72.27 SISTEMAS DE INTELIGENCIA ARTIFICIAL - PRIMER CUATRIMESTRE 2022

Metodos de aprendizaje no supervisado

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60212 - Valentino Riera Torraca
60390 - Igal Leonel Revich

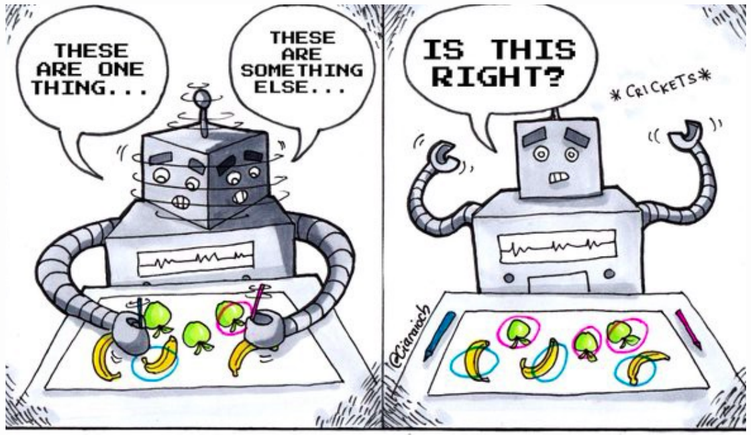
OBJETIVOS

DESARROLLO

Implementar los distintos metodos de aprendizaje no supervisado vistos en clase

EXPERIMENTACION

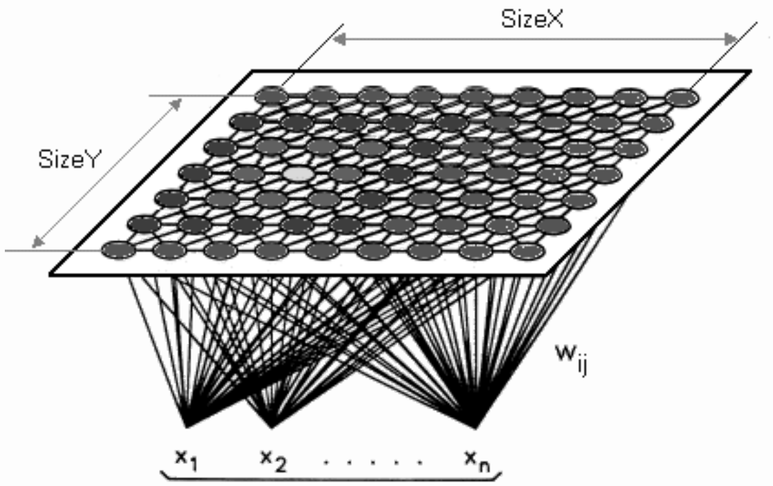
Realizar diversos analisis a partir de la aplicacion de los mismos



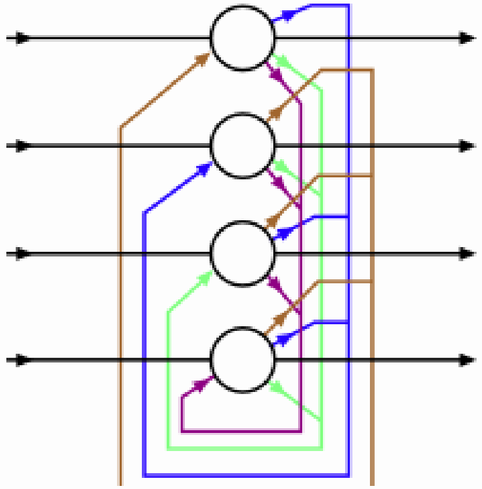
Metodos de aprendizaje utilizados

METODOS DE APRENDIZAJE UTILIZADOS

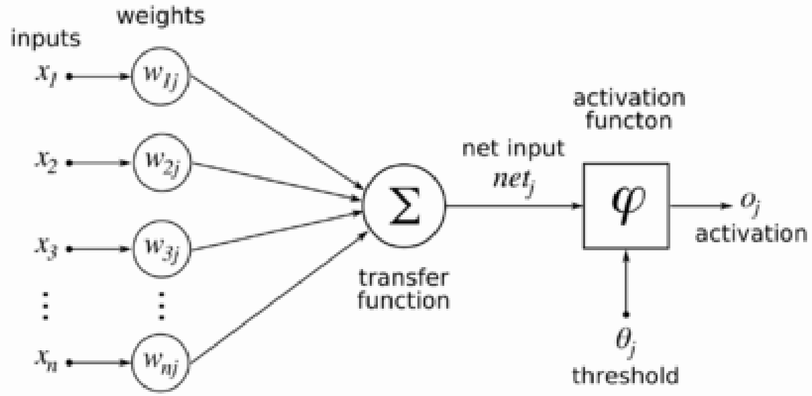
Kohonen



Hopfield



Regla de Oja



Redes de Kohonen

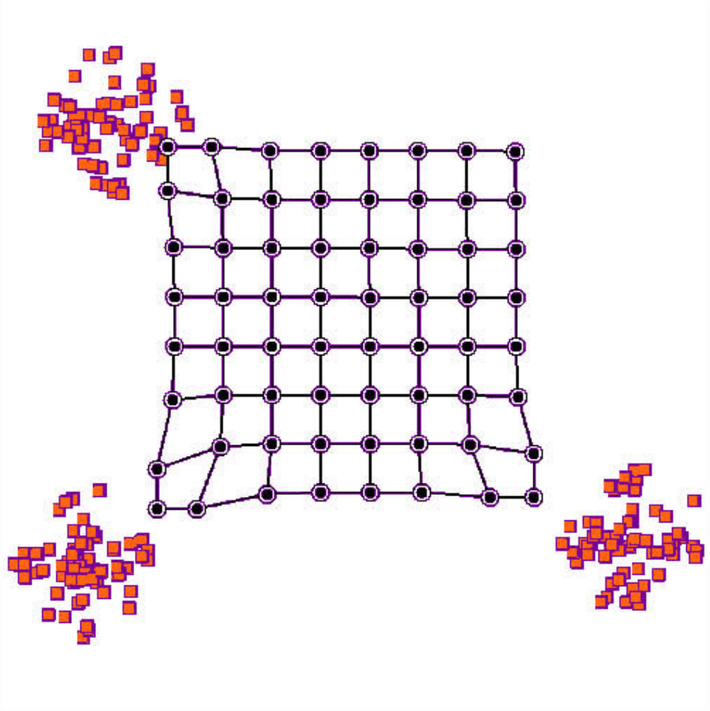
RED DE KOHONEN

DATASET

Europe.csv : Características económicas, sociales y geográficas de 28 países de Europa

PARAMETROS

- *maxEpochs:* Maxima cantidad de epocas que se entrenara la red
- *k:* Numero que indica la dimension de la matriz de neuronas de salida (k x k)
- *r0:* Radio inicial
- *initialLearningRate:* Taza de aprendizaje inicial



RED DE KOHONEN: FUNCIONES DE DECRECIMIENTO

$$R(t) = r0 * e^{-t*\frac{ln(r0)}{maxEpochs}}$$

Funcion de decrecimiento del radio

$$\eta(t) = \frac{1}{t}$$

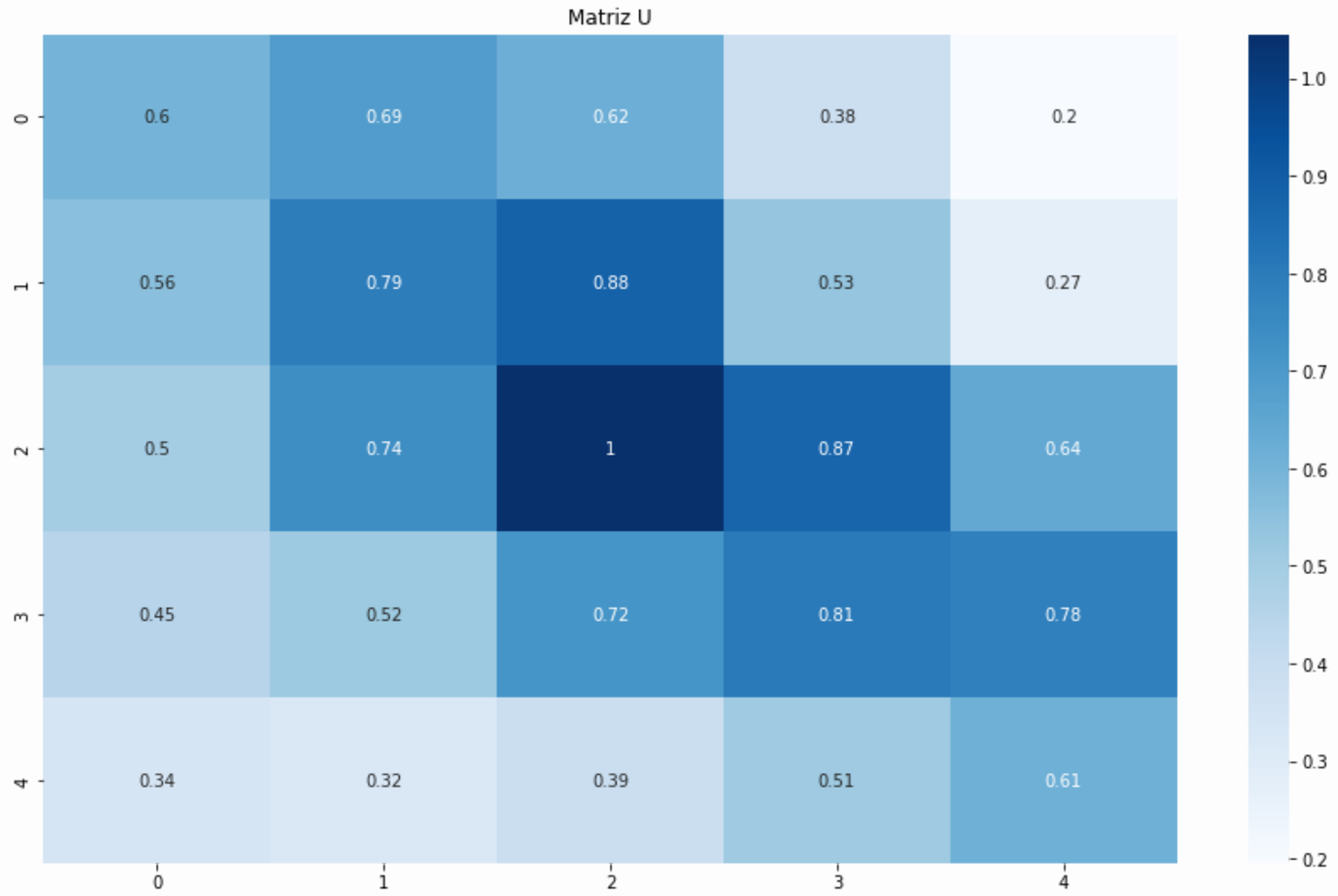
Funcion de decrecimiento del learning rate

RED DE KOHONEN: PARAMETROS PARA LAS PRUEBAS

Los párametros utilizados fueron los siguientes a menos que se indique lo contrario

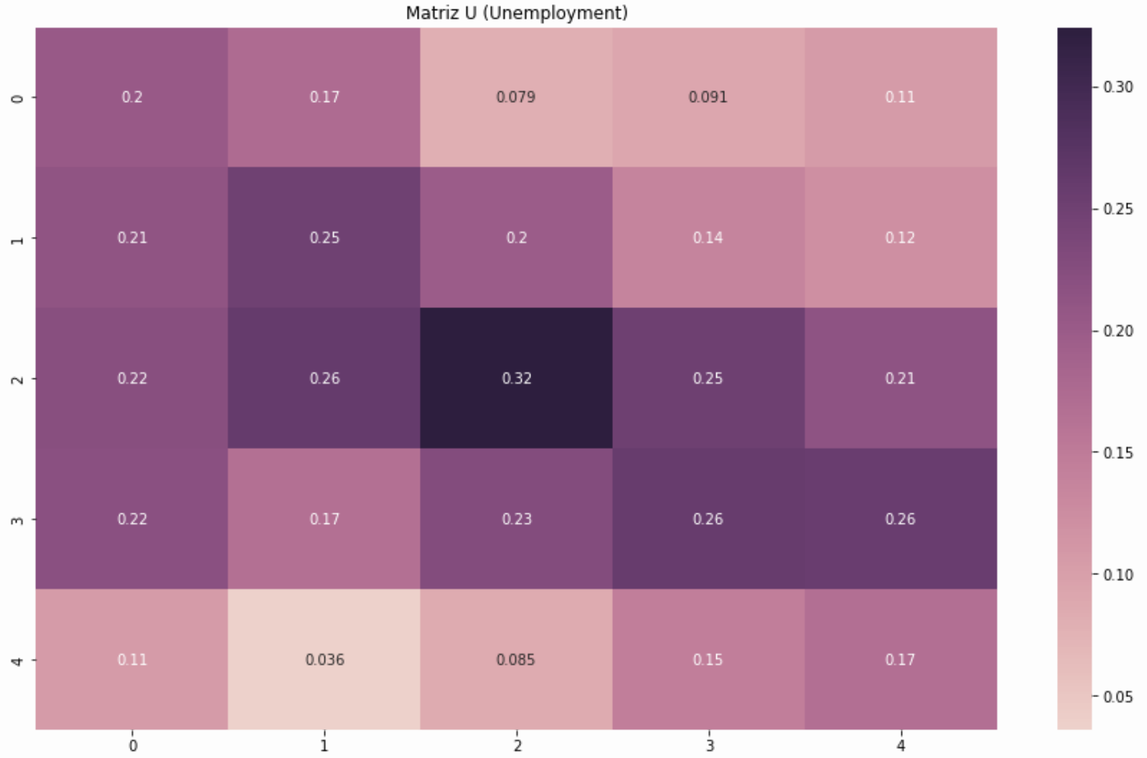
- *maxEpochs:* 350
- *k: 5*
- *r0: 4*
- *initialLearningRate:* 0.1

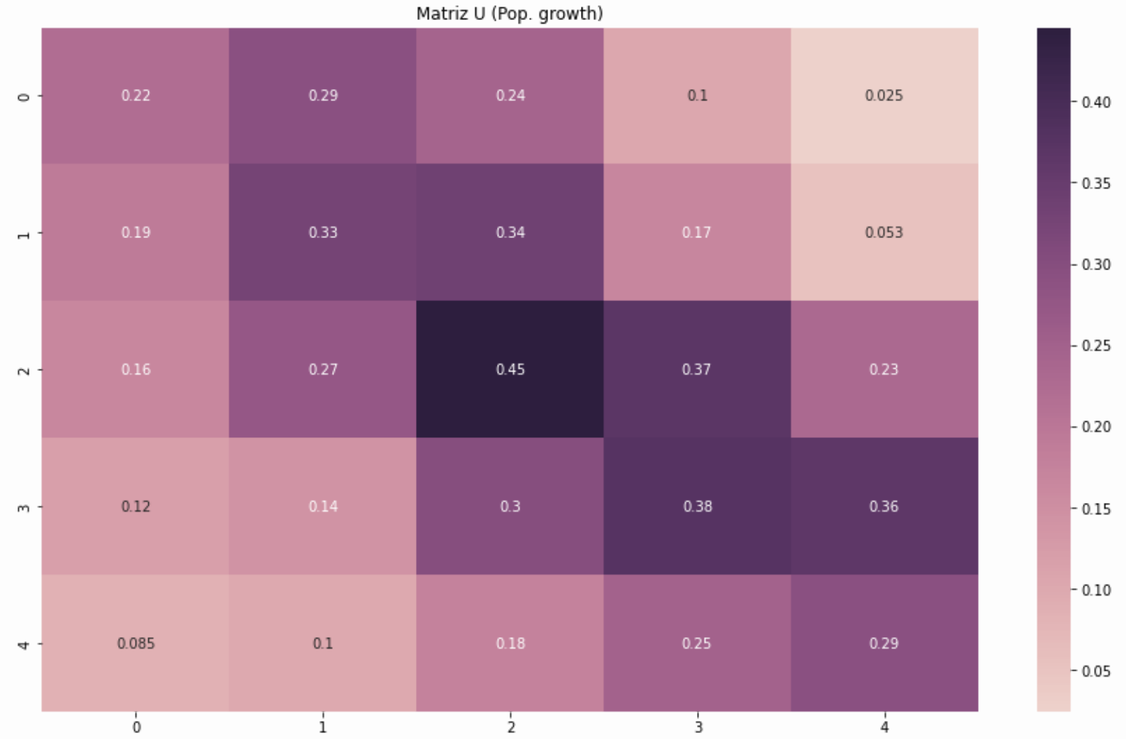
KOHONEN: MATRIZ U



Distancia entre atributos de neuronas

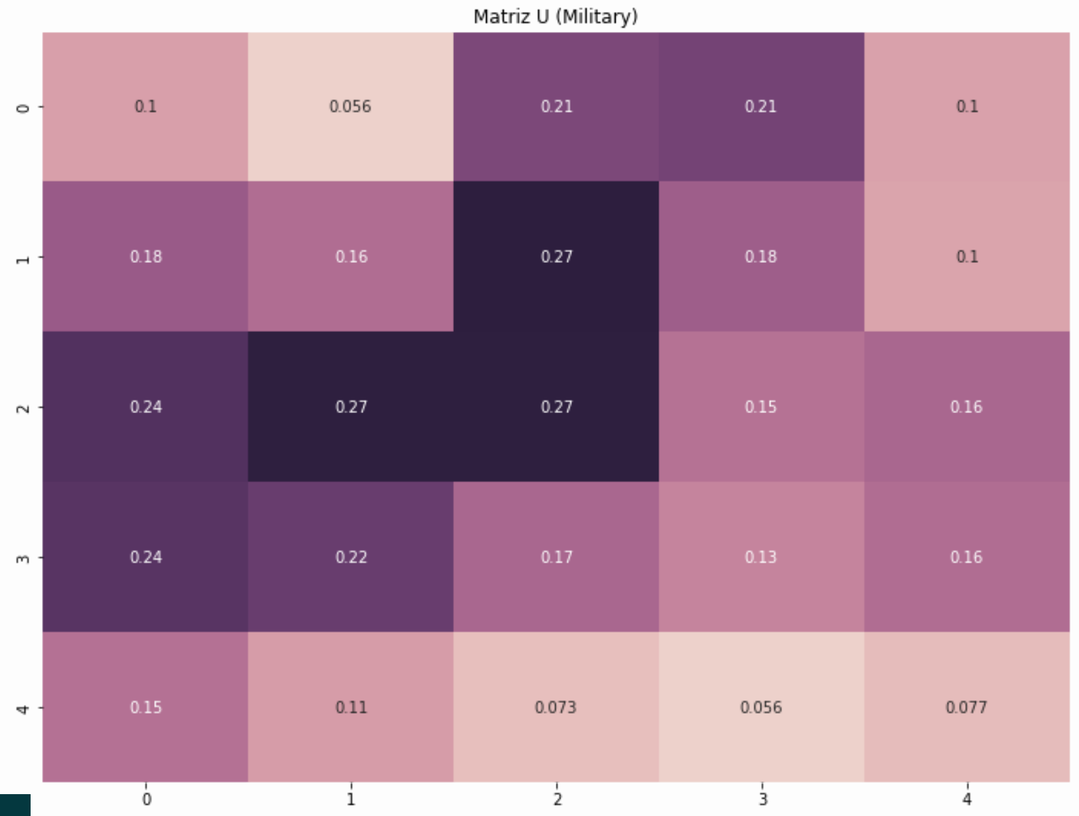
MATRIZ U POR ENTRADA:

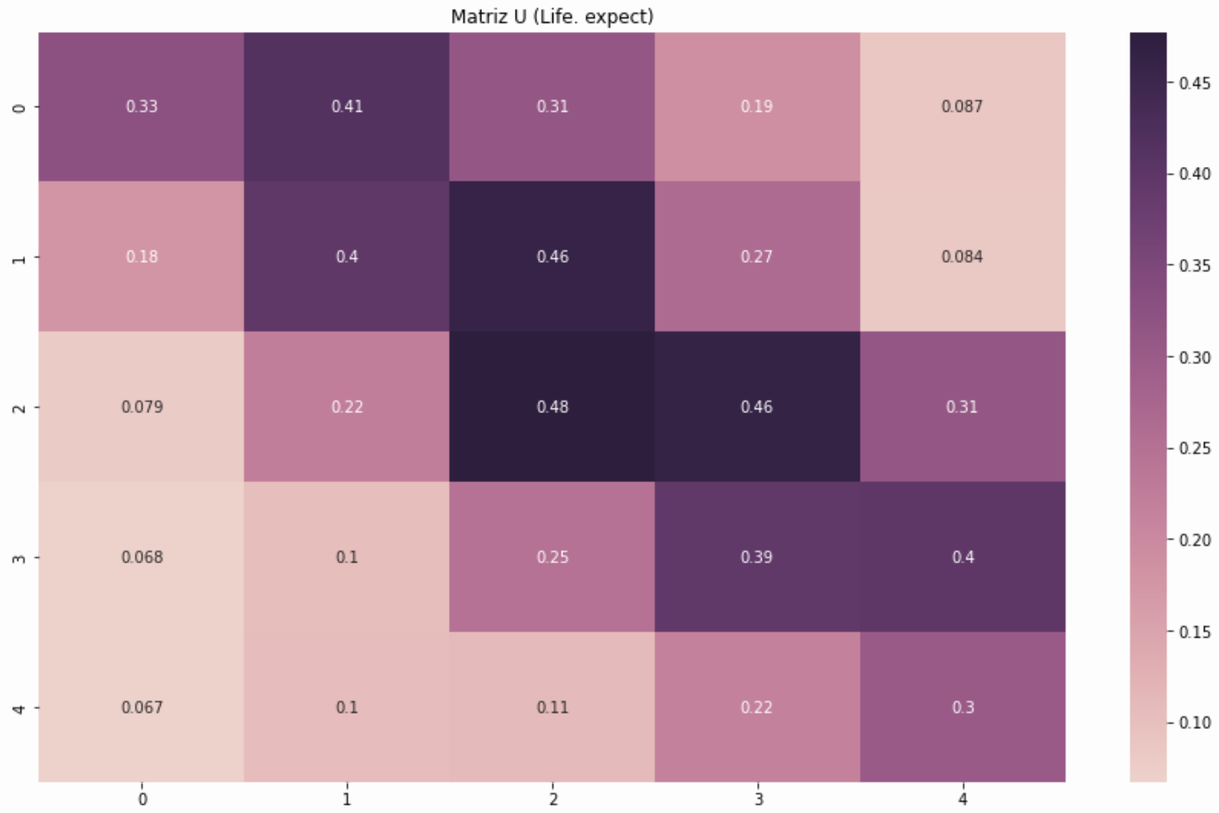




Distancia entre neuronas por característica

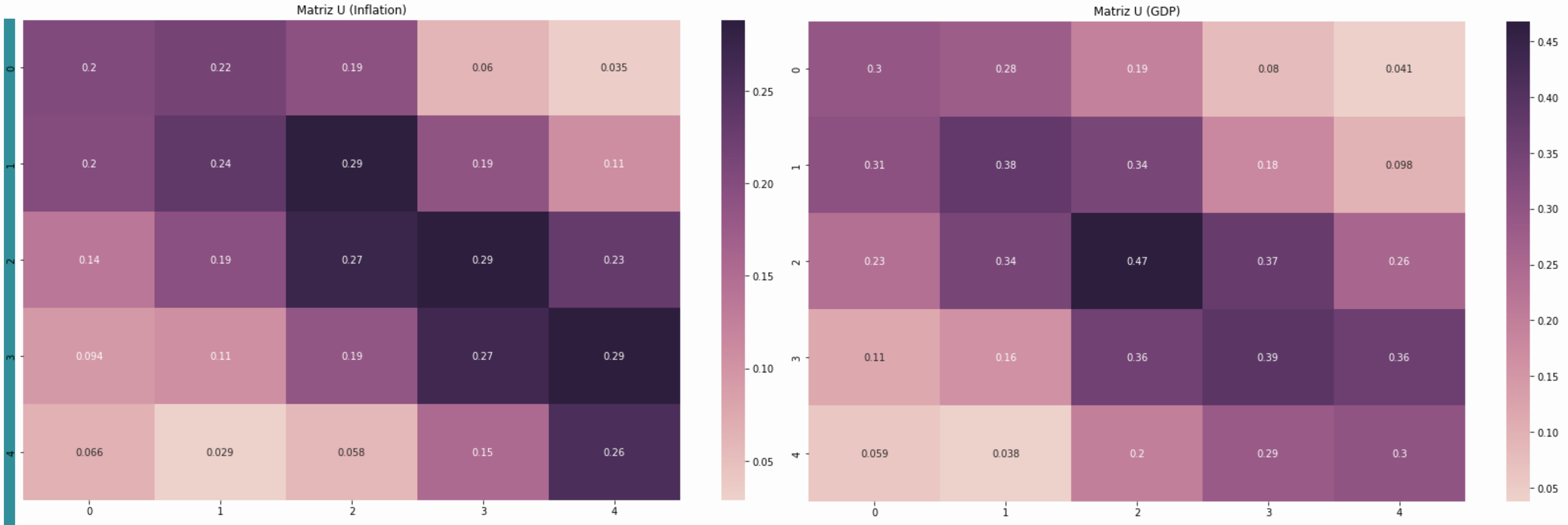
MATRIZ U POR ENTRADA:





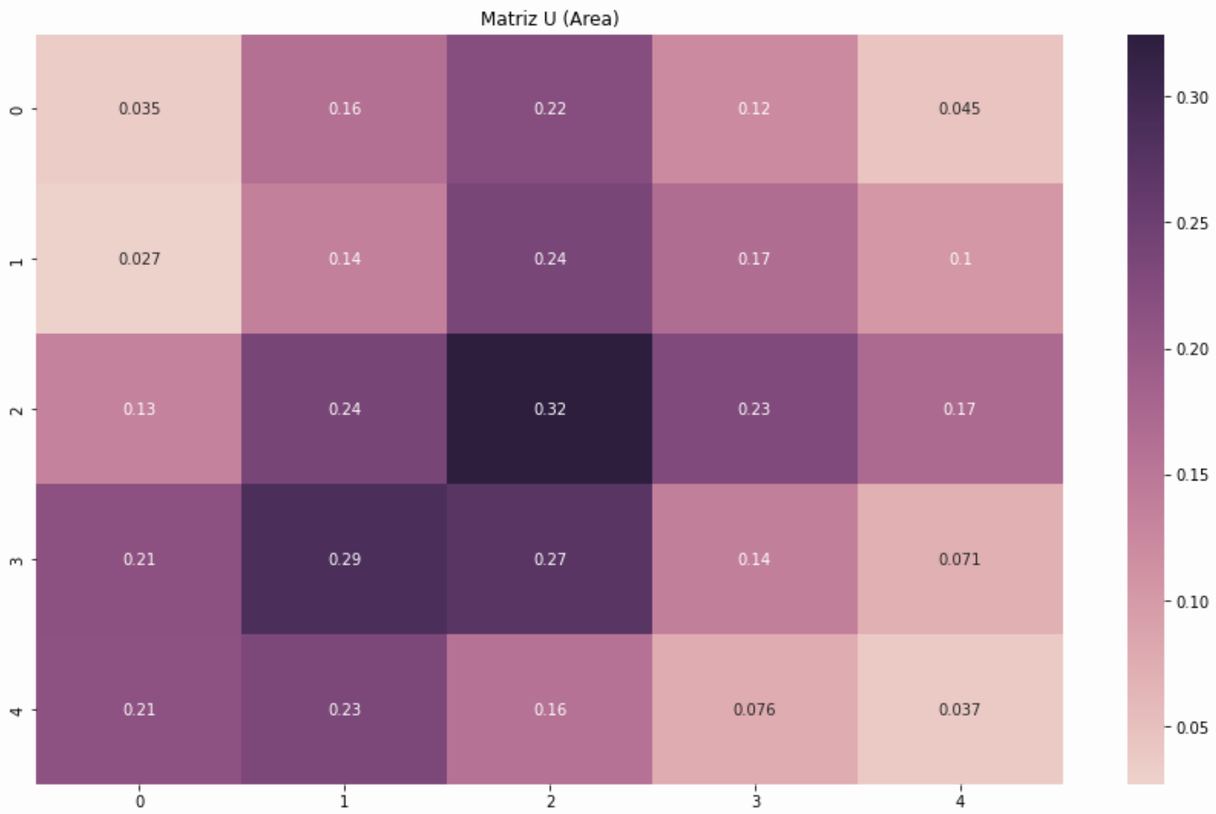
Distancia entre neuronas por característica

MATRIZ U POR ENTRADA:



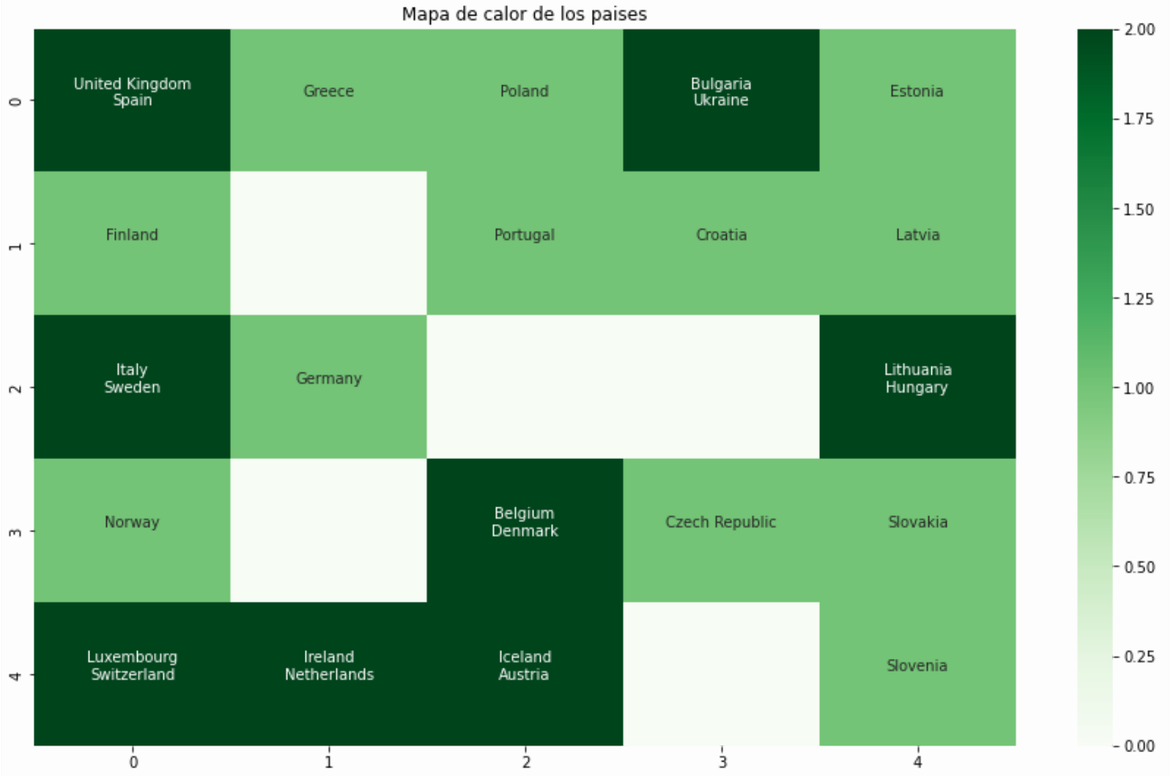
Distancia entre neuronas por característica

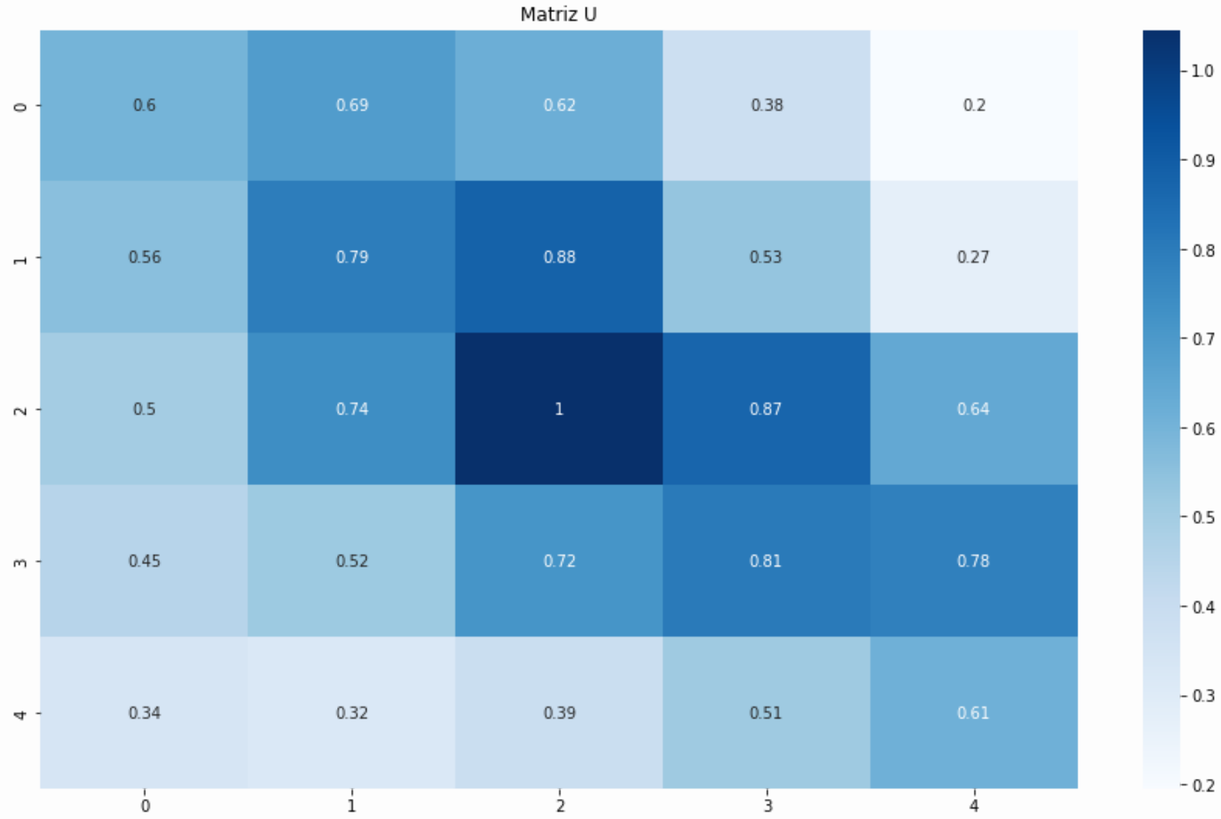
MATRIZ U POR ENTRADA:



Distancia entre neuronas por característica

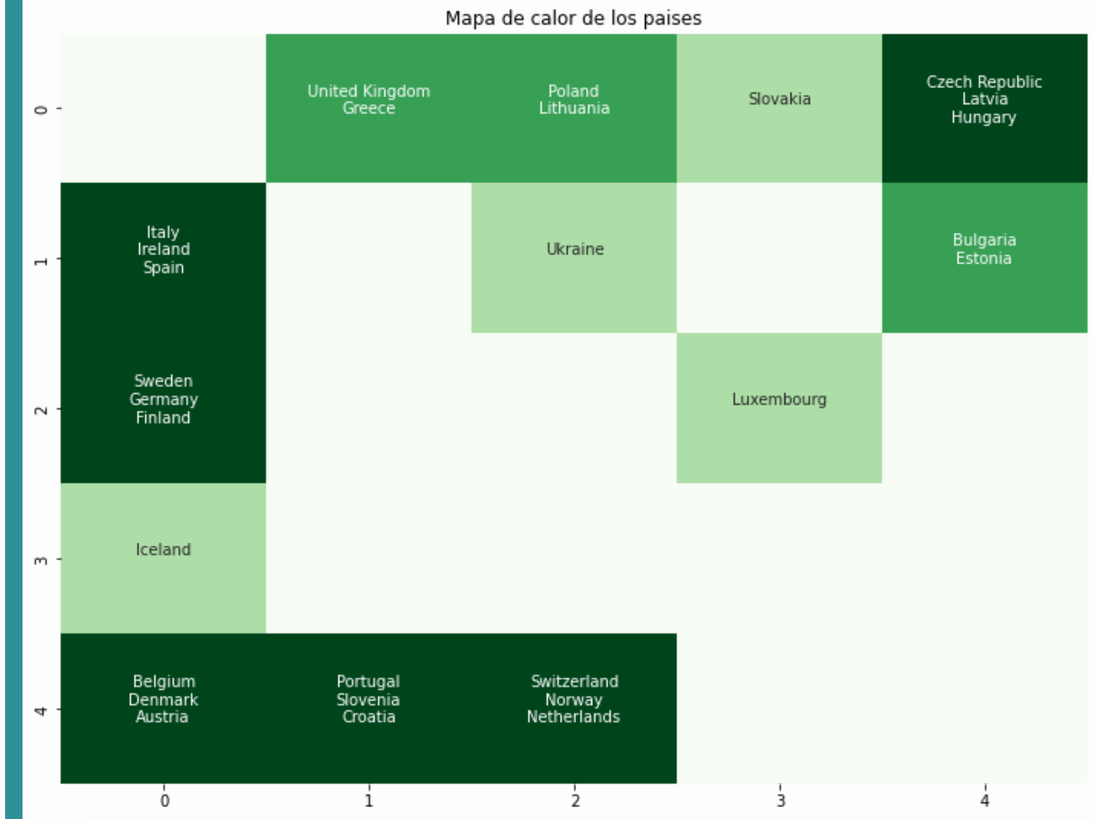
PRUEBA CON DISTINTOS LEARNING RATE:

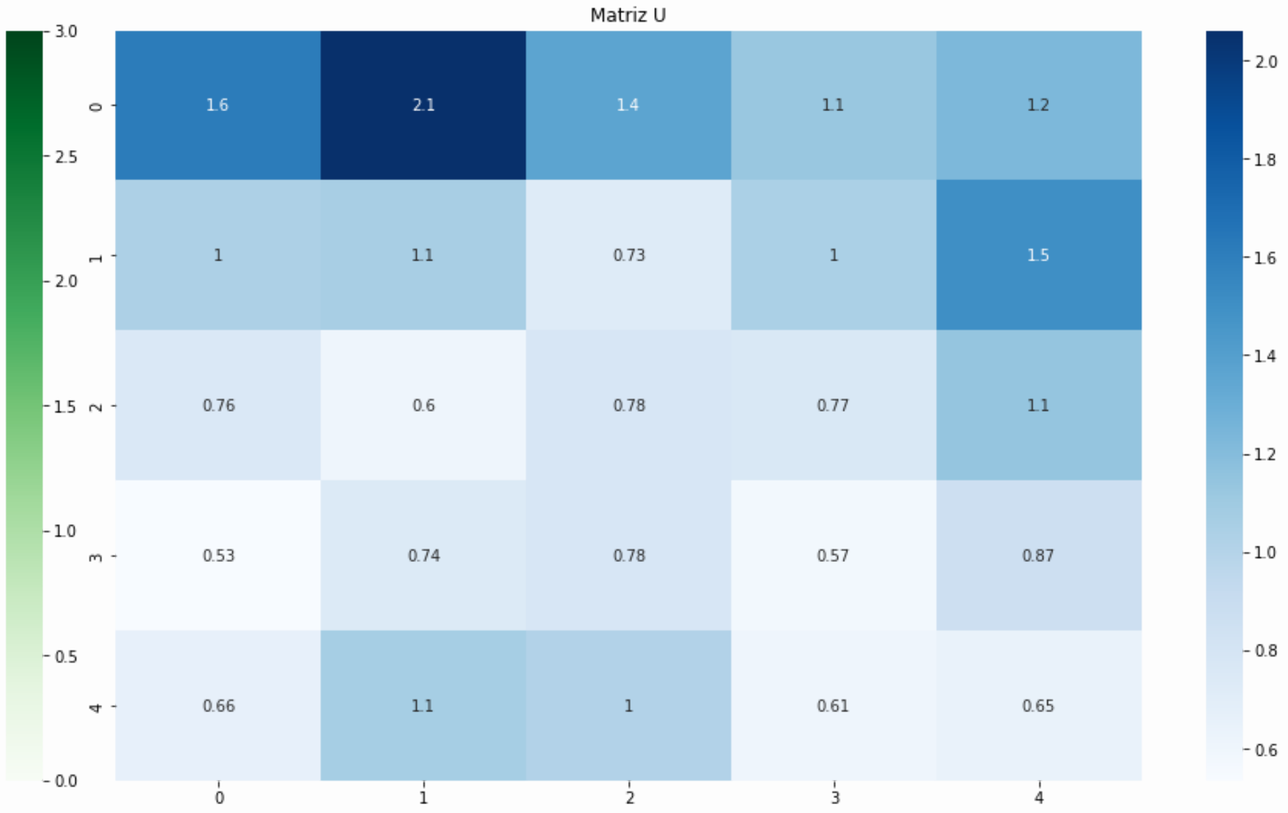




Learning Rate = 0.1

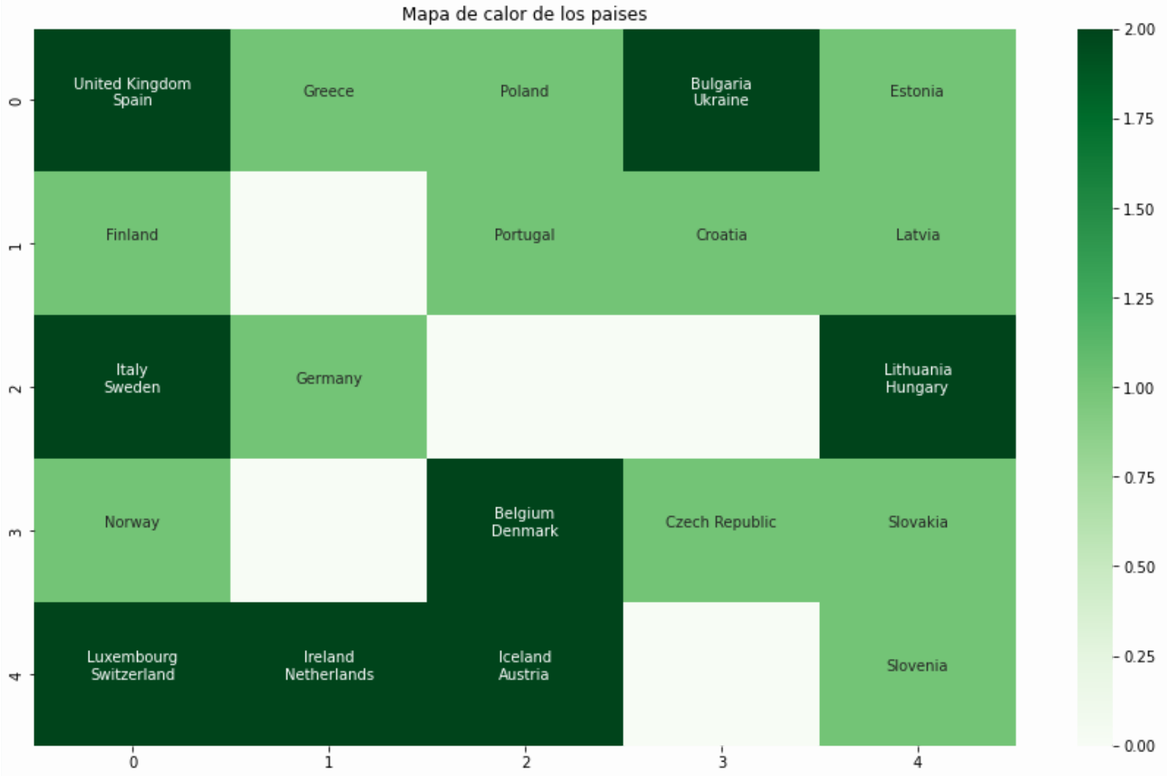
PRUEBA CON DISTINTOS LEARNING RATE:





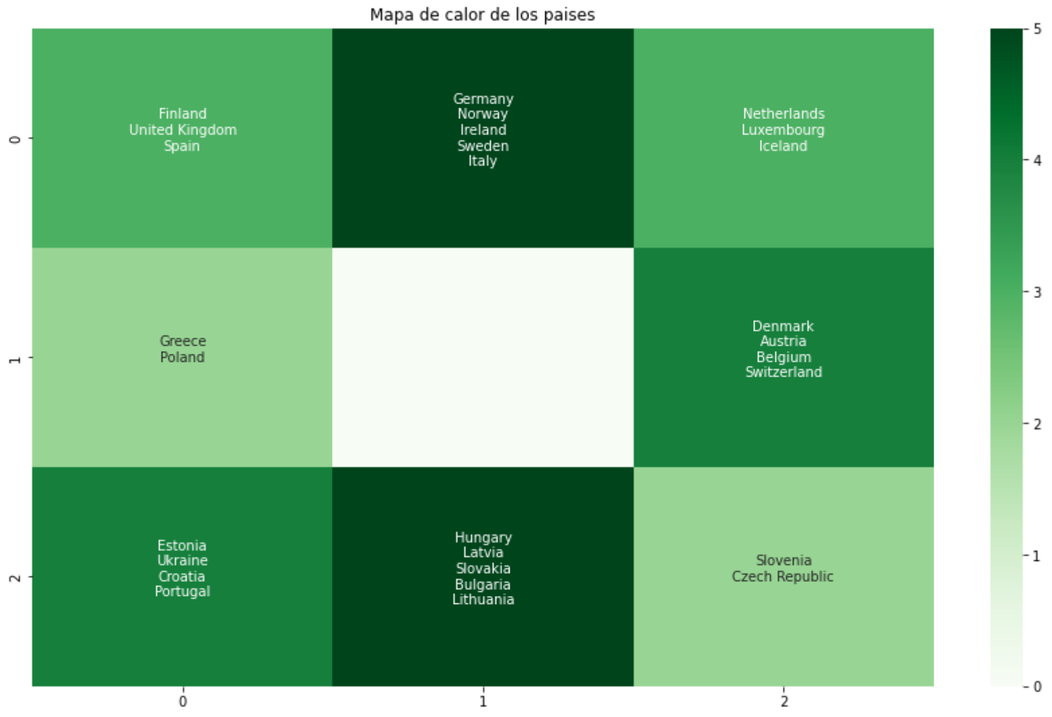
Learning Rate = 0.5

PRUEBA CON DISTINTOS LEARNING RATE:

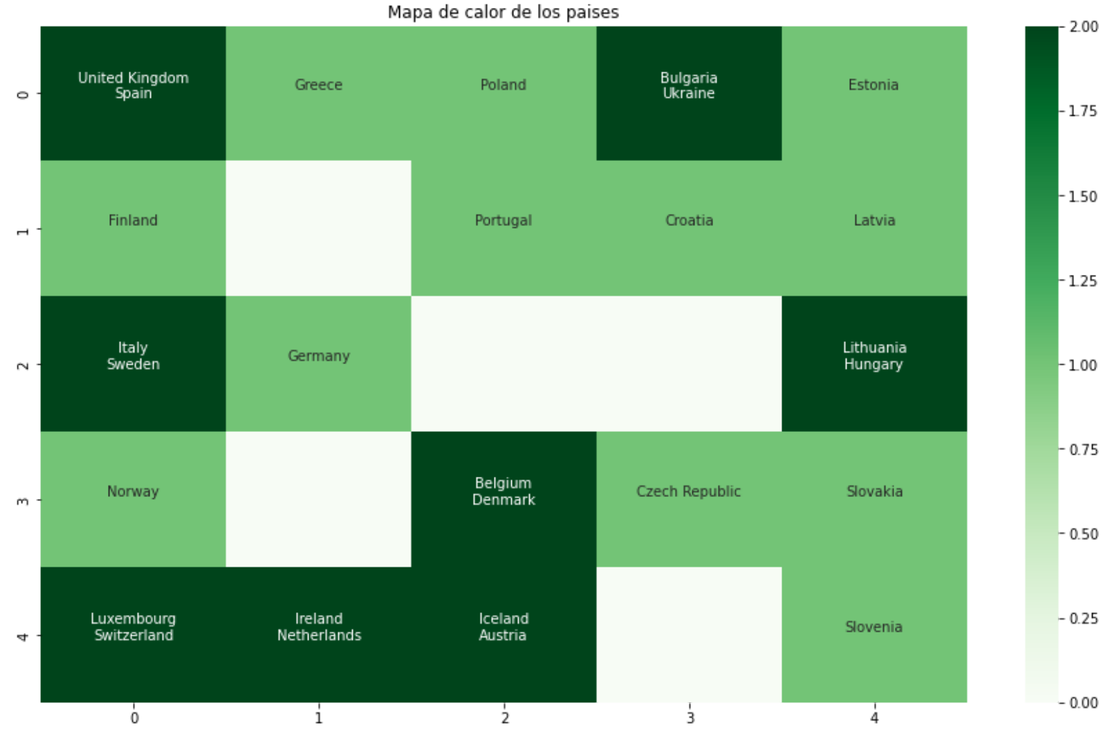


Learning Rate = 1

DISTINTOS VALORES DE K:

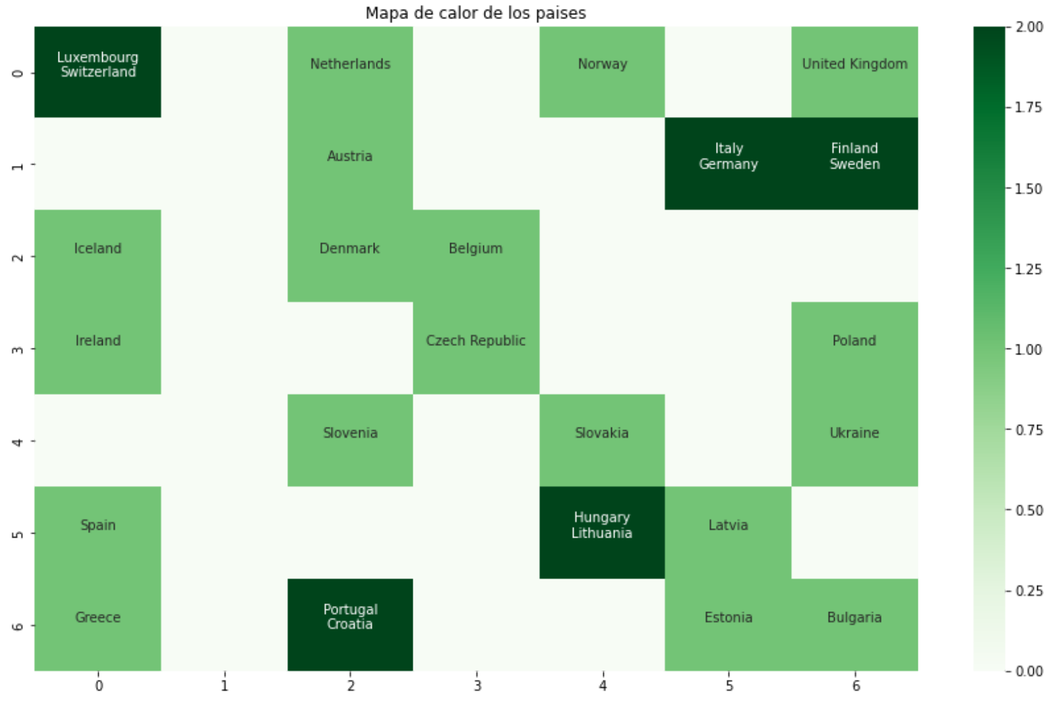


k=3

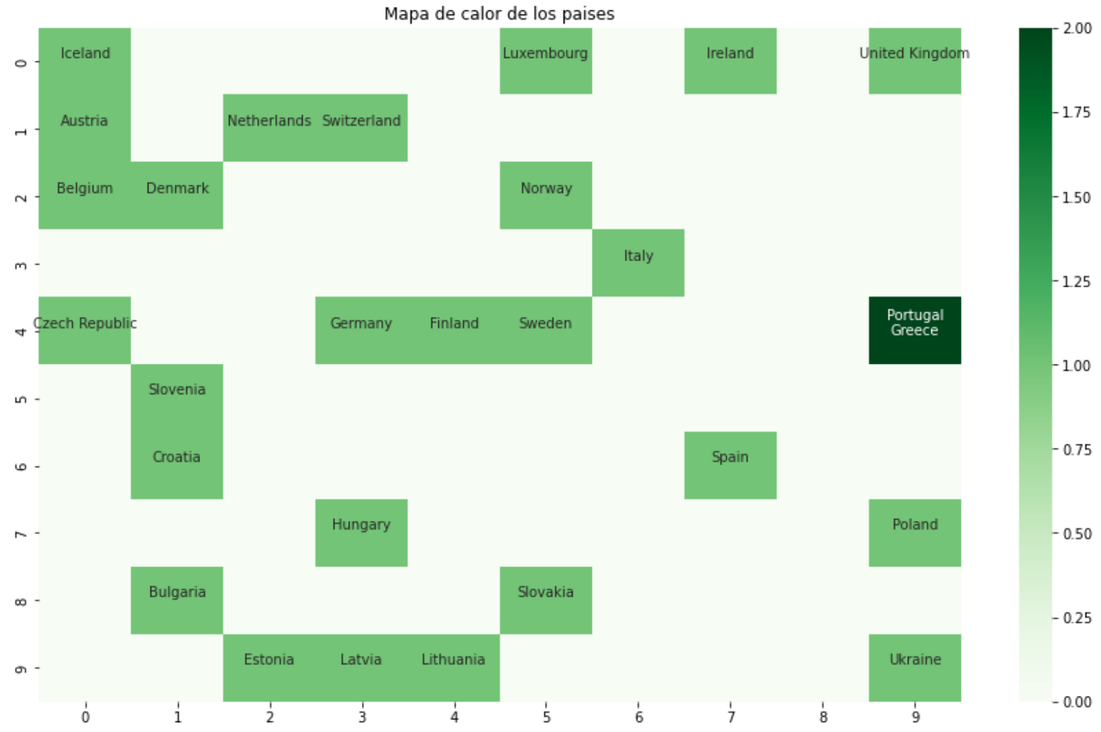


k=5

DISTINTOS VALORES DE K:

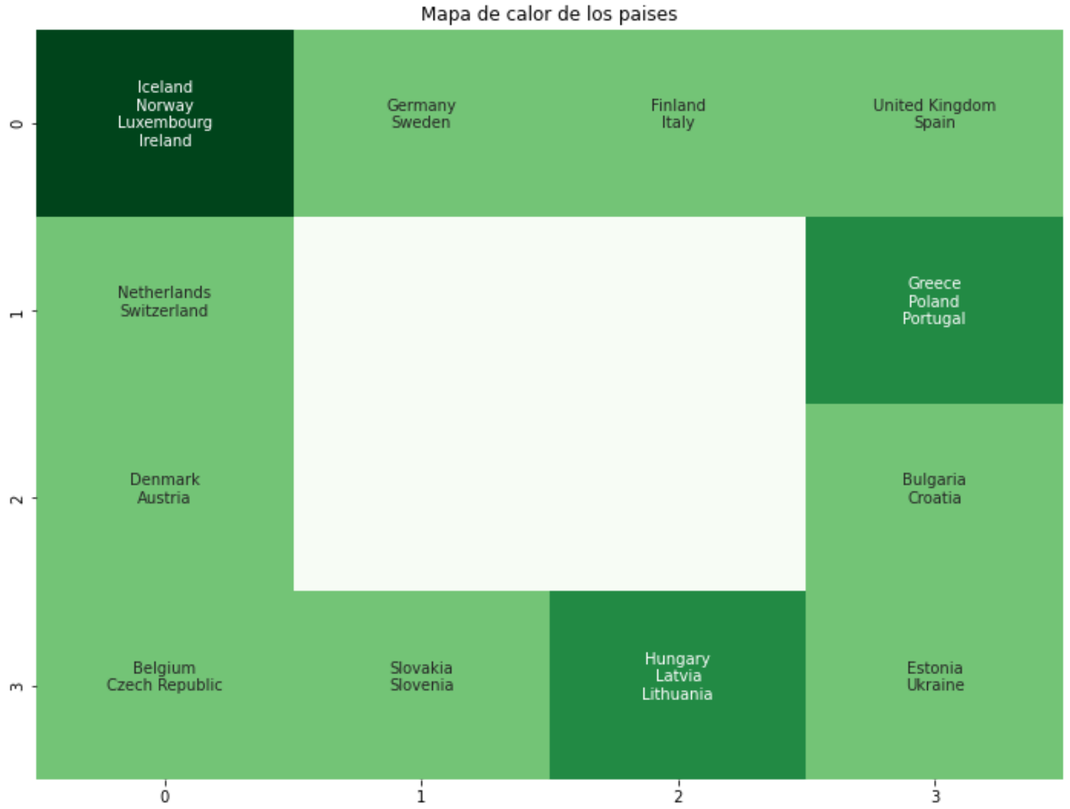


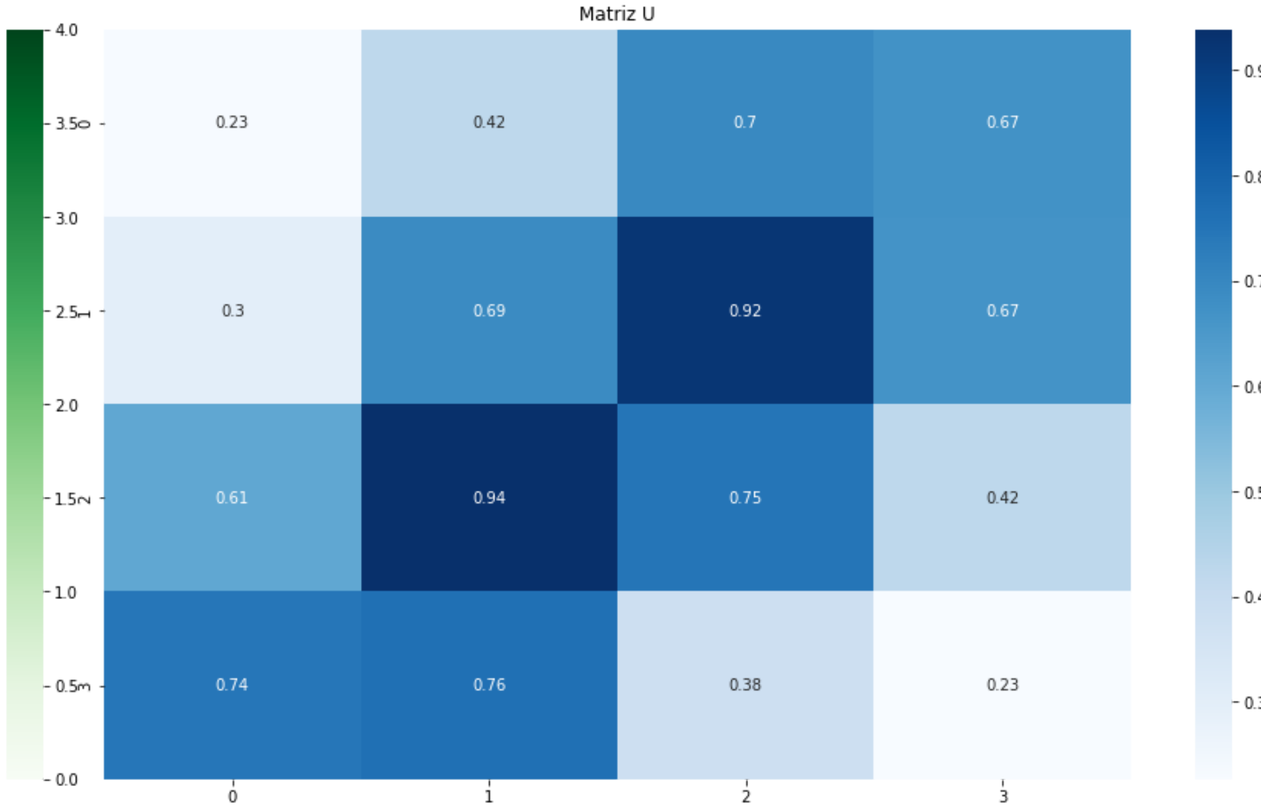
k=7



k=10

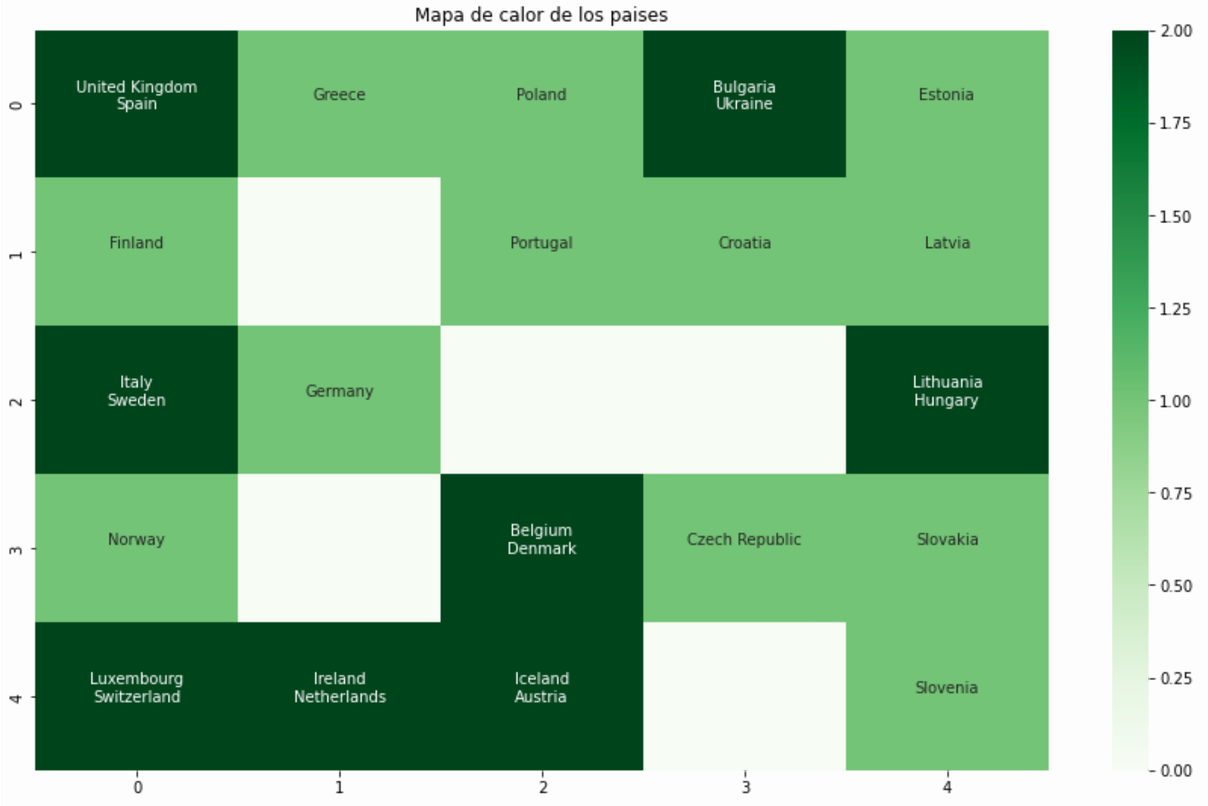
PAÍSES SIMILARES:

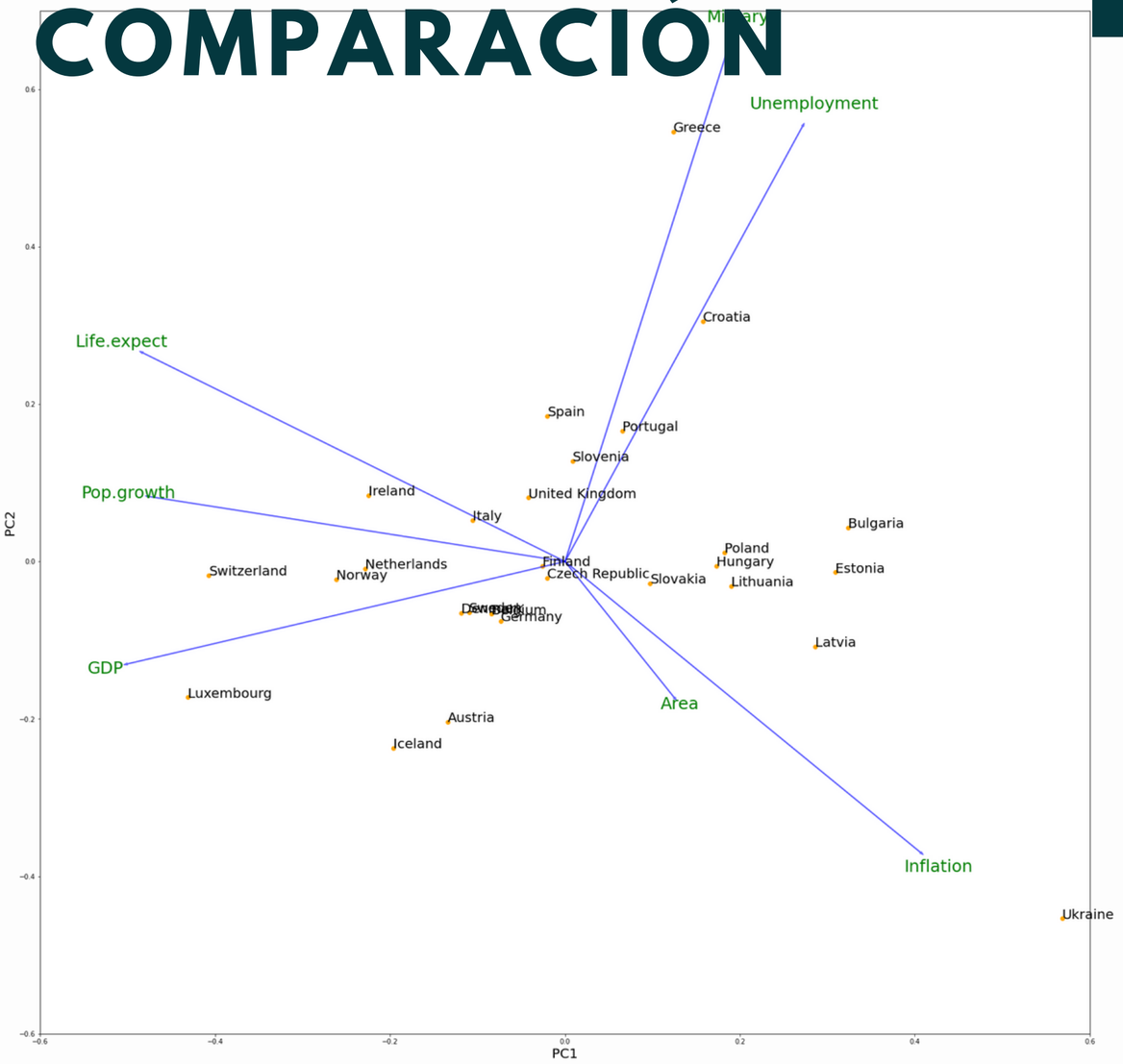




k=4

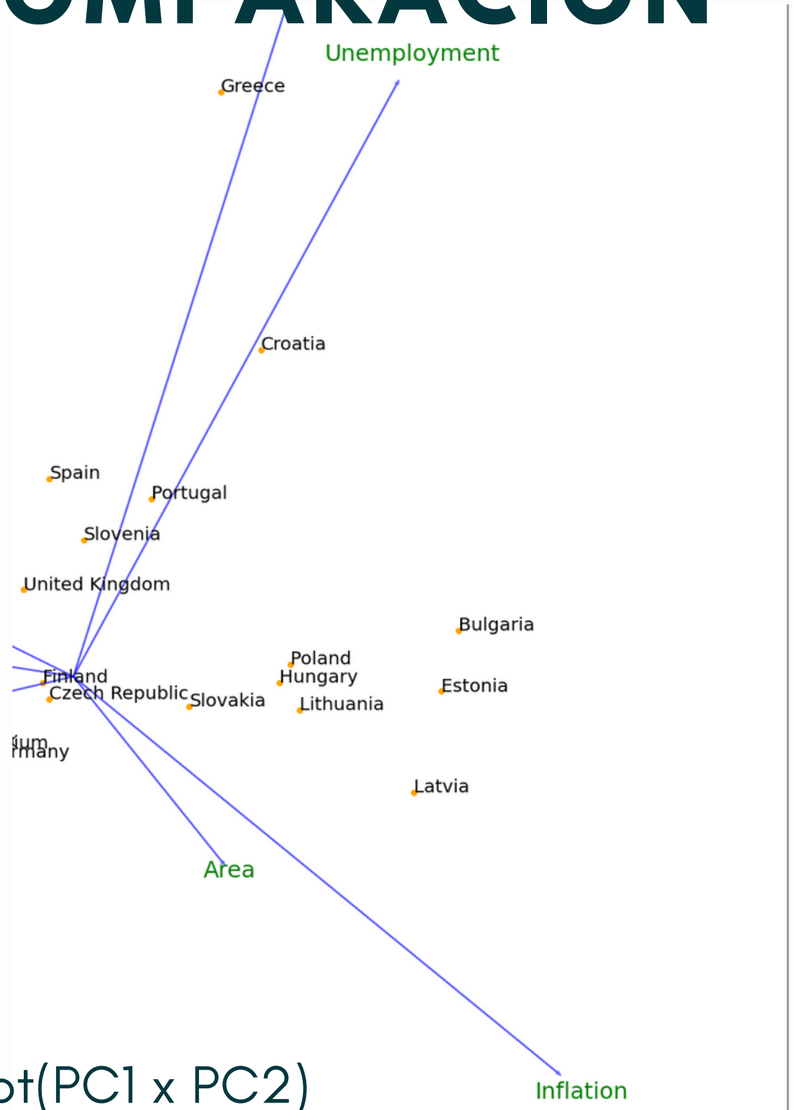
RED DE KOHONEN: COMPARACIÓN





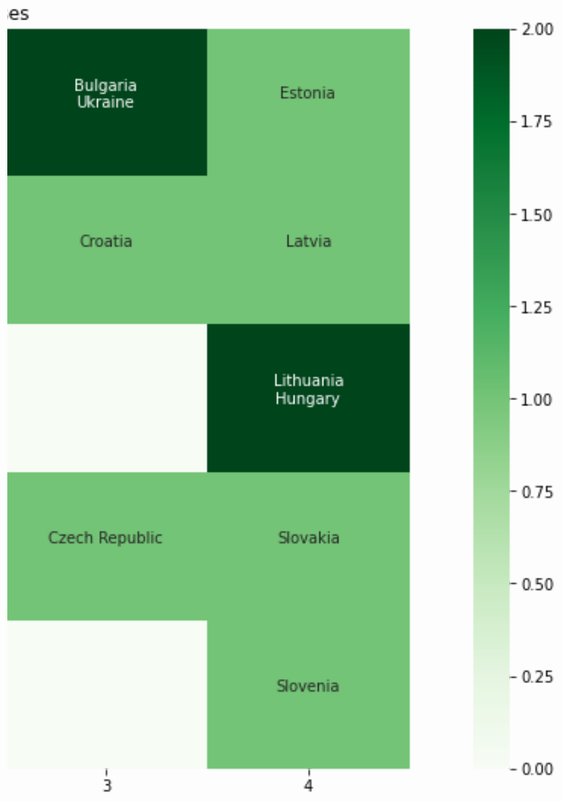
Heatmap(k=5) vs Biplot(PC1 x PC2)

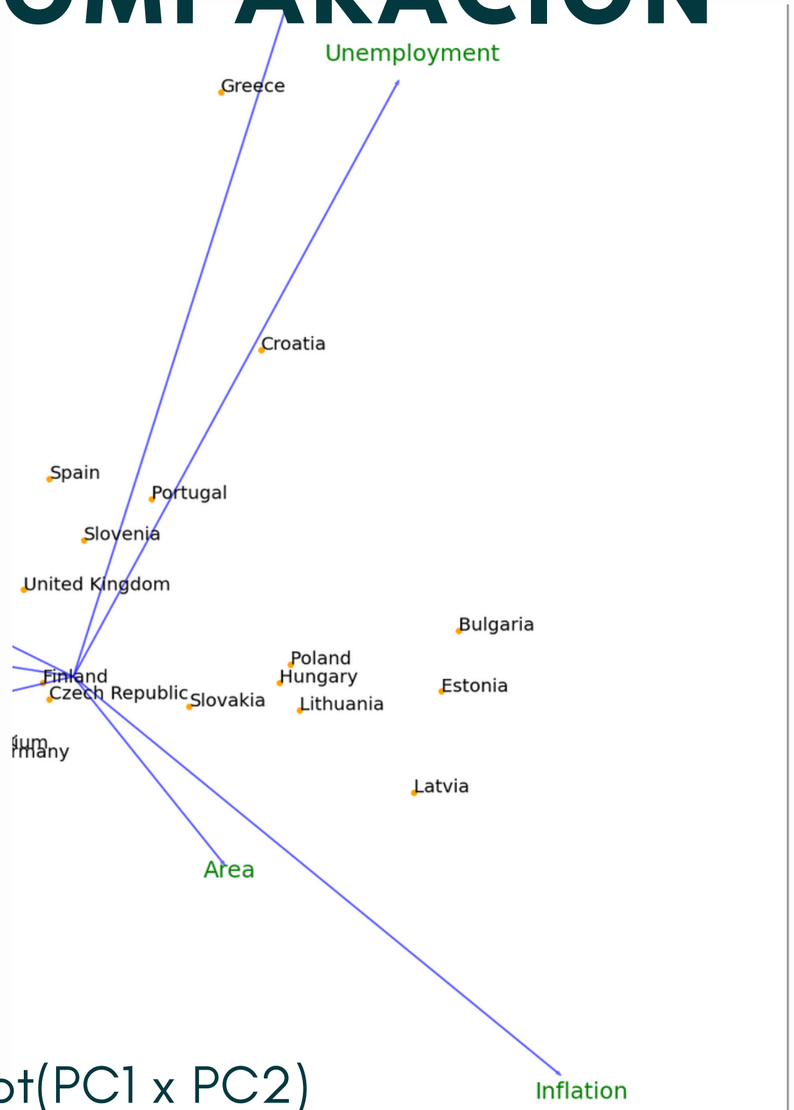
RED DE KOHONEN: COMPARACIÓN



Heatmap(k=5) vs Biplot(PC1 x PC2)

RED DE KOHONEN: COMPARACIÓN





Heatmap(k=5) vs Biplot(PC1 x PC2)

Ukraine

Regla de Oja

REGLA DE OJA : DESCRIPCION

DATASET

Europe.csv : Características económicas, sociales y geográficas de 28 países de Europa

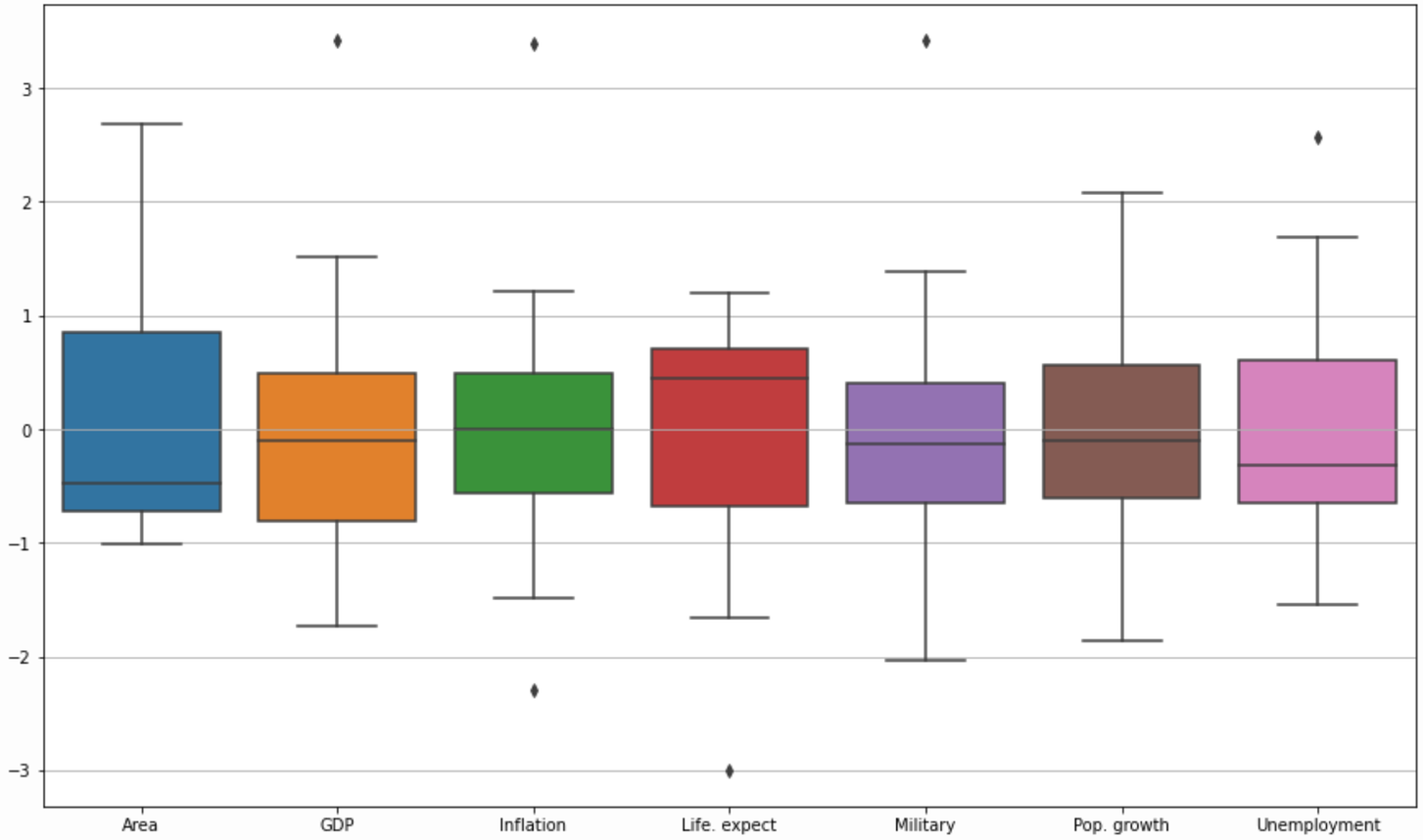
PARAMETROS

- *epochs:* Cantidad de epocas a iterar en el algoritmo
- *learningRate:* Tasa de aprendizaje

LIBRERIAS (PC)

- *sklearn*

REGLA DE OJA : DATASET



Caracteristicas de los paises estandarizadas

REGLA DE OJA : PARAMETROS PARA LAS PRUEBAS

Los párametros utilizados fueron los siguientes a menos que se indique lo contrario

- epochs: 5000
- learningRate: 0.0001

REGLA DE OJA : VECTOR DE PESOS (INICIALES Y FINALES)

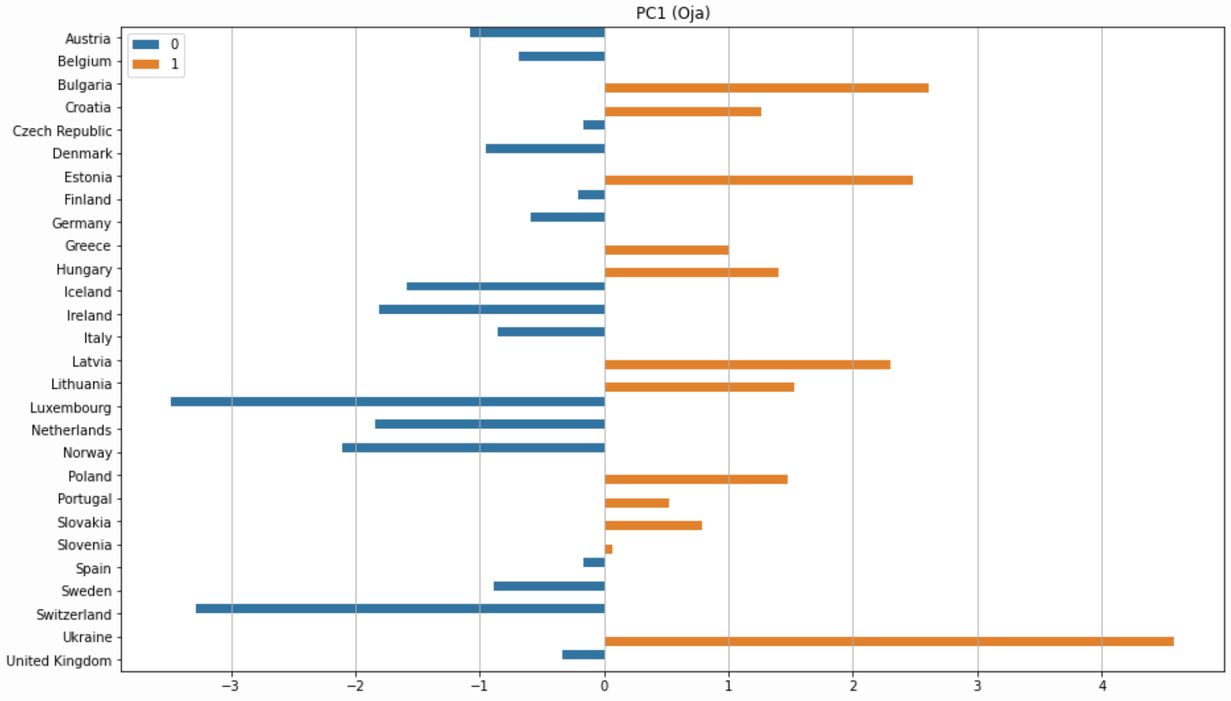
	Initial weights
0	0.542641
1	-0.958496
2	0.267296
3	0.497608
4	-0.002986
5	-0.550407
6	-0.603874

Pesos iniciales (calculados al azar)

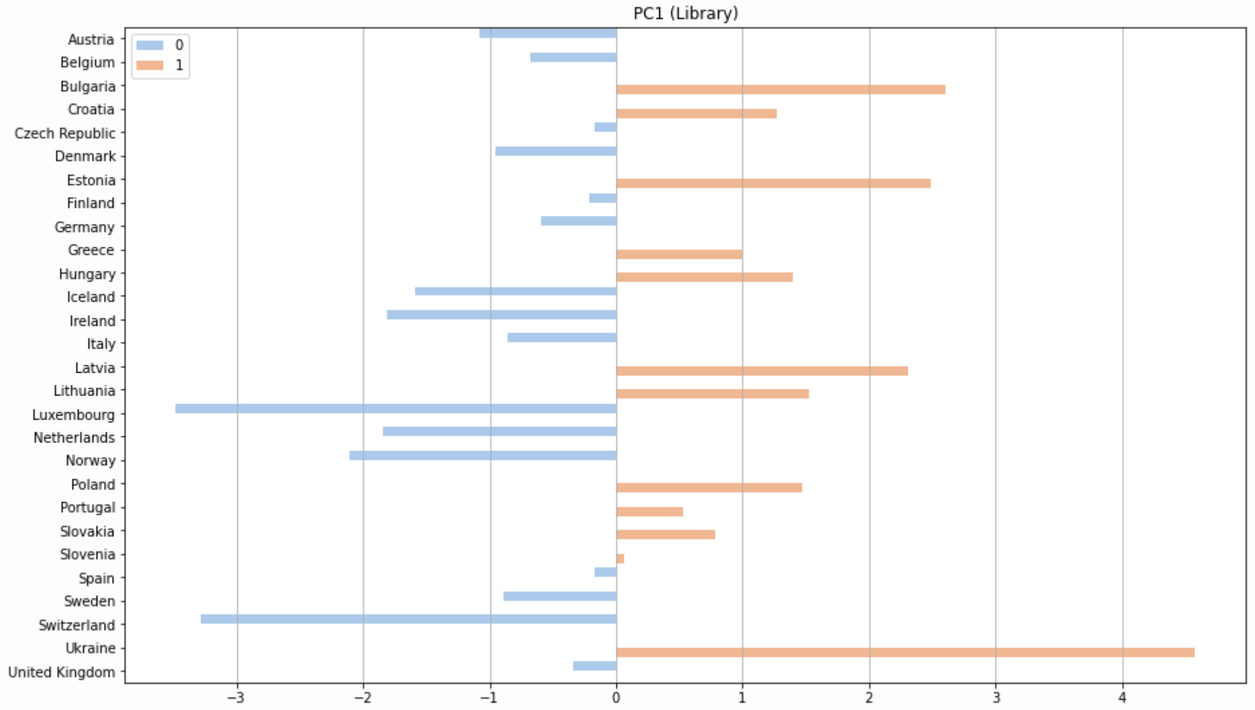
	Final weights (Oja)	PC1 eigenvector (Library)
0	0.125589	0.124874
1	-0.500443	-0.500506
2	0.407222	0.406518
3	-0.483021	-0.482873
4	0.187514	0.188112
5	-0.475552	-0.475704
6	0.271308	0.271656

Vector de pesos final (Oja) vs Autovector asociado al autovalor dominante (Libreria)

REGLA DE OJA : PC1 DE LOS PAISES

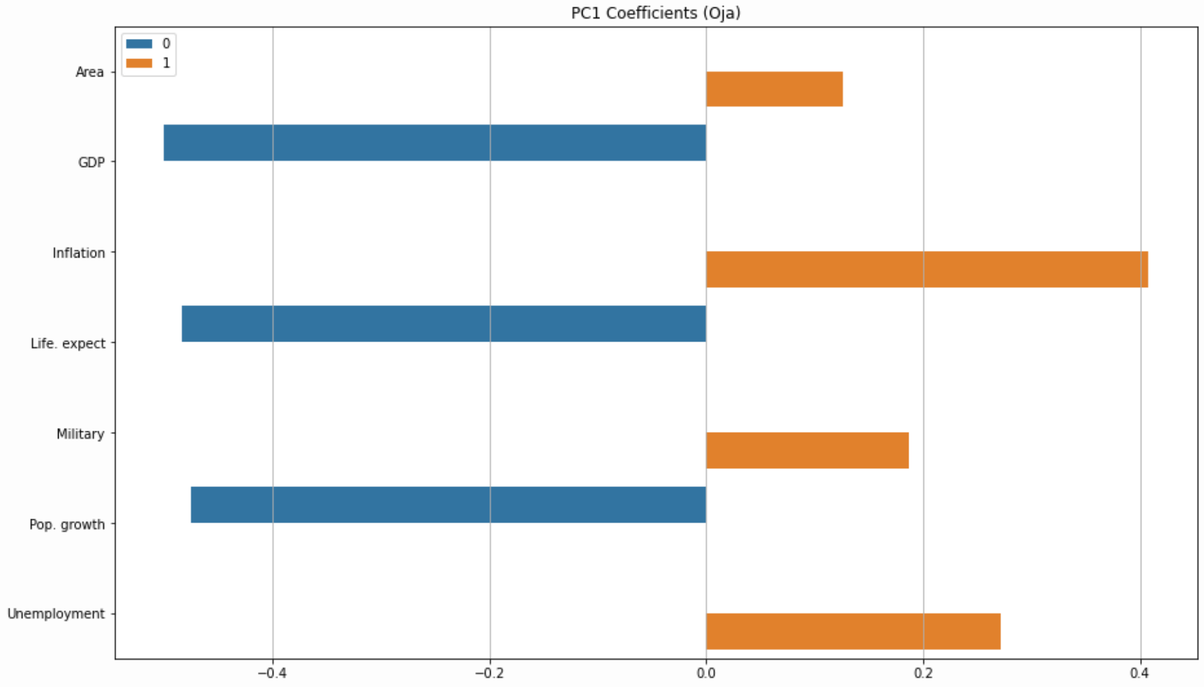


PC1 de los paises (Oja)

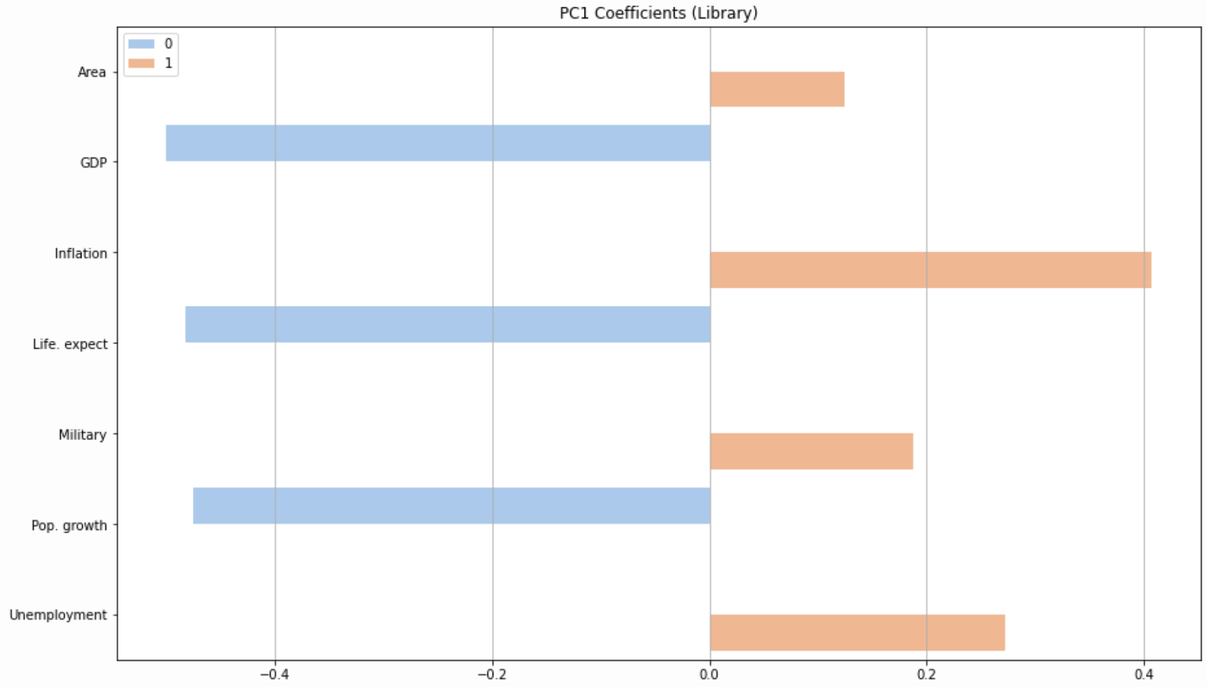


PC1 de los paises (Libreria)

REGLA DE OJA : COEFICIENTES DE LA PC1

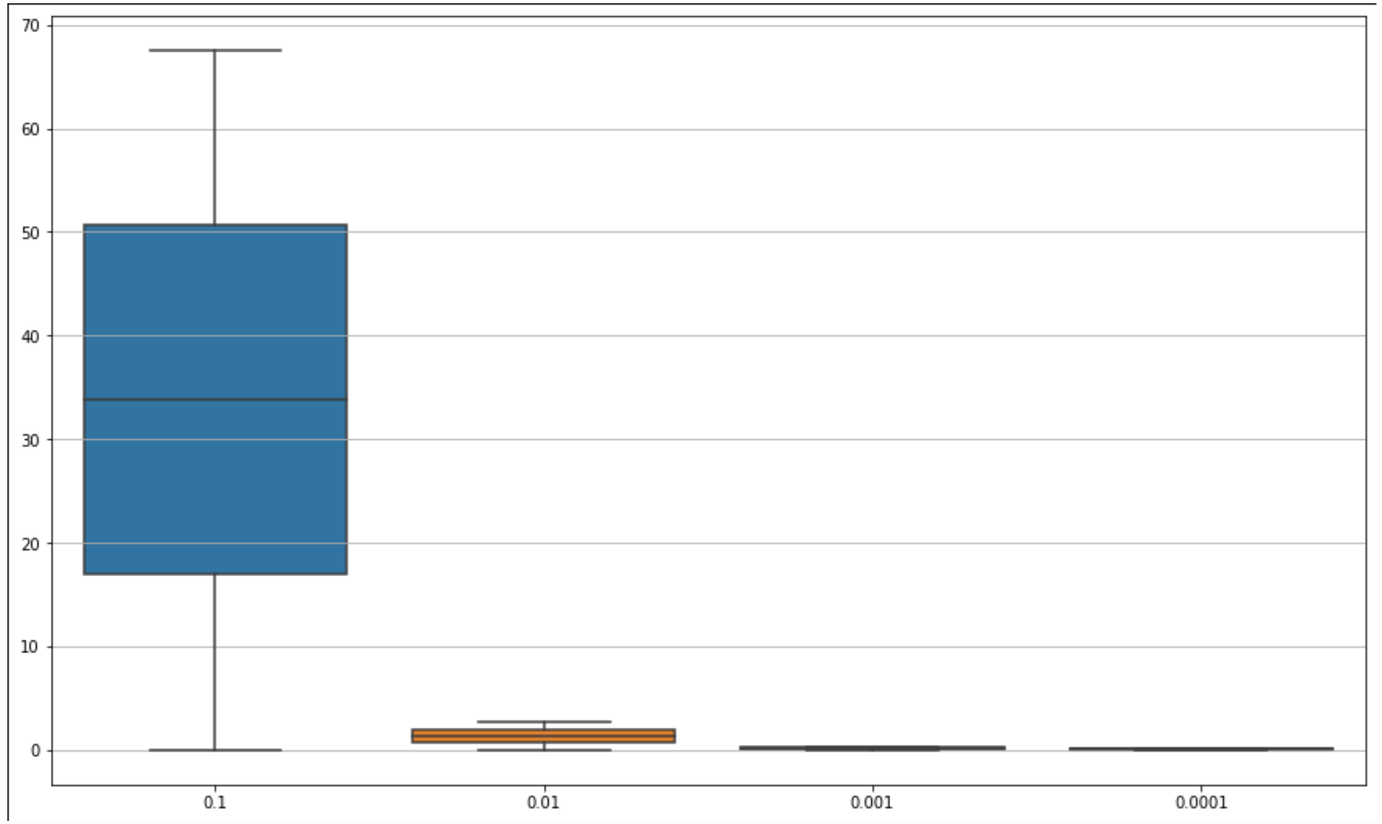


Coeficientes de PC1 (Oja)



Coeficientes de PC1 (Libreria)

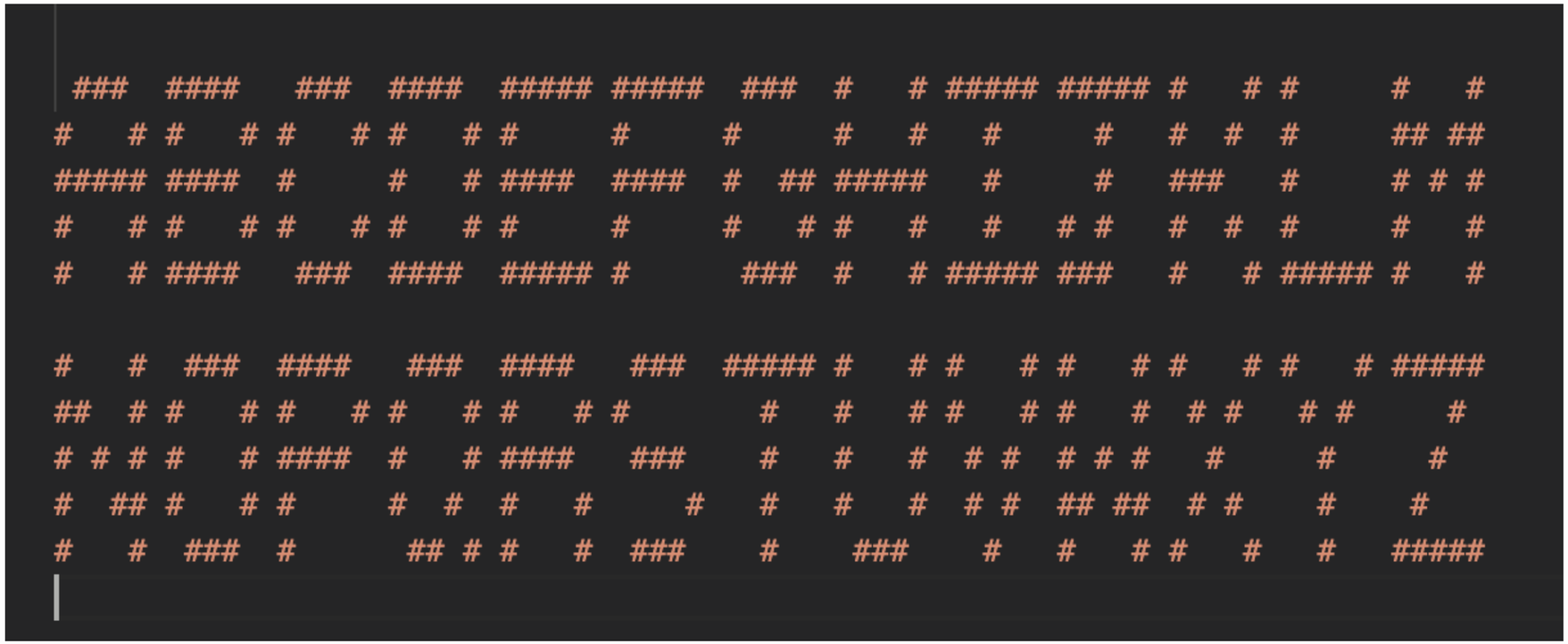
REGLA DE OJA : ERROR ABSOLUTO VS LEARNING RATE

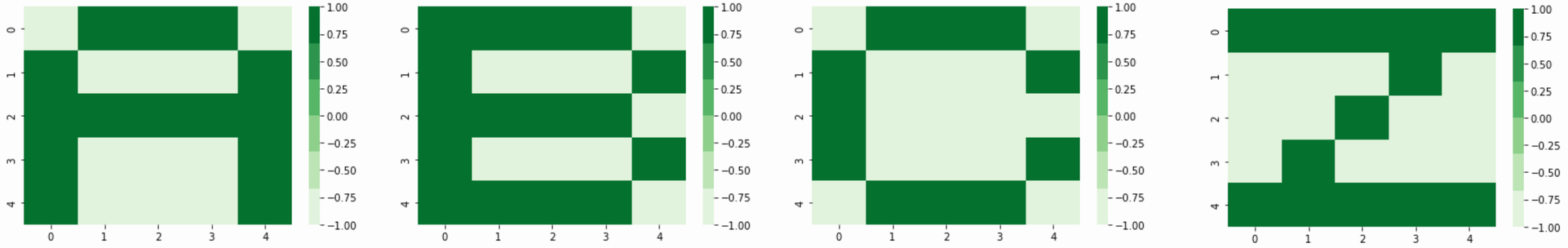


Error absoluto acumulado de la PC1 en funcion del learning rate

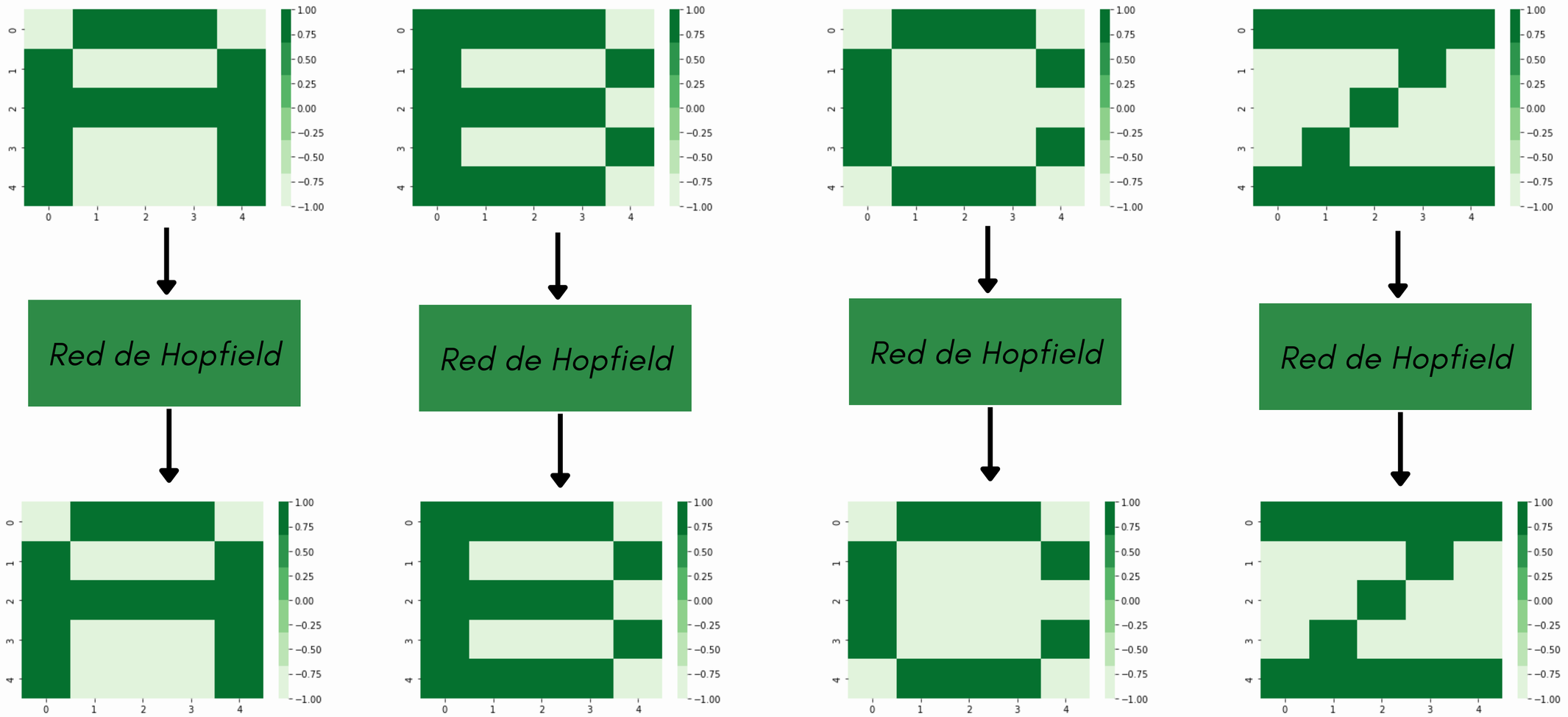
Redes de Hopfield

DATASET

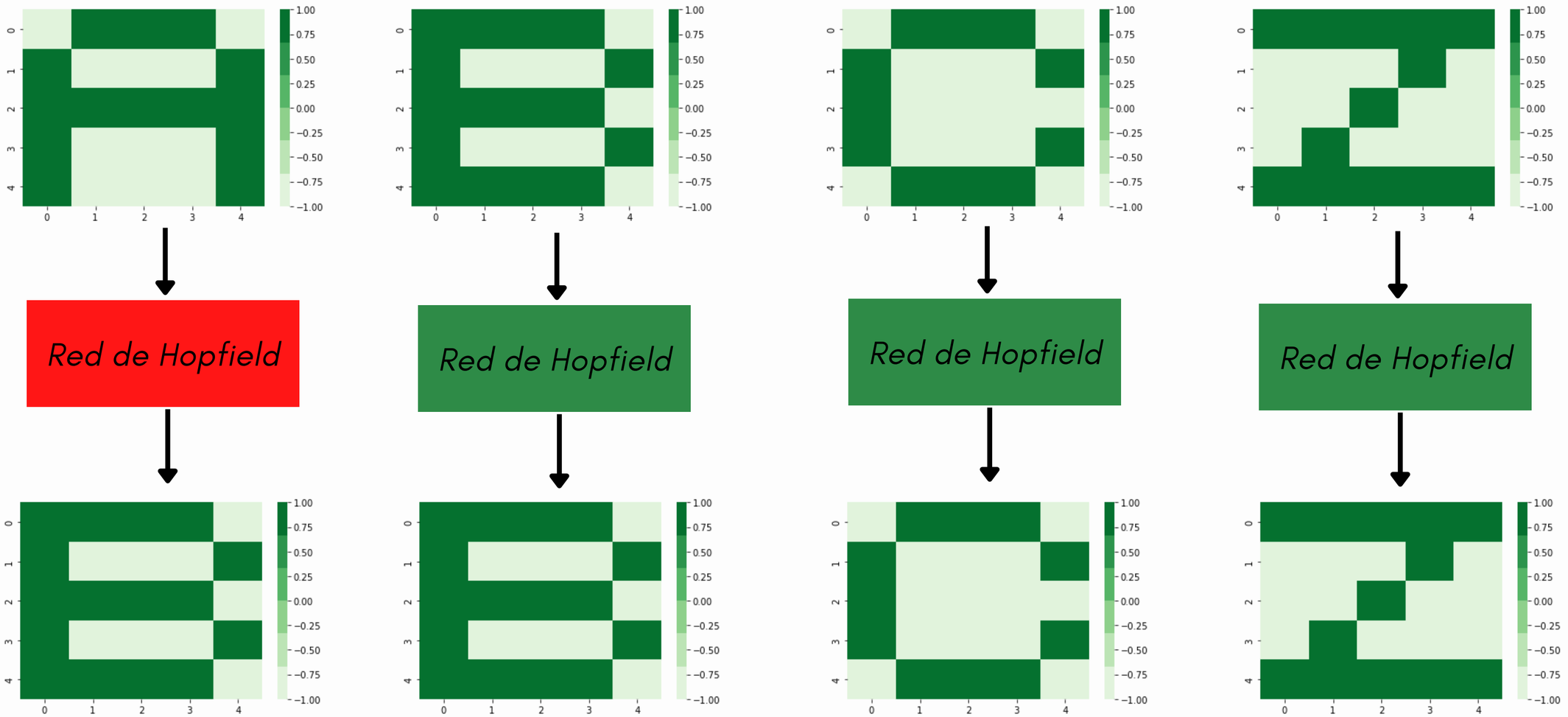




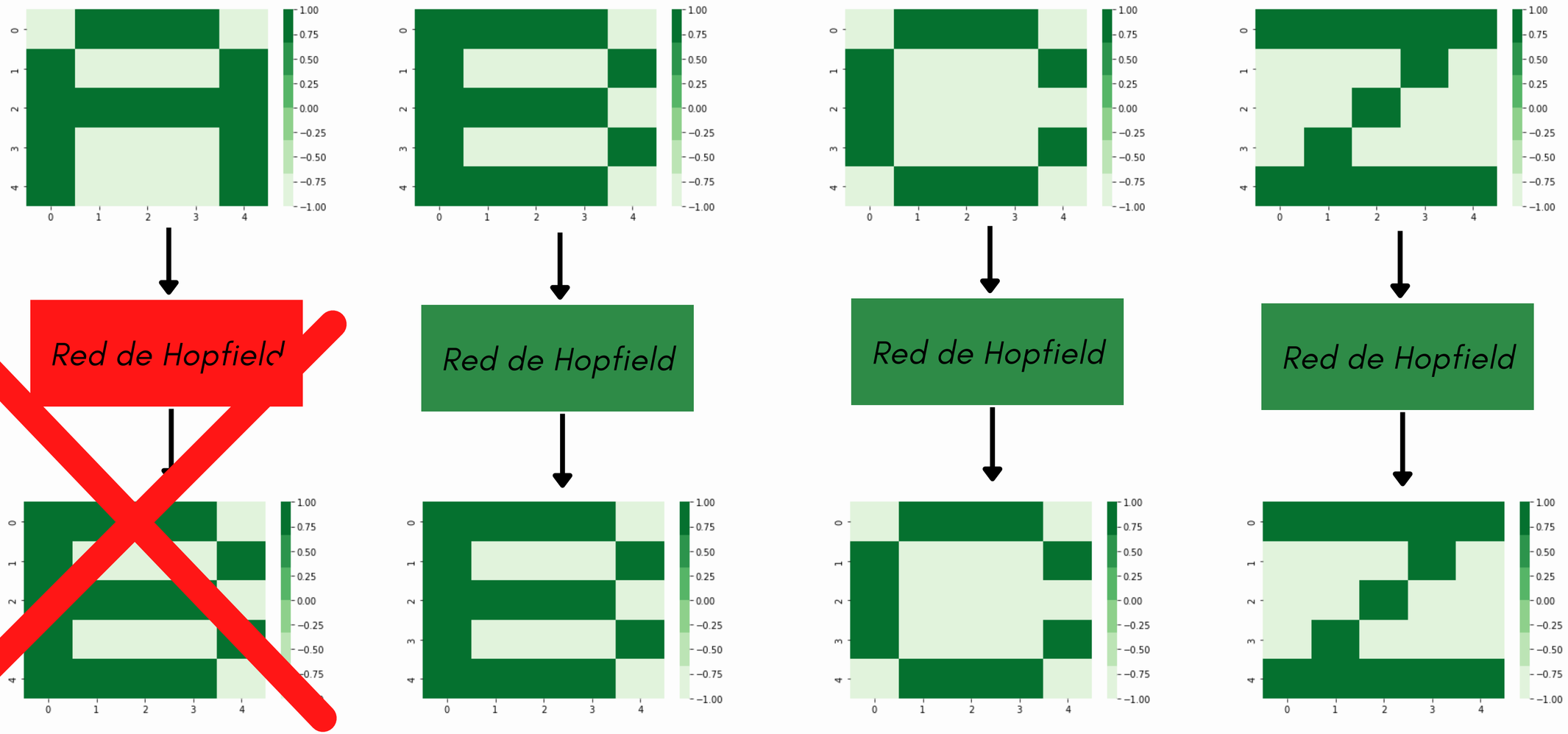
OBJETIVO


Red de Hopfield
Red de Hopfield
Red de Hopfield
Red de Hopfield

OBJETIVO

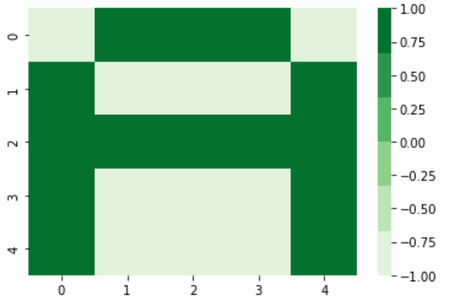

Red de Hopfield
Red de Hopfield
Red de Hopfield
Red de Hopfield

OBJETIVO

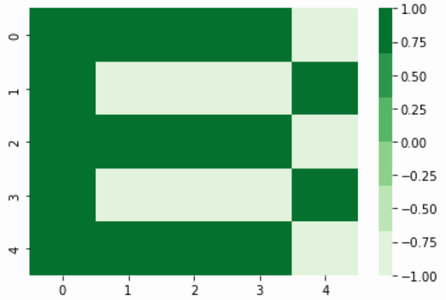

Red de Hopfield
Red de Hopfield
Red de Hopfield
Red de Hopfield

ORTOGONALIDAD

PRODUCTO INTERNO

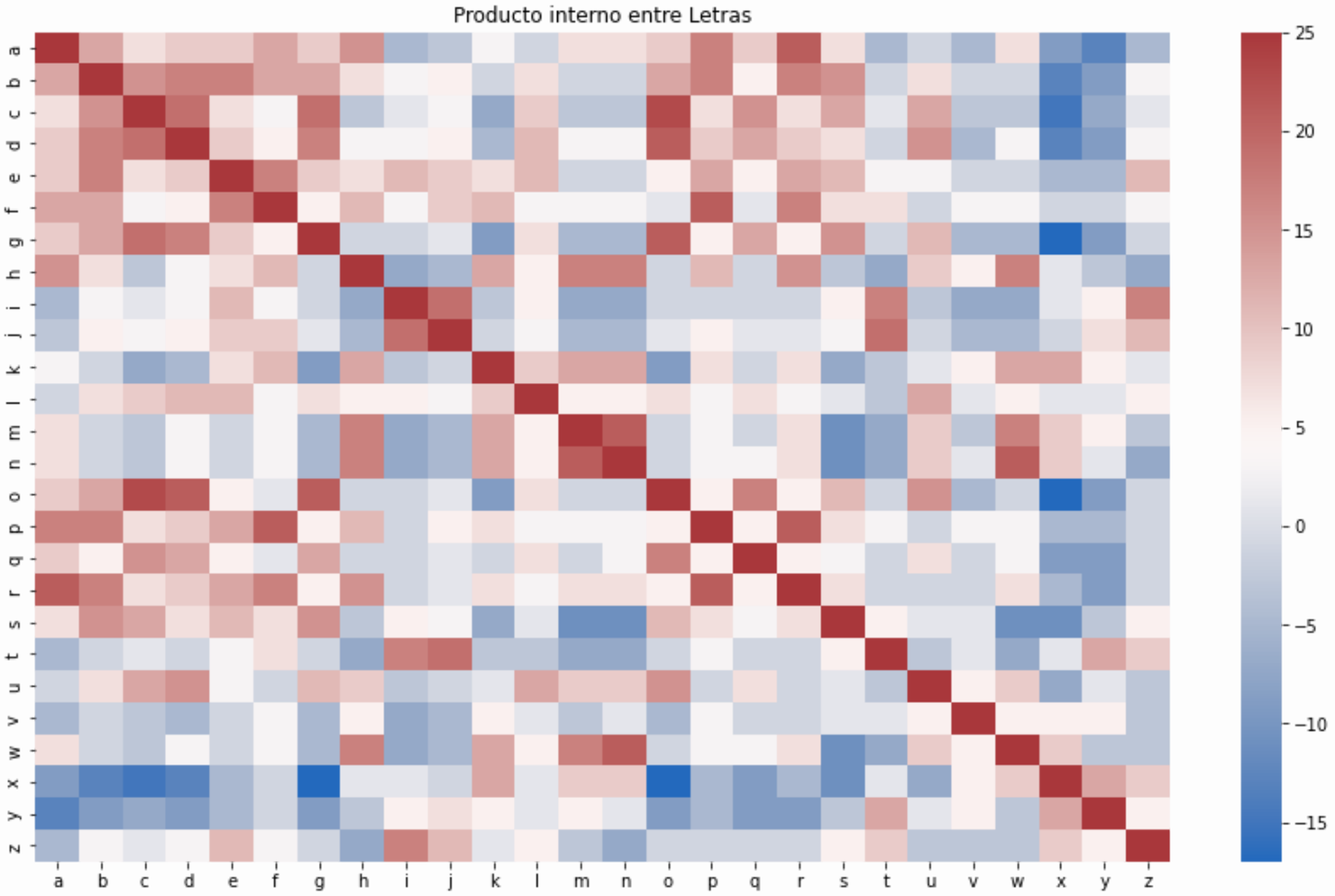


X

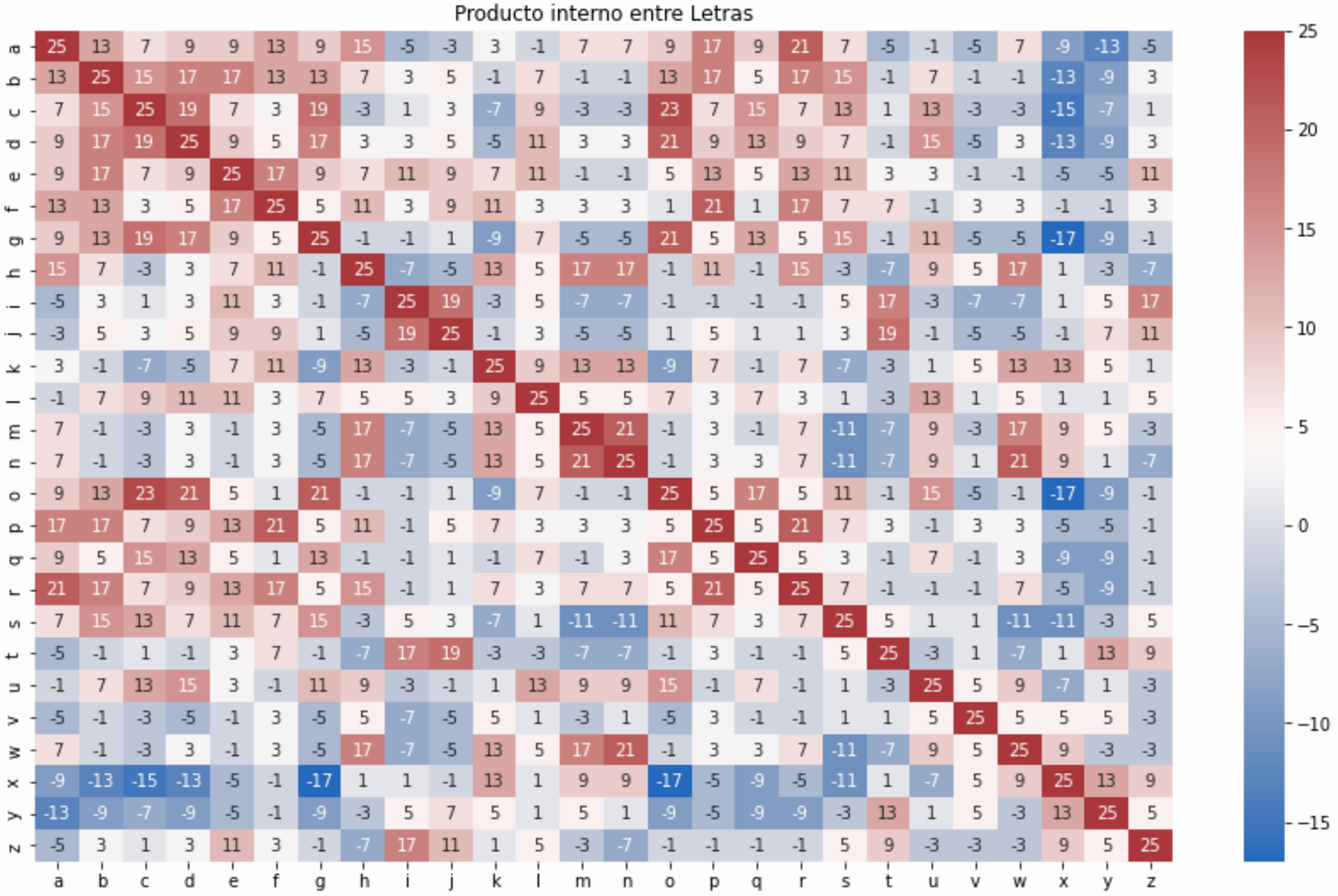


$$= \begin{bmatrix} -1 \\ 1 \\ 1 \\ \dots \\ -1 \\ 1 \end{bmatrix} X \begin{bmatrix} 1 \\ 1 \\ 1 \\ \dots \\ 1 \\ -1 \end{bmatrix} = 13$$

ORTOGONALIDAD



ORTOGONALIDAD



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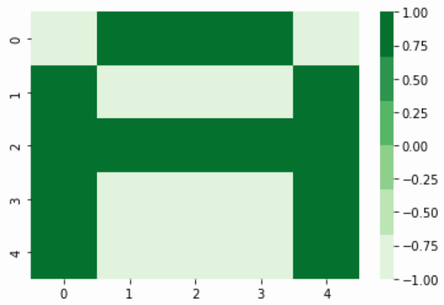

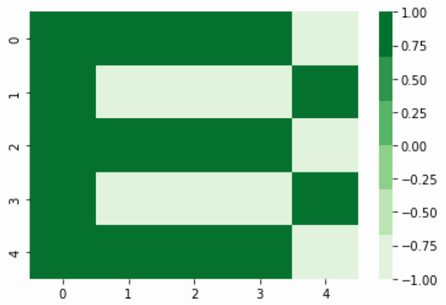

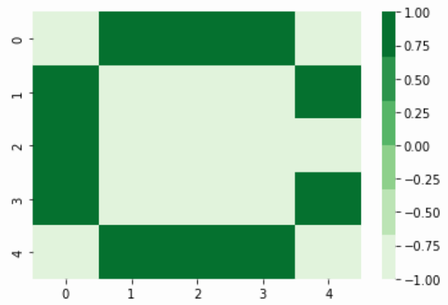

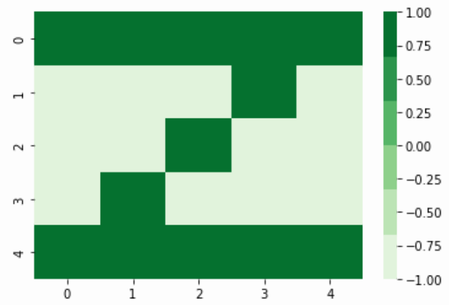

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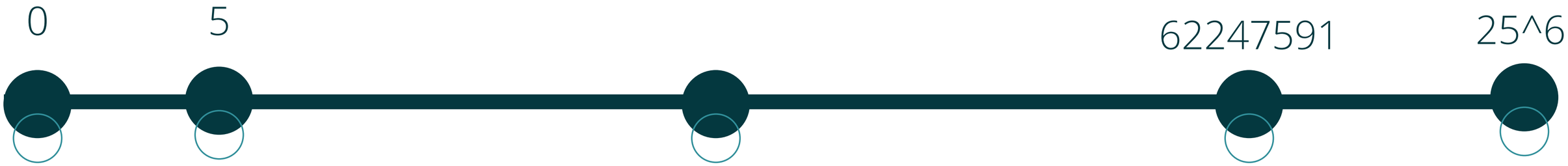
PI("A","C")* 7*
PI("A","Z")* =5* = 20475
PI("B","C")* 15*
PI("B","Z")* 3*
PI("C","Z") 1

ORTOGONALIDAD



[V, T, R, Q]
[B, N, V, T]

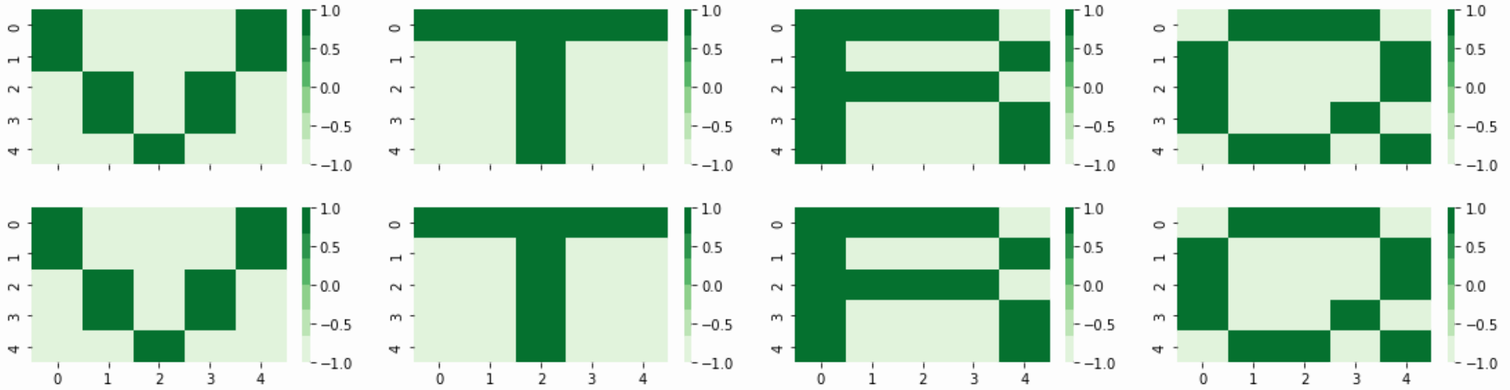
[A, B, C, D]
[K, N, S, V]

[O, G, C, D]
[B, N, V, T]

RUIDO 0 - VTRQ

PATRON ORIGINAL

ITERACION 1

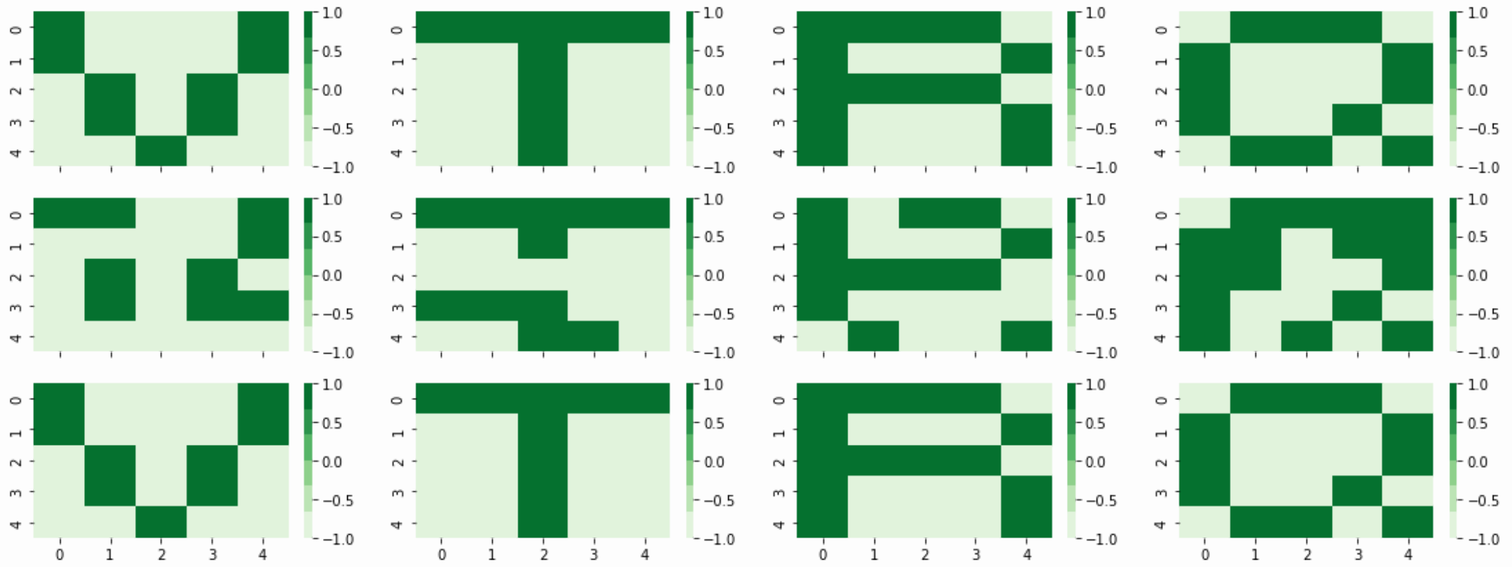


RUIDO 0.2 - VTRQ

PATRON ORIGINAL

PATRON C/ RUIDO

ITERACION 1



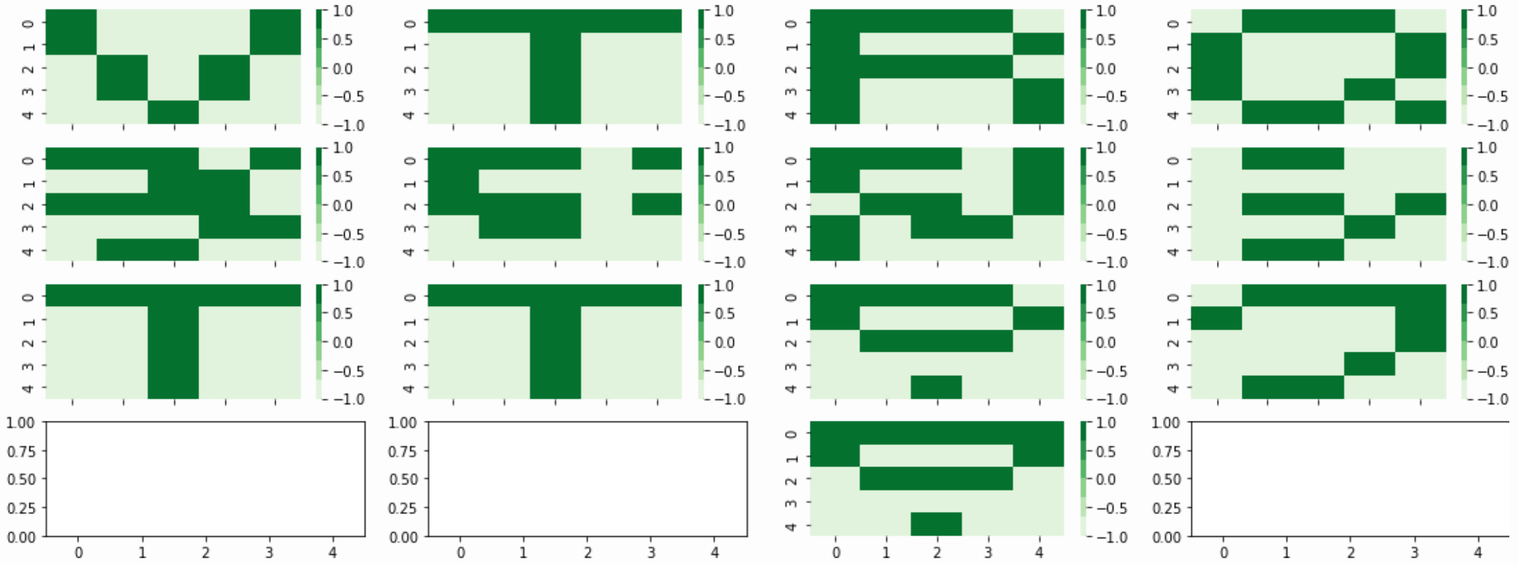
RUIDO 0.4 - VTRQ

PATRON ORIGINAL

PATRON C/ RUIDO

ITERACION 1

ITERACION 2

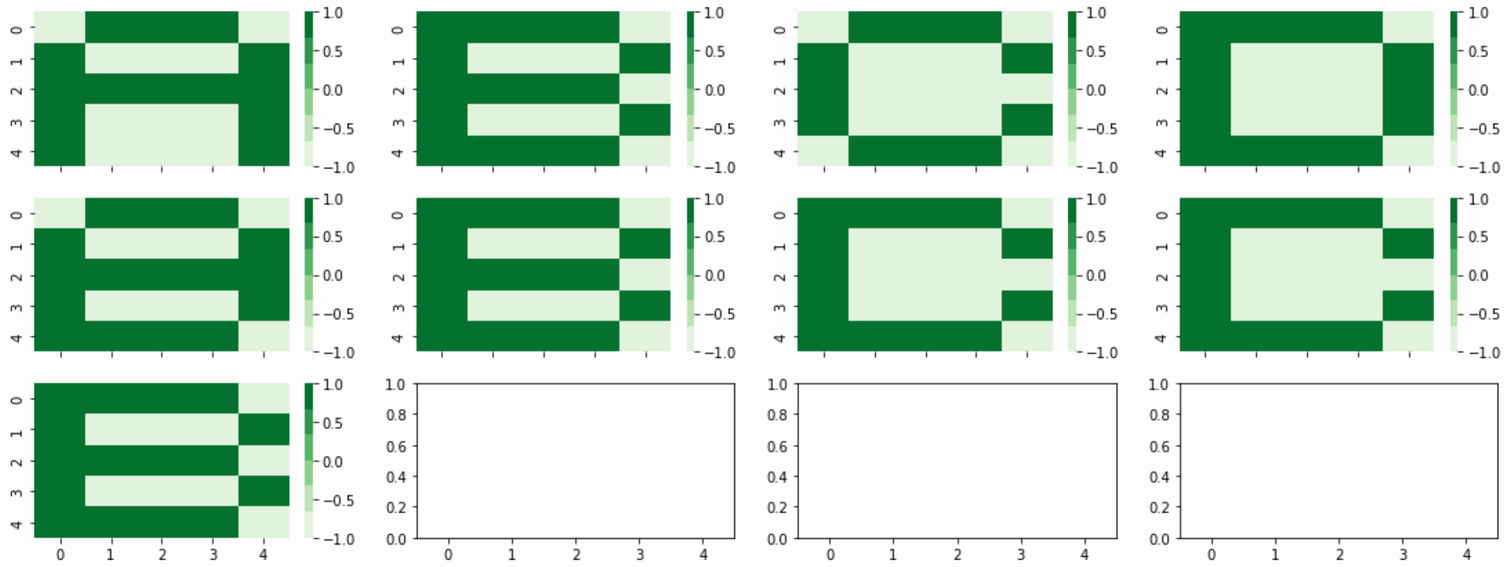


RUIDO 0 - ABCD

PATRON ORIGINAL

ITERACION 1

ITERACION 2



RUIDO 0.2 - ABCD

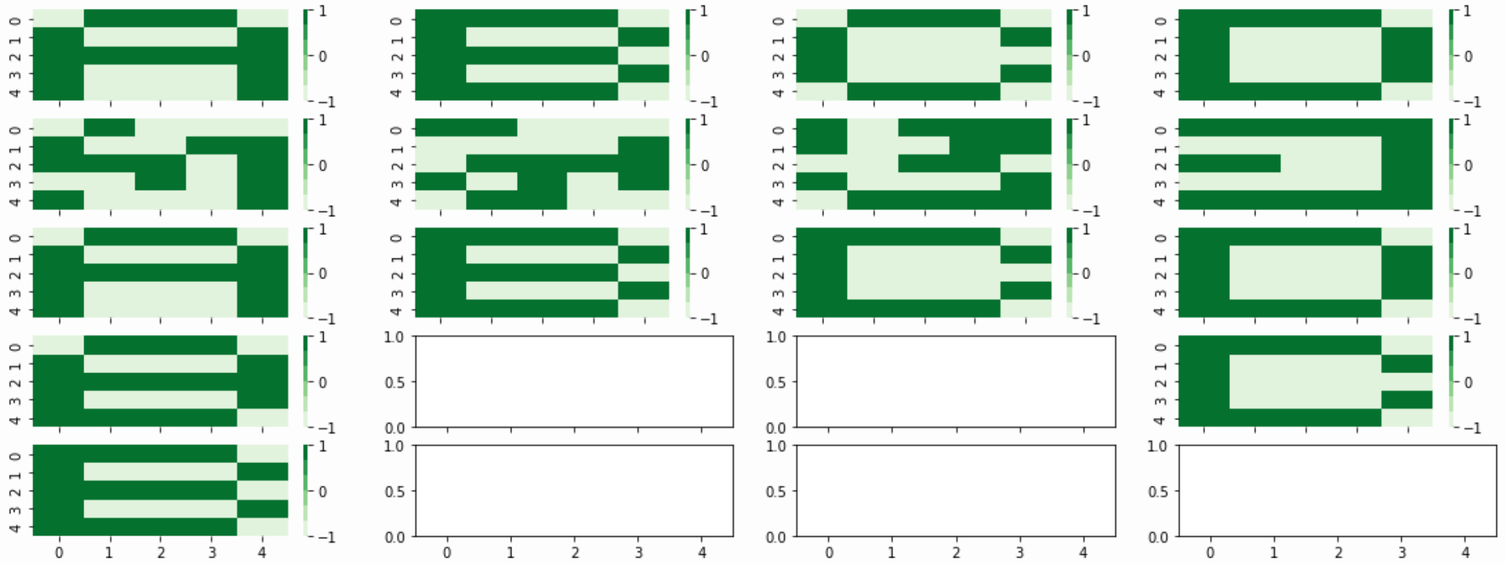
PATRON ORIGINAL

PATRON C/ RUIDO

ITERACION 1

ITERACION 2

ITERACION 3



RUIDO 0.4 - ABCD

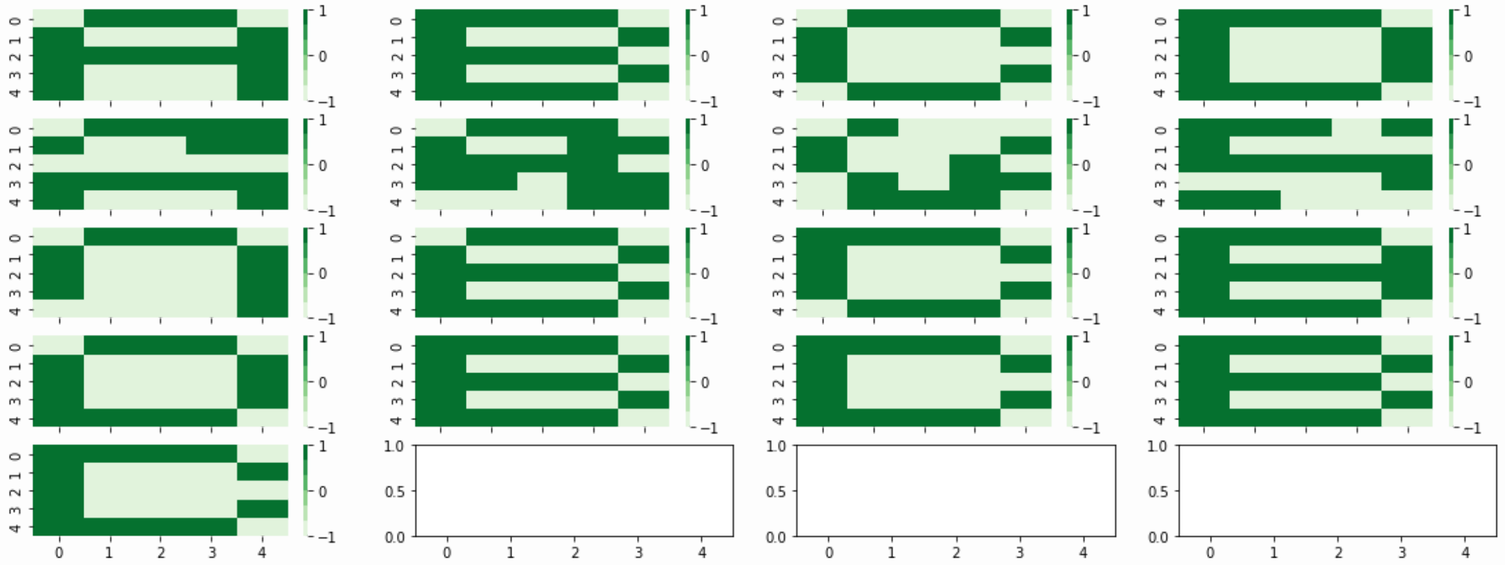
PATRON ORIGINAL

PATRON C/ RUIDO

ITERACION 1

ITERACION 2

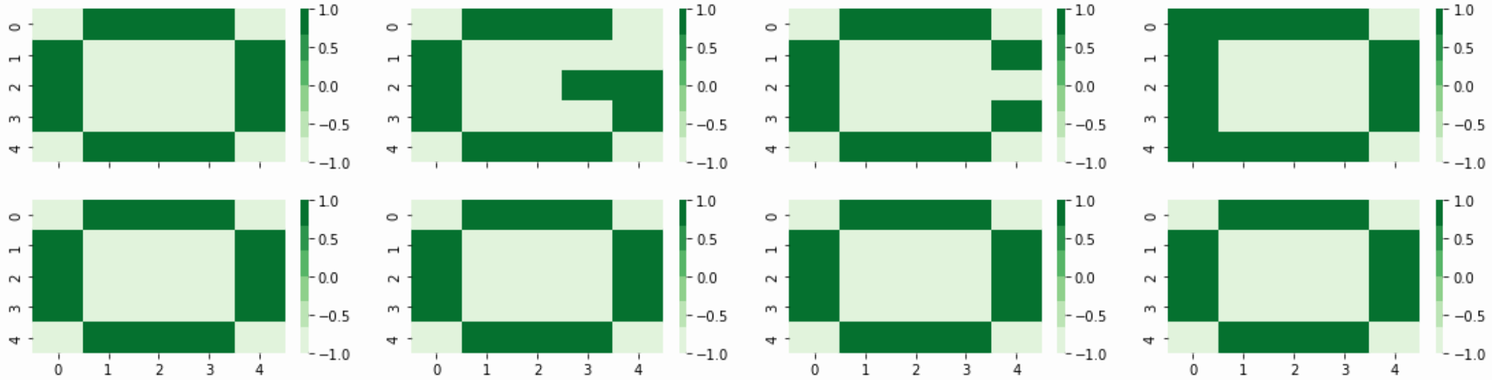
ITERACION 3



RUIDO 0 - OGCD

PATRON ORIGINAL

ITERACION 1

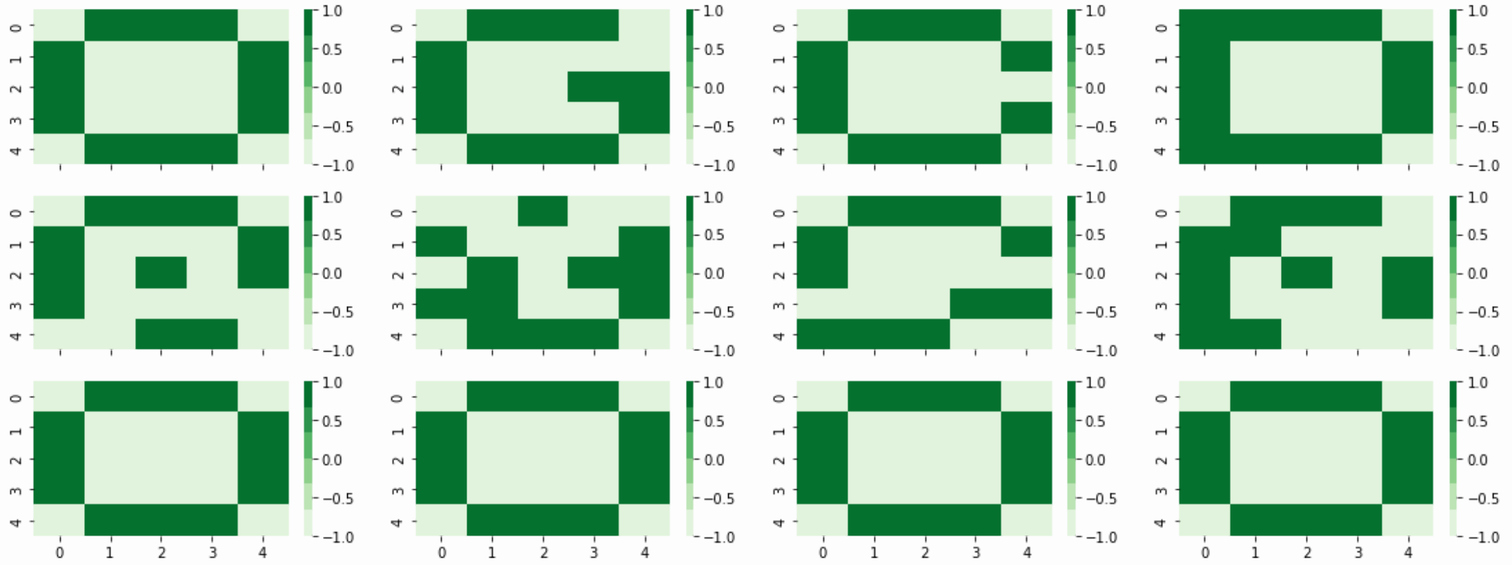


RUIDO 0.2 - OGCD

PATRON ORIGINAL

PATRON C/ RUIDO

ITERACION 1



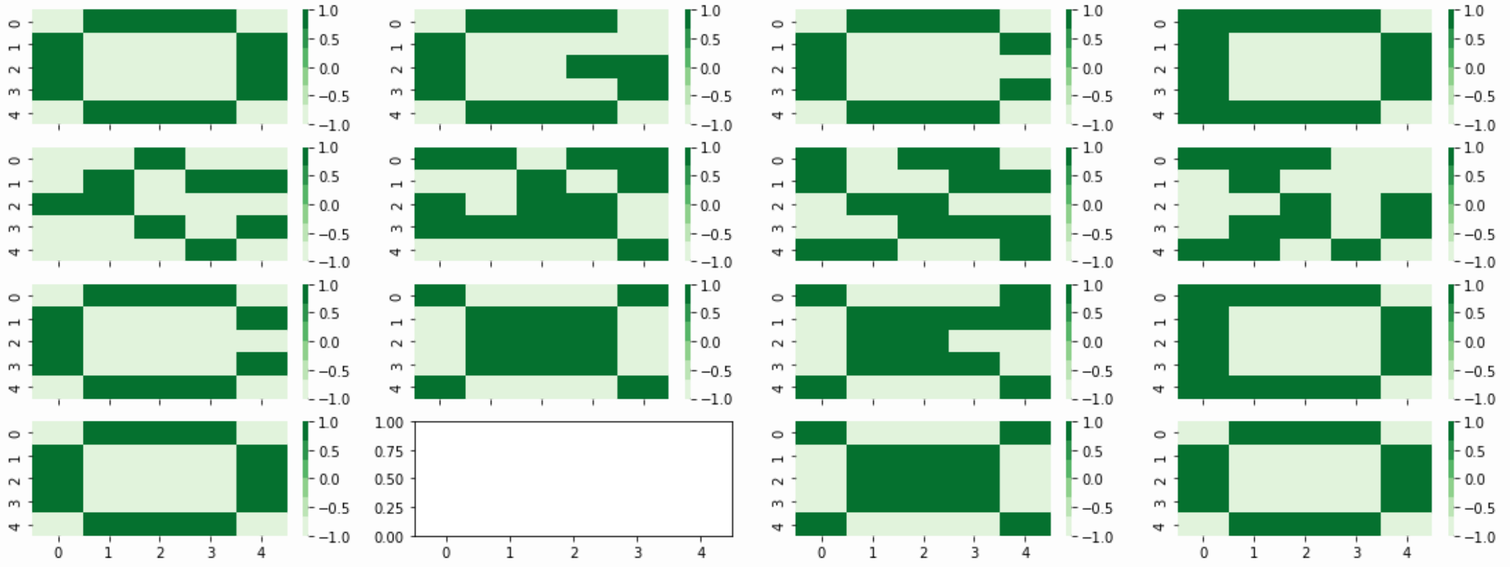
RUIDO 0.4 - OGCD

PATRON ORIGINAL

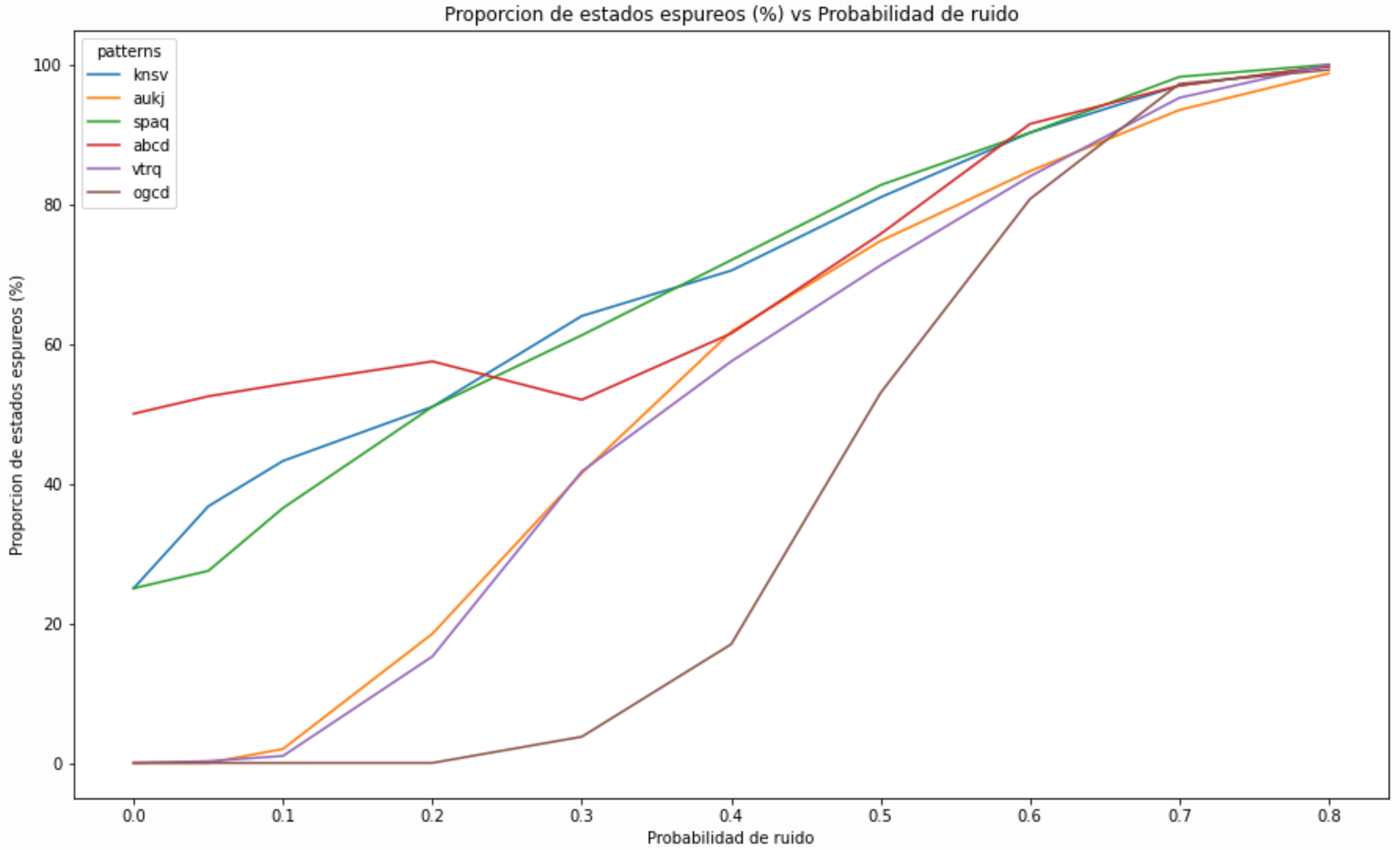
PATRON C/ RUIDO

ITERACION 1

ITERACION 2

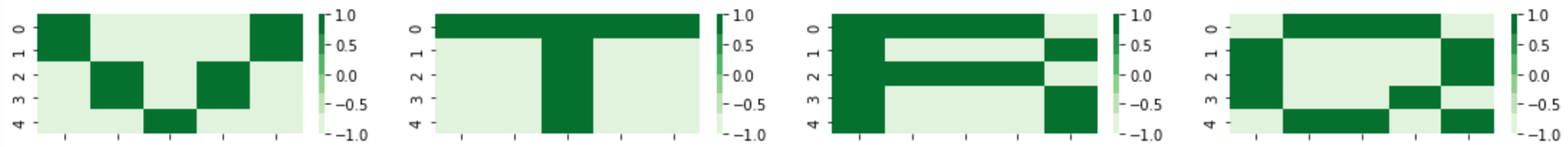


ANALISIS RUIDO

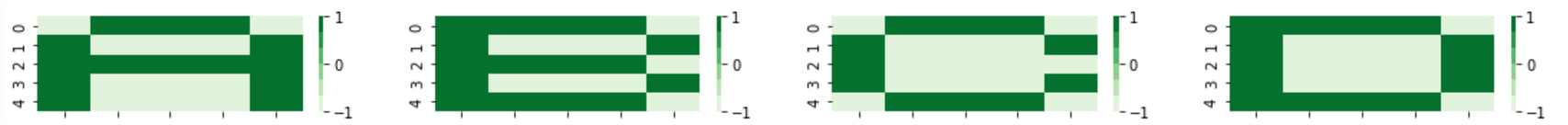


CALCULO DE ENERGIA

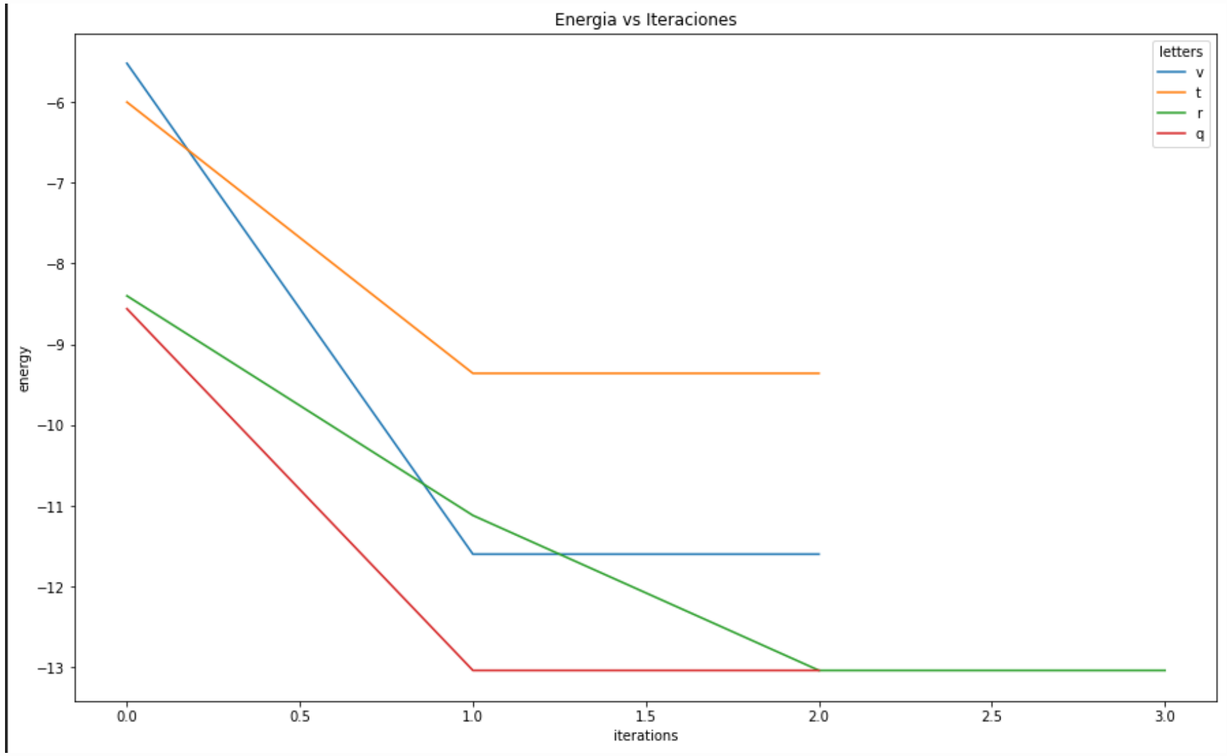
CONJUNTO ORTOGONAL



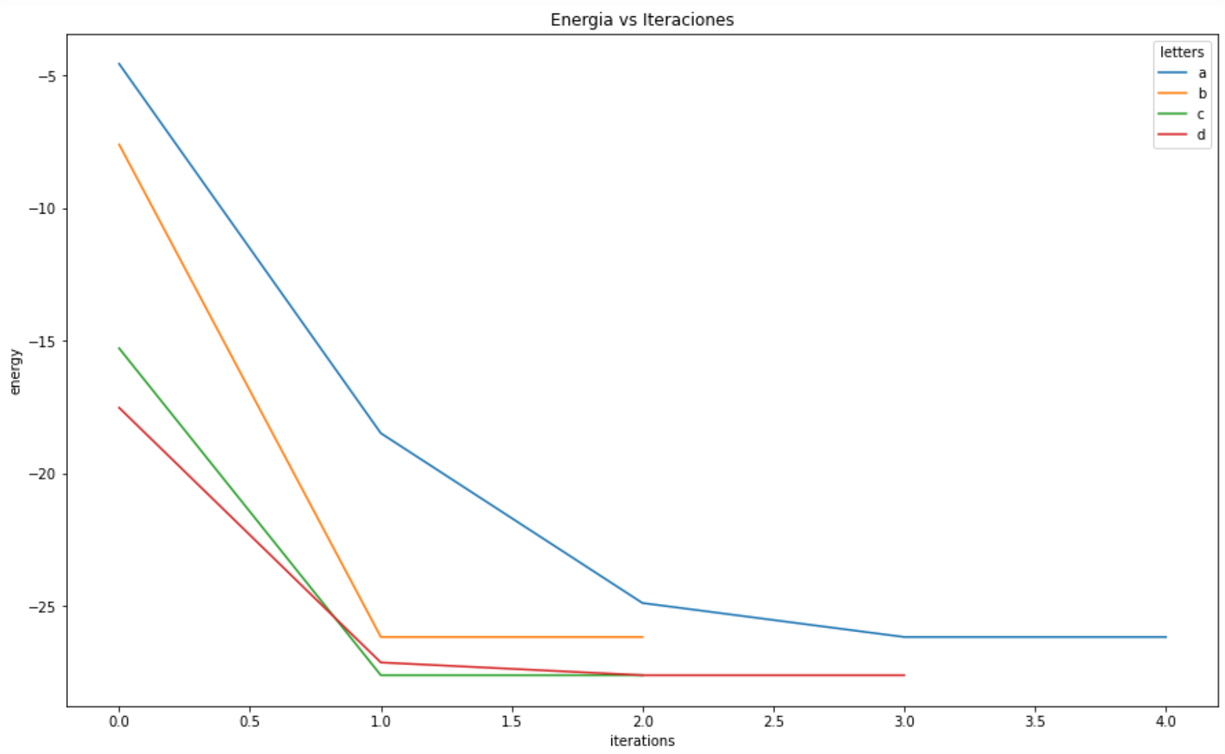
CONJUNTO NO ORTOGONAL



HOPFIELD: ENERGIA VS ITERACIONES



Conjunto ortogonal (v,t,r,q)



Conjunto no ortogonal (a,b,c,d)

Probabilidad de ruido : 0.2

Conclusiones

CONCLUSIONES

KOHONEN

- No se justifica utilizar valores de k muy altos ya que superan la cantidad de paises, dando asi neuronas muertas
- Kohonen agrupa los paises segun cercania siendo el factor mas influyente la PC1

REGLA DE OJA

- A menor learning rate, el calculo de la PC1 se asemeja mas al de la libreria (en modulo)
- Interpretacion de la primera componente : ***"Prosperidad"***

HOPFIELD

- Los combos de letras mas ortogonales disminuyen mas rapido su energia
- La ortogonalidad de los patrones no esta directamente relacionado con la cant de estados espureos que produce
- La ortogonalidad influye fuertemente en la capacidad de devolver el patron que corresponde

Muchas gracias !!!