Métodos de Aprendizaje No Supervisado

Sistemas de Inteligencia Artificial

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Aprendizaje no supervisado

Estos métodos aprenden a generalizar, clasificar y predecir valores de un conjunto de datos. Para esto se basan en la experiencia y en los atributos de cada elemento del conjunto de datos. Además, ninguno de estos elementos tiene una variable “objetivo” o “respuesta”.

1

Red de Kohonen

Entrada: 28 países de Europa con sus características

2

Regla de Oja

Entrada: 28 países de Europa con sus características

3

Modelo de Hopfield

Red de Kohonen

Introducción

La red de kohonen es una matriz de neuronas que agrupan a las entradas comparando su propio vector de pesos sinápticos con el vector de atributos de la entrada.
Este vector de pesos la neurona lo aprende desde el mismo conjunto de datos.

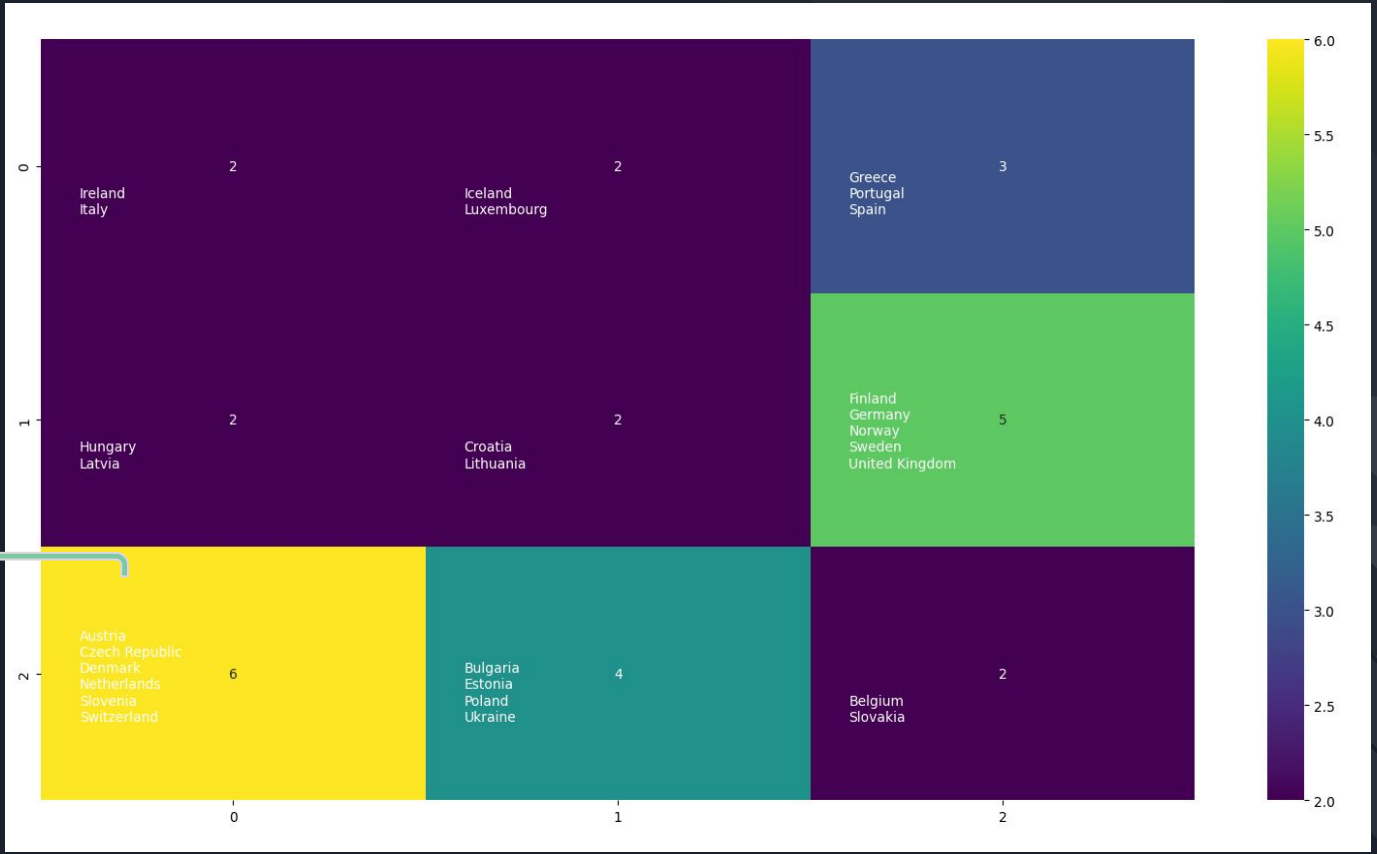
Resultados

Constantes

- eta(t): **1 / t**
- iteraciones: **500 * k^2**
- R(t): **(1 - r0) / iteraciones* t + r0**

Agrupación de Países

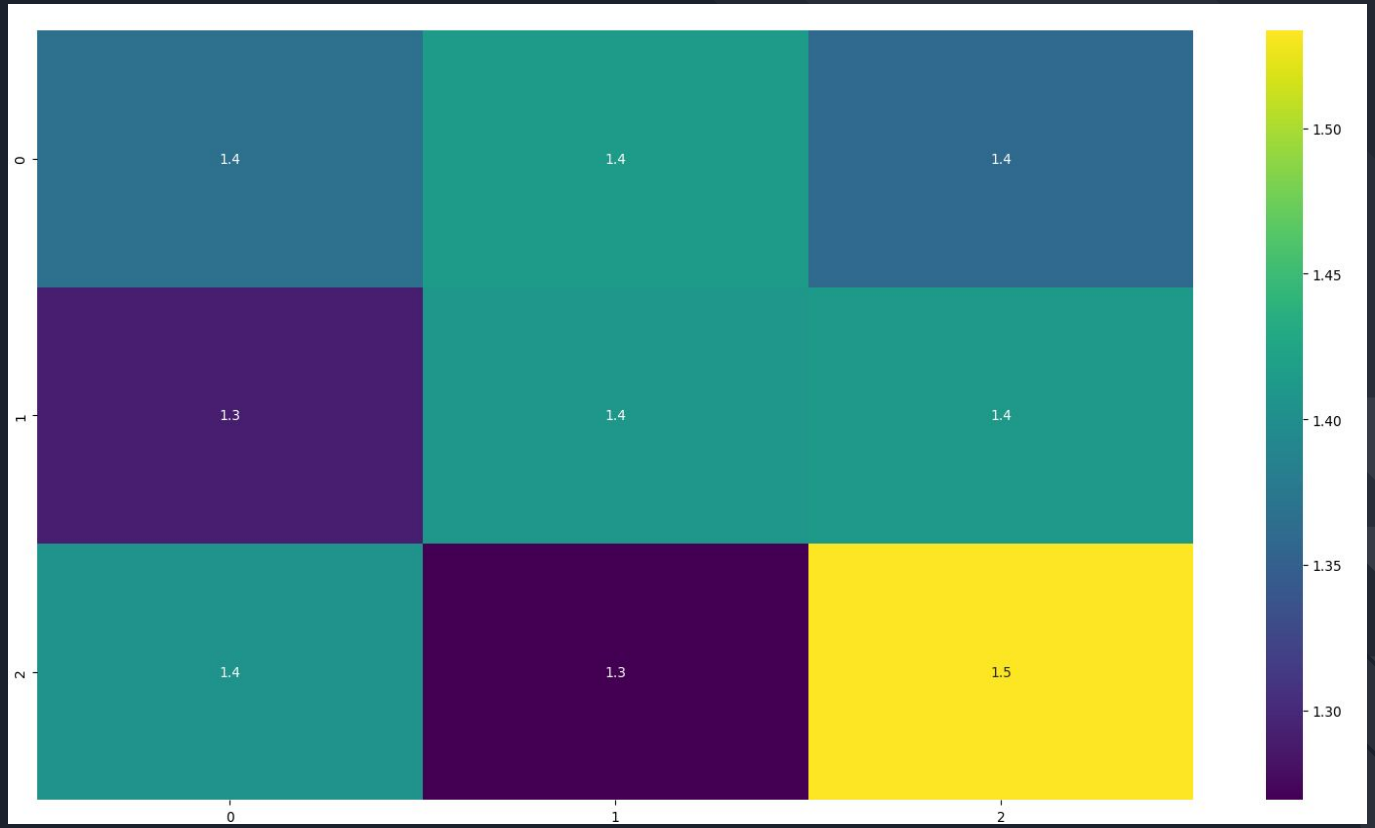
- k: 3
- r0: 2



Austria,
Czech Republic,
Denmark,
Netherlands,
Slovenia,
Switzerland

Matriz U

- k: 3
- r0: 2

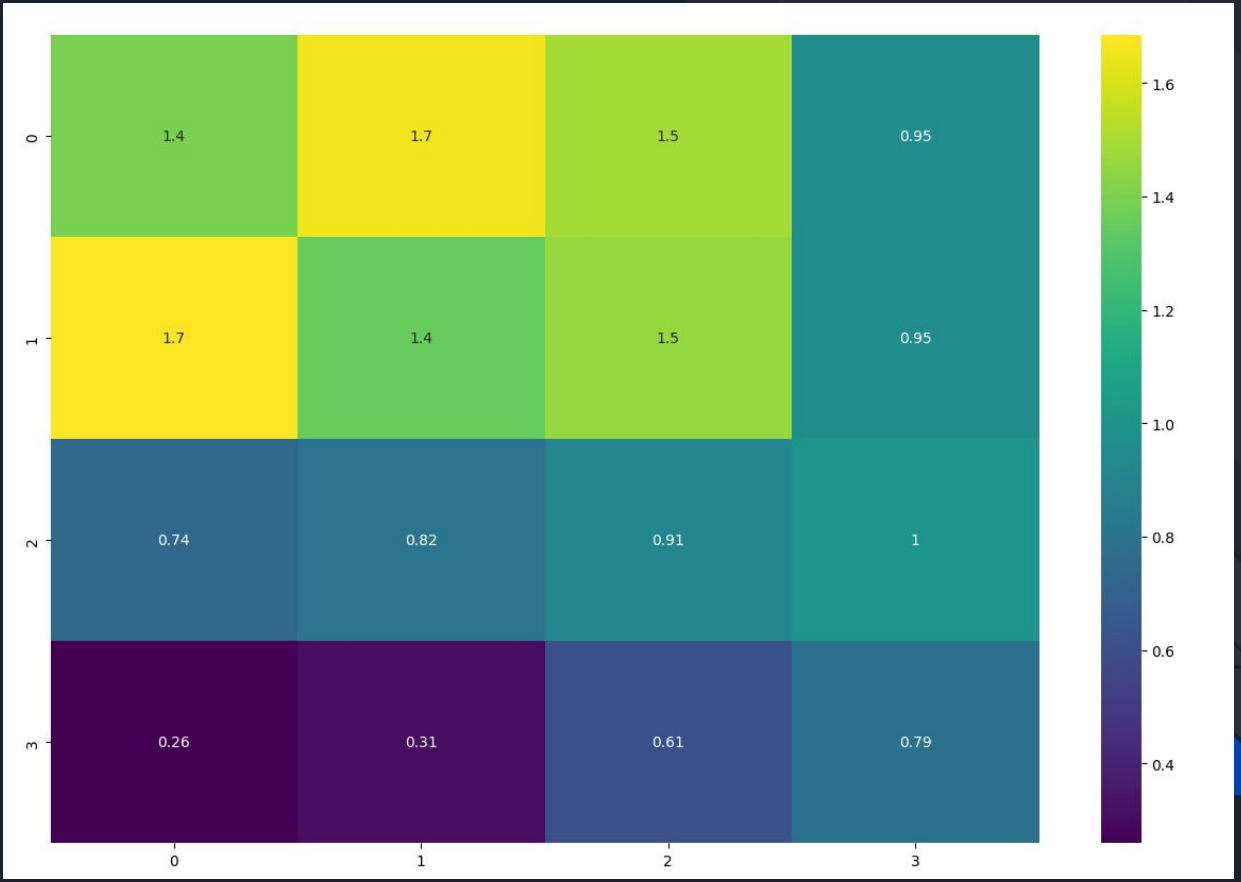


Agrupación de Países

- k: 4
- r0: 3

Matriz U

- k: 4
- r0: 3

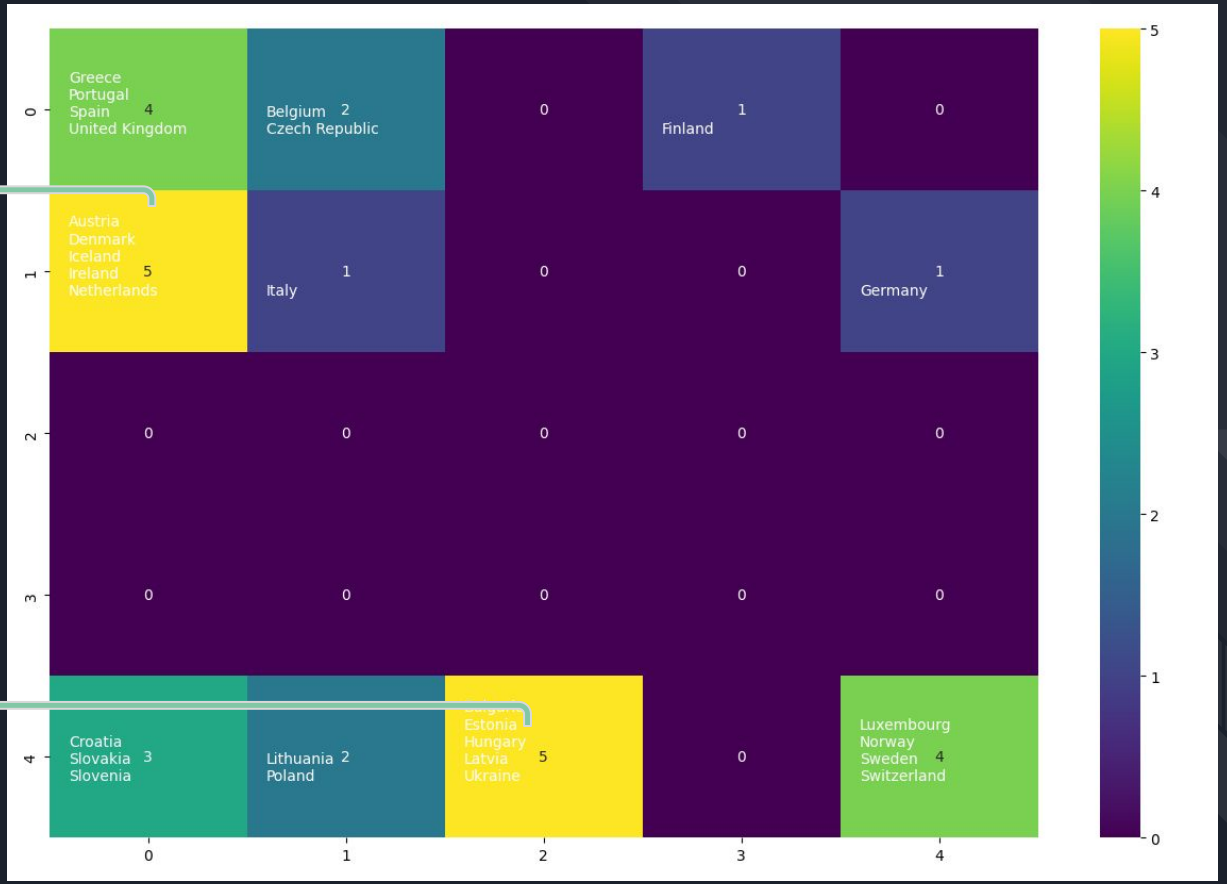


Agrupación de Países

- k: 5
- r0: 4

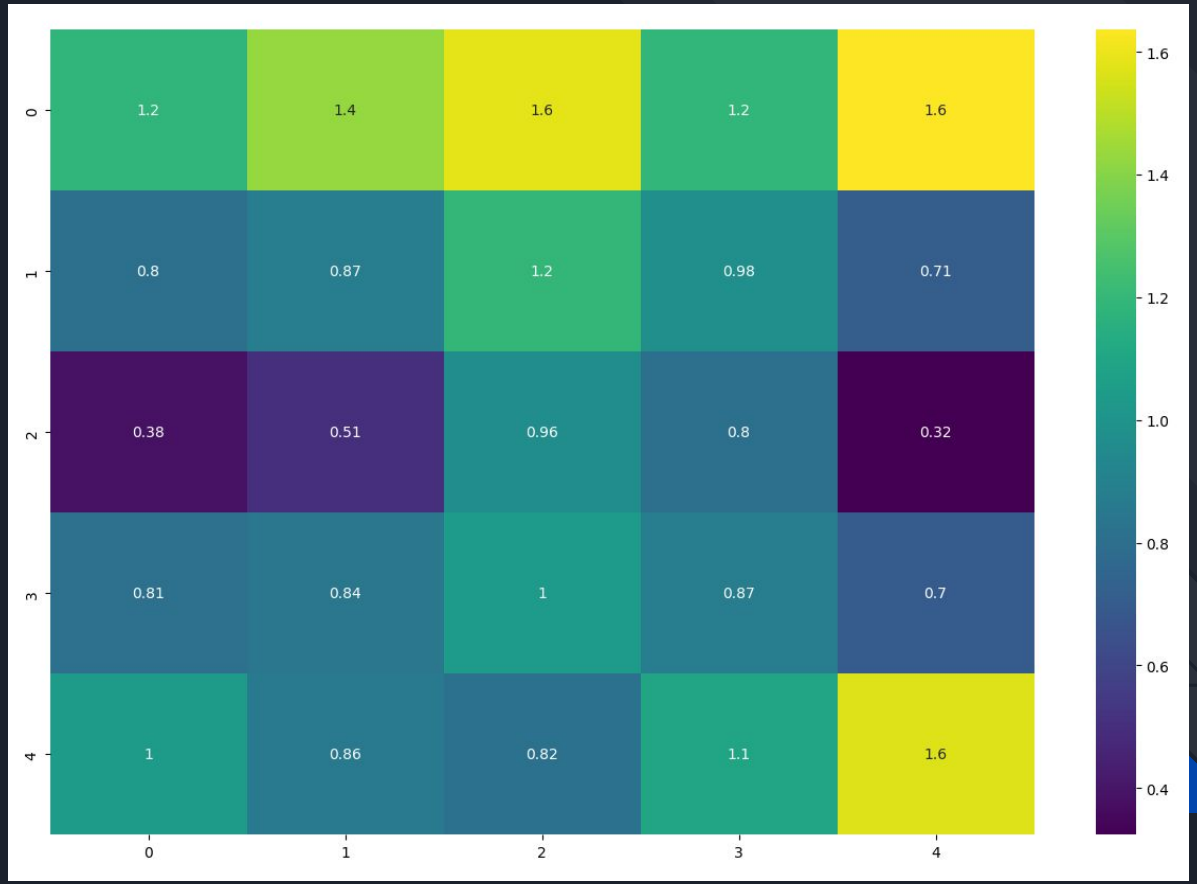
Austria, Denmark, Iceland, Ireland, Netherlands

Bulgaria, Estonia, Hungary, Latvia, Ukraine



Matriz U

- k: 5
- r0: 4



Regla de Oja

Regla de Oja: Primera Componente

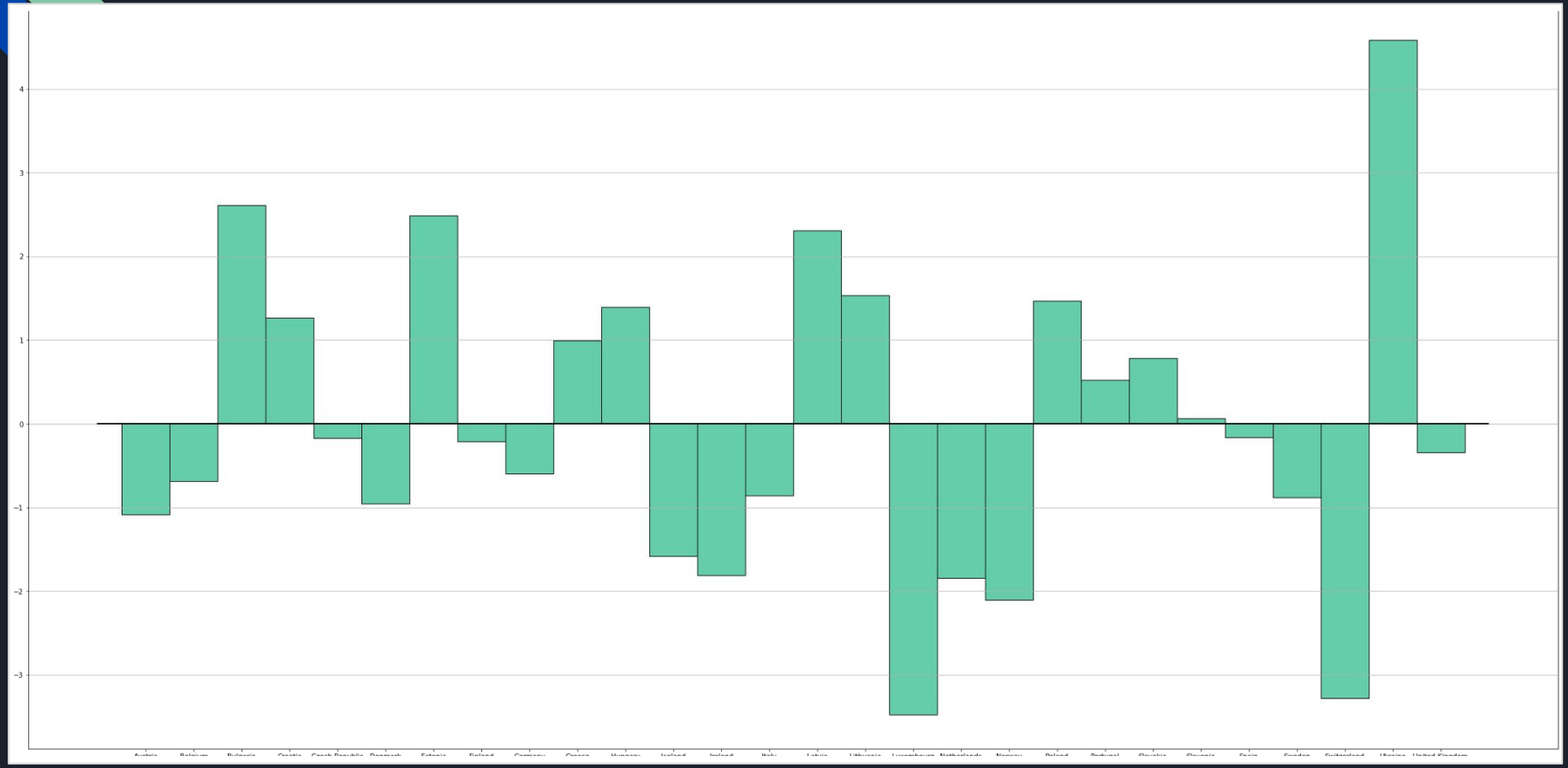
A mano

```
Autovector:  [ 0.12558938 -0.50044306
0.40722235 -0.48302071  0.18751446
-0.47555222 0.27130766]
```

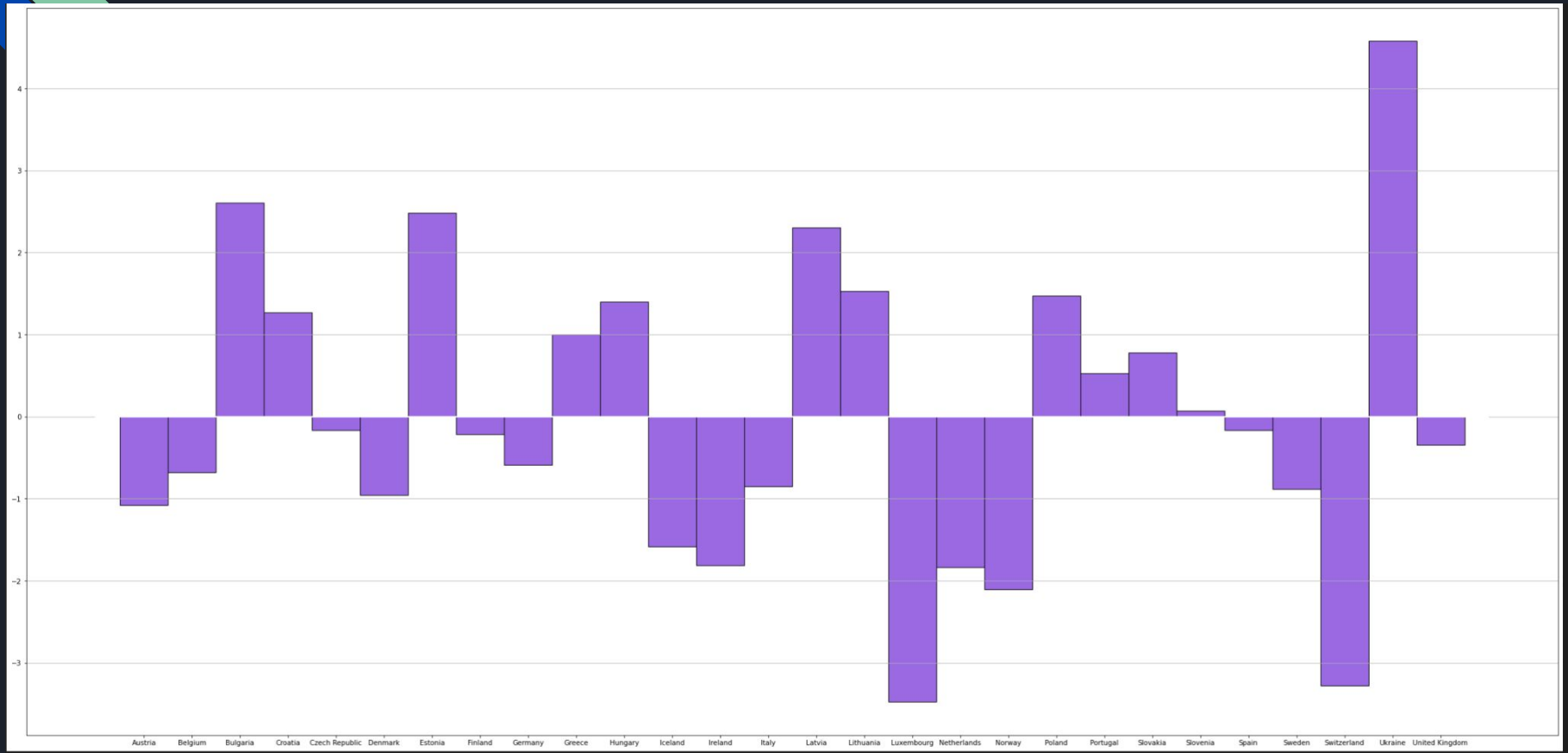
Librerías

```
Autovector: [ 1.24873902e-01 -5.00505858e-01
4.06518155e-01 -4.82873325e-01 1.88111616e-01
-4.75703554e-01  2.71655820e-01]
```

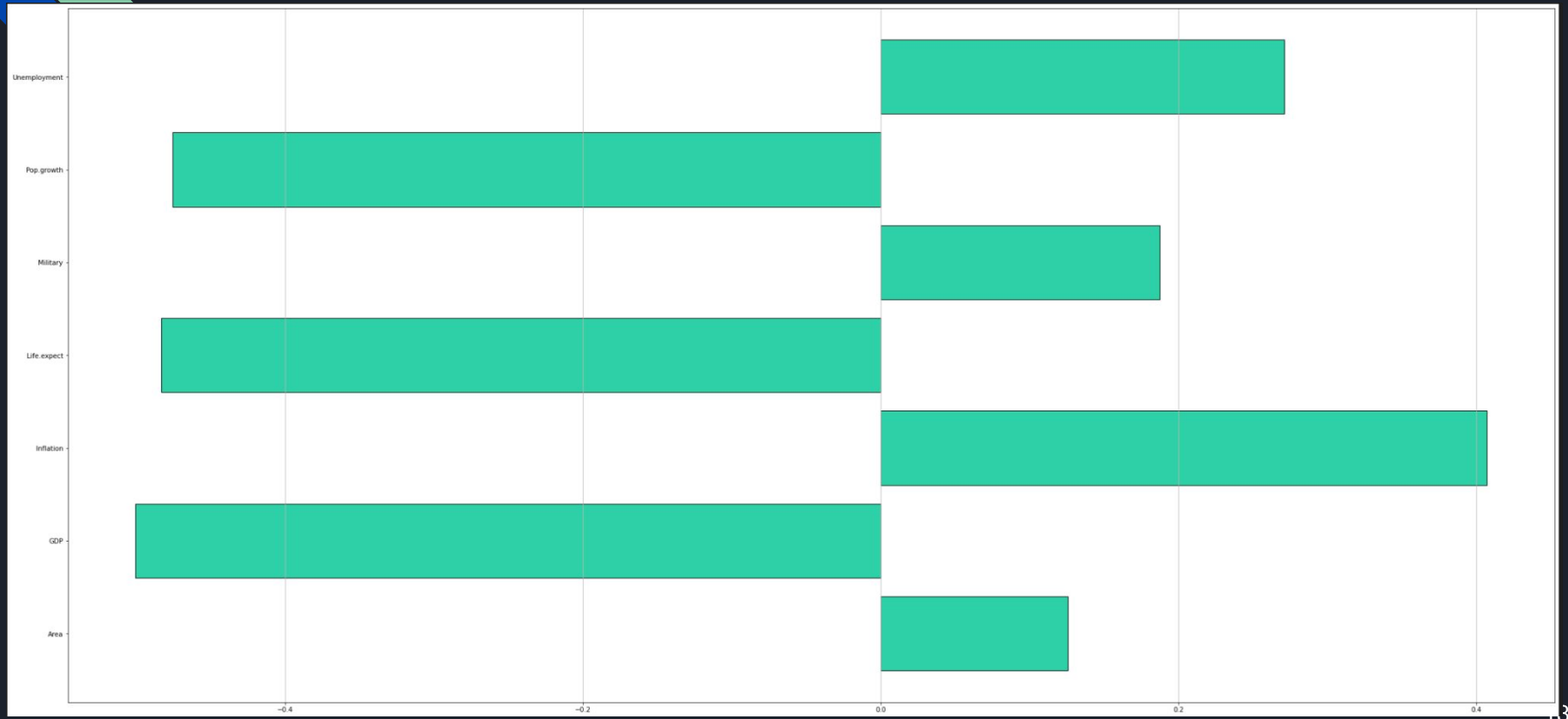
Regla de Oja: Primera componente



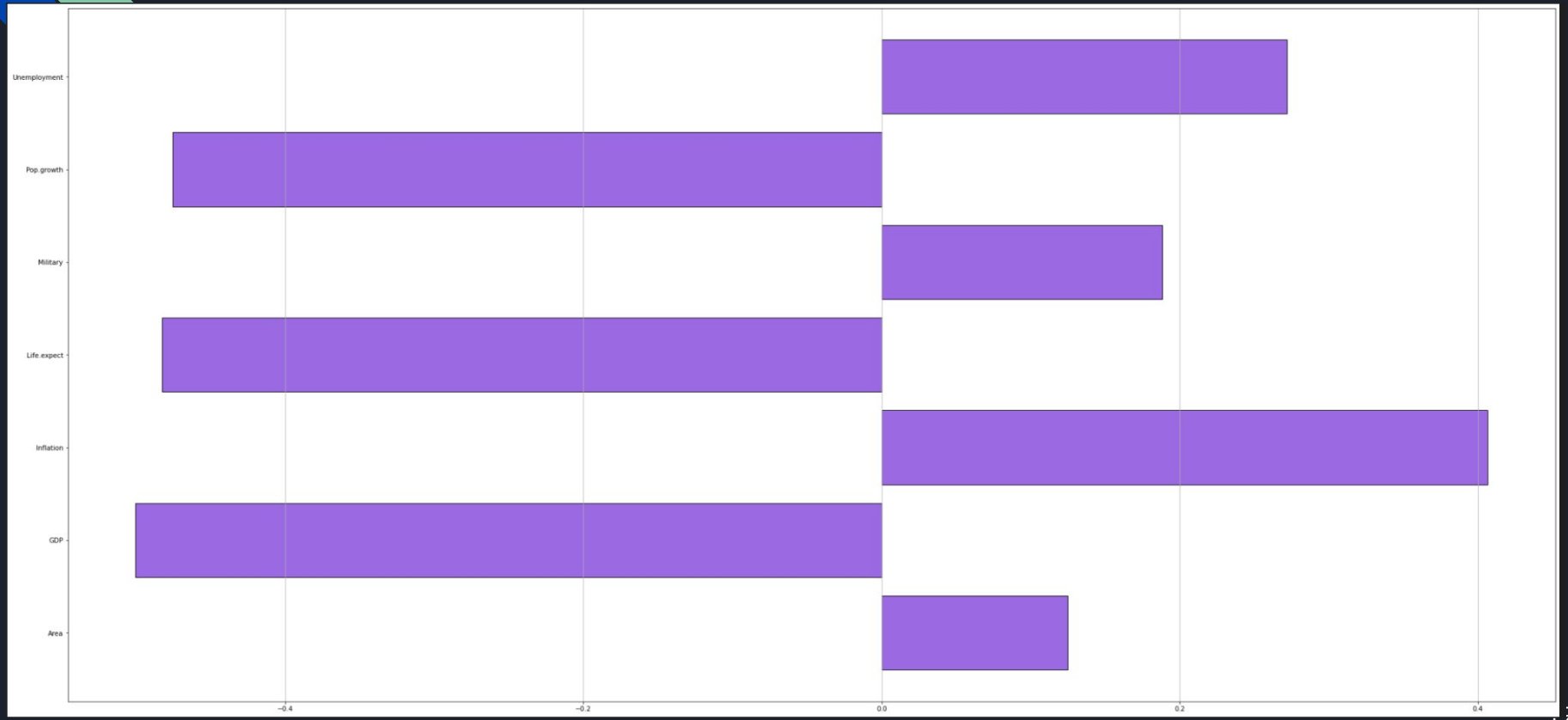
Regla de Oja: Primera componente con librerías



Regla de Oja: Peso de las variables



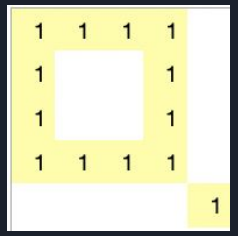
Regla de Oja: Peso de las variables con librería



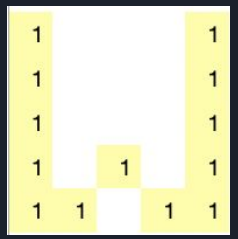
Modelo de Hopfield

Abecedario

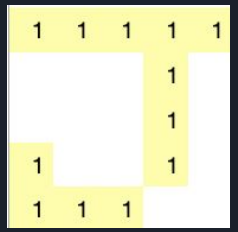
- Letra: Q 1 1 1 1 -1
  1 -1 -1 1 -1
  1 -1 -1 1 -1
  1 1 1 1 -1
  -1 -1 -1 -1 1



- Letra: W 1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 -1 1 -1 1
  1 1 -1 1 1



- Letra: J 1 1 1 1 1
  -1 -1 -1 1 -1
  -1 -1 -1 1 -1
  1 -1 -1 1 -1
  1 1 1 -1 -1



- Letra: B 1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1

Abecedario: Paso a Paso

➔ Paso 1:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 2:

1	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 3:

1	-1	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 4:

1	-1	-1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Abecedario: Paso a Paso

➔ Paso 5:

1	-1	-1	-1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 6:

1	-1	-1	-1	1
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 7:

1	-1	-1	-1	1
1	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 8:

1	-1	-1	-1	1
1	-1	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Abecedario: Paso a Paso

➔ Paso 9:

1	-1	-1	-1	1
1	-1	-1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 10:

1	-1	-1	-1	1
1	-1	-1	-1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 11:

1	-1	-1	-1	1
1	-1	-1	-1	1
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 12:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Abecedario: Paso a Paso

➔ Paso 13:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	0	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 14:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	0	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 15:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	0
0	0	0	0	0
0	0	0	0	0

➔ Paso 16:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
0	0	0	0	0
0	0	0	0	0

Abecedario: Paso a Paso

➔ Paso 17:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	0	0	0	0
0	0	0	0	0

➔ Paso 18:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	0	0	0
0	0	0	0	0

➔ Paso 19:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	0	0
0	0	0	0	0

➔ Paso 20:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	0
0	0	0	0	0

Abecedario: Paso a Paso

➔ Paso 21:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
0	0	0	0	0

➔ Paso 22:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
1	0	0	0	0

➔ Paso 23:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
1	1	0	0	0

➔ Paso 24:

1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
1	1	-1	0	0

Abecedario: Paso a Paso

➔ Paso 25:

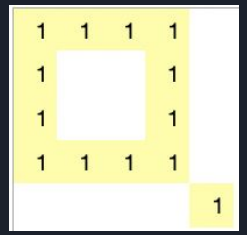
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
1	1	-1	1	0

➔ Paso 26:

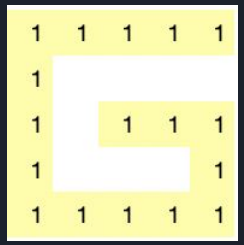
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	-1	-1	1
1	-1	1	-1	1
1	1	-1	1	1

Abecedario

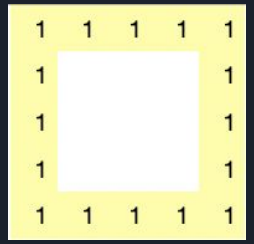
- Letra: Q 1 1 1 1 -1
  1 -1 -1 1 -1
  1 -1 -1 1 -1
  1 1 1 1 -1
  -1 -1 -1 -1 1



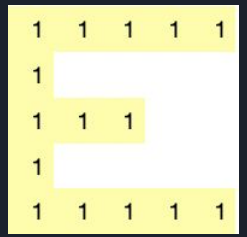
- Letra: G 1 1 1 1 1
  1 -1 -1 -1 -1
  1 -1 1 1 1
  1 -1 -1 -1 1
  1 1 1 1 1



- Letra: O 1 1 1 1 1
  1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 1 1 1 1



- Letra: E 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 -1 -1
  1 -1 -1 -1 -1
  1 1 1 1 1

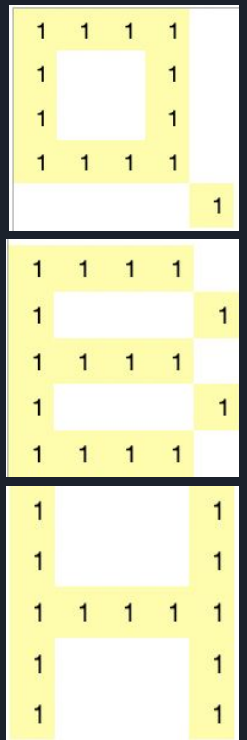


Abecedario

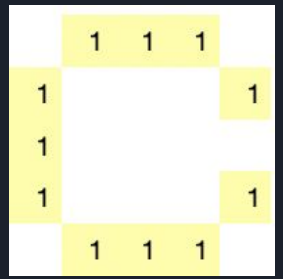
```
Letra según Hopfield:
*****
*
* ***
*   *
*****
Letra original:
*****
*   *
*   *
*   *
*****
Patrón de letra incorrecto
```

Abecedario, con ruido=0,02

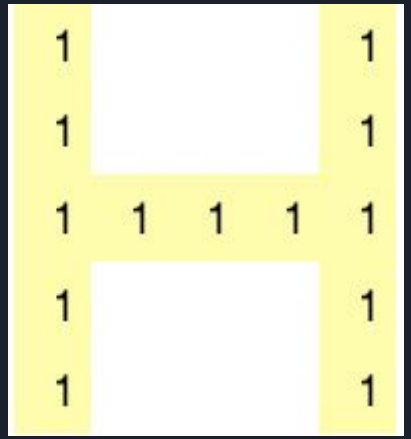
- Letra: C, -1 1 1 1 -1
  1 -1 -1 -1 1
  1 -1 -1 -1 -1
  1 -1 -1 -1 1
  -1 1 1 1 -1
- Letra: B, 1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1
- Letra: H, 1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 1 1 1 1
  1 -1 -1 -1 1
  1 -1 -1 -1 1



- Letra: Q, 1 1 1 1 -1
  1 -1 -1 1 -1
  1 -1 -1 1 -1
  1 1 1 1 -1
  -1 -1 -1 -1 1



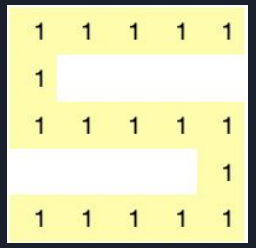
Abecedario, con ruido=0,02



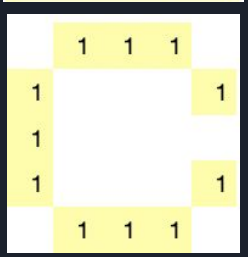

```
Letra según Hopfield:
*   *
*   *
*****
*   *
*   *
Letra original:
**  *
*   *
*****
 *  *
    *
```

Abecedario, con ruido=0,1

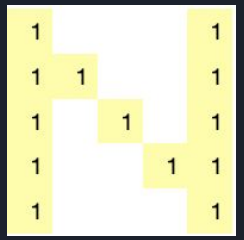
- Letra: S 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 1 1
  -1 -1 -1 -1 1
  1 1 1 1 1



- Letra: C -1 1 1 1 -1
  1 -1 -1 -1 1
  1 -1 -1 -1 -1
  1 -1 -1 -1 1
  -1 1 1 1 -1

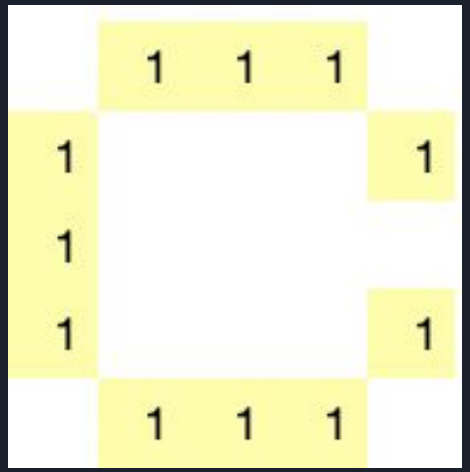


- Letra: N 1 -1 -1 -1 1
  1 1 -1 -1 1
  1 -1 1 -1 1
  1 -1 -1 1 1
  1 -1 -1 -1 1



- Letra: B 1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1

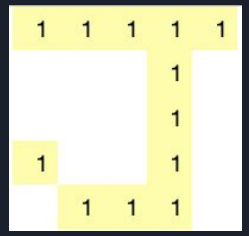
Abecedario, con ruido=0,1



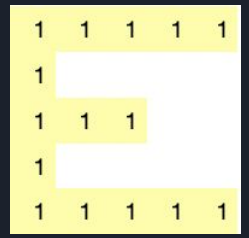

```
Letra según Hopfield:
 ***
*   *
*
*   *
 ***
Letra original:
*****
  * *
*  *
*   *
****
```

Abecedario, con ruido=0,1

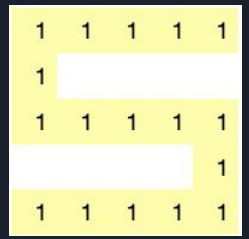
- Letra: J 1 1 1 1 1
  -1 -1 -1 1 -1
  -1 -1 -1 1 -1
  1 -1 -1 1 -1
  1 1 1 -1 -1



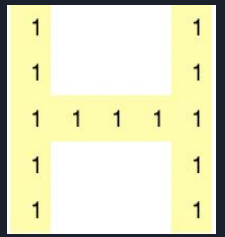
- Letra: E 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 -1 -1
  1 -1 -1 -1 -1
  1 1 1 1 1



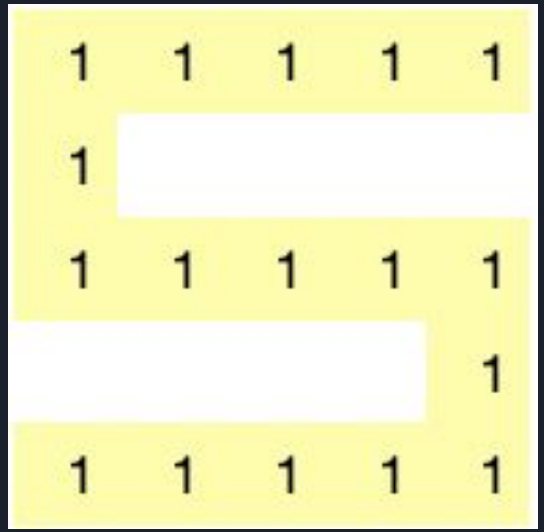
- Letra: S 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 1 1
  -1 -1 -1 -1 1
  1 1 1 1 1



- Letra: H, 1 -1 -1 -1 1
  1 -1 -1 -1 1
  1 1 1 1 1
  1-1 -1 -1 1
  1 -1 -1 -1 1



Abecedario, con ruido=0,1

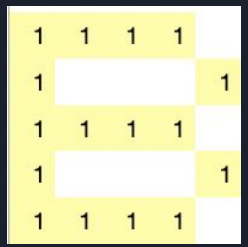



```
Letra según Hopfield:
*****
*
****
*
*****
Letra original:
*****
** **
*** *
*   *
 * *
```

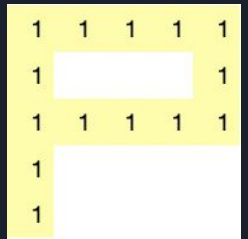
Abecedario, con ruido=0,2

- Letra: F 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 1 -1
  1 -1 -1 -1 -1
  1 -1 -1 -1 -1

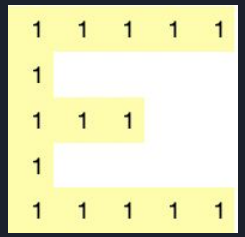
- Letra: B 1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1
  1 -1 -1 -1 1
  1 1 1 1 -1



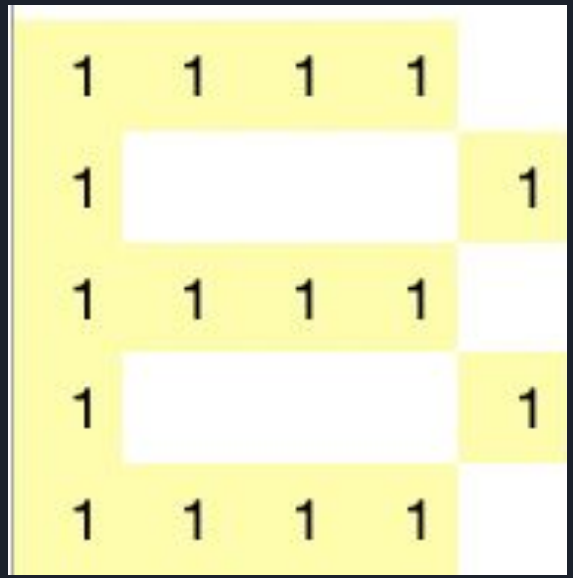
- Letra: P 1 1 1 1 1
  1 -1 -1 -1 1
  1 1 1 1 1
  1 -1 -1 -1 -1
  1 -1 -1 -1 -1



- Letra: E 1 1 1 1 1
  1 -1 -1 -1 -1
  1 1 1 -1 -1
  1 -1 -1 -1 -1
  1 1 1 1 1



Abecedario, con ruido=0,2




```
Letra según Hopfield:
*   *
 ****
 ****
 ***

Letra original:
   **
  *
** *
****
  * *
```

Problemas

- Como representar los estados espúreos
- Como actualizar el radio en kohonen