DD2437 Presentation Lab 3

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Convergence and attractors

Stored patterns

```
Old pattern was  [-1. -1.  1. -1.  1. -1. -1.  1.]  updated pattern is  [-1. -1.  1. -1.  1. -1. -1.  1.]
They're the same
Old pattern was  [-1. -1. -1. -1. -1.  1. -1. -1.]  updated pattern is  [-1. -1. -1. -1. -1.  1. -1. -1.]
They're the same
Old pattern was  [-1.  1.  1. -1. -1.  1. -1.  1.]  updated pattern is  [-1.  1.  1. -1. -1.  1. -1.  1.]
They're the same
```

Distorted patterns

```
The new patterns is  [-1. -1.  1. -1.  1. -1. -1.  1.]  and the correct pattern was  [-1. -1.  1. -1.  1. -1. -1.  1.]
They're the same
The new patterns is  [-1.  1. -1. -1. -1.  1. -1. -1.]  and the correct pattern was  [-1. -1. -1. -1. -1.  1. -1. -1.]
The new patterns is  [-1.  1.  1. -1. -1.  1. -1.  1.]  and the correct pattern was  [-1.  1.  1. -1. -1.  1. -1.  1.]
They're the same
```

The network is able to store all three patterns and it can recall some distorted patterns (x2d does not converge towards x2)

Very dissimilar patterns

```
The new patterns is  [ 1.  1.  1.  1.  1. -1.  1.  1.]  and the correct pattern was  [-1. -1.  1. -1.  1. -1. -1.  1.]
They are different
The new patterns is  [ 1.  1.  1.  1.  1. -1.  1.  1.]  and the correct pattern was  [-1. -1. -1. -1. -1.  1. -1. -1.]
They are different
The new patterns is  [ 1. -1. -1.  1.  1. -1.  1. -1.]  and the correct pattern was  [-1.  1.  1. -1. -1.  1. -1.  1.]
They are different
```

The network cannot recall too dissimilar patterns

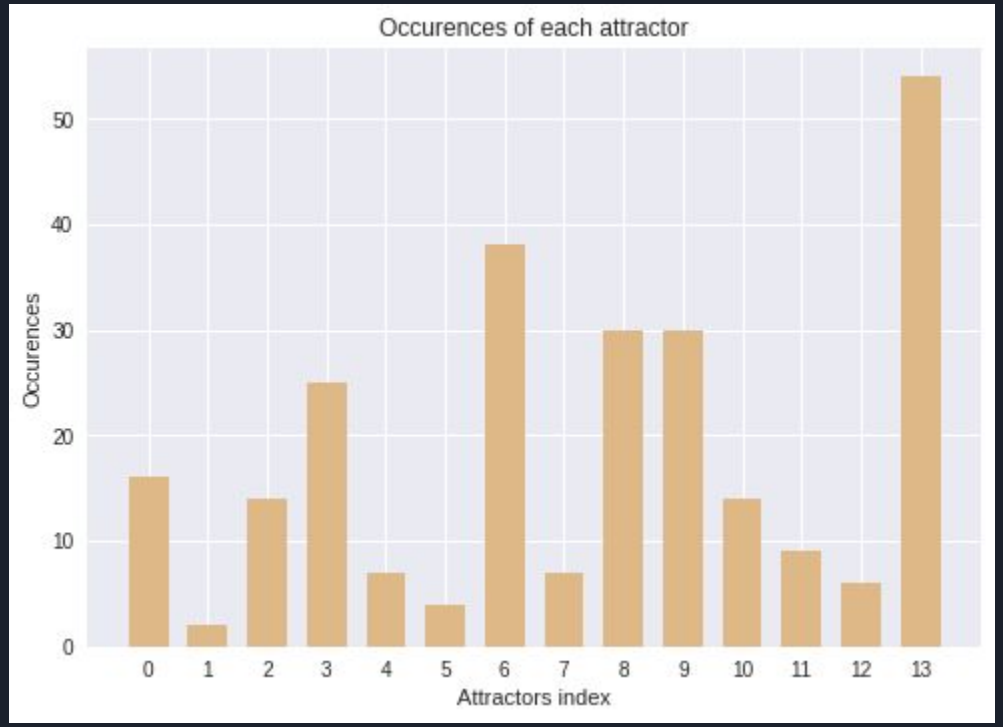

Figure 1 : Occurrences for each attractor

We found 14 attractors in this network. Moreover, if a pattern is an attractor, the opposite pattern in an attractor too.

Sequential Update

In batch mode :

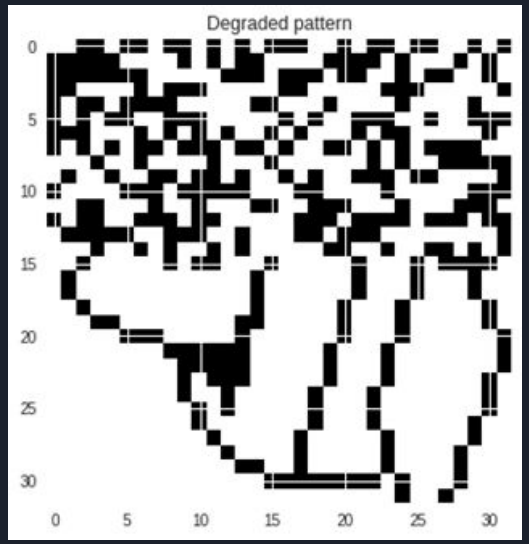

Figure 2 : Degraded pattern p10

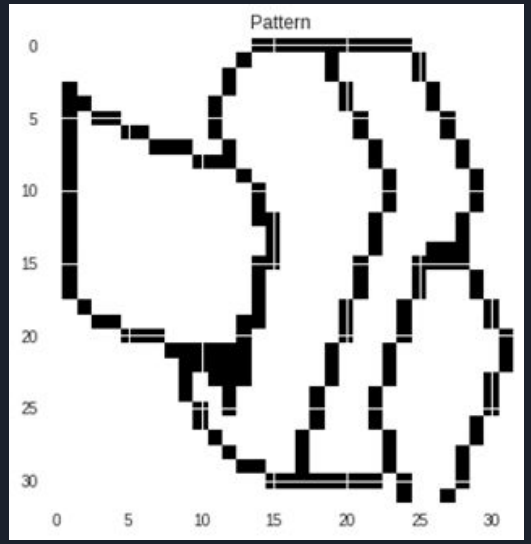

Figure 3 : Restored pattern p1

The network can restore a degraded pattern in batch mode

Sequential Update

In batch mode :

The network cannot complete a pattern that is a mixture of two learnt patterns in batch mode

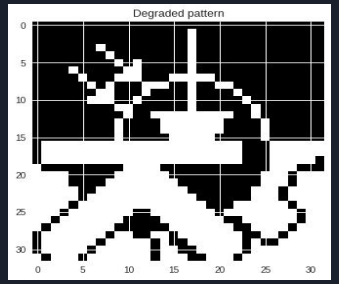

Figure 4 : Degraded pattern p11

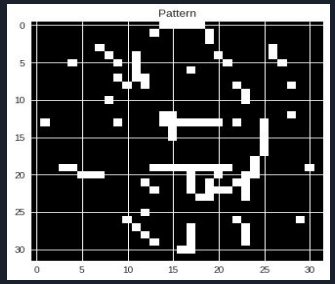

Figure 5 : Restored pattern

With a sequential update, the pattern converges most of the time to the pattern p3 in a few iterations

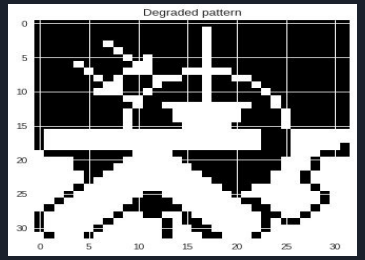

Figure 6 : Degraded pattern p11

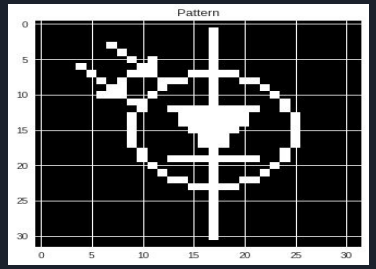

Figure 7 : Restored pattern p3

Energy

Energy at the different attractors :

```
The energy at attractor p1 is -1439.390625
The energy at attractor p2 is -1365.640625
The energy at attractor p3 is -1462.25
```

Energy at the different attractors :

```
The energy at distorded pattern p4 is -720.48046875
The energy at distorded pattern p5 is -525.890625
The energy at distorded pattern p6 is -683.296875
The energy at distorded pattern p7 is -685.73046875
The energy at distorded pattern p8 is -171.546875
The energy at distorded pattern p9 is -267.51171875
The energy at distorded pattern p10 is -415.98046875
The energy at distorded pattern p11 is -173.5
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Evolution of the energy

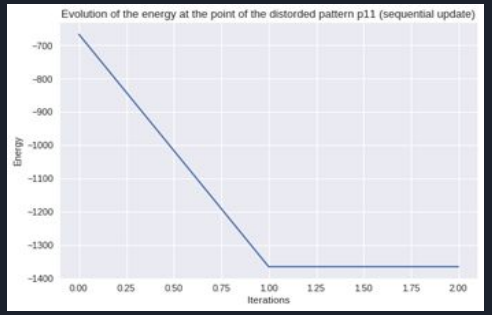


Figure 8 : Sequential update

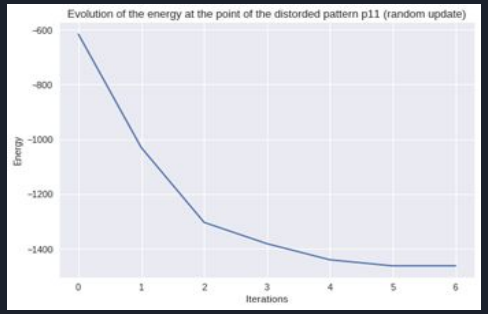


Figure 9 : Random update

Sequential update converges faster than the random update, but the energy is lower for the random update.
The energy convergences toward the energy of p3

Behavior with a random matrix

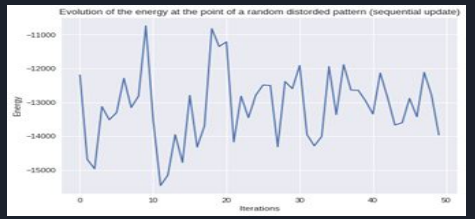


Figure 10 : Random matrix

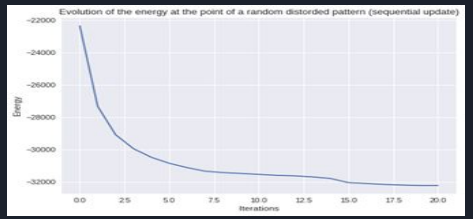
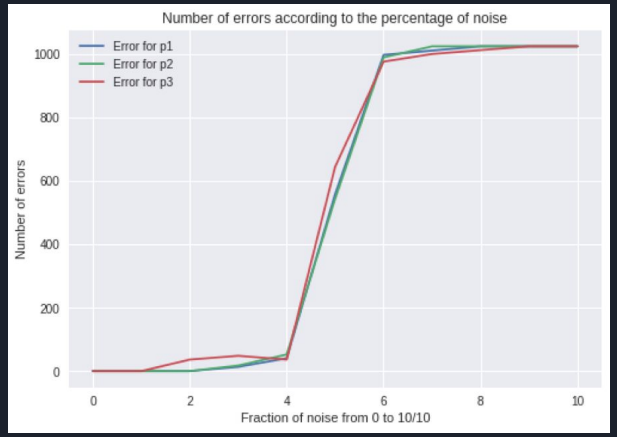
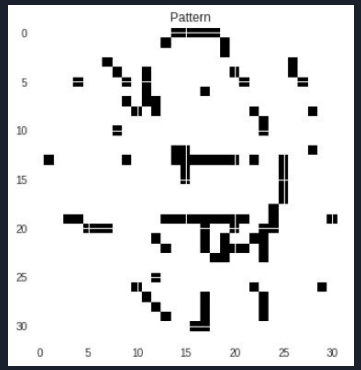


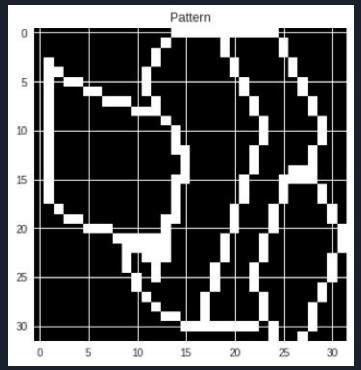
Figure 11 : Random and symmetric matrix

With a symmetric random matrix, the convergence is possible and the energy decreases until it reaches a minimum.

Distortion Resistance







- Good results until 40% of noise.
- Almost 100% error after 60% : exact contrary of the wanted pattern.
- Results don’t change whatever is the pattern.
- Doesn’t converge to right attractor but exact contrary.
- Extra iteration doesn’t change the results, it is an attractor, stable.
- One noisy attractor.

Capacity

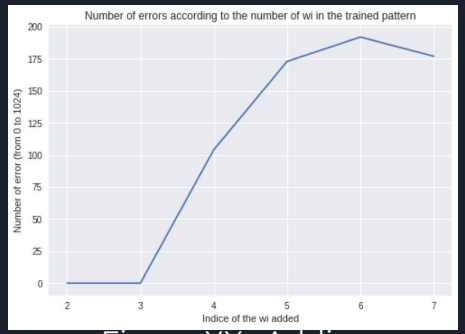


Figure XX : Adding structured patterns

- Moderatly distorted pattern (20% of noise)
- Add some patterns in the network.
- Abrupt change.

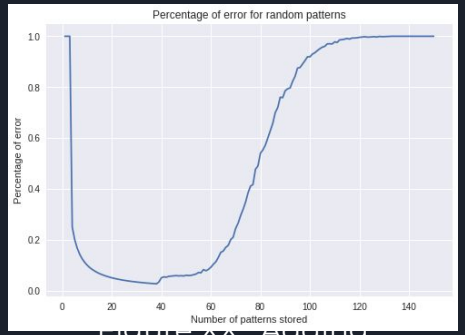
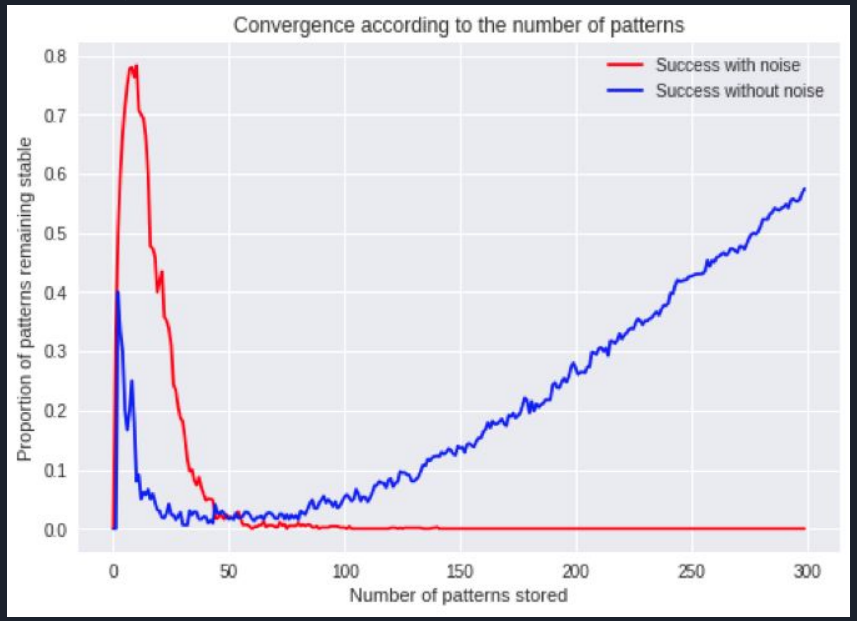


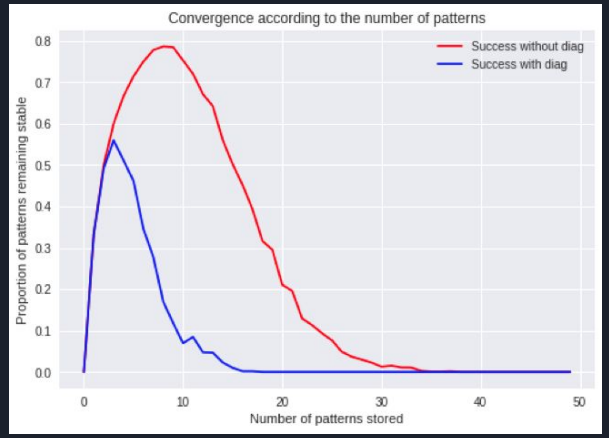
Figure XX : Adding random patterns

- Adding some random patterns to the network.
- Less abrupt change.
- We can add more random patterns than structured pattern.
- Hypothesis : random patterns are less attractive, less symetric.
- Capacity : Almost 138.

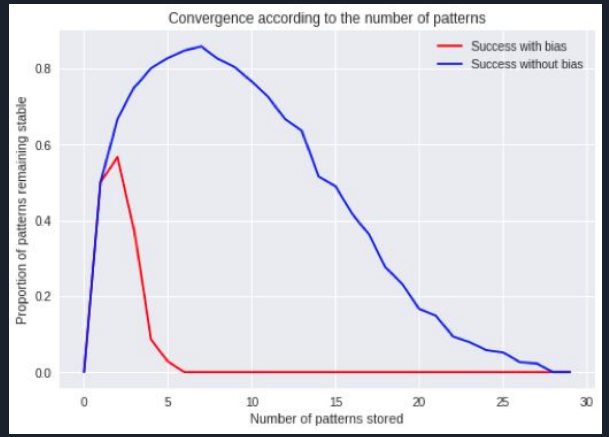


- Drops until 0,138N.
- Increases after. Hypothesis : accumulation of random points, creating a local minima = attractor.

- With noise, no increasement. Due to the importance of the diagonal values.
- Better success rate.

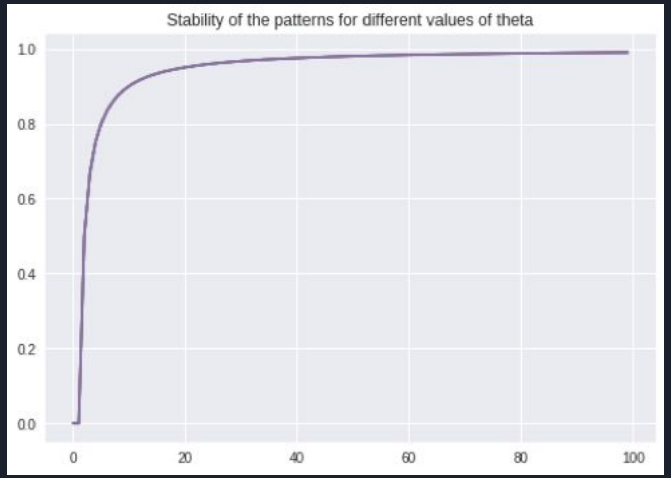


- Better results without diag : all w(i,i) have importance now, you can more easily find a pattern.



- Add bias : 75% of -1 for instance.
- Could store less pattern than random patterns : bias = more structured pattern, same problem as before.

Sparse patterns



- Change the way of updating patterns by adding bias term.
- When Theta is higher, we have better results ?
- Strange results...