL
profile	FALSE
batch	FALSE
path	.
semantics	byValue

Table: All parameters of xegaRun of treatment NNtop1sga2k (Part 6)