

Métodos de aprendizaje no supervisados

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Ejercicio 1

Conjunto de datos de entrada

Datos desnormalizados

**7 variables
numéricas**

Área, PBI, Inflación,
etc.

**28
registros**

1 por cada país de
europa

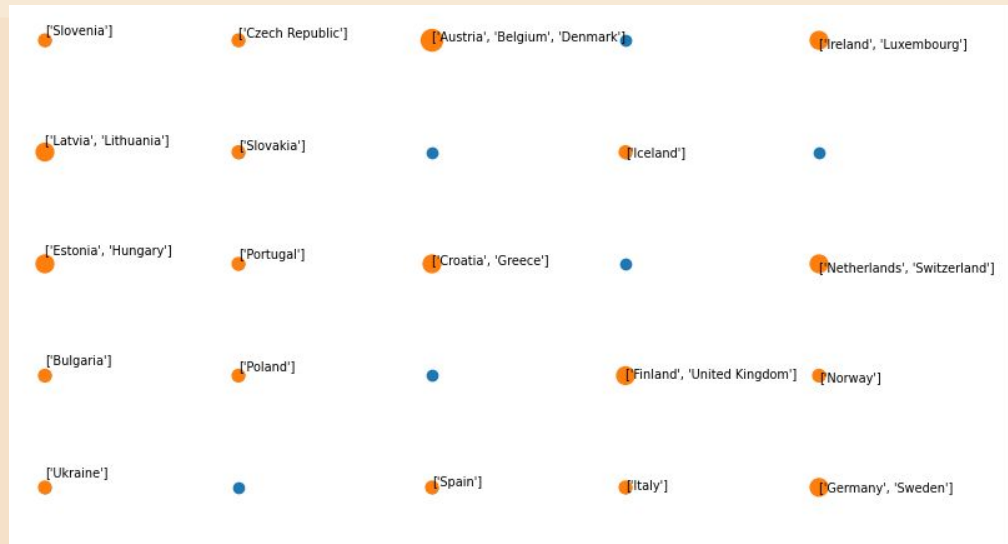
| Country | Area | GDP | Inflation | Life,expect | Military | Pop.growth | Unemployment |
|----------------|--------|-------|-----------|-------------|----------|------------|--------------|
| Austria | 83871 | 41600 | 3,5 | 79,91 | 0,8 | 0,03 | 4,2 |
| Belgium | 30528 | 37800 | 3,5 | 79,65 | 1,3 | 0,06 | 7,2 |
| Bulgaria | 110879 | 13800 | 4,2 | 73,84 | 2,6 | -0,8 | 9,6 |
| Croatia | 56594 | 18000 | 2,3 | 75,99 | 2,39 | -0,09 | 17,7 |
| Czech Republic | 78867 | 27100 | 1,9 | 77,38 | 1,15 | -0,13 | 8,5 |
| Denmark | 43094 | 37000 | 2,8 | 78,78 | 1,3 | 0,24 | 6,1 |
| Estonia | 45228 | 20400 | 5 | 73,58 | 2 | -0,65 | 12,5 |
| Finland | 338145 | 36000 | 3,3 | 79,41 | 2 | 0,07 | 7,8 |

Red de Kohonen

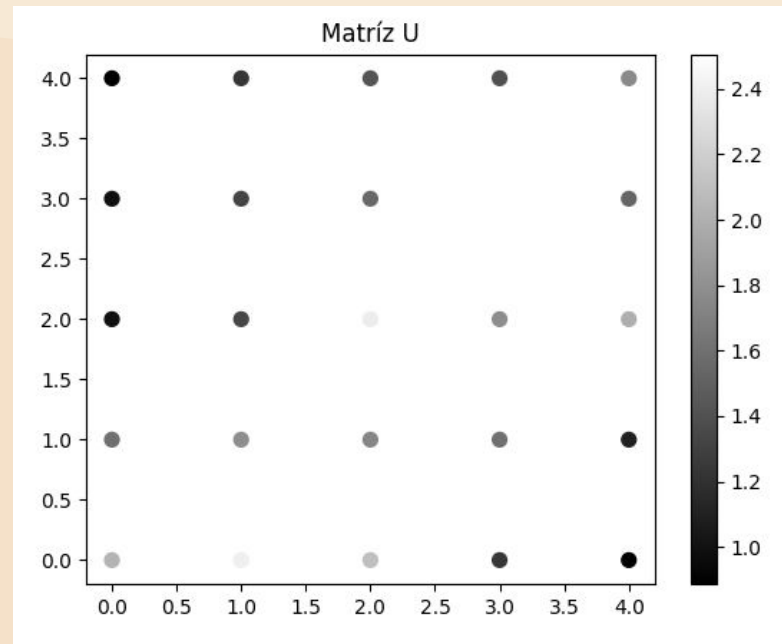
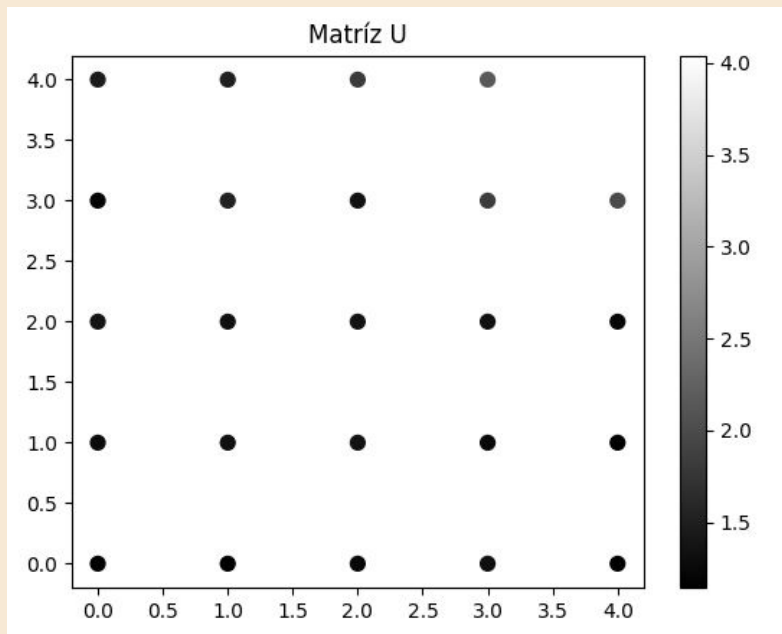
Parámetros de ejecución:

- **Número de épocas:** 500 x Cantidad de neuronas de entrada
- **Tasa de aprendizaje:** Inicial de 0.5, con función de disminución en función del tiempo $n(t)$
- **Constante de tiempo:** 1000
- **Tamaño del vecindario:** Inicial de 5, con función de disminución en función del tiempo $R(t)$
- **Función de distancia entre vectores:** Euclídea
- **Pesos iniciales:** Elegidos de forma aleatoria
- **Matriz salida:** 5x5

Análisis de resultados



Análisis de resultados



Regla de Oja

Parámetros de ejecución:

- **Número de épocas:** 5000
- **Tasa de aprendizaje:** Inicial de 0.5, con función de disminución en función del tiempo $n(t)$
- **Pesos iniciales:** Elegidos de forma aleatoria

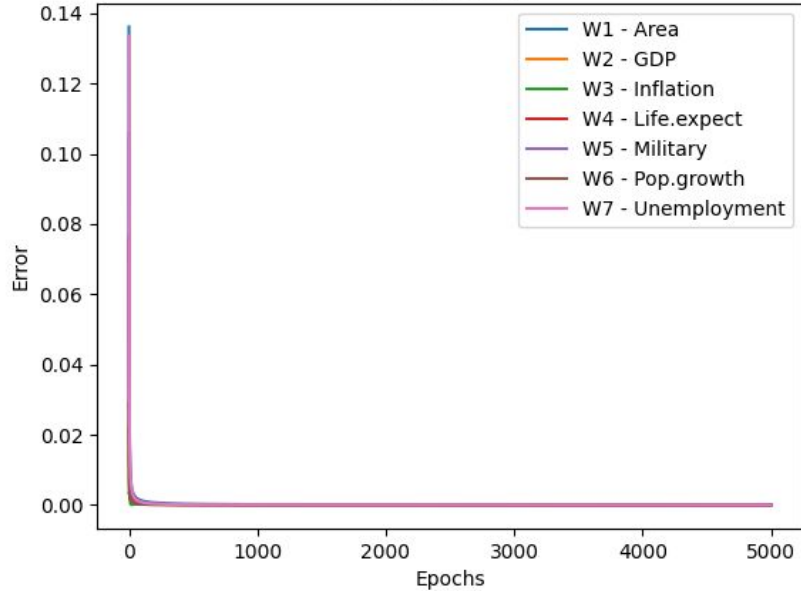
$$\Delta w_j = \eta(y * x_j^n - y^2 * w_j^n)$$

Análisis de Resultados

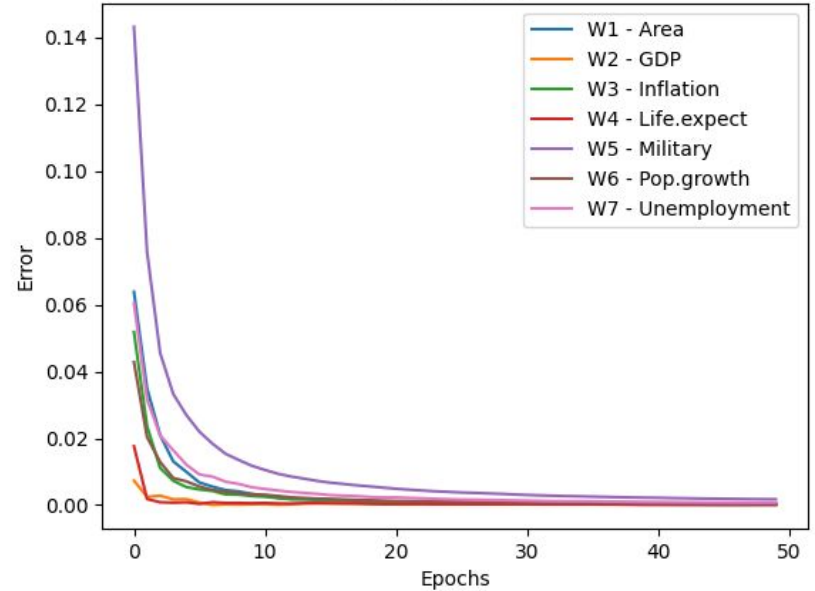
```
Training network...  
Weights signs had to be inverted to match expected order  
Final weight error:  
[0.00003179 0.00000149 0.00001041 0.00000544 0.00000626 0.00000331 0.00000372]
```


Análisis de Resultados

Weight error



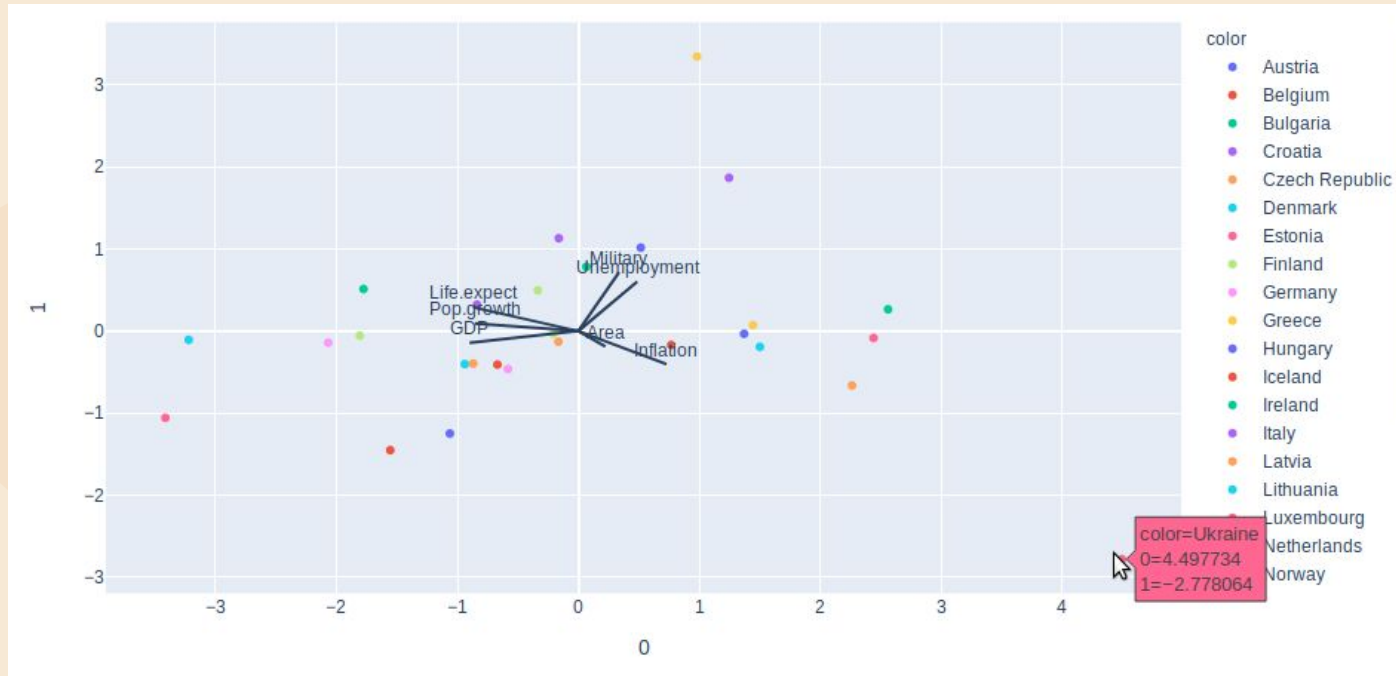
Weight error



Análisis de Resultados

| COUNTRY | SCORE | EXPECTED | ERROR |
|----------------|----------------------|----------------------|------------------------|
| Austria | -1.062279165681026 | -1.062255115785943 | 2.4049895082978168e-05 |
| Belgium | -0.6688489585840226 | -0.6688210981928605 | 2.786039116209338e-05 |
| Bulgaria | 2.5628418454599164 | 2.5628501209089847 | 8.27544906822908e-06 |
| Croatia | 1.24724127795674 | 1.2472614091083405 | 2.013115160059975e-05 |
| Czech Republic | -0.16423111992056308 | -0.1641964633307718 | 3.46565897912654e-05 |
| Denmark | -0.9380104929522071 | -0.9379787423315349 | 3.1750620672177376e-05 |
| Estonia | 2.442890056510202 | 2.442907488422047 | 1.7431911845111614e-05 |
| Finland | -0.20673341015027452 | -0.20676891484377607 | 3.55046935015535e-05 |
| Germany | -0.5816918466803416 | -0.58171901908668 | 2.7172406338427102e-05 |
| Greece | 0.9824674775881082 | 0.9824439585763942 | 2.3519011713935e-05 |
| Hungary | 1.3717128773170282 | 1.3717269121041213 | 1.4034787093164525e-05 |
| Iceland | -1.5551957923037931 | -1.5551818748850332 | 1.3917418759890055e-05 |
| Ireland | -1.776338401829509 | -1.7763218310144777 | 1.6570815031258235e-05 |
| Italy | -0.8378181409252631 | -0.8378492983766787 | 3.1157451415575466e-05 |
| Latvia | 2.2644800061222154 | 2.264505385059275 | 2.537893705945038e-05 |
| Lithuania | 1.502507654541863 | 1.5025282839007286 | 2.0629358865598135e-05 |
| Luxembourg | -3.415790701386707 | -3.415755319088453 | 3.5382298253949784e-05 |
| Netherlands | -1.806926853375554 | -1.8068965738969471 | 3.027947860689828e-05 |
| Norway | -2.0685375962782366 | -2.0685525744091082 | 1.4978130871590167e-05 |
| Poland | 1.445288647214117 | 1.4452532080639944 | 3.543915012271803e-05 |
| Portugal | 0.5170044694860022 | 0.5170061914939632 | 1.7220079610025252e-06 |
| Slovakia | 0.7688346256658346 | 0.7688573205118819 | 2.2694846047333073e-05 |
| Slovenia | 0.0662861440369274 | 0.06632627793932264 | 4.013390239523962e-05 |
| Spain | -0.16073746200599226 | -0.16081595915779962 | 7.849715180735517e-05 |
| Sweden | -0.8691022993308071 | -0.8691561598899682 | 5.386055916112298e-05 |
| Switzerland | -3.2225022491446853 | -3.222453607460654 | 4.864168403129199e-05 |
| Ukraine | 4.497830968793555 | 4.497733954105657 | 9.701468789824474e-05 |
| United Kingdom | -0.3346415601435741 | -0.33467795844402276 | 3.6398300448658993e-05 |

Análisis de Resultados



| | | | |
|----------------|---------------------|----------------------|------------------------|
| Switzerland | -3.2225022491446853 | -3.222453607460654 | 4.864168403129199e-05 |
| Ukraine | 4.497830968793555 | 4.497733954105657 | 9.701468789824474e-05 |
| United Kingdom | -0.3346415601435741 | -0.33467795844402276 | 3.6398300448658993e-05 |

Ejercicio 2

Modelo de Hopfield

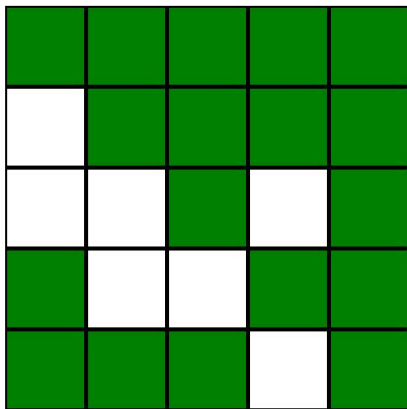
Parámetros:

- Patrones de entrada: Matrices de 5x5
- Máximo de patrones para entrenar: 4 (una de las limitaciones del modelo)
- Función de energía:

$$H(w) = -\frac{1}{2} \sum_{i,j} w_{ij} S_i S_j$$

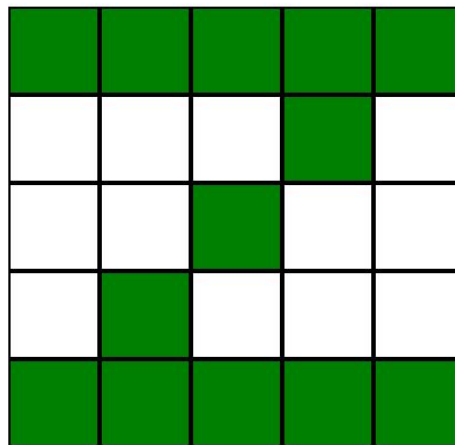
Análisis de resultados

Patrones de entrada

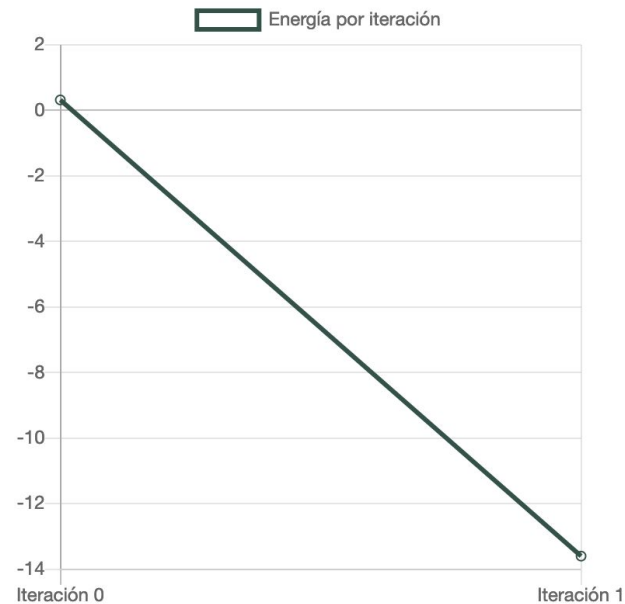


Patrones aprendidos: 0 de 4

Resultado



Listo!





Demo

Test en vivo – Hopfield

[Click acá!](#)