A Genetic Algorithm using an Entropy based Selection Scheme

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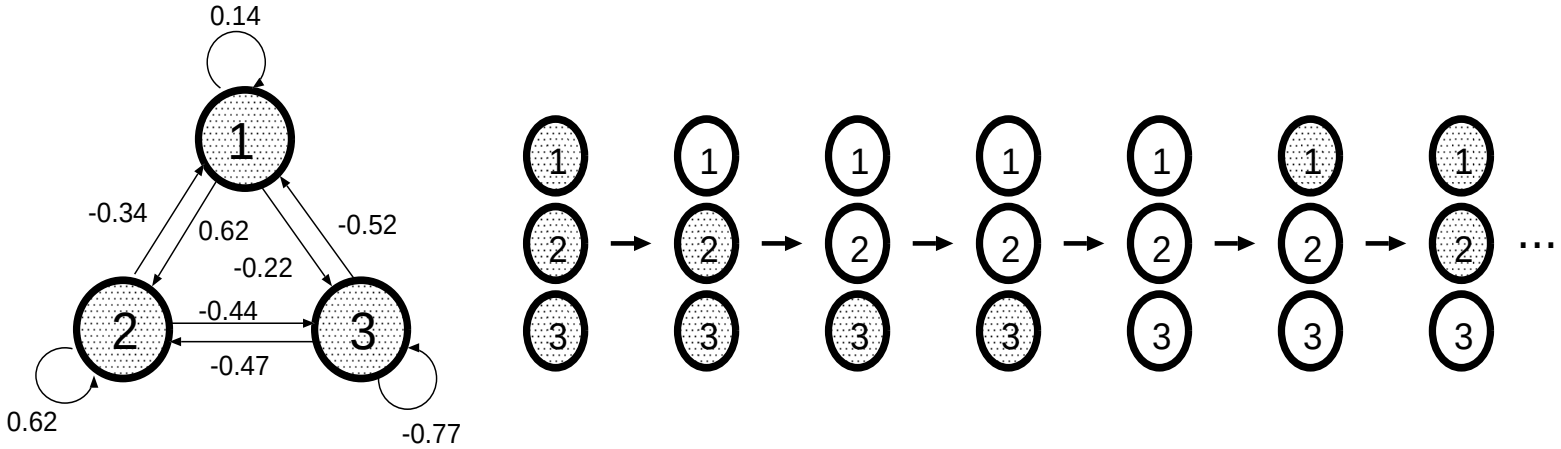
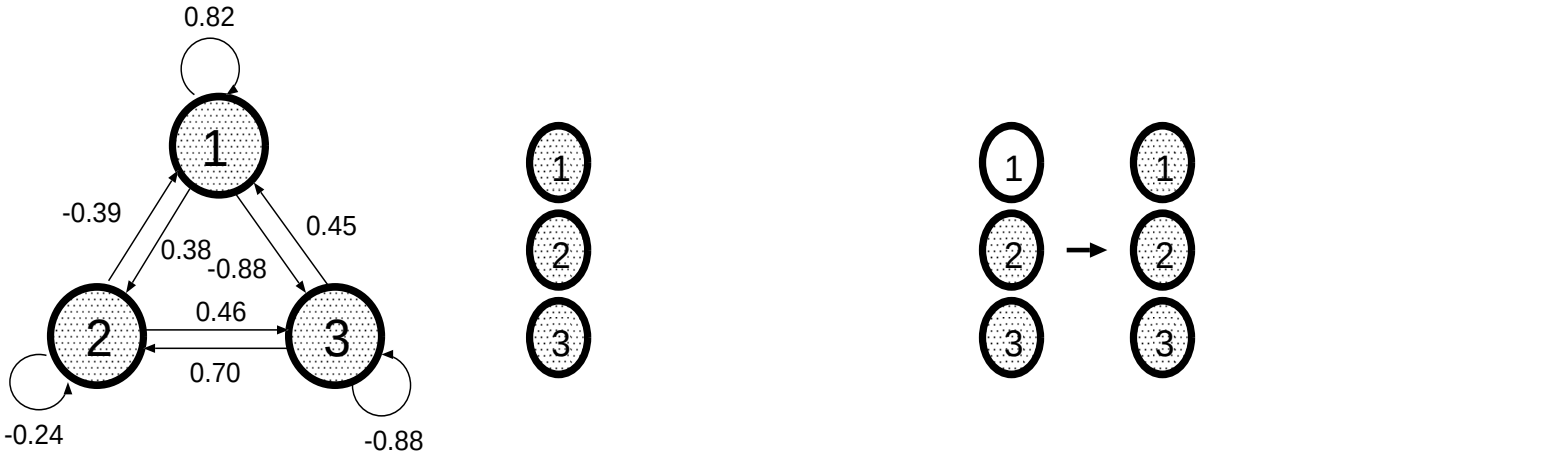
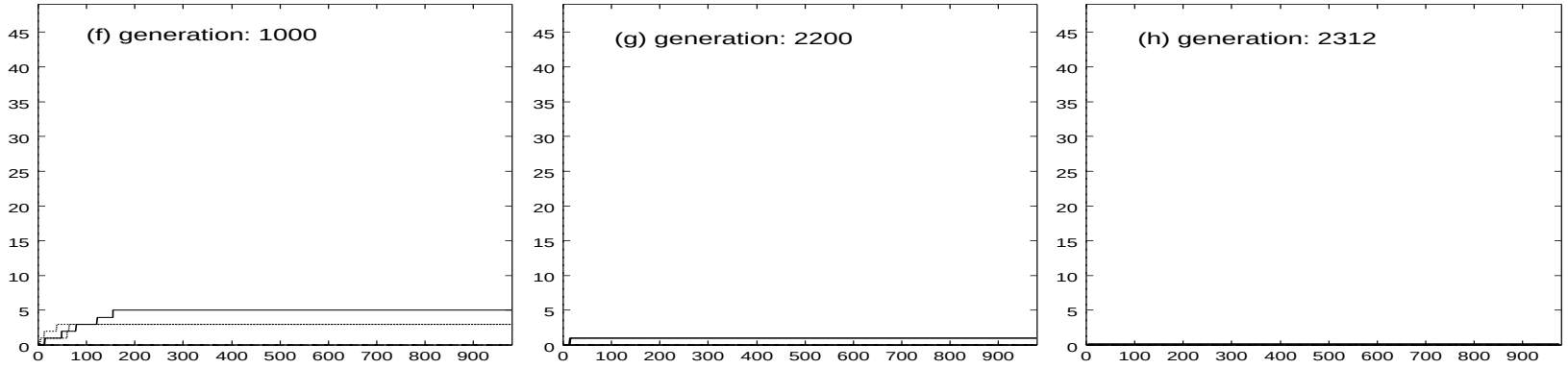
Introduction:

- We apply
  - ECs to neural network model of Associative Memory.
- We study
  - basic behaviors of the model under simple evolutionary processes.
- Here,
  - we use a selection scheme based on entropy of the population.
    (Lee and Han, 1997)

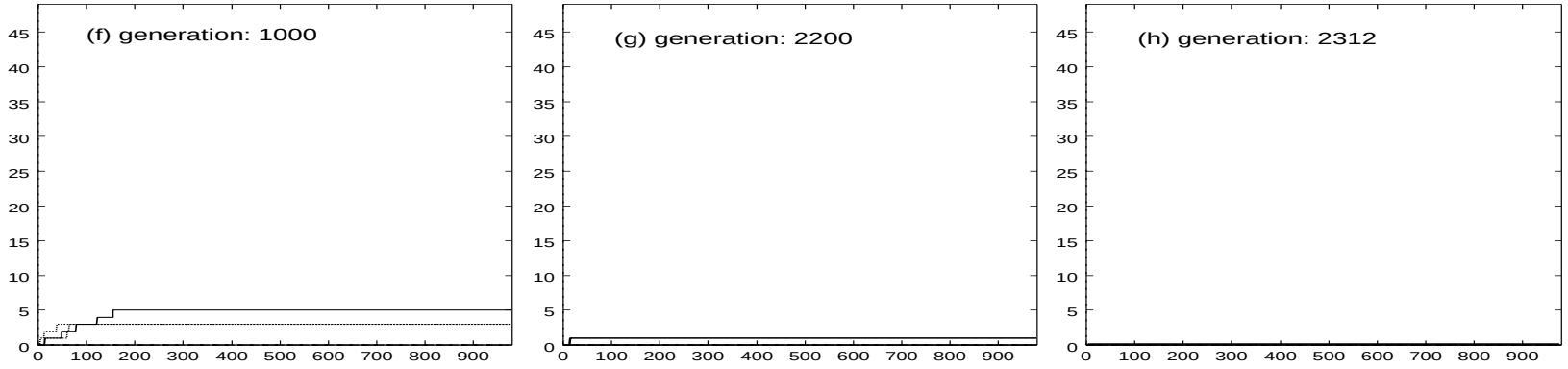

0.14
1
-0.34
0.62
-0.52
-0.22
2
-0.44
3
-0.47
0.62
-0.77
1
2
3
1
2
3
1
2
3
1
2
3
1
2
3
1
2
3
1
2
3
...


0.82
1
-0.39
0.38
0.45
-0.88
2
0.46
3
0.70
-0.24
-0.88
1
2
3
1
2
3
1
2
3


(f) generation: 1000
(g) generation: 2200
(h) generation: 2312
0
5
10
15
20
25
30
35
40
45
0
100
200
300
400
500
600
700
800
900

Weight Space and String Space:

- weight space
  - a given set of patterns to be memorized: fixed
  - N^2-dimensional; real-valued genes
- string space
  - weight: fixed
  - N-dimensional; binary genes


(f) generation: 1000
(g) generation: 2200
(h) generation: 2312
0
5
10
15
20
25
30
35
40
45
0
100
200
300
400
500
600
700
800
900

Entropic Sampling:

- Fitness level is devided into 21 classes (from row to high).

$\Downarrow$

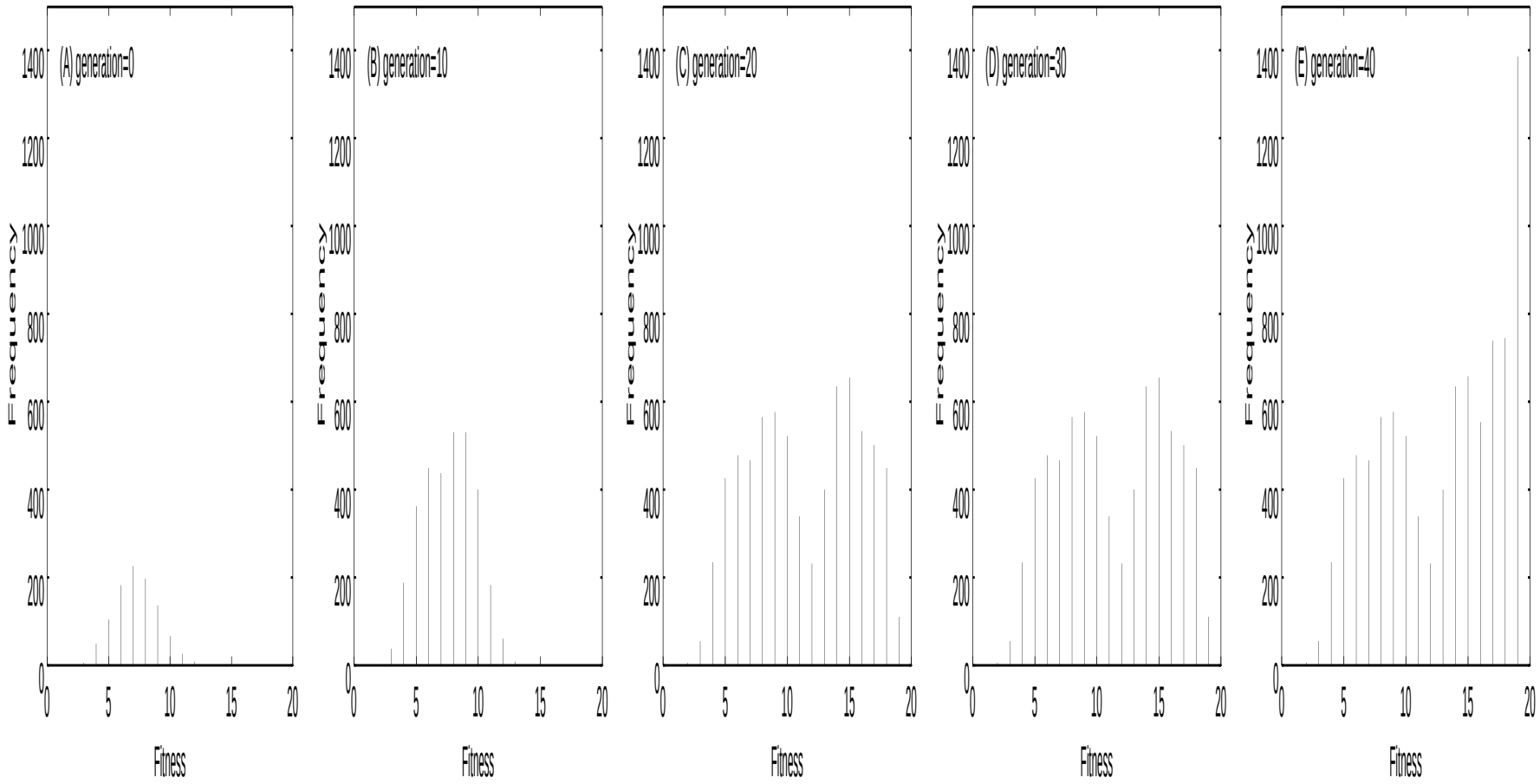
- The last class is only for perfect fitness.

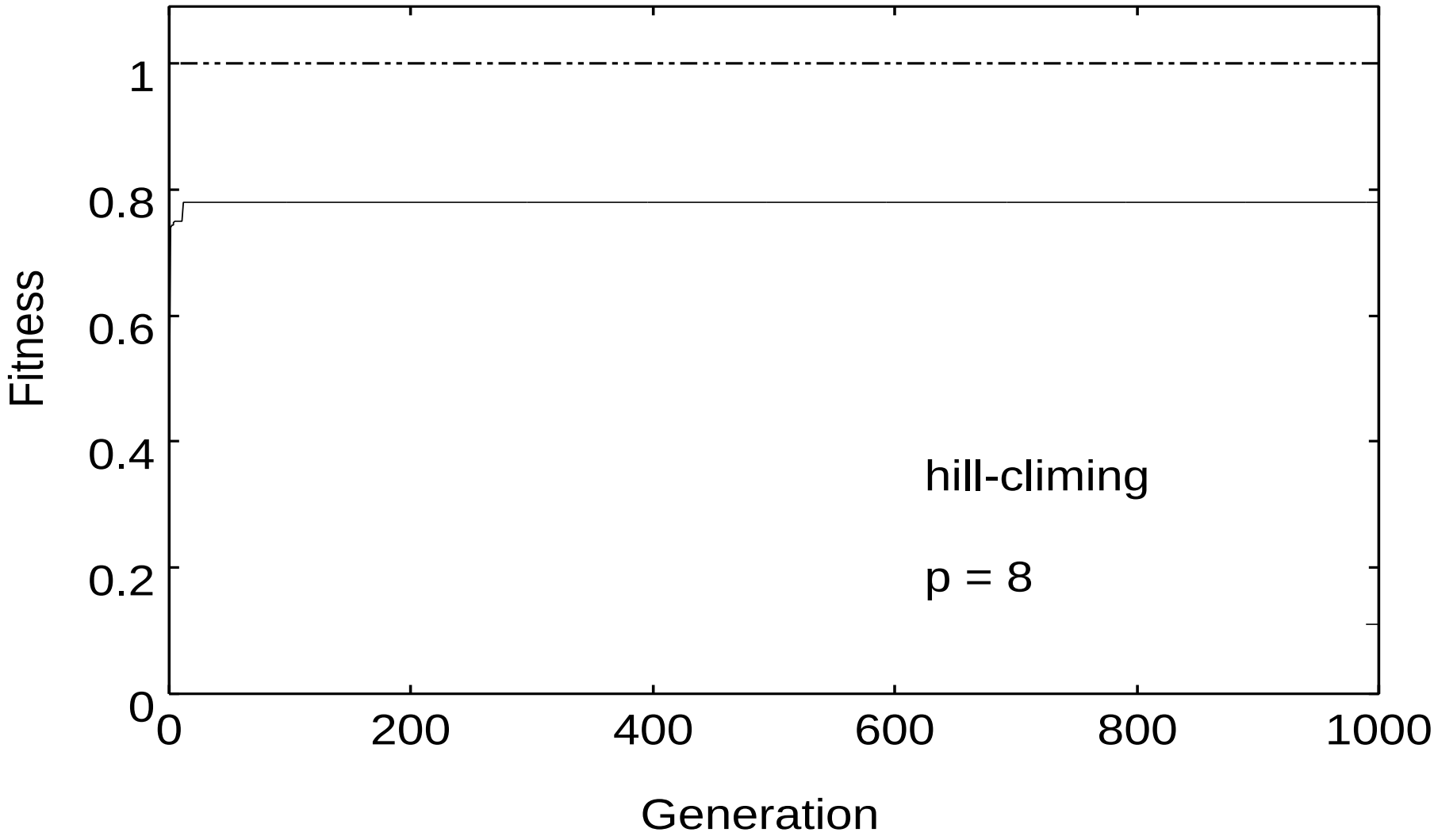
$\Downarrow$

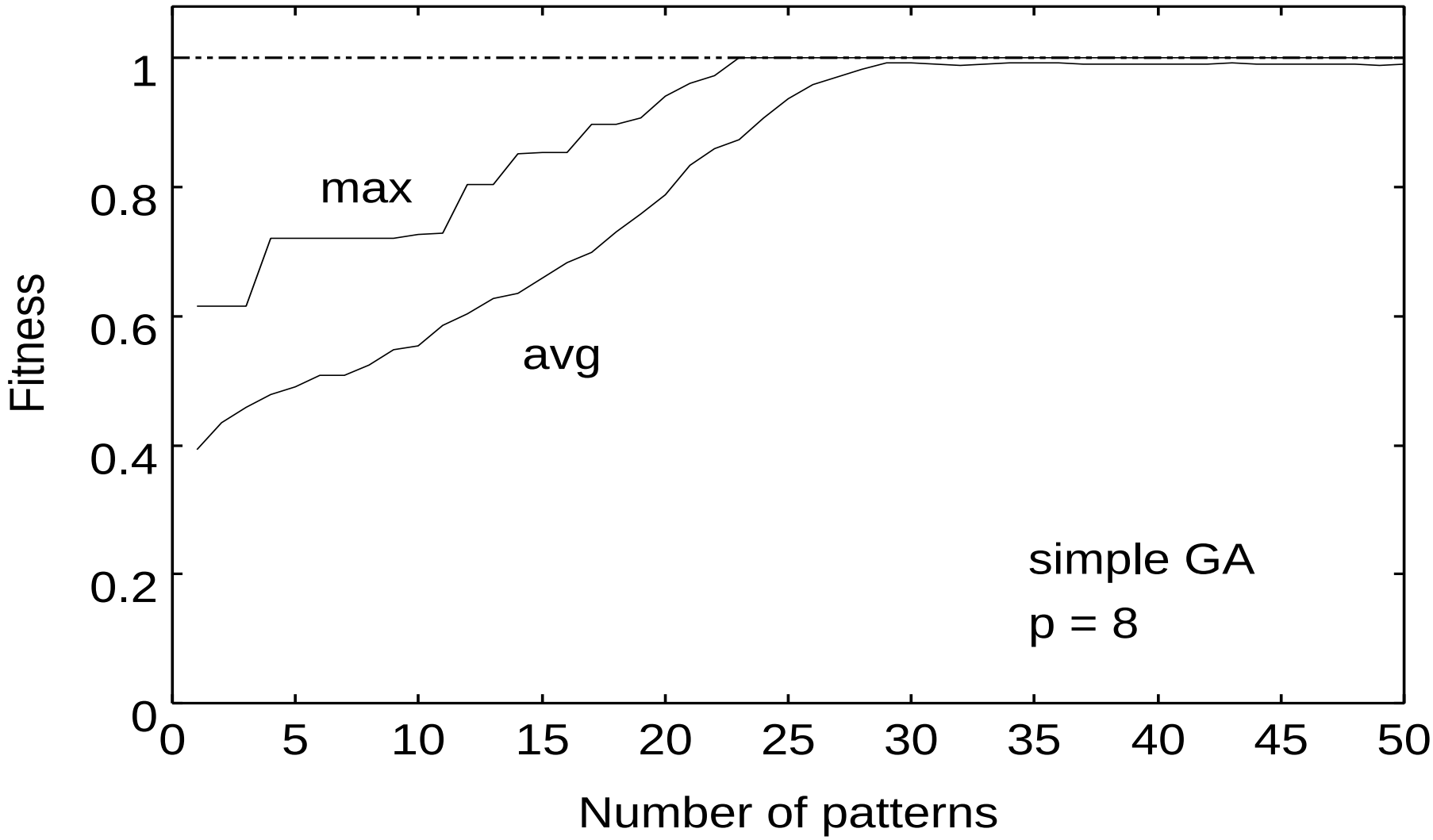
- The rare indivisuals are, the higher the probability to be selected.
(cf. fitness proportionate selection)

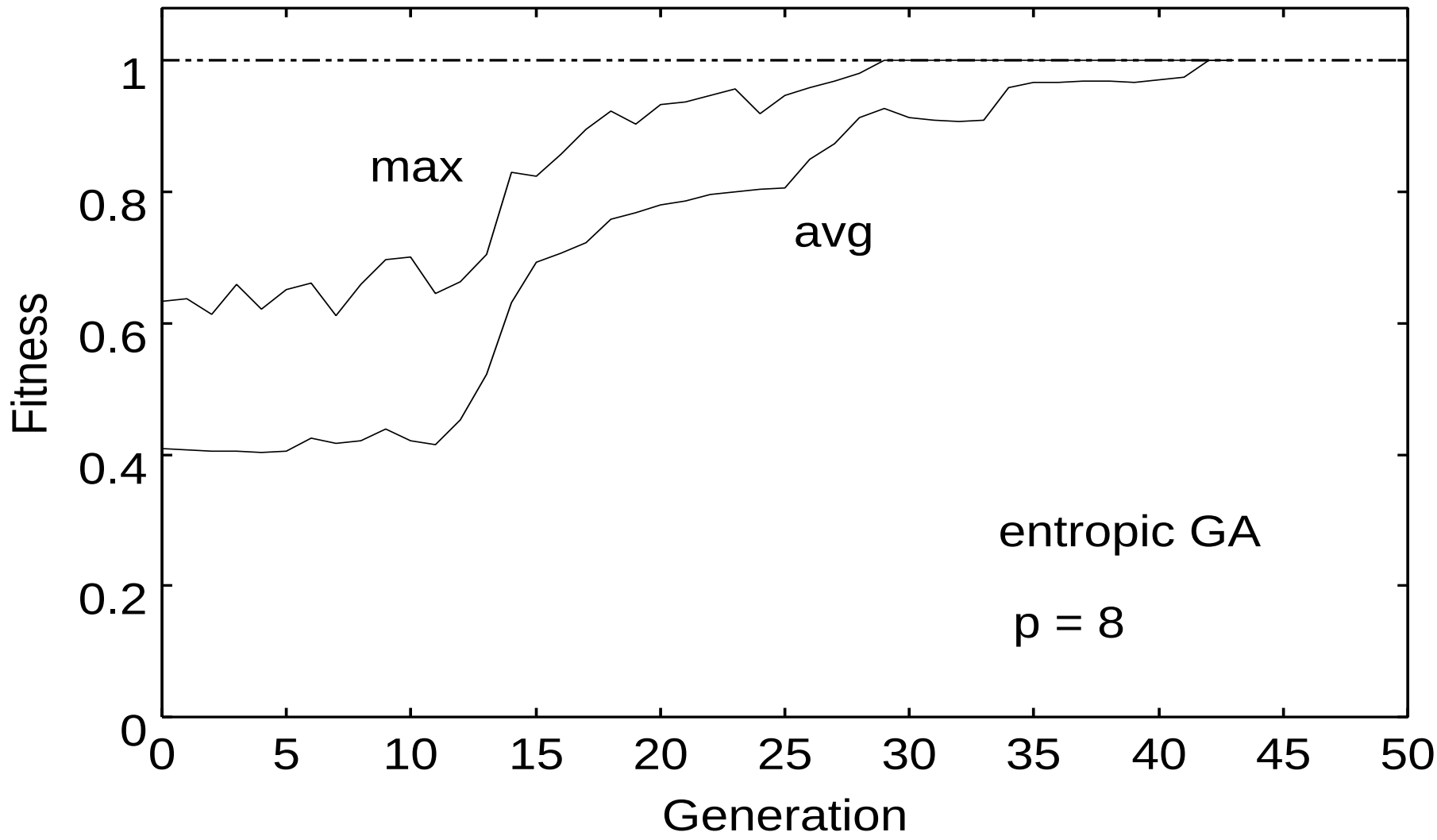
$\Downarrow$

- Can we locate multiple peaks at a run?


(A) generation=0
(B) generation=10
(C) generation=20
(D) generation=30
(E) generation=40
Frequency
Fitness
0
200
400
600
800
1000
1200
1400
0
5
10
15
20


Fitness
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000
Generation
hill-climing
p = 8


Fitness
1
0.8
0.6
0.4
0.2
0
max
avg
simple GA
p = 8
0
5
10
15
20
25
30
35
40
45
50
Number of patterns


Fitness
1
0.8
0.6
0.4
0.2
0
max
avg
entropic GA
p = 8
0
5
10
15
20
25
30
35
40
45
50
Generation

□ **Conclusions:**

- **The "entropic sampling" works as well as simple GA.**
  - **The more complicated landscape, the more effective?**
  - **Can we locate multiple solutions simultaneously?**

- **These studies shed new light on the analysis of the Hopfield model of associative memory.**