

**TP4**

# Aprendizaje No Supervisado

Grupo 2



# Tabla de contenidos

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- 2 → Europa: Distancia promedio
- 3 → PCA: Librería
- 4 → PCA: Oja
- 5 → Patrones: Sin ruido
- 6 → Patrones: Con ruido
- 7 → Extras

# Ejercicio Europa

# **Red de Kohonen**

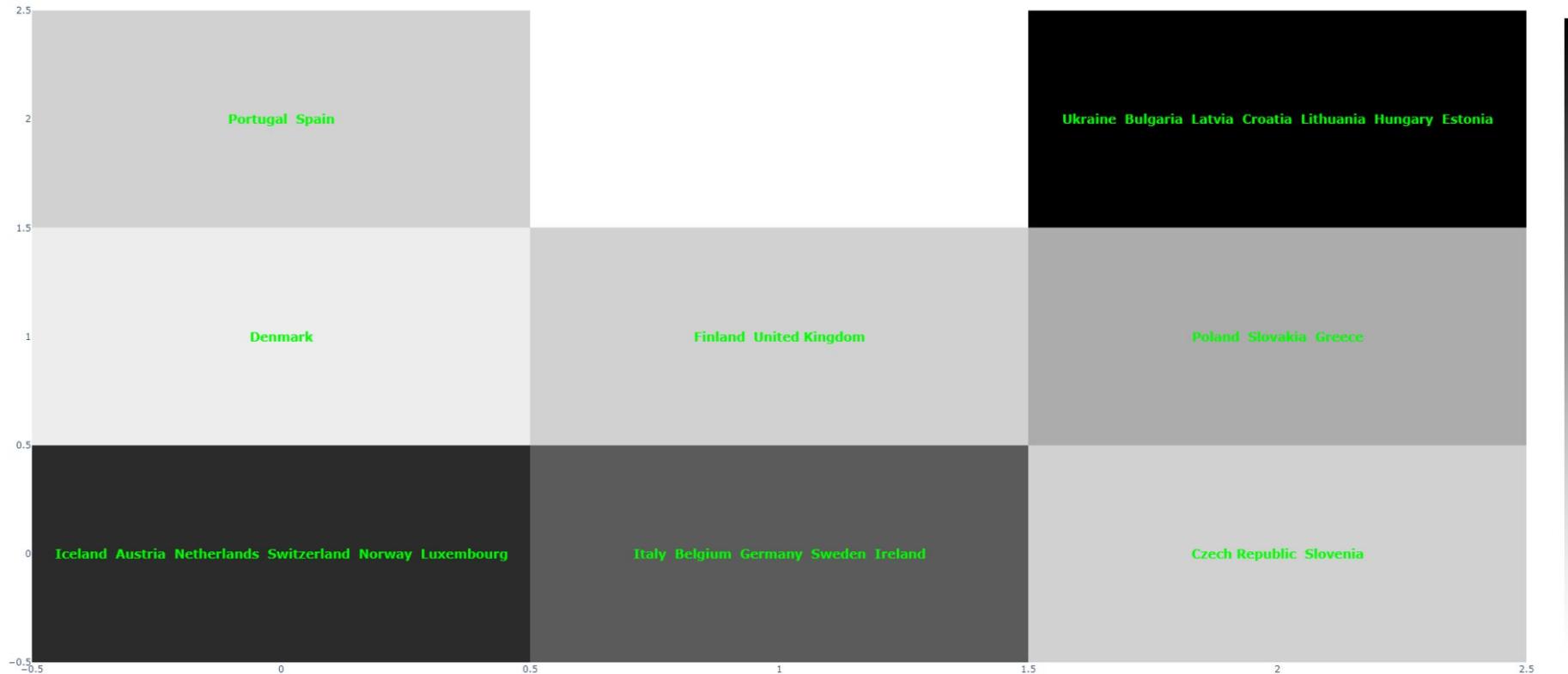
# Asociación de países

*Asociar los países que posean las mismas características geopolíticas, económicas y sociales.*

Cantidad de neuronas: 3  
Similaridad: Euclidiana  
Inicialización de pesos: Random  
Radio: 3  
Learning Rate: 0.1

# Asociación de países

Complete Heatmap



# Distancia promedio entre neuronas

*Analizar la cantidad de elementos que fueron asociados a cada neurona.*

❓ Preguntas:

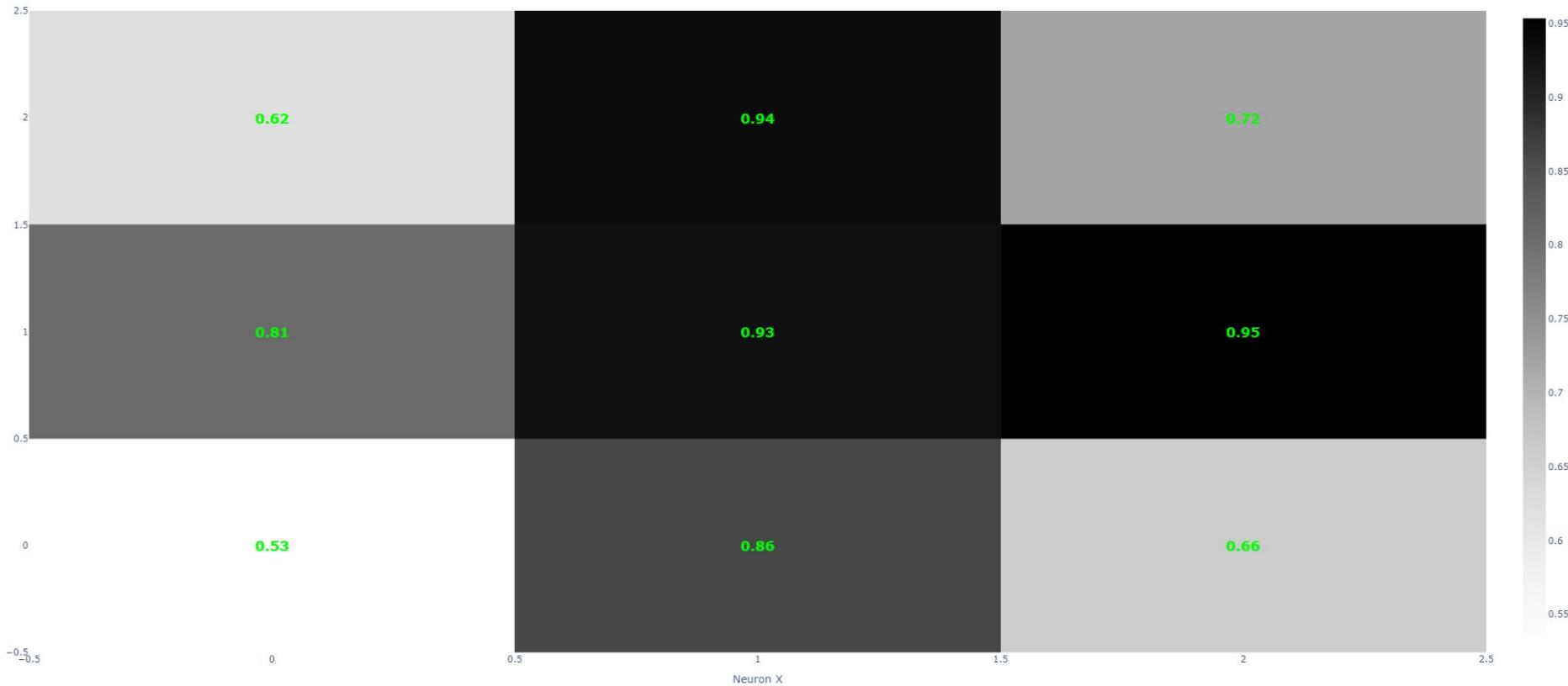
- ¿Qué significa que el valor sea alto o bajo?
- ¿Qué tanto contribuyen las variables a la organización del mapa final?

Cantidad de neuronas: 3  
Similaridad: Euclidiana  
Inicialización de pesos: Random  
Radio: 3  
Learning Rate: 0.1

# Distancia promedio entre neuronas

Todas las variables

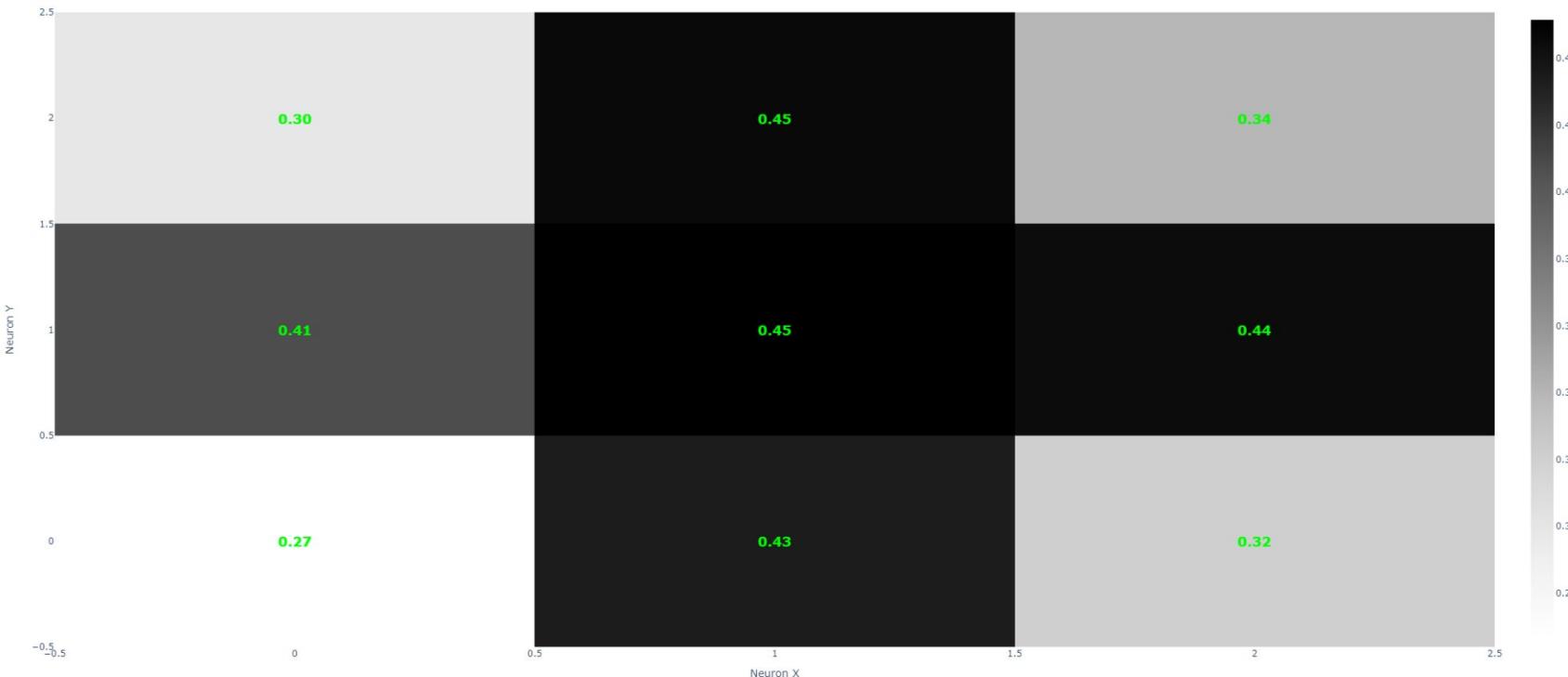
Unified Distance Matrix (U-Matrix)



# Distancia promedio entre neuronas

Por variable

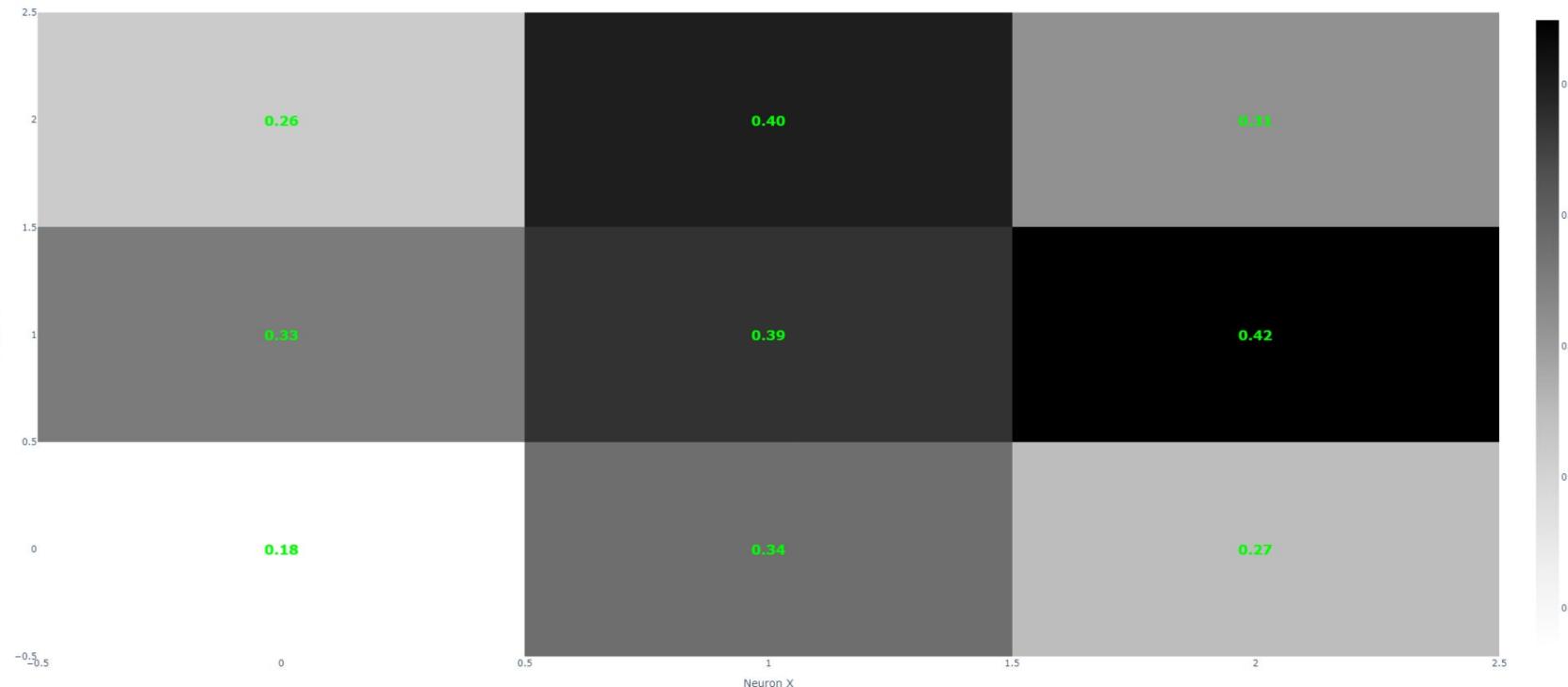
Unified Distance Matrix (U-Matrix) for GDP



# Distancia promedio entre neuronas

Por variable

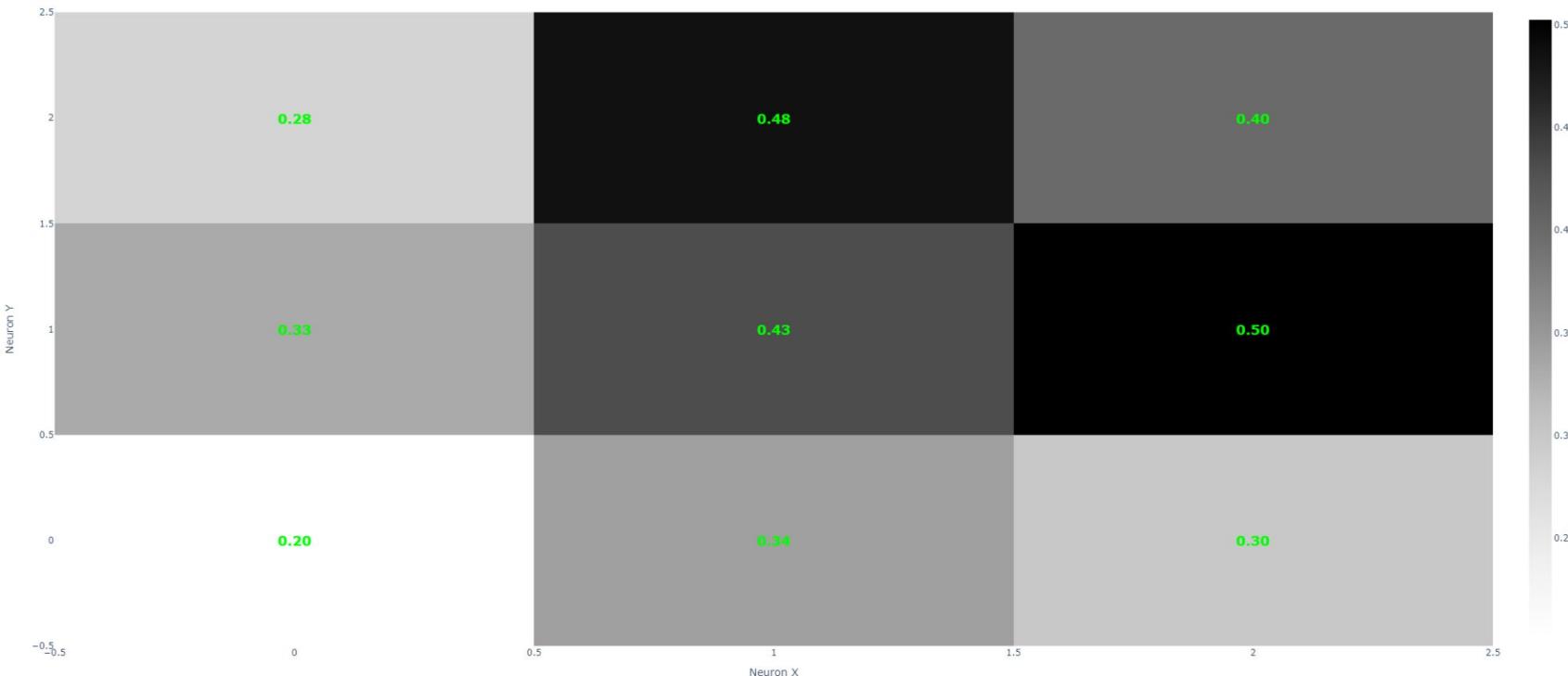
Unified Distance Matrix (U-Matrix) for Pop.growth



# Distancia promedio entre neuronas

Por variable

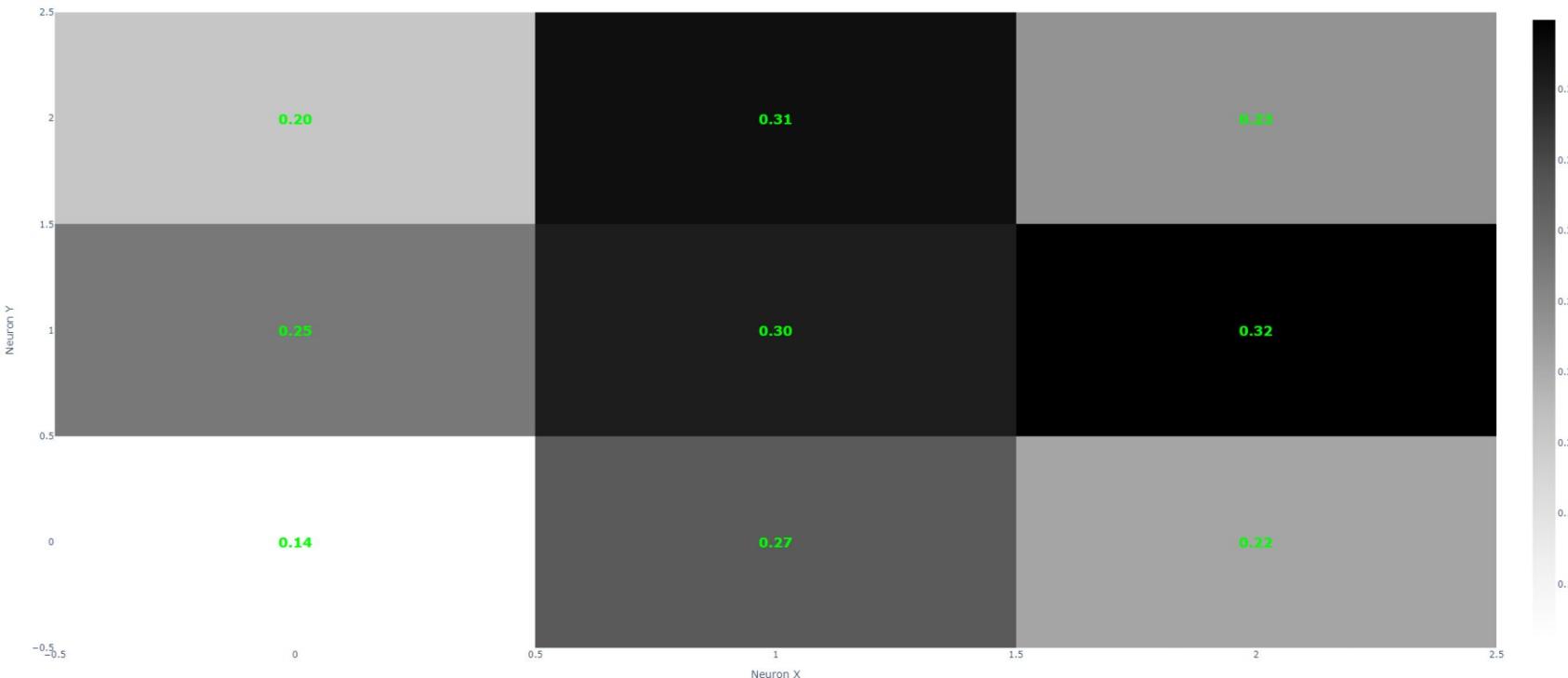
Unified Distance Matrix (U-Matrix) for Life.expect



# Distancia promedio entre neuronas

Por variable

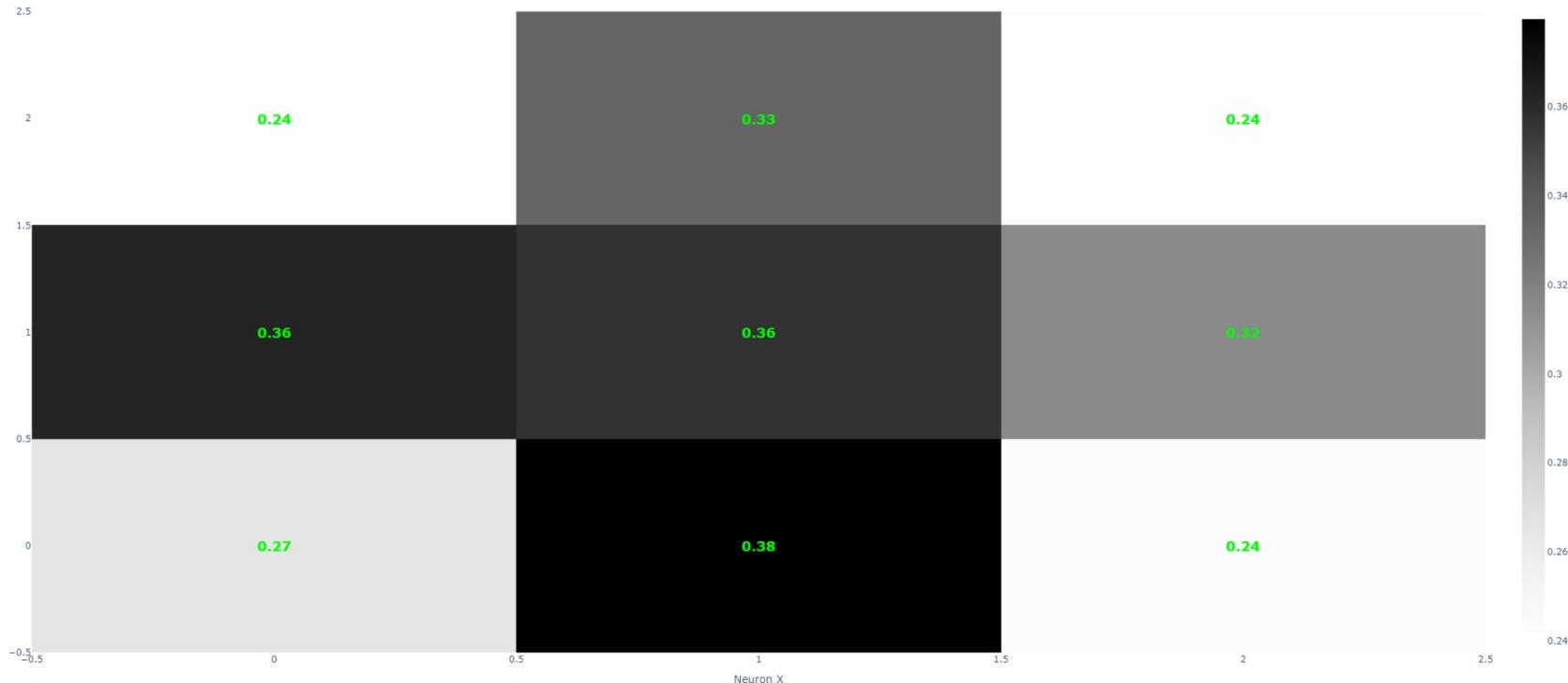
Unified Distance Matrix (U-Matrix) for Inflation



# Distancia promedio entre neuronas

Por variable

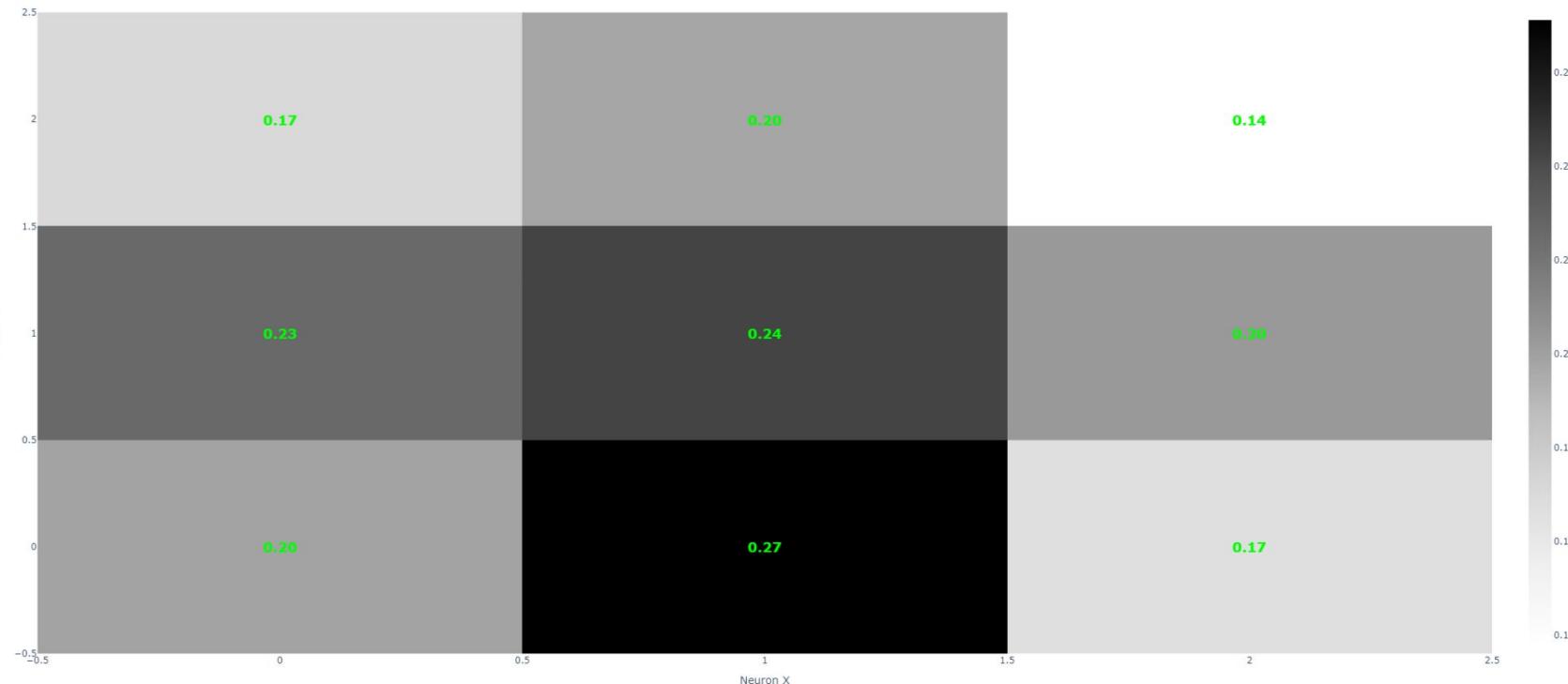
Unified Distance Matrix (U-Matrix) for Unemployment



# Distancia promedio entre neuronas

Por variable

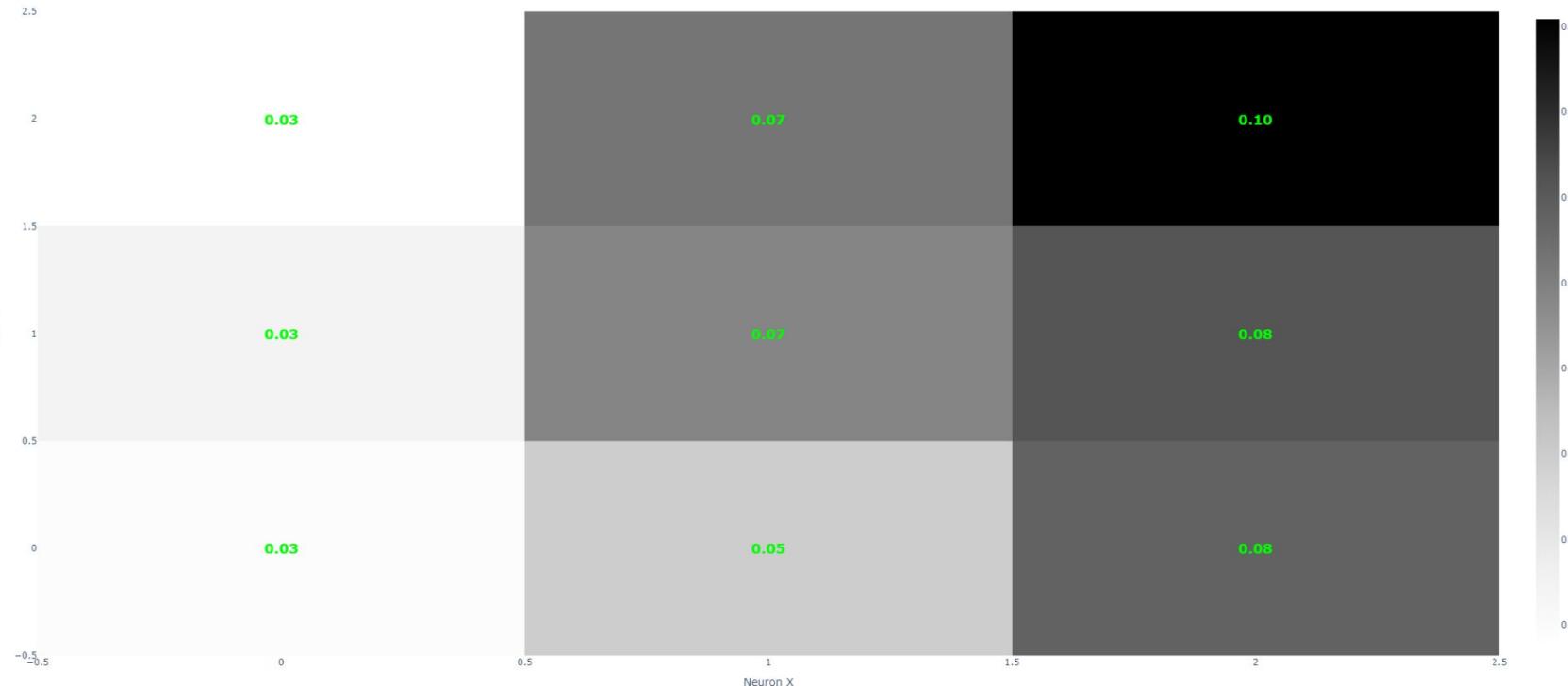
Unified Distance Matrix (U-Matrix) for Military



# Distancia promedio entre neuronas

Por variable

Unified Distance Matrix (U-Matrix) for Area



# Valor promedio por variable

*Qué pasa si no frenamos en la asociación? Podemos extraer más datos del mapa?*

*Los siguientes gráficos muestran el valor promedio en cada neurona de cada variable (Area, GDP, etc.).*

*Voy a mostrar una tendencia en el mapa de calor y las variables individuales.*

Cantidad de neuronas: 4  
Similaridad: Euclíadiana  
Inicialización de pesos: Random  
Radio: 4  
Learning Rate: 0.1

# Clusterización de los países (4x4)



# Valor promedio por neurona

Por variable: Area

Variable: 0



# Valor promedio por neurona

Por variable: GDP

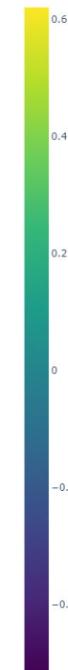
Variable: 1



# Valor promedio por neurona

Por variable: Inflation

Variable: 2



# Valor promedio por neurona

Por variable: Life.expect

Variable: 3



# Valor promedio por neurona

Por variable: Military

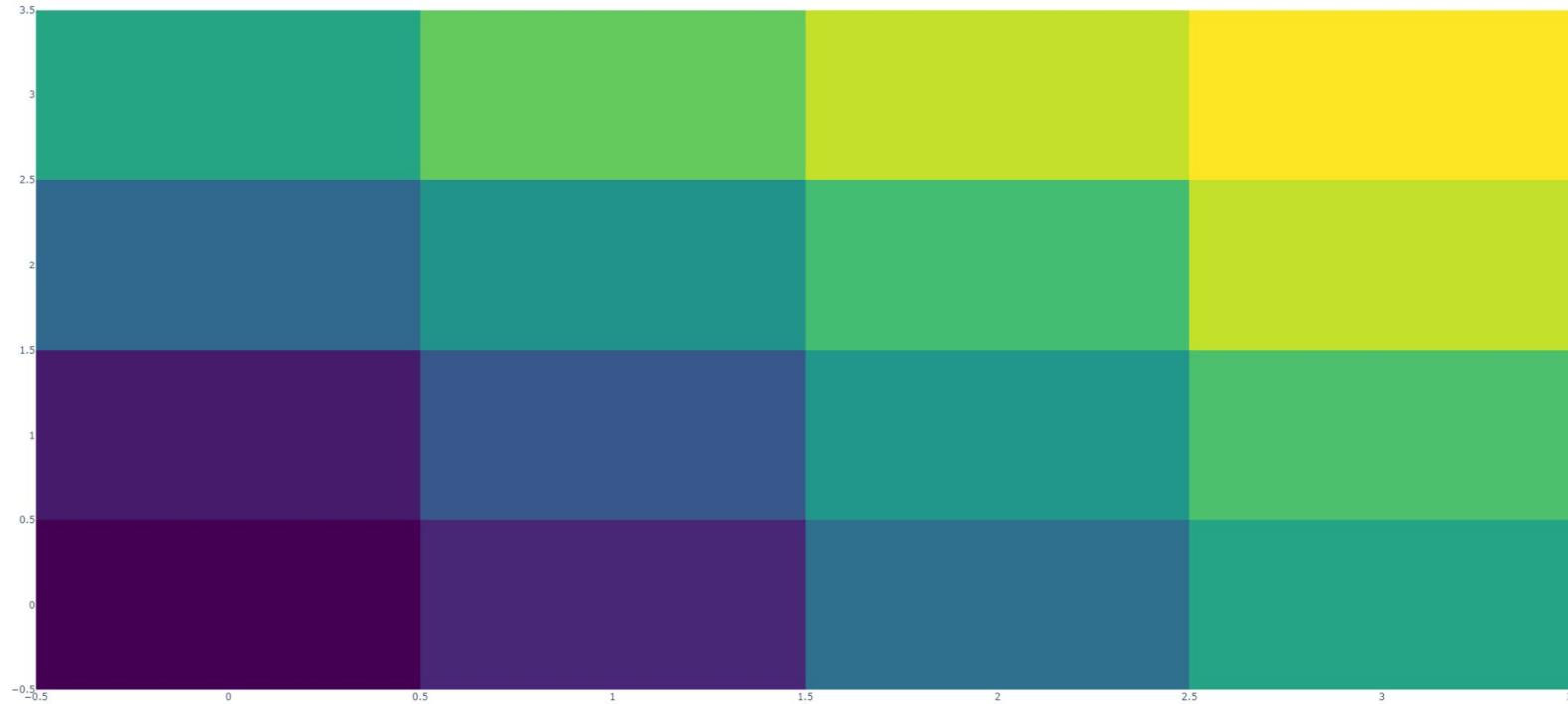
Variable: 4



# Valor promedio por neurona

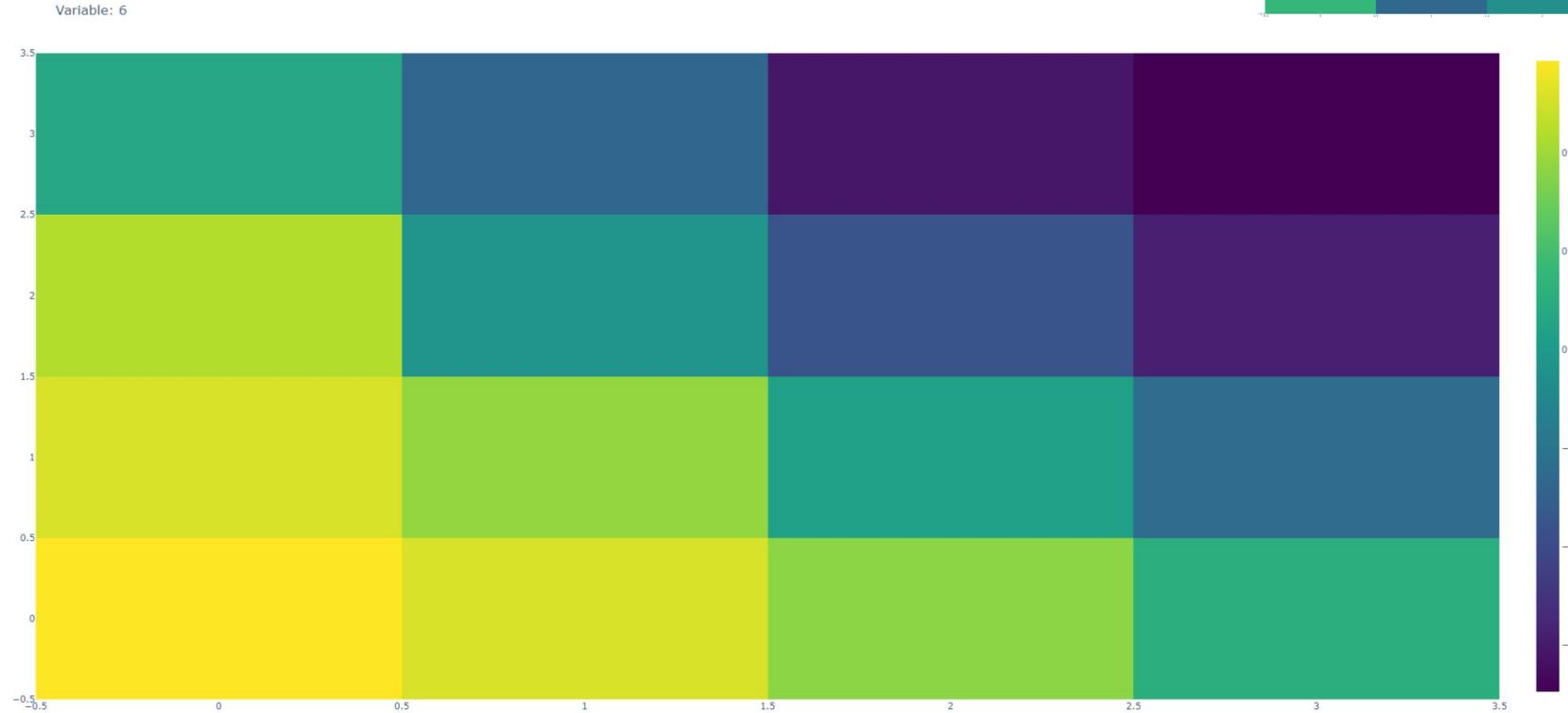
Por variable: Pop.growth

Variable: 5

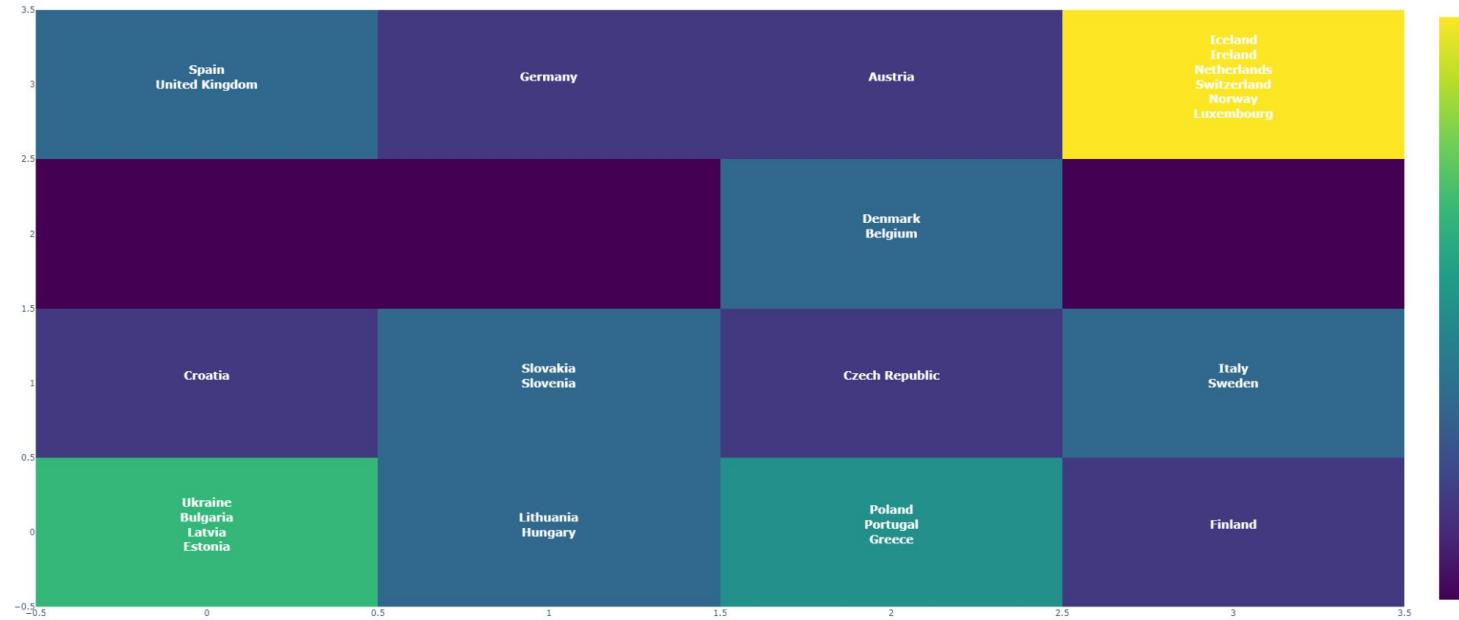


## Valor promedio por neurona

## Por variable: Unemployment



Complete Heatmap



Se podría interpretar de los datos vistos que la **diagonal positiva** marca en tendencia los **atributos favorables** de una nación

Hacer un análisis cruzado con PCA dá mucho para hablar

# Modelo de Oja

# Cálculo de PCA

*Comparar el resultado de Oja con el resultado de calcular PCA con una librería.*

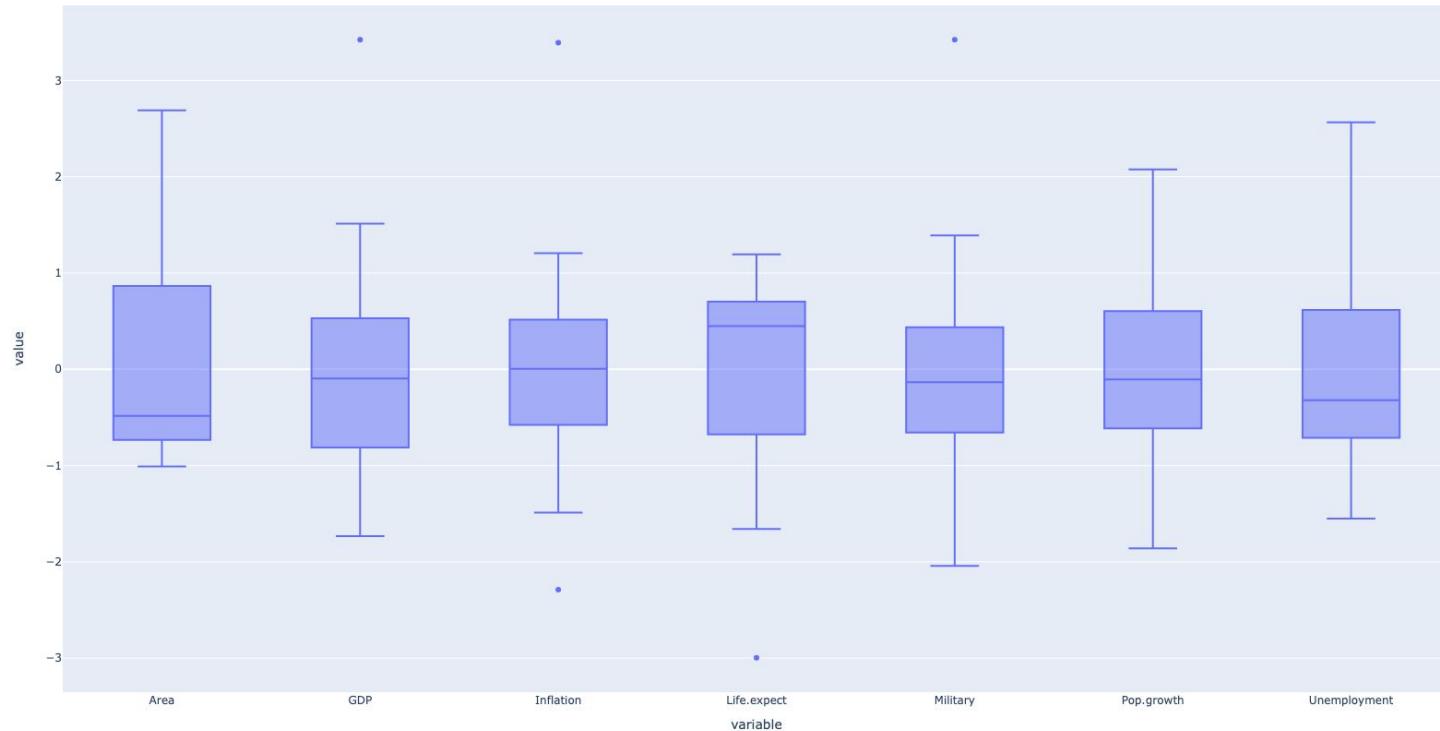
❓ Preguntas:

- ¿Qué nos dice el PCA? Interpretar el resultado.

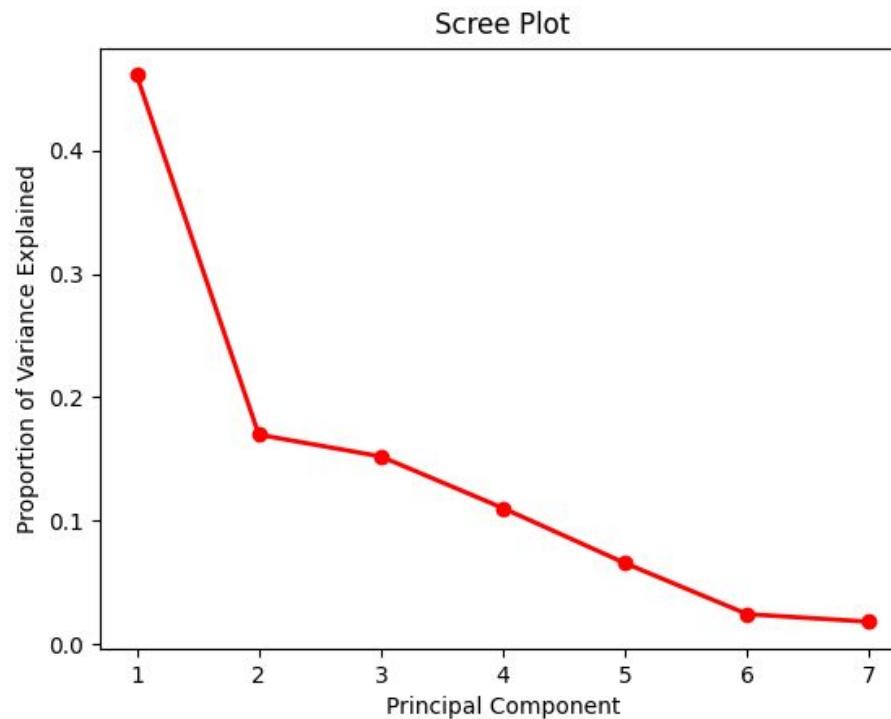
# PCA con librería

# PCA: Variables

Box plot of the variables

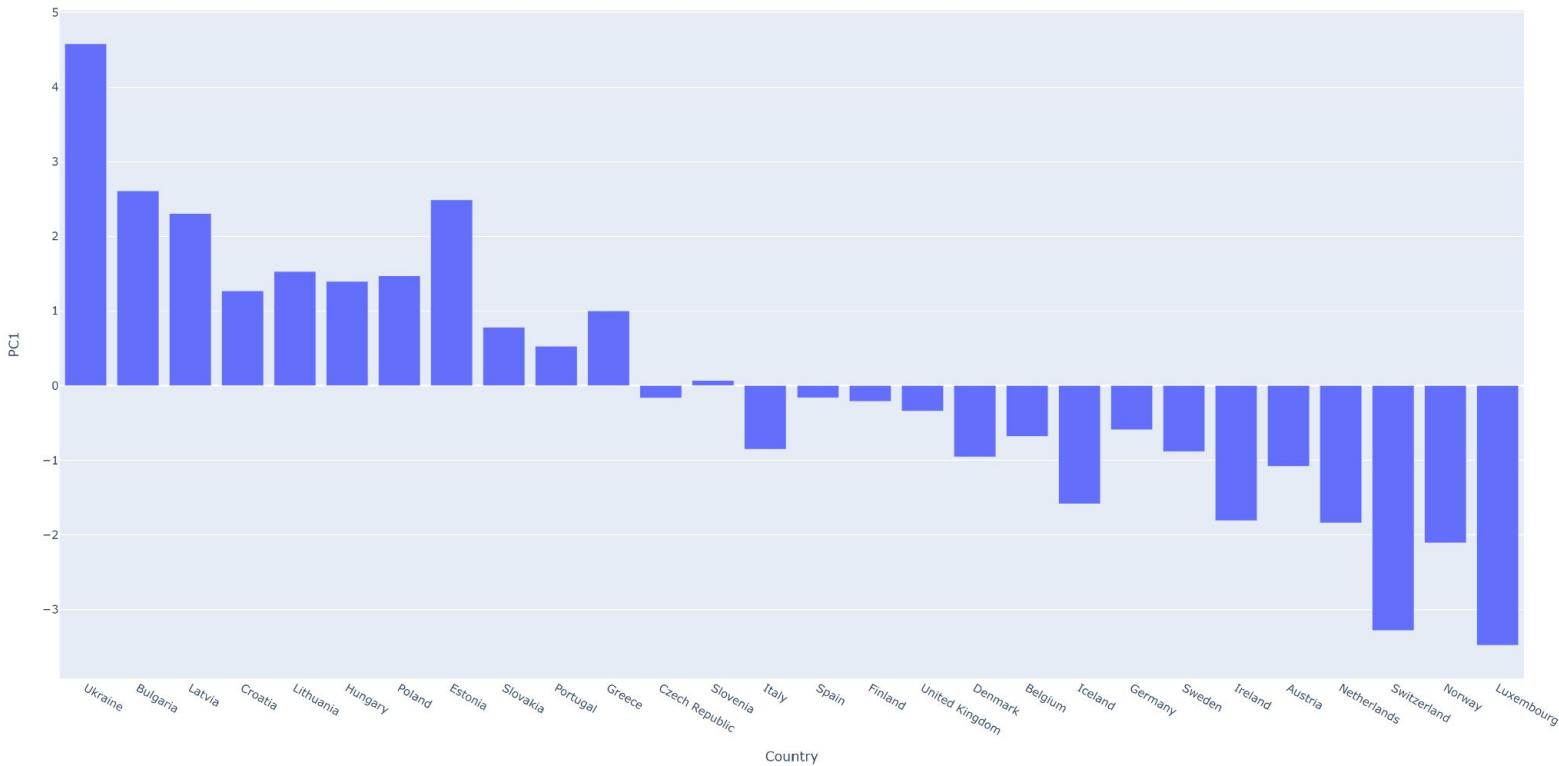


# Proporción de varianza

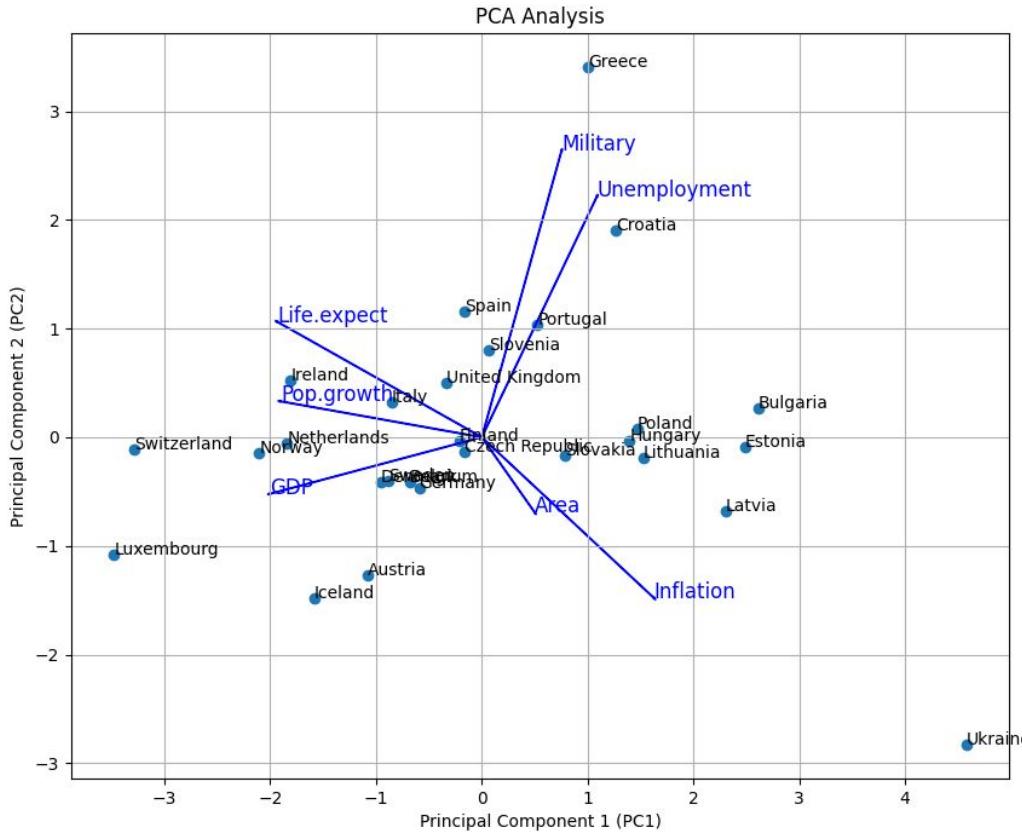


# PC1

PC1 by country



# PCA



# Conclusión

- Life Expectancy, GDP y Population Growth varian juntas.
- A su vez, Military y Unemployment están relacionadas.
- Inflation tiene una correlación inversa a Life Expectancy.
- Military y Unemployment no influyen en gran manera a Population Growth, Life expectancy y GDP.

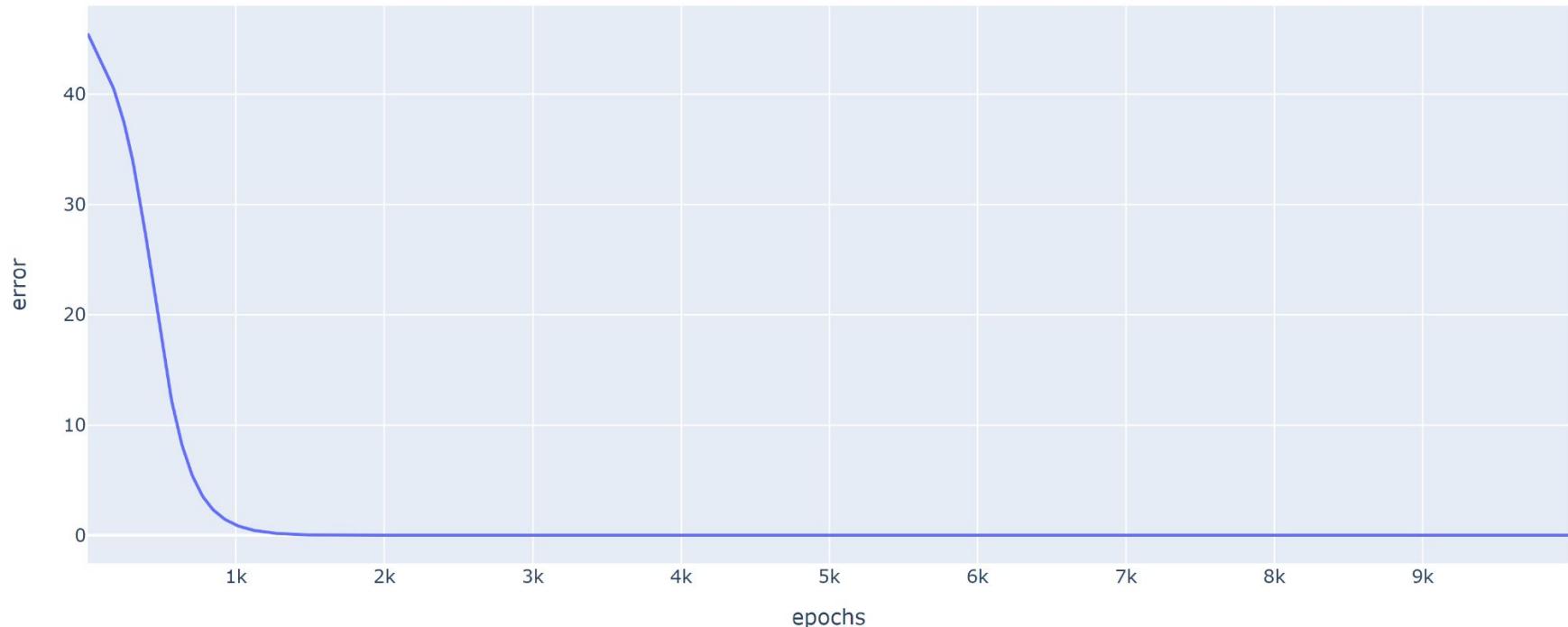
En cuanto a los países, podemos ver 4 grupos:

- **Ucrania** está en su propio grupo, y se ve extremadamente afectado por la inflación. Su life expectancy y pop.growth es baja por lo que invertir en estas dos sería bueno (ya que tienen una correlación negativa, ie. subir unas implica que las otras bajan). De esta manera, se espera que baje la inflación y ucrania se acerque al centro del gráfico.
- Los **países del centro** tienen todo medianamente bien, de todos modos se distribuyen de dos maneras distintas pero la tendencia entre ellos es la misma y es que crecen positivamente hacia la derecha.  
De estos países podemos sacar dos grupos, aquellos a la derecha del 0 son los que peor están pues se ven más afectados por “military, unemployment e inflación”. Políticas que reduzcan el unemployment o la inflación podrían ser buenas ideas. Los de la izquierda del 0 son los países que mejor están pues son los que tienen mejor life.expect, pop.growth y gdp.
- Por último, países como **Grecia** y **Croacia** tienen un alto nivel de “military” y “unemployment” respectivamente. Para el caso de grecia sería buena idea bajar el gasto militar pues eso haría que se acerque al centro, y para croacia se deberían introducir políticas que bajen el desempleo.

# PCA con Oja

# Error del Oja en función de las épocas

Error by epochs



# Ejercicio Patrones

# Modelo de Hopfield

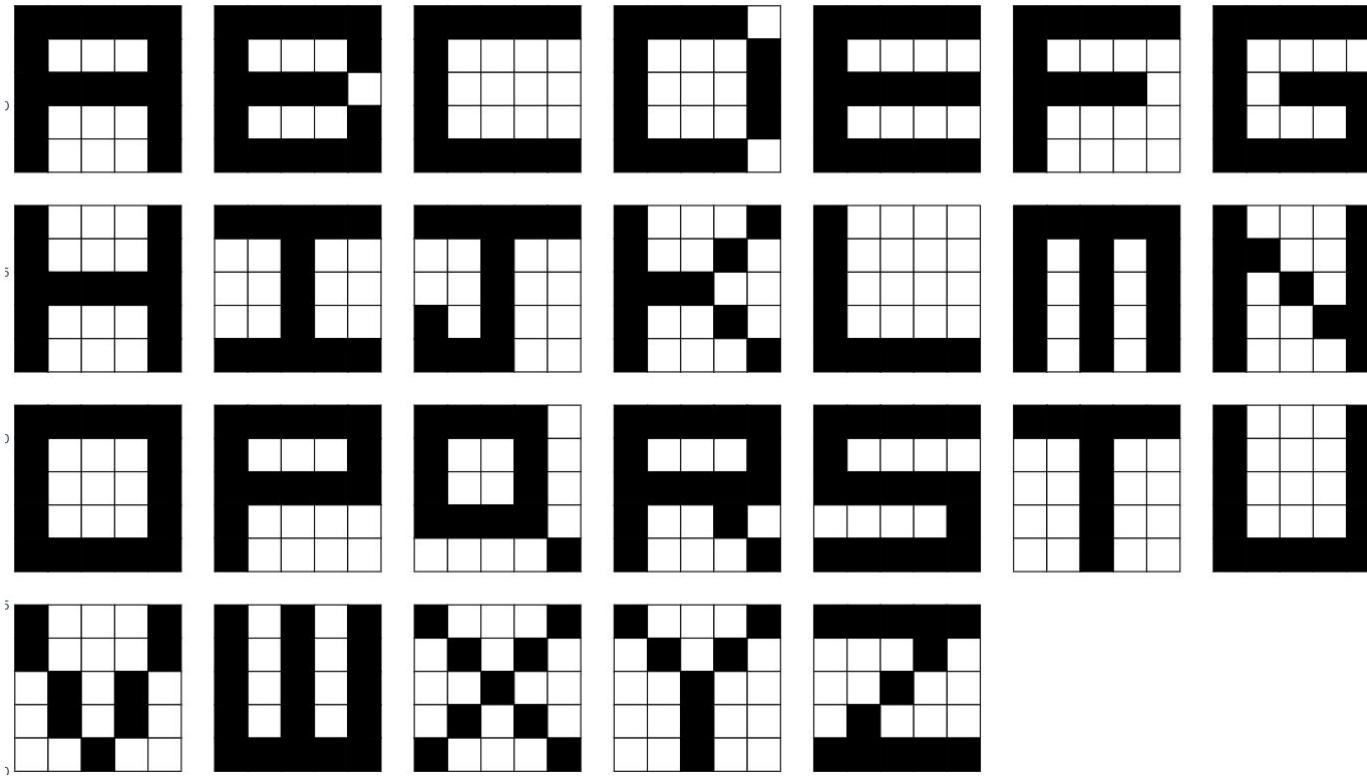
# Patrones sin ruido

*Almacenar 4 patrones de letras. Implementar el modelo de Hopfield para asociar matrices ruidosas de 5×5 con los patrones de las letras almacenadas. Los patrones de consulta deben ser alteraciones aleatorias de los patrones originales. Mostrar los resultados que se obtienen en cada paso hasta llegar al resultado final.*

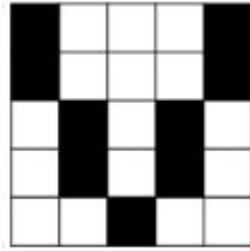
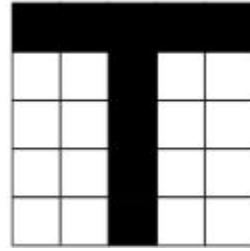
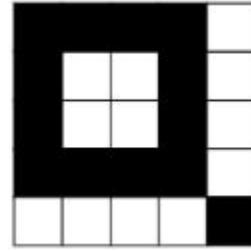
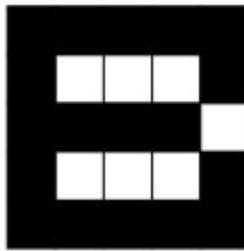
## ❓ Preguntas:

- Análisis de distinta combinación de patrones. Promedio de producto escalar entre patrones, máximos y cantidad. Balance entre promedio cercano a 1 y máximos chicos.
- ¿Cómo se comporta con malos patrones?
- ¿Cómo se comporta con casos borde?
- ¿Qué ocurre con la función de energía a lo largo de las épocas?

# Patrones: Letras



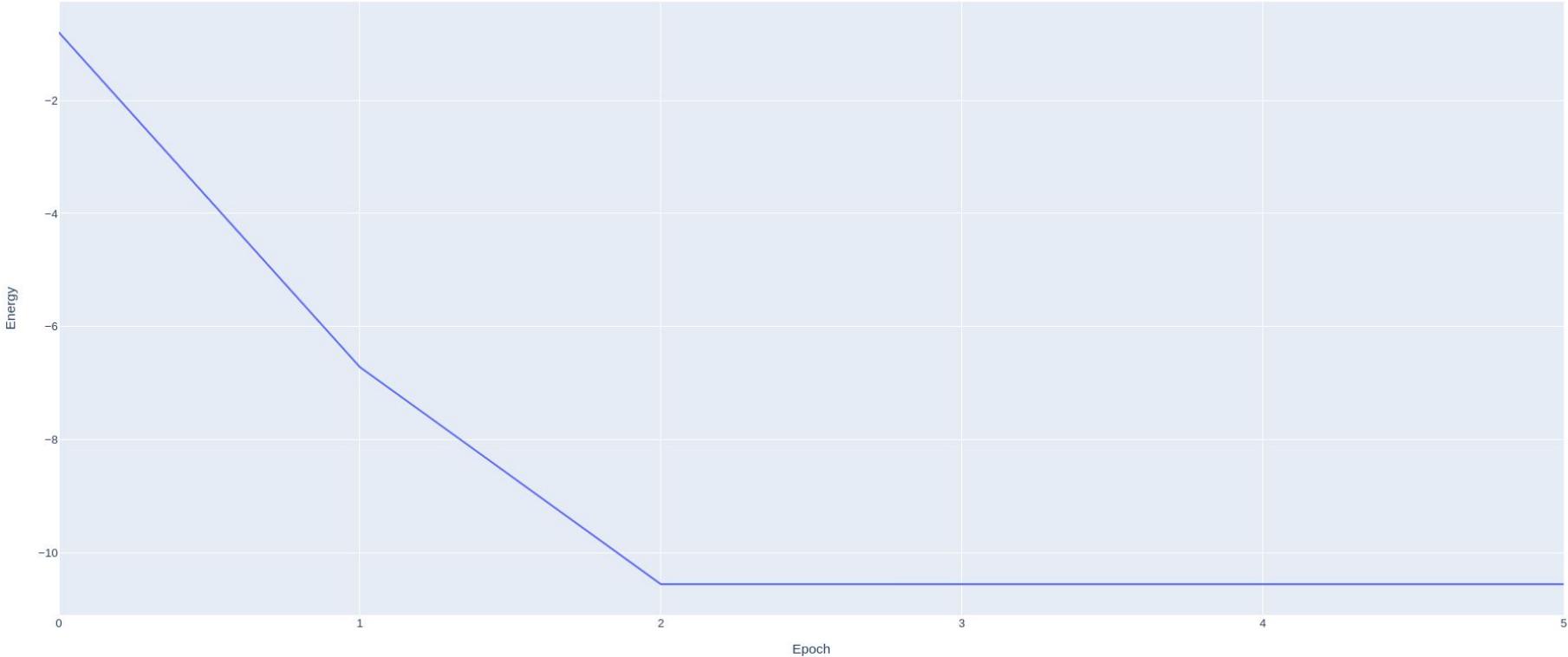
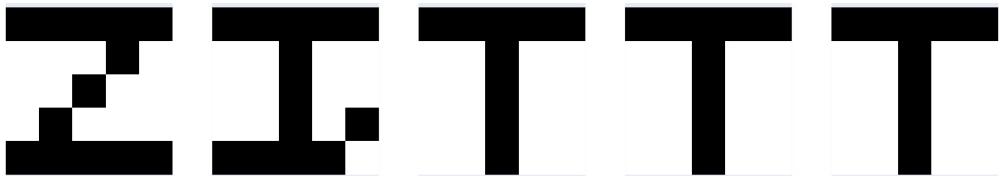
# Mejor combinación



Avg. producto escalar: 1

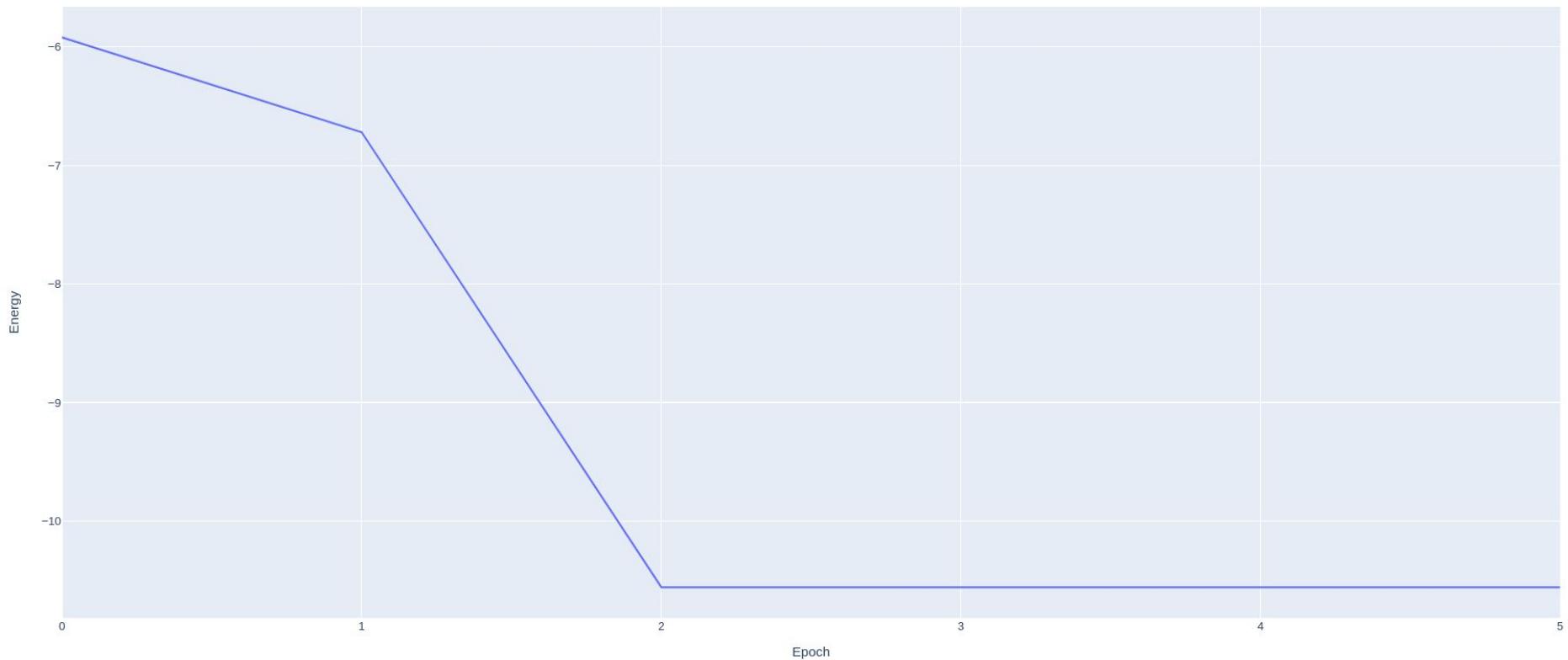
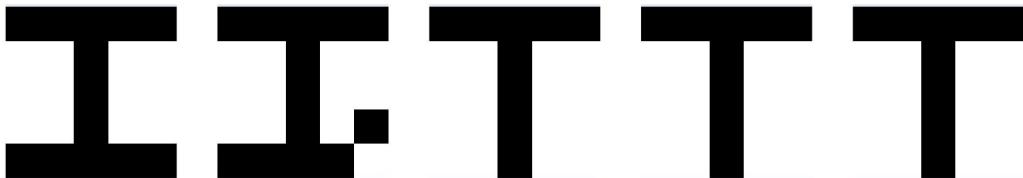
# Función de energía

Energy through epochs



# Función de energía

Energy through epochs

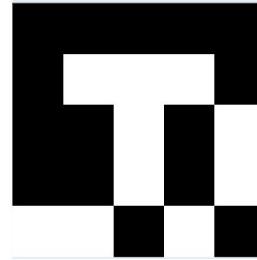


# Estados espurios

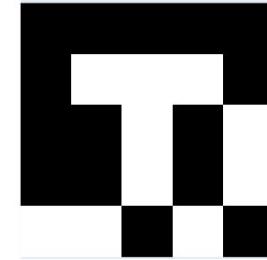
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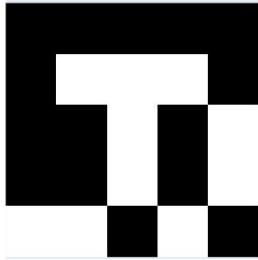
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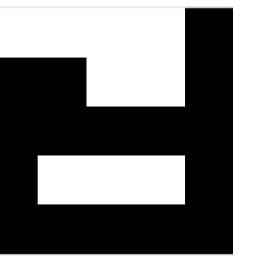
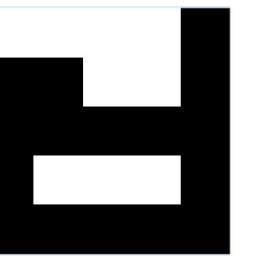
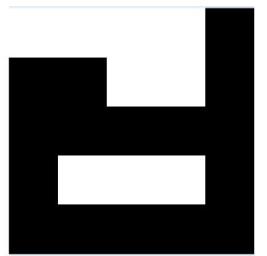
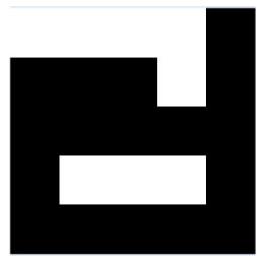
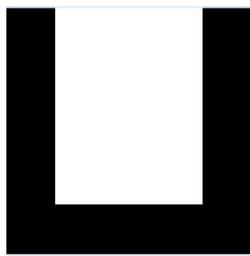
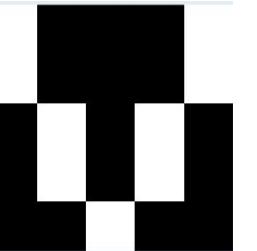
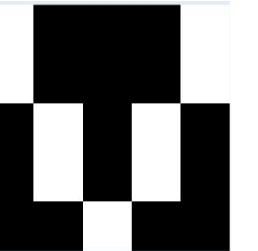
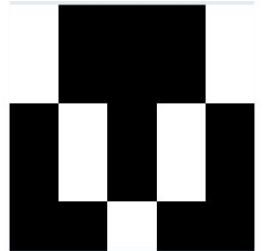
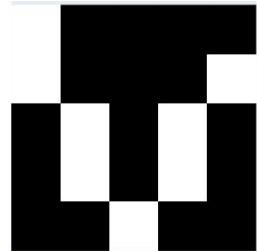
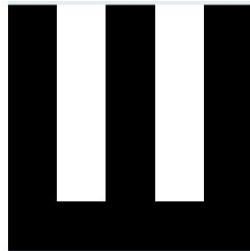
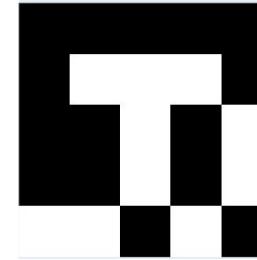
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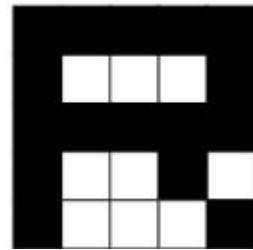
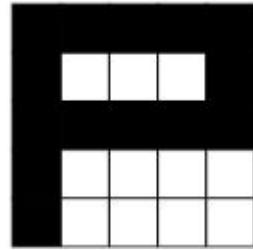
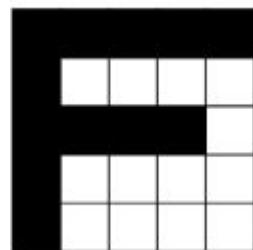
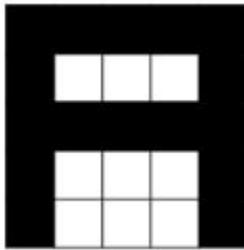
4



5



# Peor combinación

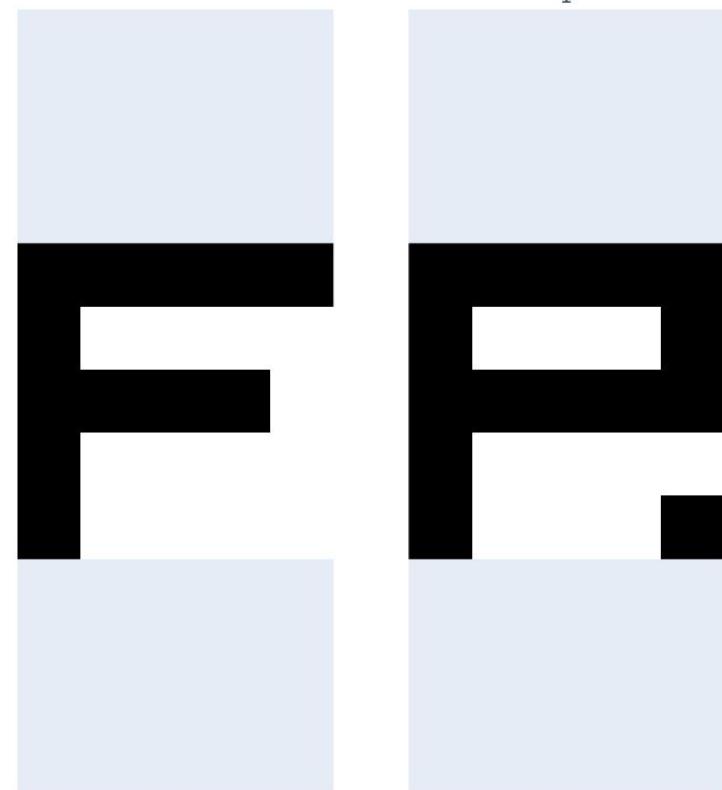
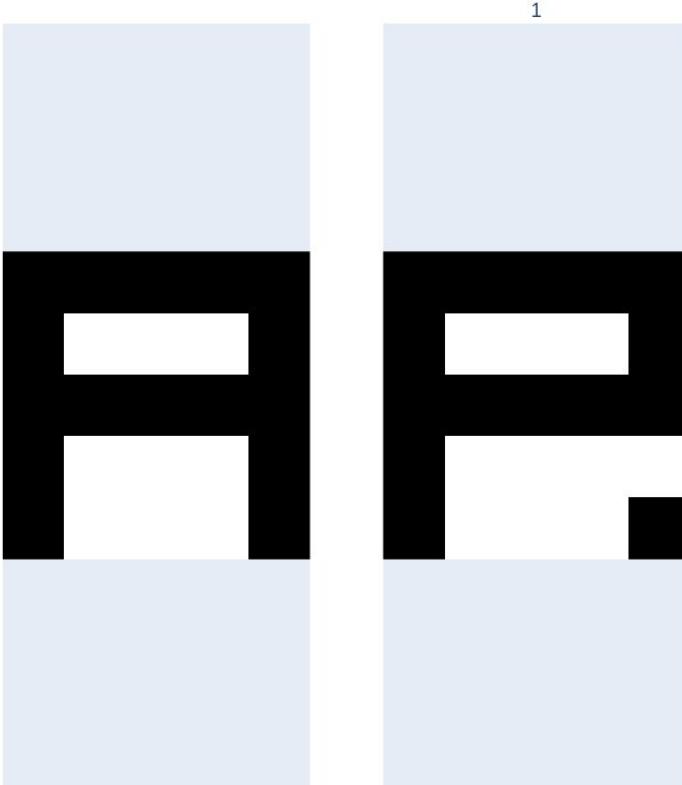
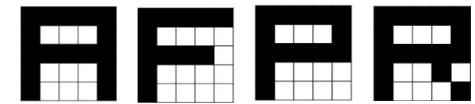


Avg. producto escalar: 19.67

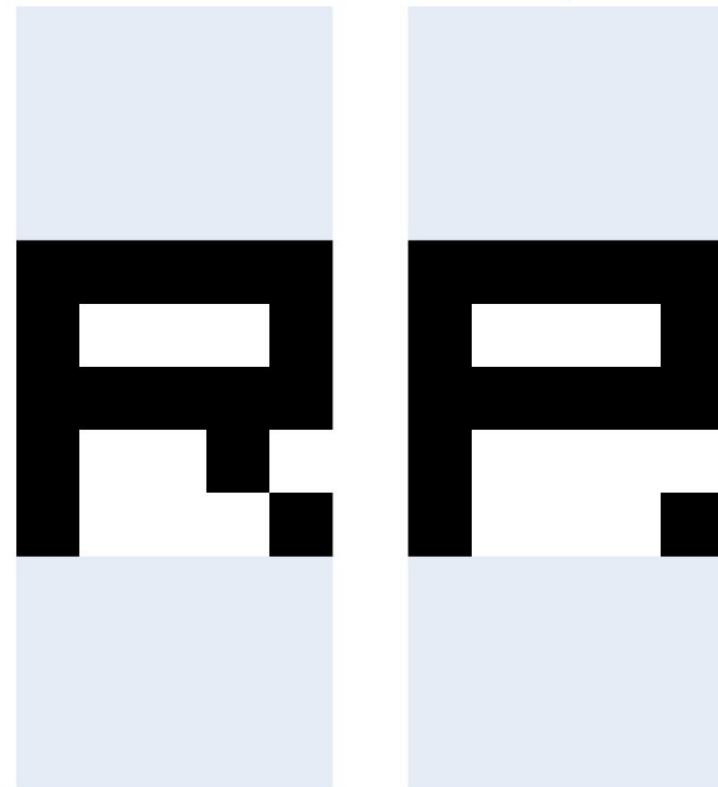
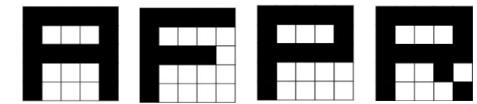
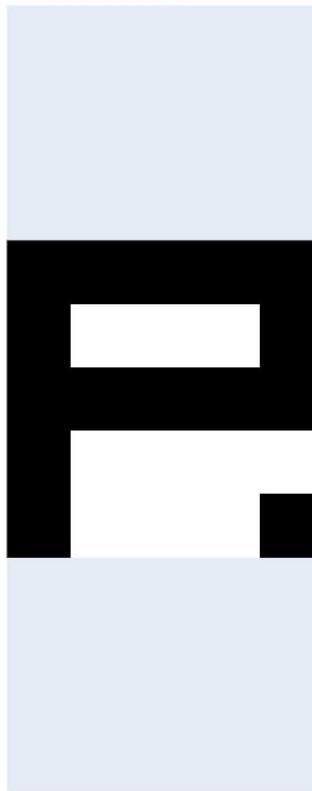
Max. valor: 21

# Max. valor : 4

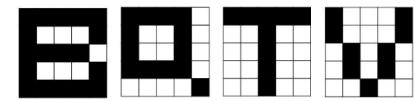
# Peor combinación: A y F



# Peor combinación: P y R



# Mejor combinación: Patrones invertidos (B)

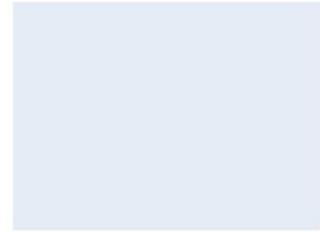
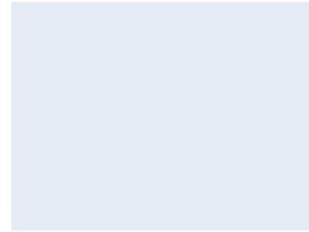
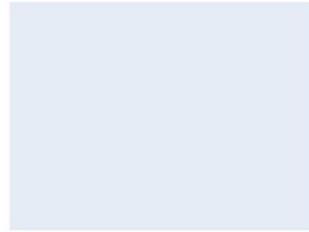
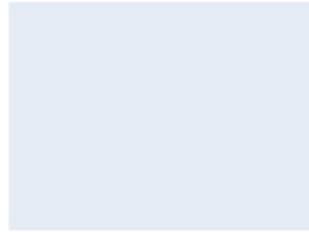
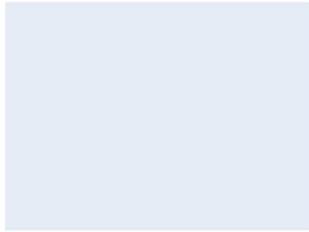
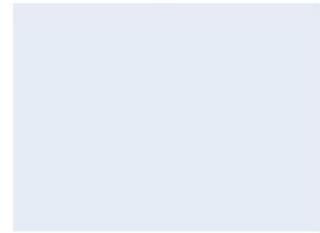
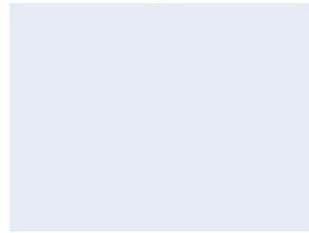
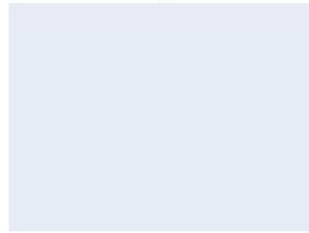
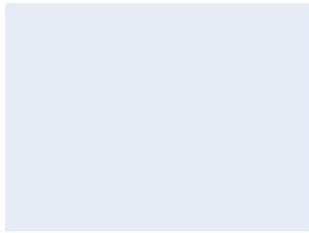


1

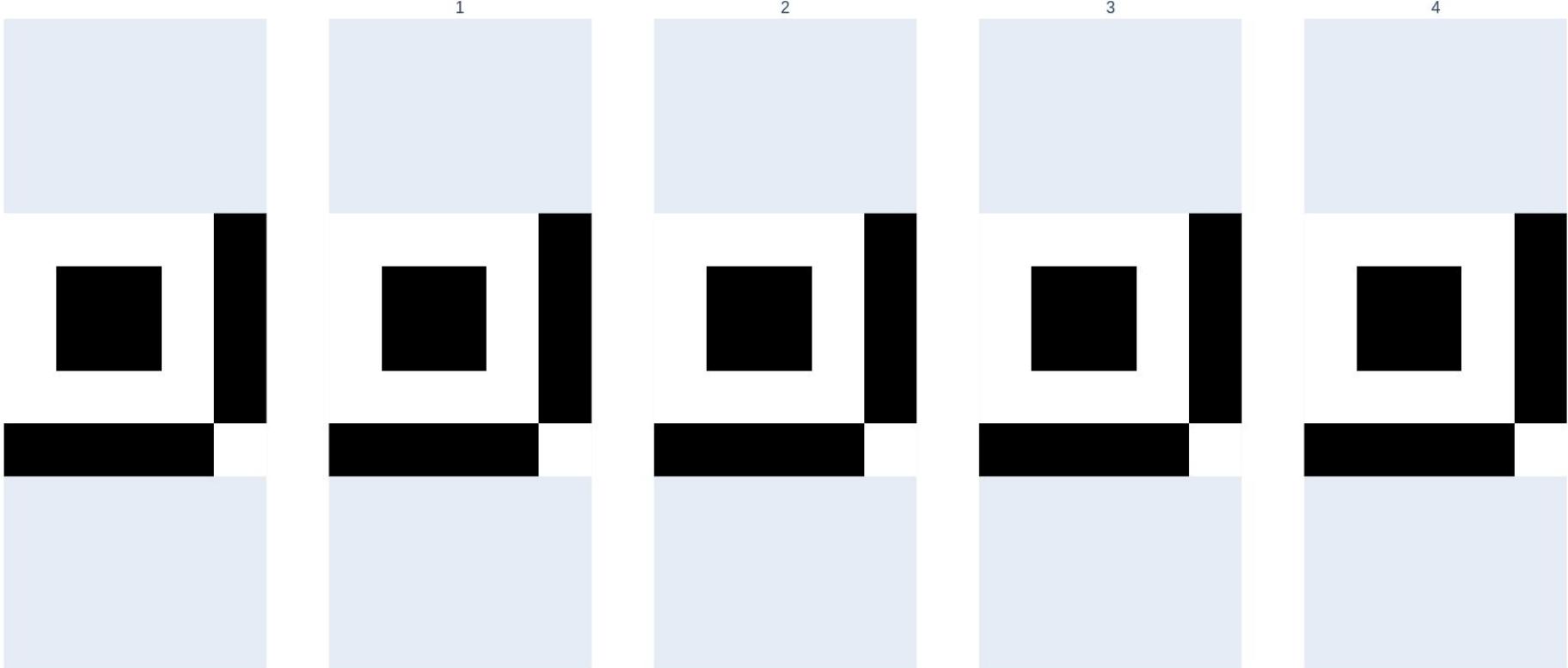
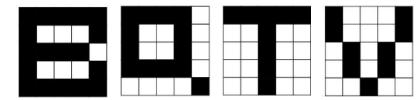
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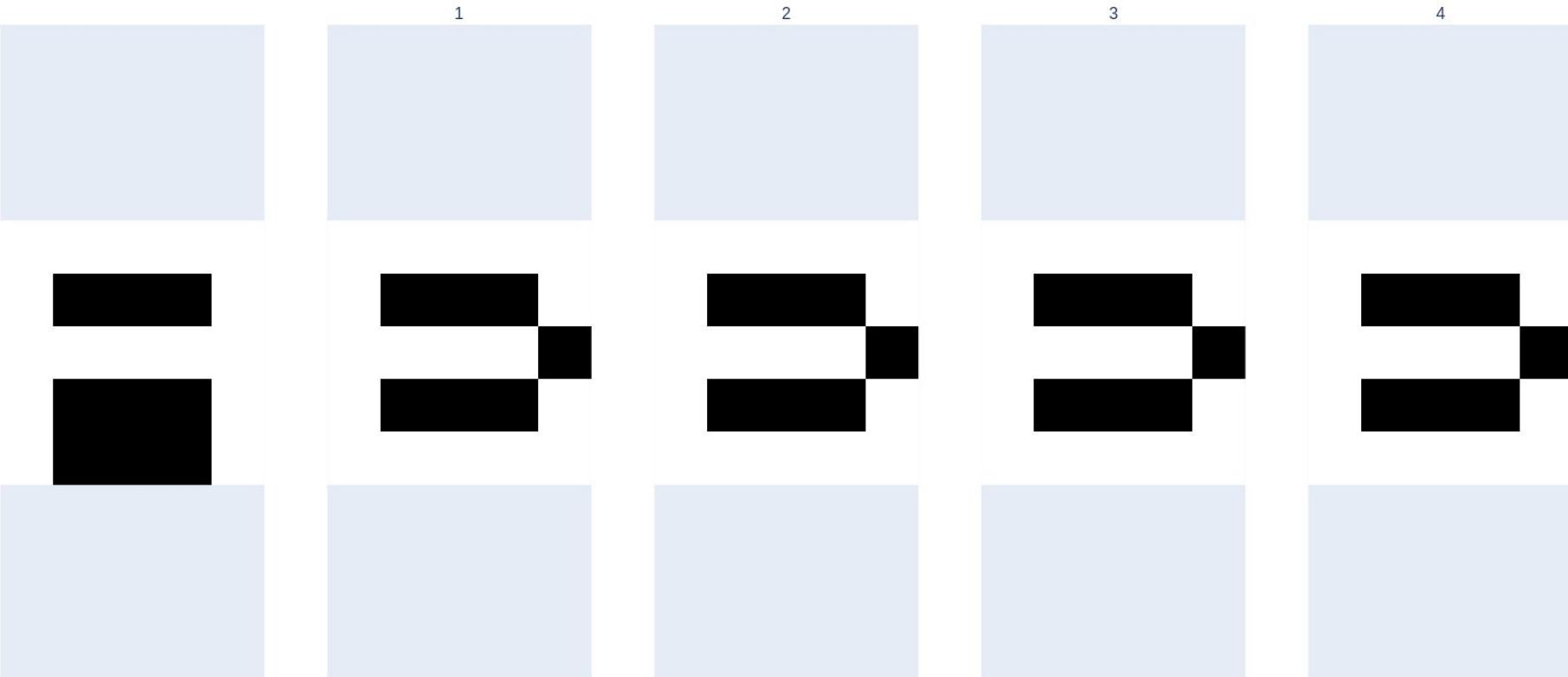
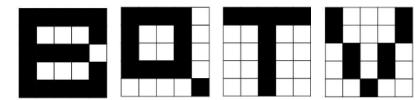
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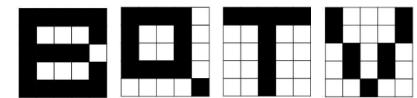
# Mejor combinación: Patrones invertidos (Q)



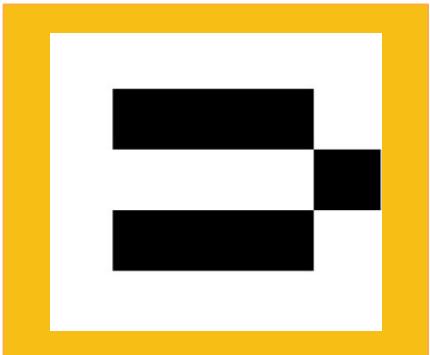
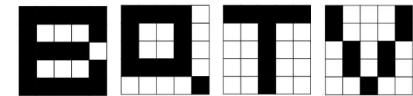
# Mejor combinación: Patrones invertidos (A)



# Mejor combinación: Patrones invertidos (Z)



# Por qué ocurre esto?



$W =$



```
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 [ -1  1  1  1 -1 ]
 [ -1 -1 -1 -1  1 ]
 [ -1  1  1  1 -1 ]
 [ -1 -1 -1 -1 -1 ]]
```

```
[0, 0.08, 0.08, 0.08, 0.08, -0.16, -0.08, 0.0, 0.0, 0.0, 0.08, -0.16, 0.0, 0.0, 0.0, 0.0, -0.08, -0.08, 0.08, -0.08, 0.0]
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# Cálculos y conclusión

$(W * B_{inversa}) =$

$$\begin{bmatrix} [-0.72 & -0.8 & -0.8 & -0.8 & -0.8] \\ [-0.8 & 0.72 & 0.8 & 0.8 & -0.88] \\ [-0.88 & -0.88 & -0.88 & -0.8 & 0.72] \\ [-0.88 & 0.88 & 0.88 & 0.88 & -0.96] \\ [-0.96 & -0.96 & -0.8 & -0.96 & -0.88] \end{bmatrix}$$

$\text{signo}(W * B_{inversa}) = B_{inversa}$

No convergerá jamás y se repetirá el patrón de la inversa de B.

Matemáticamente no pudimos realizar una demostración completa, pero vimos que este comportamiento se repitió en todos nuestros casos de uso.

**Hipótesis:** la inversa de un patrón en memoria es un estado espurio.

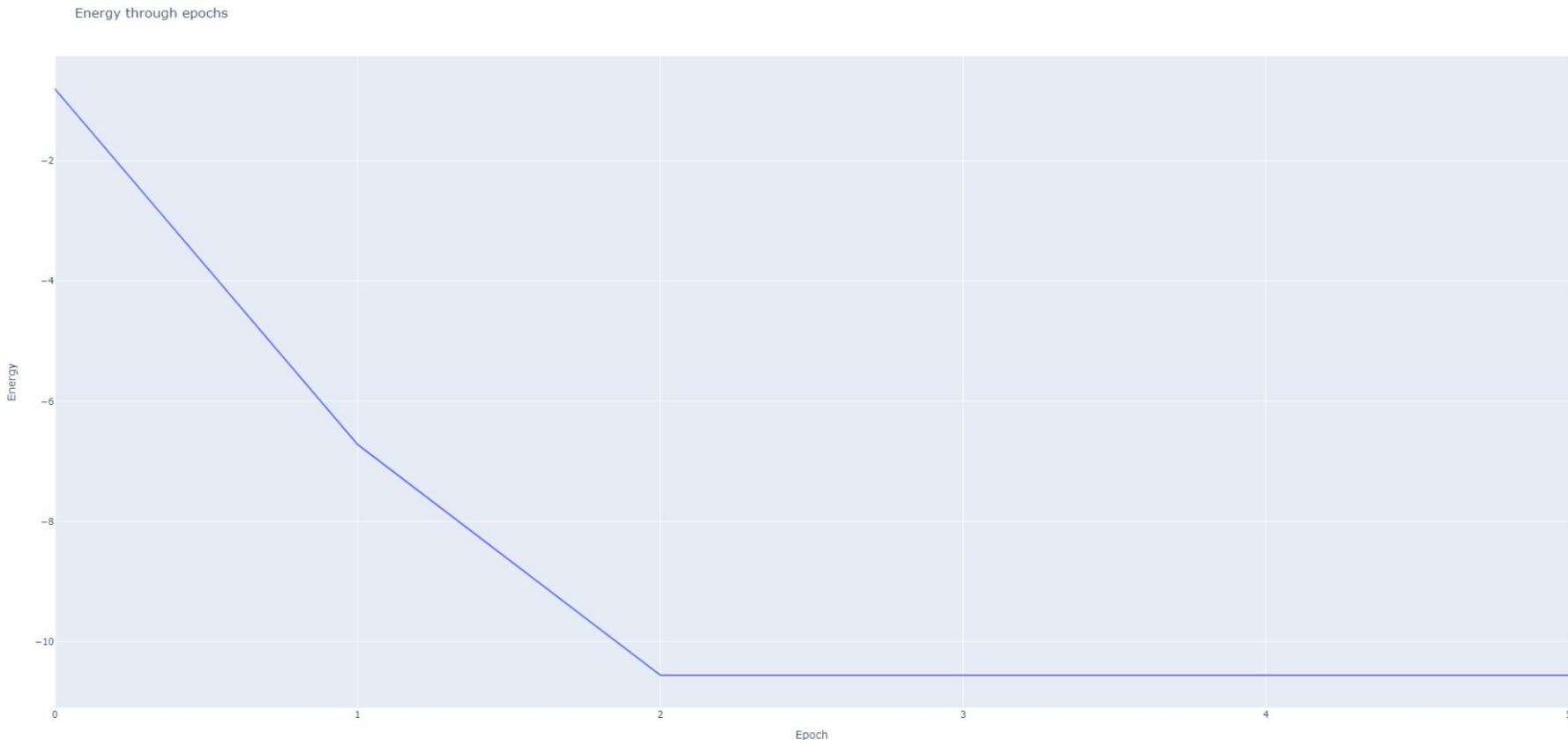
No se hallaron resultados en internet para afirmar o negar nuestra hipótesis.

# Patrones con ruido

*Identificación de estados espúreos.*

# Patrones con ruido (mejor combinación)

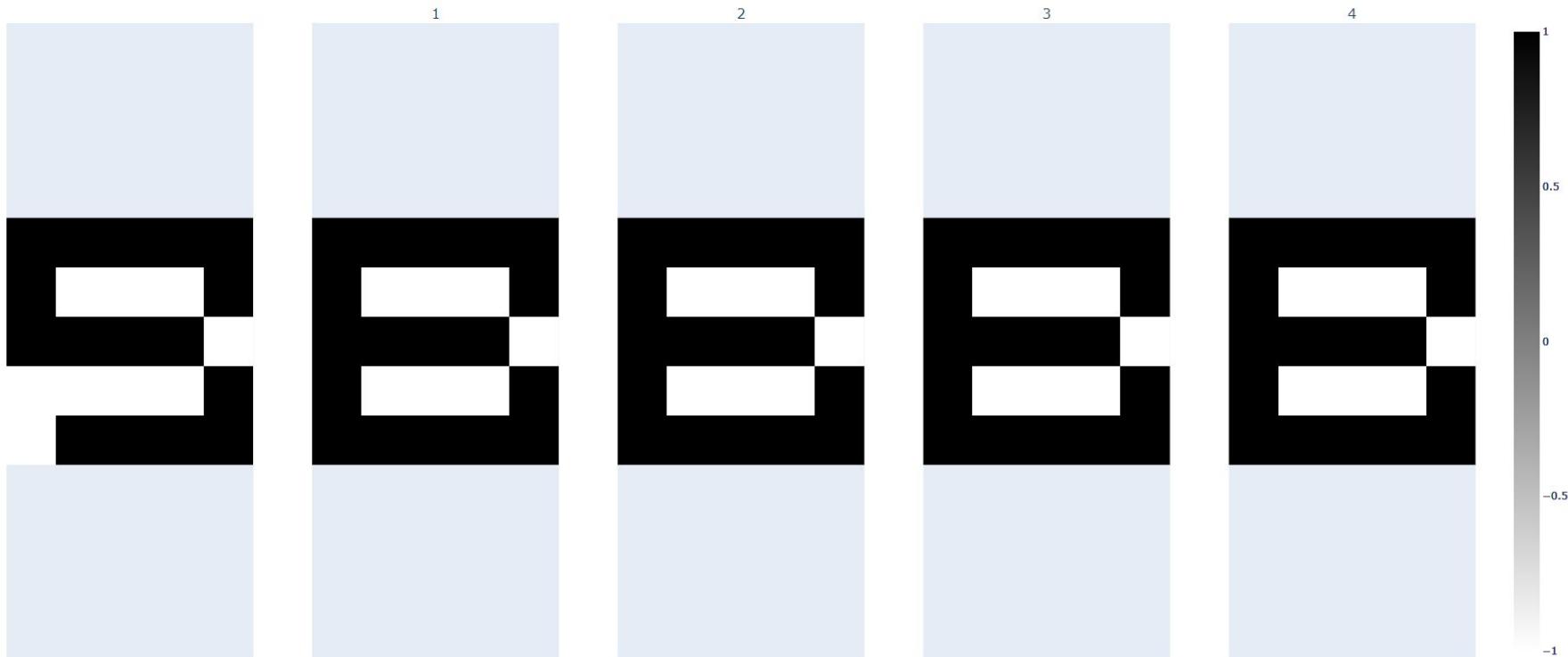
Noise ratio = 0.2



# Patrones con ruido (mejor combinación)

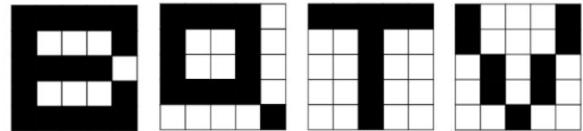
Noise ratio = 0.1

Neuron states by epochs (noise ratio = 0.1)

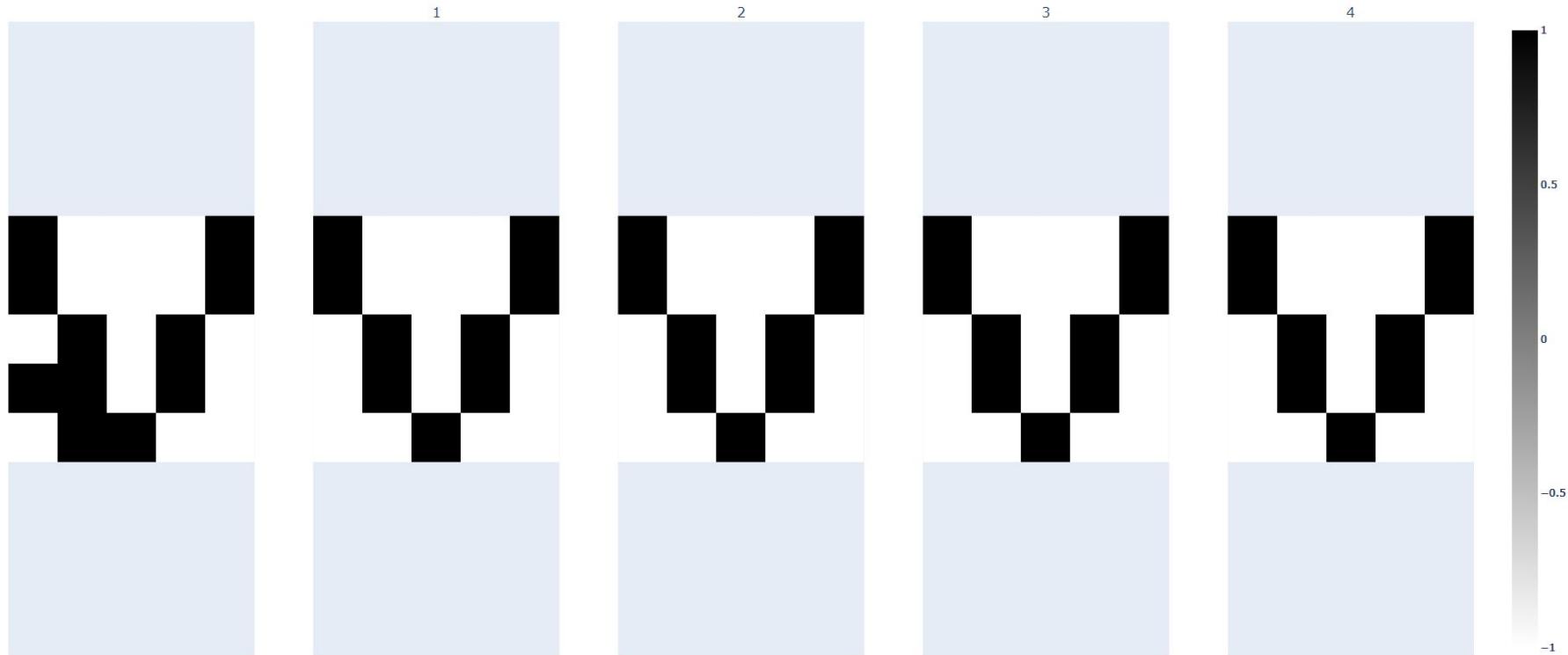


# Patrones con ruido (mejor combinación)

Noise ratio = 0.1

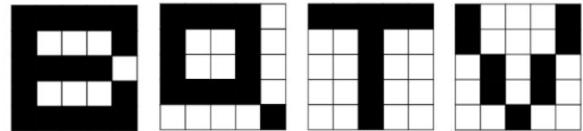


Neuron states by epochs (noise ratio = 0.1)

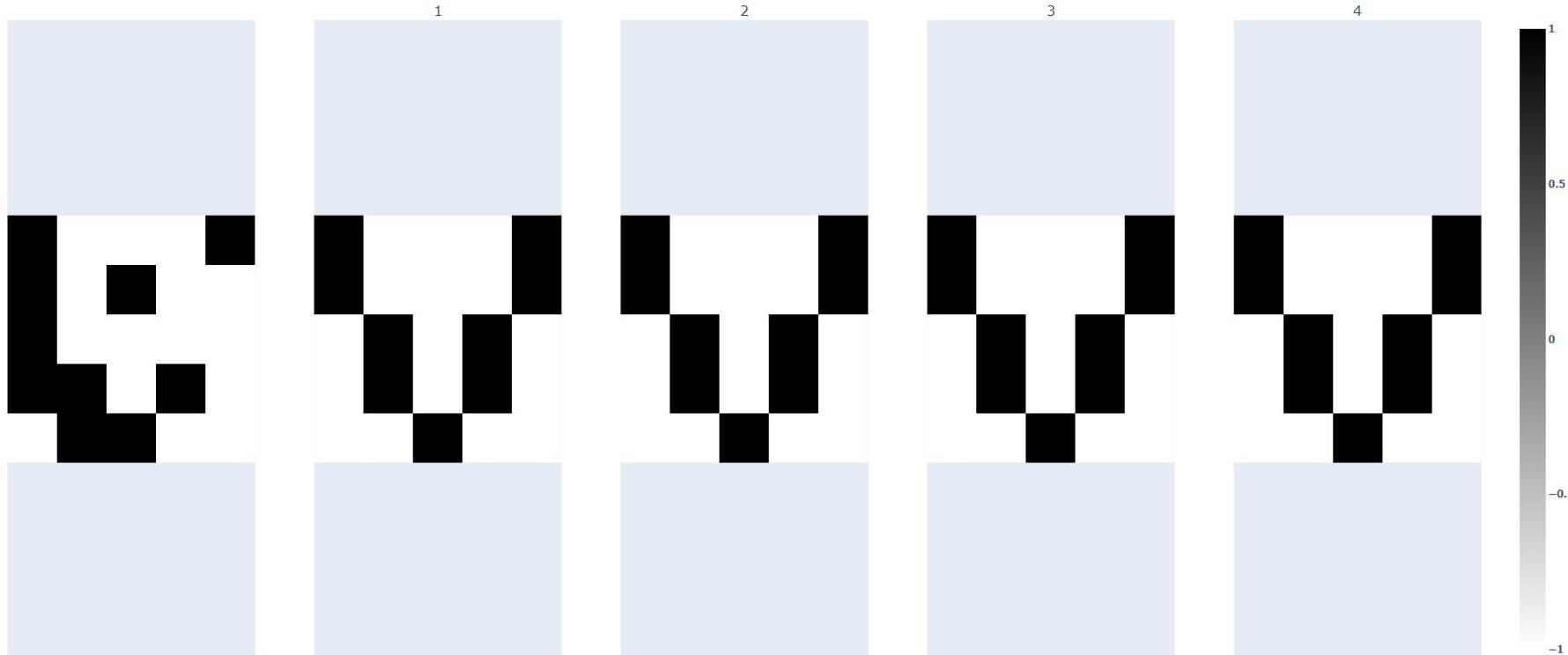


# Patrones con ruido (mejor combinación)

Noise ratio = 0.3

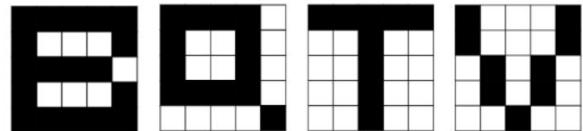


Neuron states by epochs (noise ratio = 0.3)

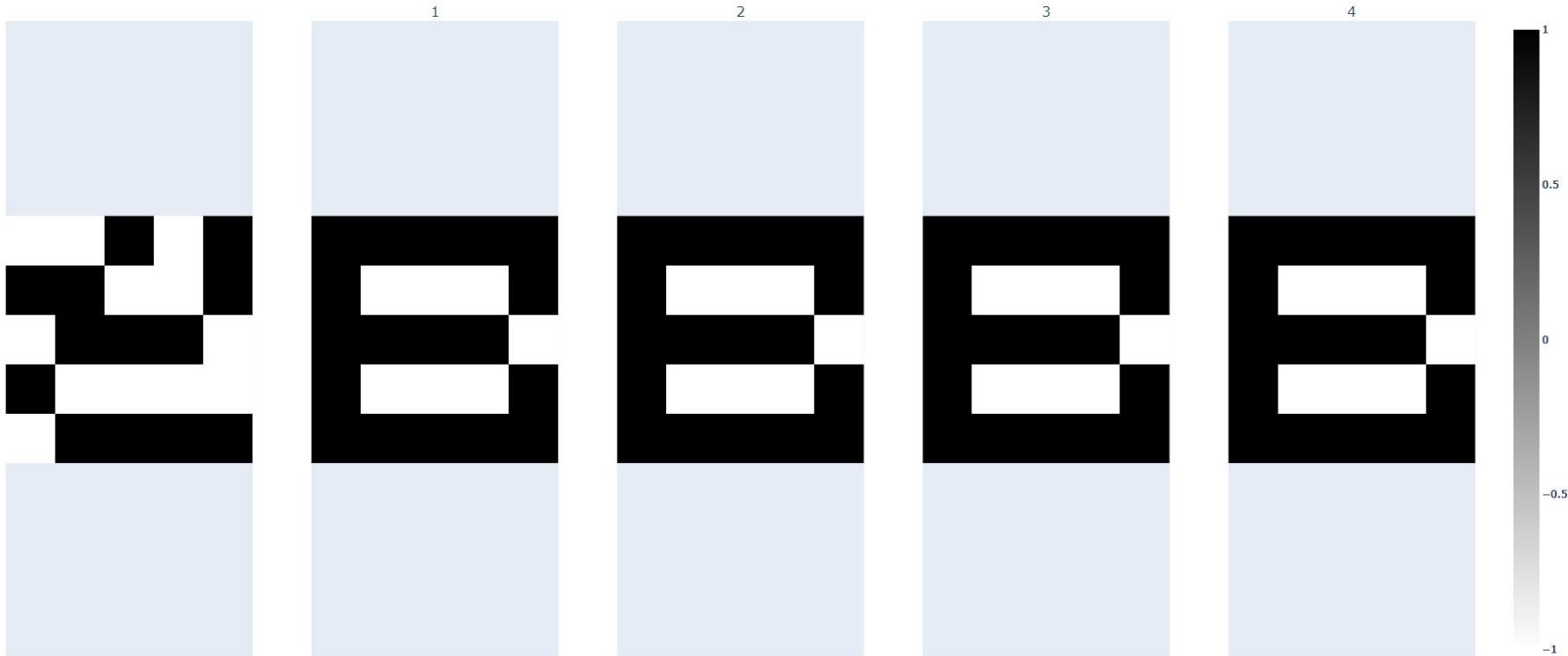


# Patrones con ruido (mejor combinación)

Noise ratio = 0.3

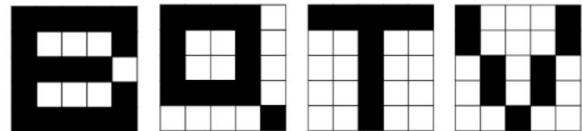


Neuron states by epochs (noise ratio = 0.3)

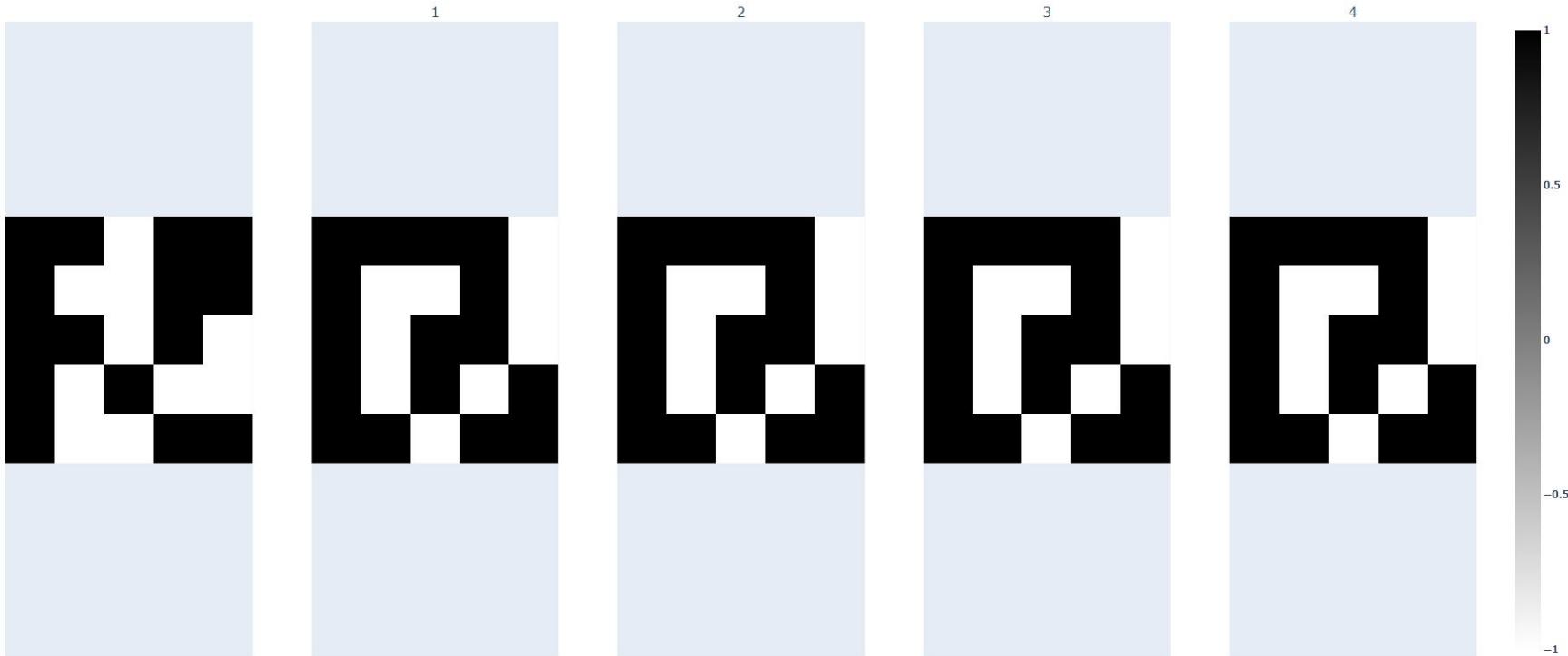


# Patrones con ruido (mejor combinación)

Noise ratio = 0.3

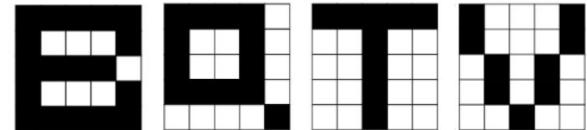


Neuron states by epochs (noise ratio = 0.3)

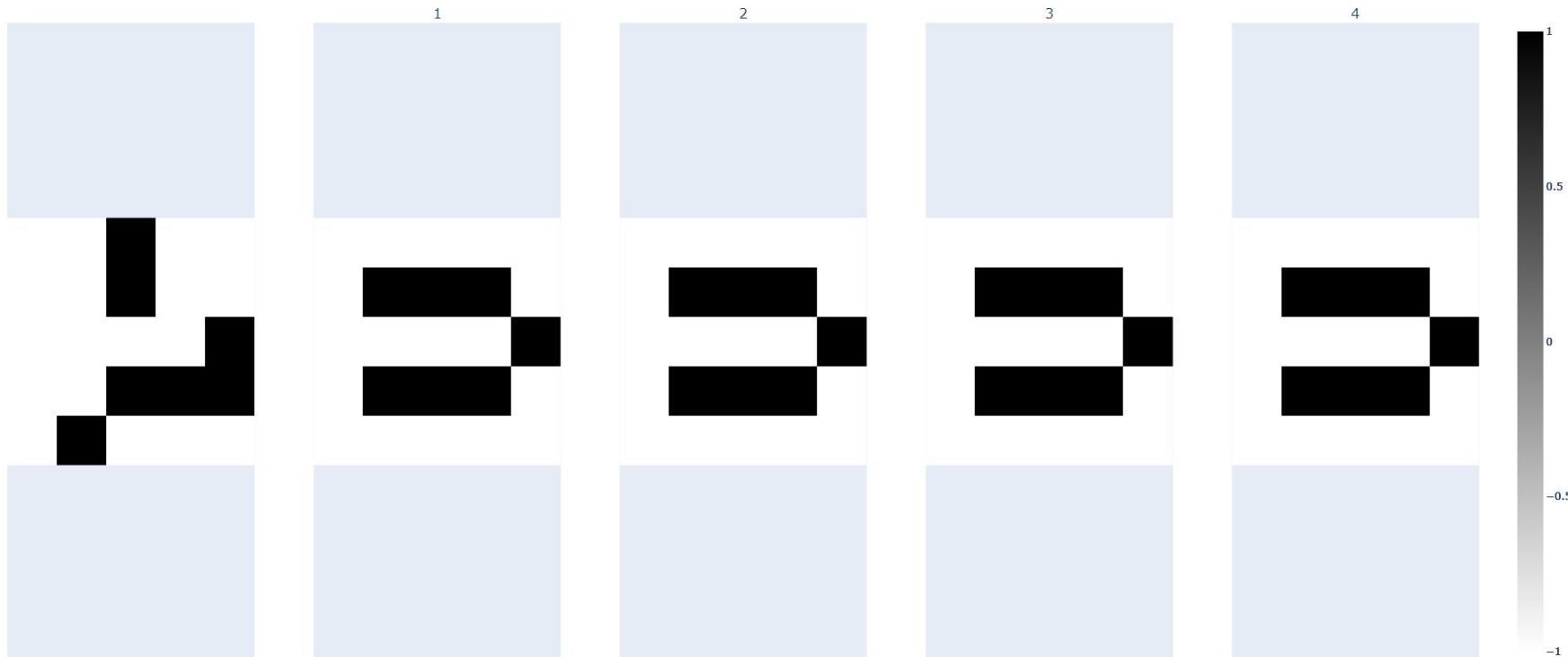


# Patrones con ruido (mejor combinación)

Noise ratio = 0.4

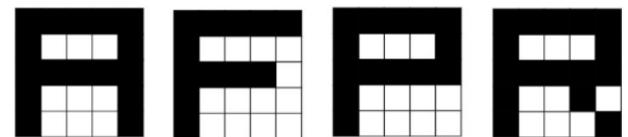


Neuron states by epochs (noise ratio = 0.4)

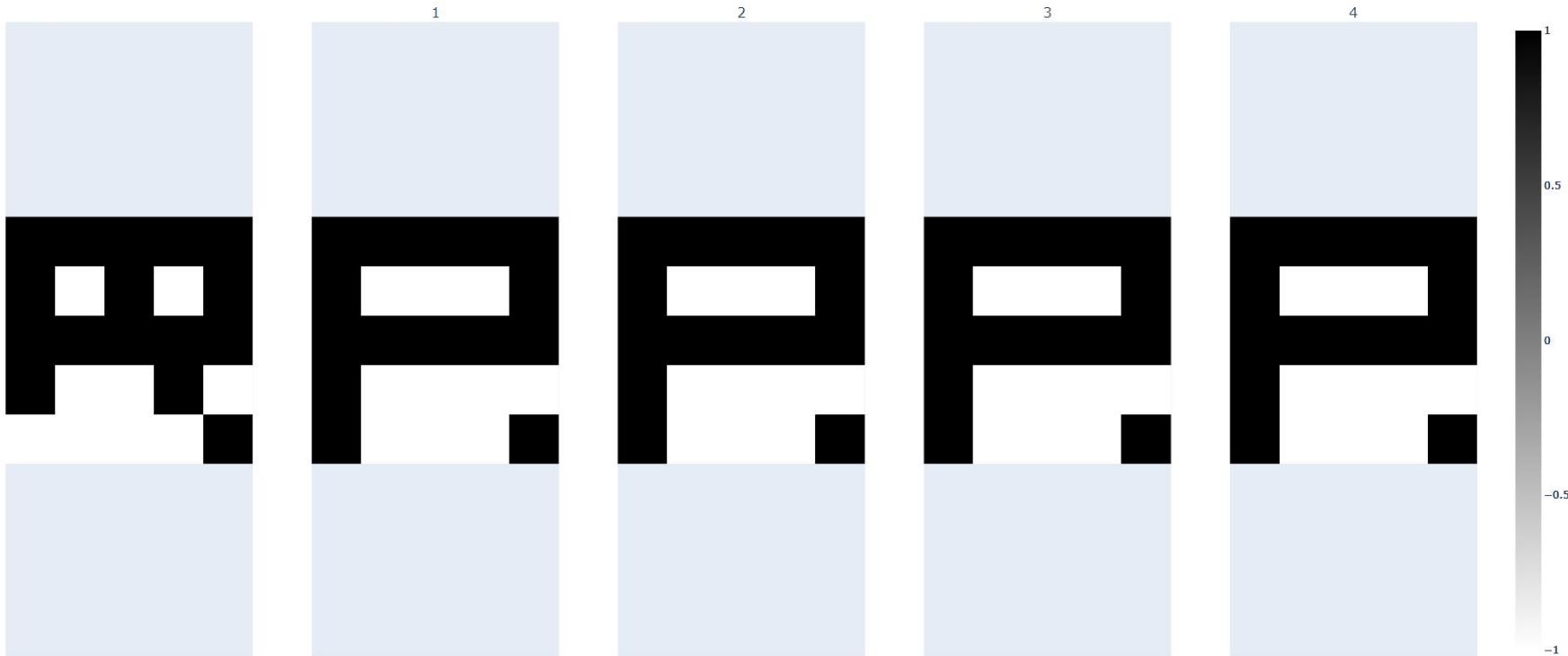


# Patrones con ruido (peor combinación)

Noise ratio = 0.1



Neuron states by epochs (noise ratio = 0.1)

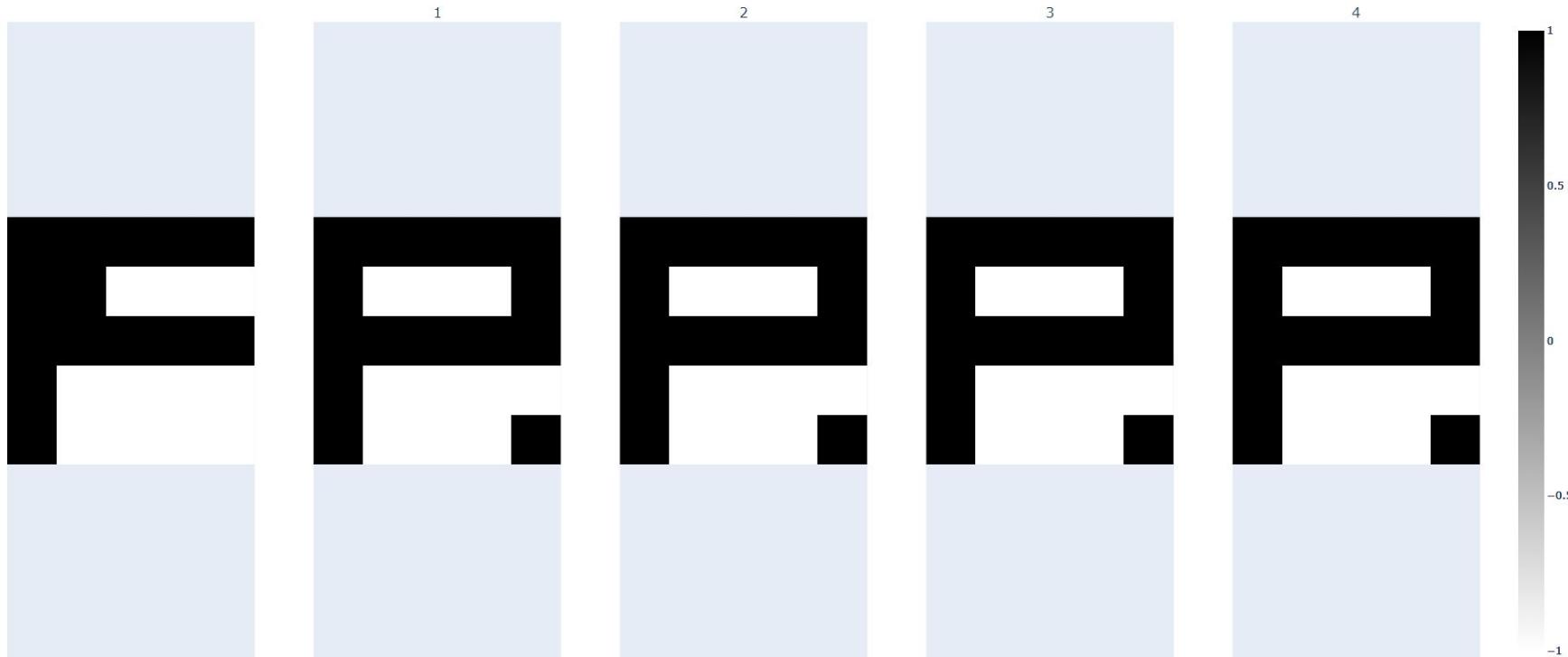


# Patrones con ruido (peor combinación)

Noise ratio = 0.1



Neuron states by epochs (noise ratio = 0.1)

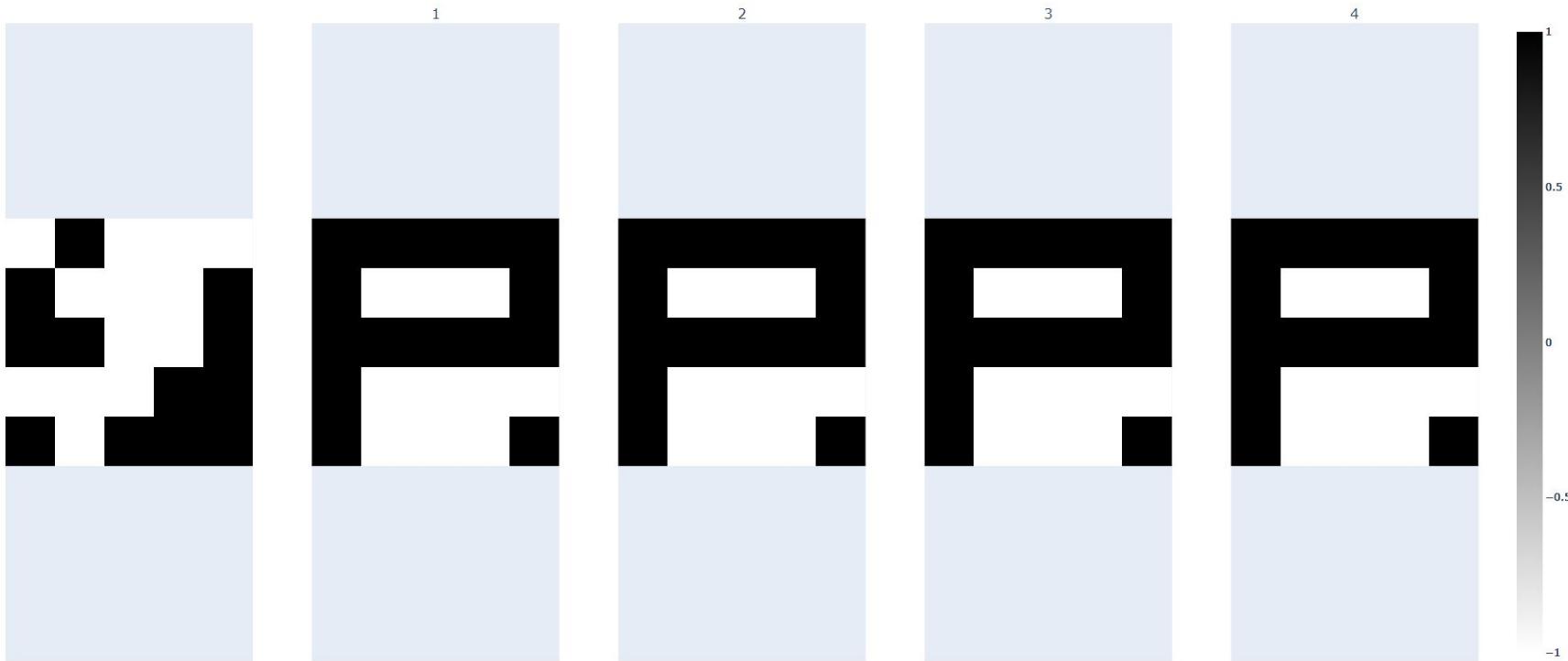


# Patrones con ruido (peor combinación)

Noise ratio = 0.4



Neuron states by epochs (noise ratio = 0.4)



# One more thing...

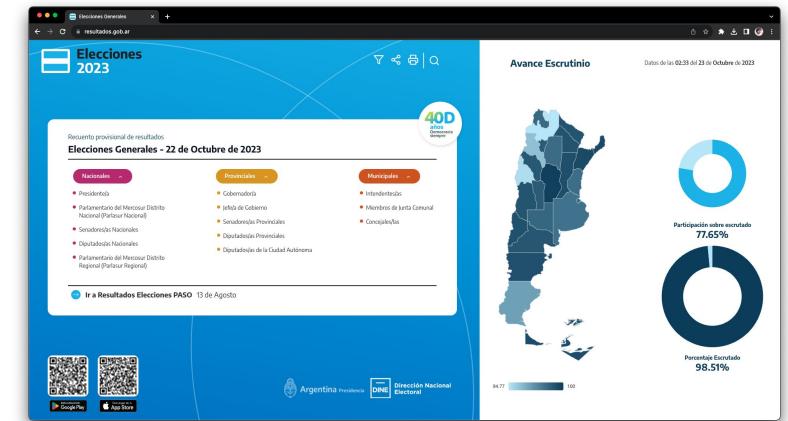
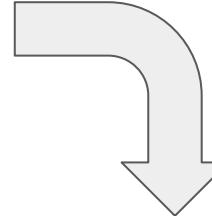


# Elecciones 2023

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provincia	blancos	UNION POR LA PATRIA	LA LIBERTAD AVANZA	JUNTOS POR EL CAMBIO	HACEMOS POR NUESTRO PAIS	FRENTE DE IZQUIERDA Y DE TRABAJADORES - UNIDAD
Buenos Aires	2.64	42.87	25.71	24.09	3.72	3.58
Catamarca	5.16	42.79	32.03	17.16	6.42	1.57
Chaco	1.09	43.69	27.76	24.13	3.62	0.77
Chubut	1.27	32.26	35.01	20.58	7.73	4.4
Ciudad Autónoma de Buenos Aires	1.69	32.27	19.84	41.22	3.09	3.55
Corrientes	1.1	37.2	26.88	32.12	2.73	1.04
Córdoba	0.76	13.42	33.54	22.62	29.01	1.38
Entre Ríos	4.24	33.25	29.74	30.09	5.37	1.53
Formosa	1.28	52.32	29.04	15.39	2.45	0.77
Jujuy	1.35	32.31	37.38	19.94	6.81	3.54
La Pampa	0.88	34.79	33.53	21.92	7.44	2.3
La Rioja	1.48	41.1	37.65	11.8	8.51	0.92
Mendoza	1.65	23.98	42.35	25.85	4.32	3.48
Misiones	2.74	37.91	42.12	14.44	4.13	1.38
Neuquén	2.69	31.77	36.71	20.53	5.95	5.01
Río Negro	2.81	37.85	33.72	18.13	6.26	4.02
Salta	1.09	37.61	40.4	13.94	6.27	1.76
San Juan	1.42	33.23	35.1	23.22	6.17	2.25
San Luis	1.78	27.19	43.37	20.96	6.28	2.18
Santa Cruz	6.04	37.87	36.29	16.35	6.58	2.88
Santa Fe	0.9	29.68	32.47	26.89	9.04	1.9
Santiago del Estero	1.28	65.5	22.98	8.09	2.16	1.26
Tierra del Fuego, Antártida e Islas del Atlántico Sur	1.44	38.2	33.82	14.95	9.15	3.85
Tucumán	2.07	44.97	34.93	14.61	4.01	1.44

# Elecciones 2023 (3x3)

Complete Heatmap



Provincia	UNION POR LA LIBERTAD	JUNTOS POR	HACEMOS POR	FRENTE DEIZ
Buenos Aires	42.87	25.71	24.09	3.72
Catamarca	42.79	32.03	17.16	6.42
Chaco	43.69	27.76	24.13	3.62
Chubut	32.26	35.01	20.58	7.73
Ciudad Autónoma	32.27	19.84	41.22	3.09
Corrientes	37.2	26.88	32.12	2.73
Córdoba	13.42	33.54	22.62	29.01
Entre Ríos	33.25	29.74	30.09	5.37
Formosa	52.32	29.04	15.39	2.45
Jujuy	32.31	37.38	19.94	6.81
La Pampa	34.79	33.53	21.92	7.44
La Rioja	41.1	37.65	11.8	8.51
Mendoza	23.98	42.35	25.85	4.32
Misiones	37.91	42.12	14.44	4.13
Neuquén	31.77	36.71	20.53	5.95
Río Negro	37.85	33.72	18.13	6.26
Salta	37.61	40.4	13.94	6.27
San Juan	33.23	35.1	23.22	6.17
San Luis	27.19	43.37	20.96	6.28
Santa Cruz	37.87	36.29	16.35	6.58
Santa Fe	29.68	32.47	26.89	9.04
Santiago del E	65.5	22.98	8.09	2.16
Tierra del Fue	38.2	33.82	14.95	9.15
Tucumán	44.97	34.93	14.61	4.01

Datos oficiales extraídos de la Cámara Nacional Electoral

# Elecciones 2023 (4x4)

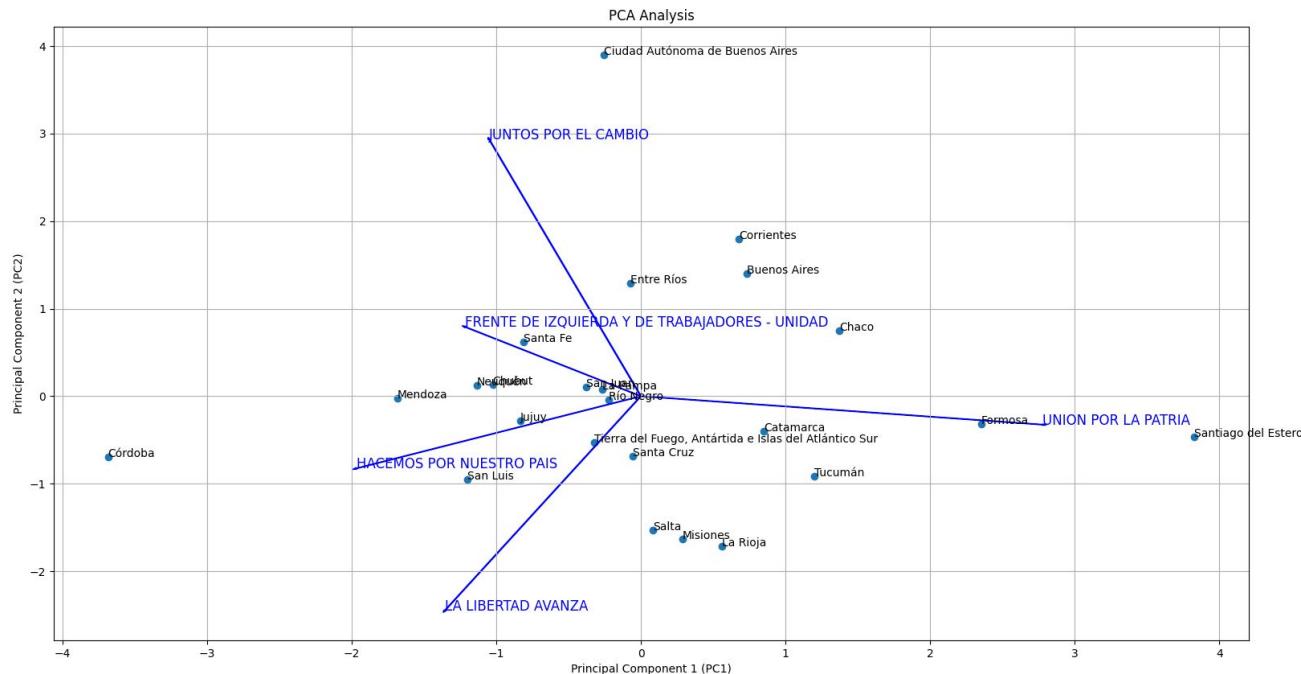
Complete Heatmap



Provincia	UNION POR LA LIBERTAD	JUNTOS POR	HACEMOS POSIBLE	FRENTE DEIZ	
Buenos Aires	42.87	25.71	24.09	3.72	3.58
Catamarca	42.79	32.03	17.16	6.42	1.57
Chaco	43.69	27.76	24.13	3.62	0.77
Chubut	32.26	35.01	20.58	7.73	4.4
Ciudad Autónoma de Buenos Aires	32.27	19.84	41.22	3.09	3.55
Corrientes	37.2	26.88	32.12	2.73	1.04
Córdoba	13.42	33.54	22.62	29.01	1.38
Entre Ríos	33.25	29.74	30.09	5.37	1.53
Formosa	52.32	29.04	15.39	2.45	0.77
Jujuy	32.31	37.38	19.94	6.81	3.54
La Pampa	34.79	33.53	21.92	7.44	2.3
La Rioja	41.1	37.65	11.8	8.51	0.92
Mendoza	23.98	42.35	25.85	4.32	3.48
Misiones	37.91	42.12	14.44	4.13	1.38
Neuquén	31.77	36.71	20.53	5.95	5.01
Río Negro	37.85	33.72	18.13	6.26	4.02
Salta	37.61	40.4	13.94	6.27	1.76
San Juan	33.23	35.1	23.22	6.17	2.25
San Luis	27.19	43.37	20.96	6.28	2.18
Santa Cruz	37.87	36.29	16.35	6.58	2.88
Santa Fe	29.68	32.47	26.89	9.04	1.9
Santiago del Estero	65.5	22.98	8.09	2.16	1.26
Tierra del Fuego, Antártida e Islas del Atlántico Sur	38.2	33.82	14.95	9.15	3.85
Tucumán	44.97	34.93	14.61	4.01	1.44

Datos oficiales extraídos de la Cámara Nacional Electoral

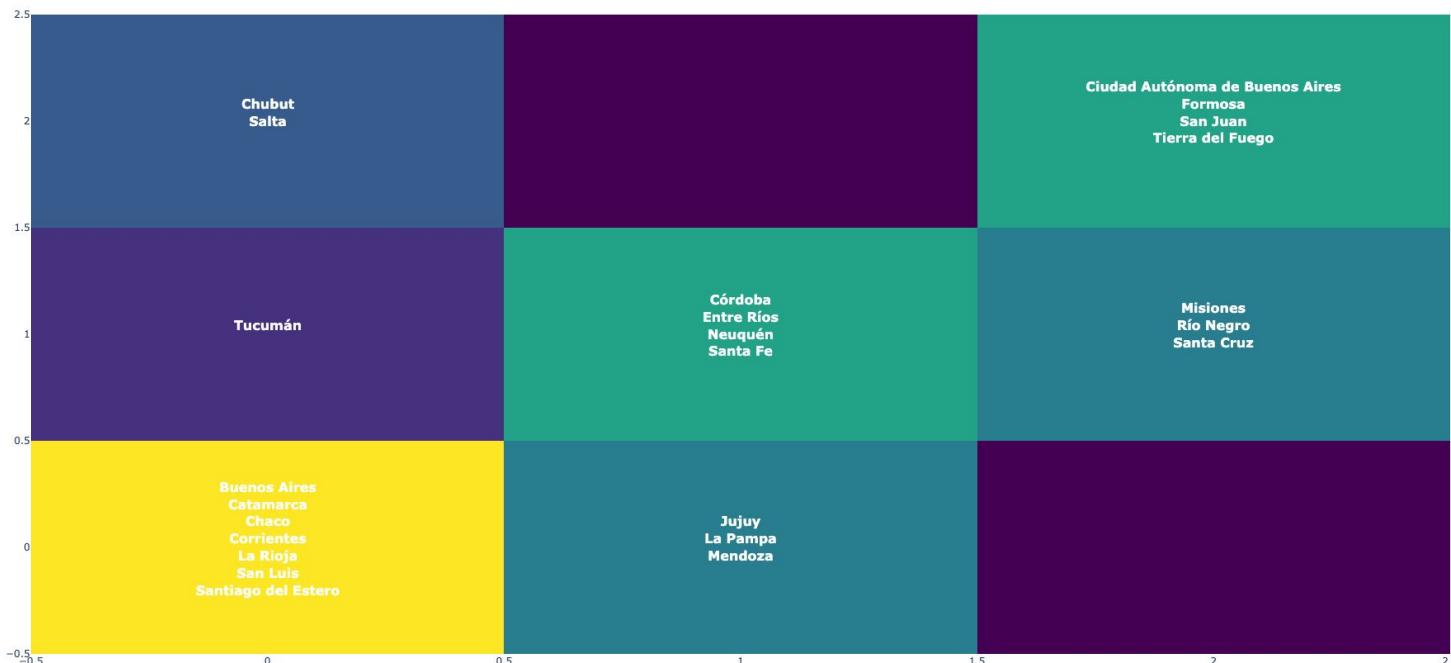
# Elecciones 2023



Provincia	T	UNION POR LA PATRIA	LA LIBERTAD AVANZA	JUNTOS POR EL CAMBIO	HACEMOS POR NUESTRO PAIS	FREnte DE IZQUIERDA Y DE TRABAJADORES - UNIDAD
Buenos Aires	42.87	25.71	24.09	3.72	3.58	
Catamarca	42.79	32.03	17.16	6.42	1.57	
Chaco	43.69	27.76	24.13	3.62	0.77	
Chubut	32.26	35.01	20.58	7.73	4.4	
Ciudad Autónoma de Buenos Aires	32.27	19.84	41.22	3.09	3.55	
Corrientes	37.2	26.88	32.12	2.73	1.04	
Córdoba	13.42	33.54	22.62	29.01	1.38	
Entre Ríos	33.25	29.74	30.09	5.37	1.53	
Formosa	52.32	29.04	15.39	2.45	0.77	
Jujuy	32.31	37.38	19.94	6.81	3.54	
La Pampa	34.79	33.53	21.92	7.44	2.3	
La Rioja	41.1	37.65	11.8	8.51	0.92	
Mendoza	23.98	42.35	25.85	4.32	3.48	
Misiones	37.91	42.12	14.44	4.13	1.38	
Neuquén	31.77	36.71	20.53	5.95	5.01	
Río Negro	37.85	33.72	18.13	6.26	4.02	
Salta	37.61	40.4	13.94	6.27	1.76	
San Juan	33.23	35.1	23.22	6.17	2.25	
San Luis	27.19	43.37	20.96	6.28	2.18	
Santa Cruz	37.87	36.29	16.35	6.58	2.88	
Santa Fe	29.68	32.47	26.89	9.04	1.9	
Santiago del Estero	65.5	22.98	8.09	2.16	1.26	
Tierra del Fuego	38.2	33.82	14.95	9.15	3.85	
Tucumán	44.97	34.93	14.61	4.01	1.44	

Pobreza primer semestre 2022 a primer semestre 2023 (3x3)

## Complete Heatmap



<b>Provincia</b>	<b>Pobreza</b>
Buenos Aires	0.45
Catamarca	0.44
Chaco	0.54
Chubut	0.41
Ciudad Autónoma de Buenos Aires	0.16
Corrientes	0.45
Córdoba	0.4
Entre Ríos	0.38
Formosa	0.34
Jujuy	0.42
La Pampa	0.42
La Rioja	0.44
Mendoza	0.42
Misiones	0.37
Neuquén	0.38
Río Negro	0.36
Salta	0.4
San Juan	0.33
San Luis	0.45
Santa Cruz	0.37
Santa Fe	0.4
Santiago del Estero	0.47
Tierra del Fuego	0.31
Tucumán	0.44

## Datos extraído del INDEC

# Pobreza primer semestre 2022 a primer semestre 2023 (4x4)

Complete Heatmap



Datos extraído del INDEC

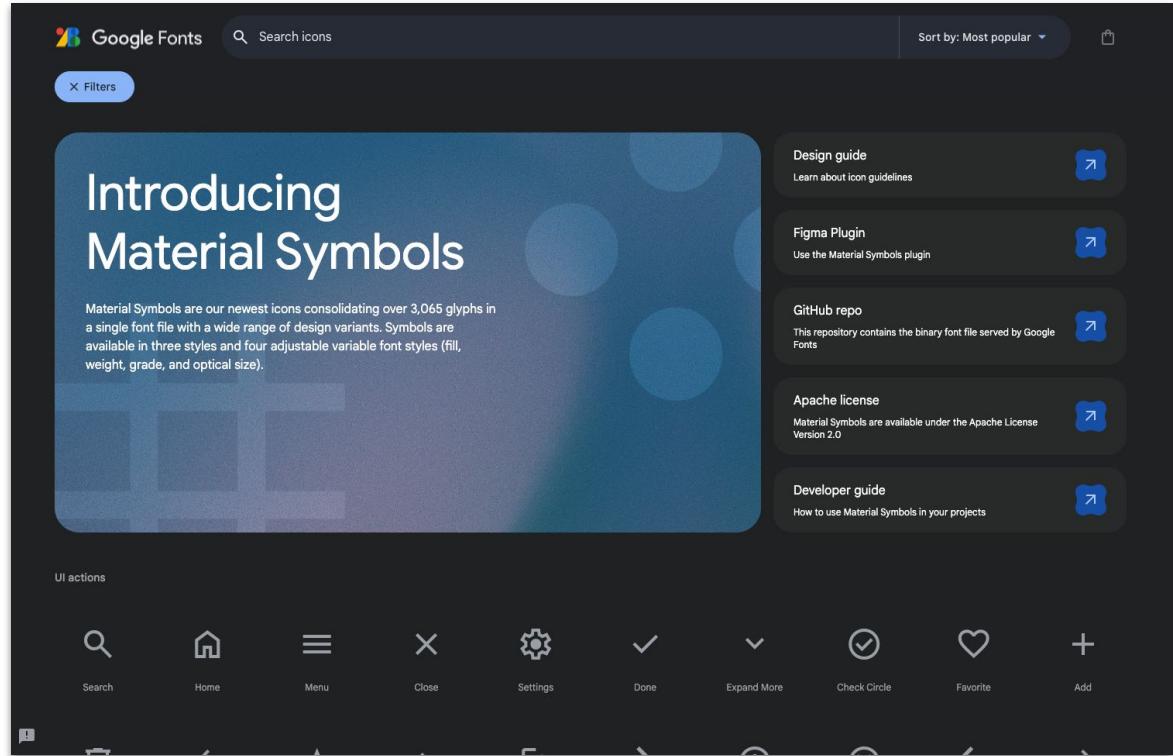
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Buenos Aires	0.45
Catamarca	0.44
Chaco	0.54
Chubut	0.41
Ciudad Autónoma de Buenos Aires	0.16
San Juan	0.45
Tierra del Fuego	0.31
Santa Cruz	0.37
Córdoba	0.4
Entre Ríos	0.38
Formosa	0.34
Jujuy	0.42
La Pampa	0.42
La Rioja	0.44
Mendoza	0.42
Misiones	0.37
Neuquén	0.38
Río Negro	0.36
Salta	0.4
San Juan	0.33
San Luis	0.45
Santa Cruz	0.37
Santa Fe	0.4
Santiago del Estero	0.47
Tucumán	0.44

# Conclusión parcial

En la segregación por provincia no hay correlación entre el voto de la población argentina y el grado de pobreza.

# Iconos

# Utilizando solo Material Design

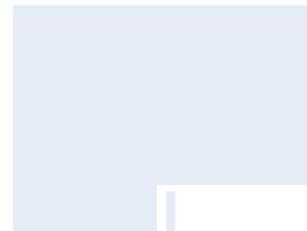
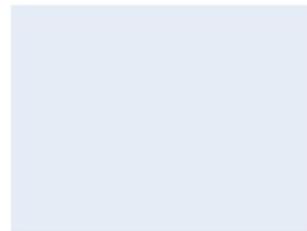
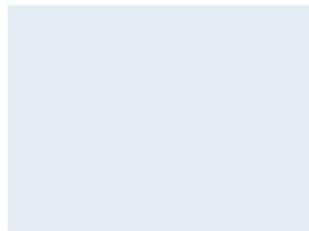
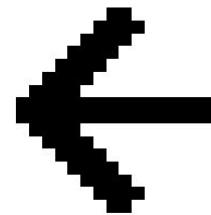
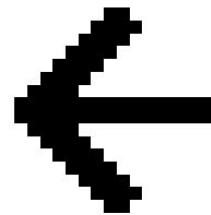
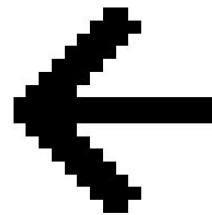
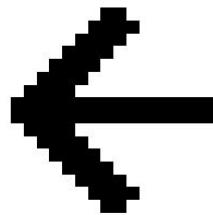
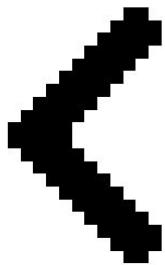
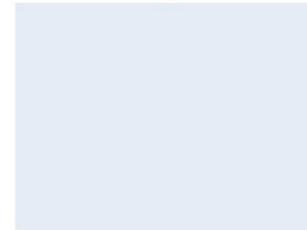
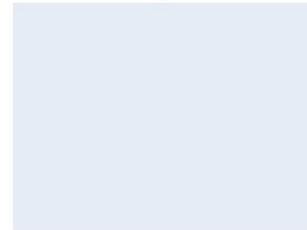
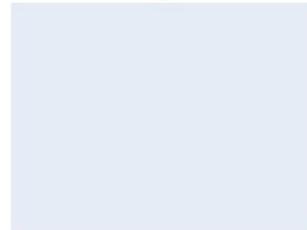
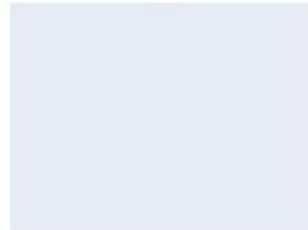
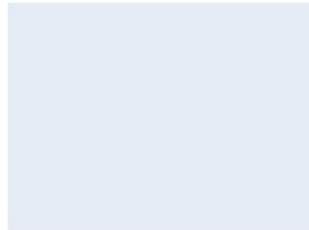


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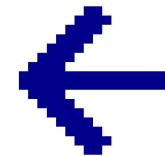
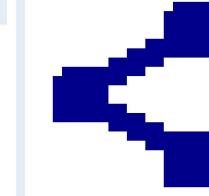
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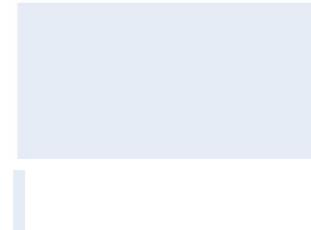
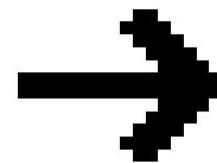
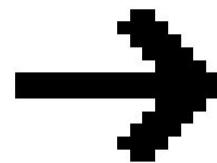
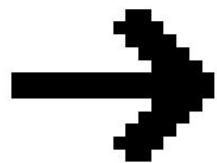
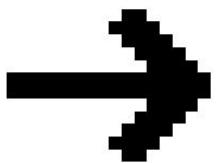
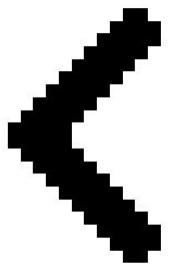
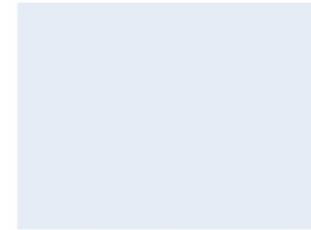
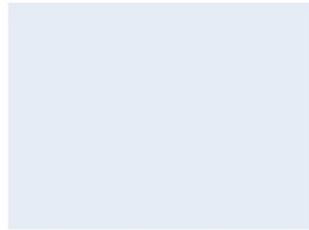
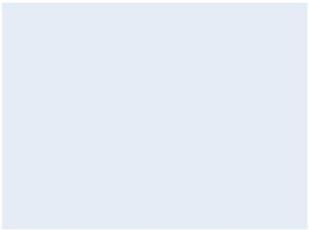


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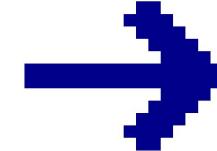
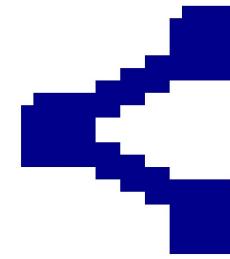
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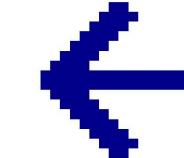
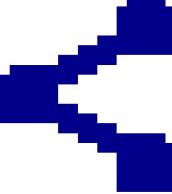
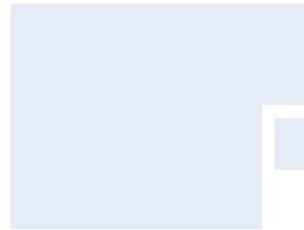
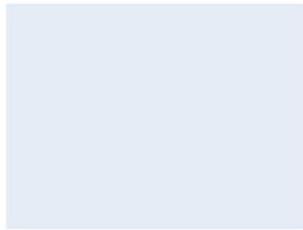
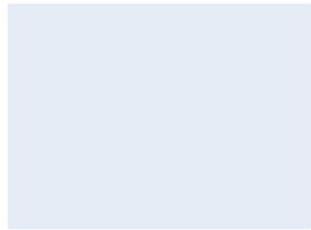
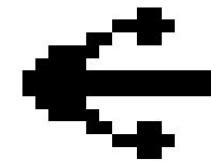
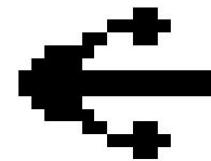
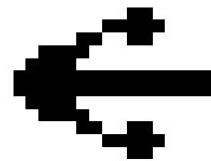
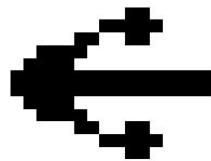
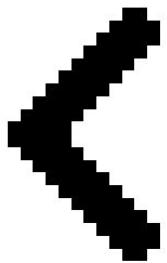
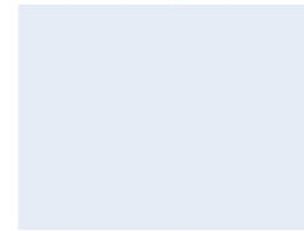
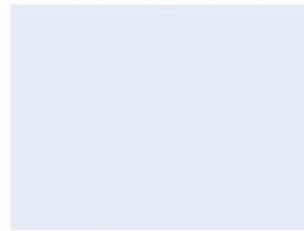
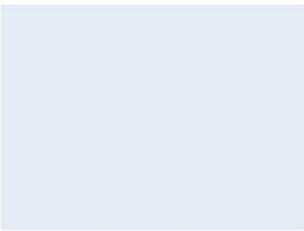
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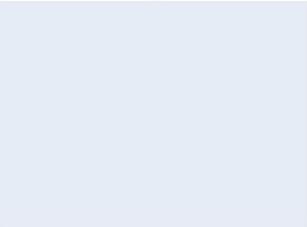
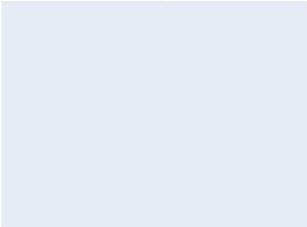
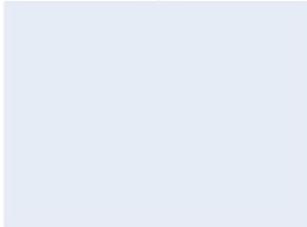
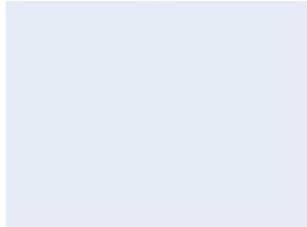
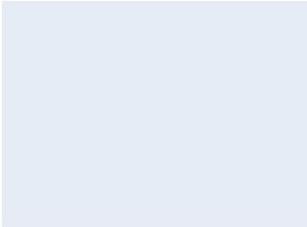


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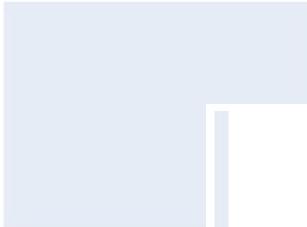
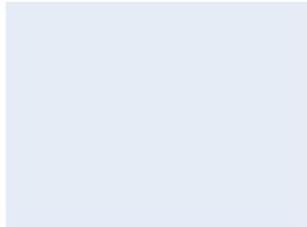
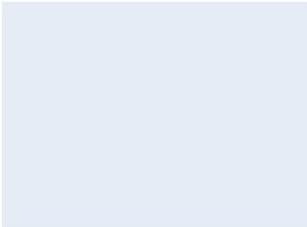




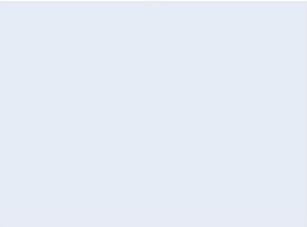
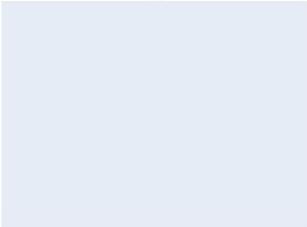
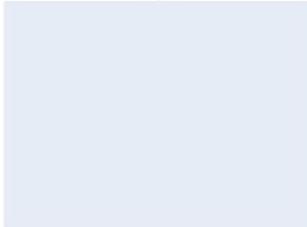
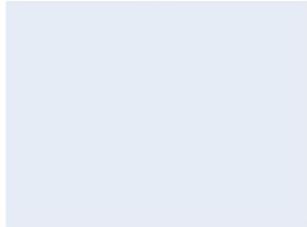
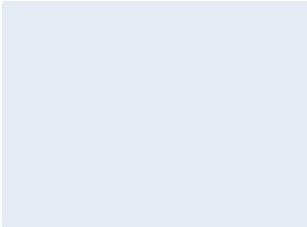
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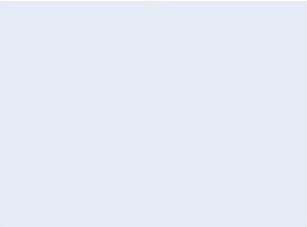
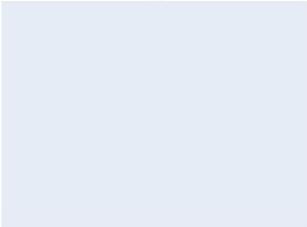
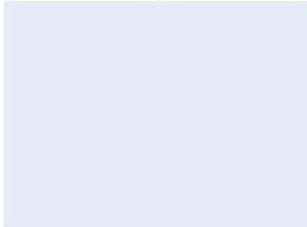
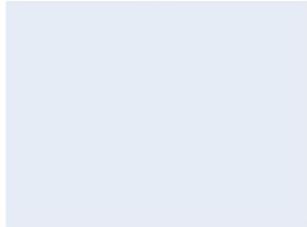
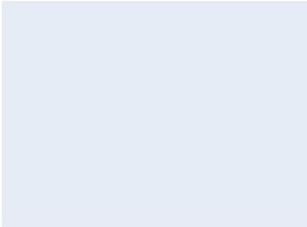
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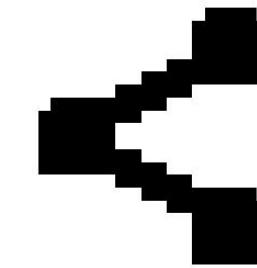
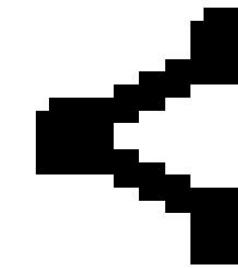
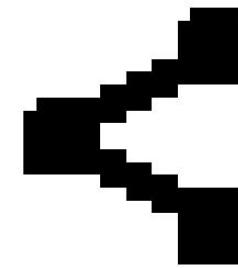
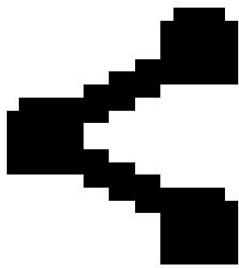
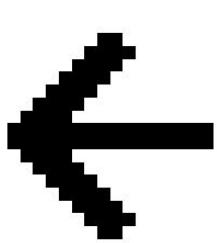
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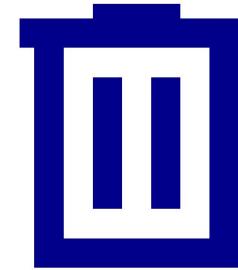
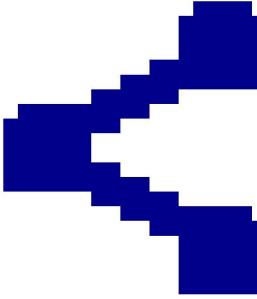
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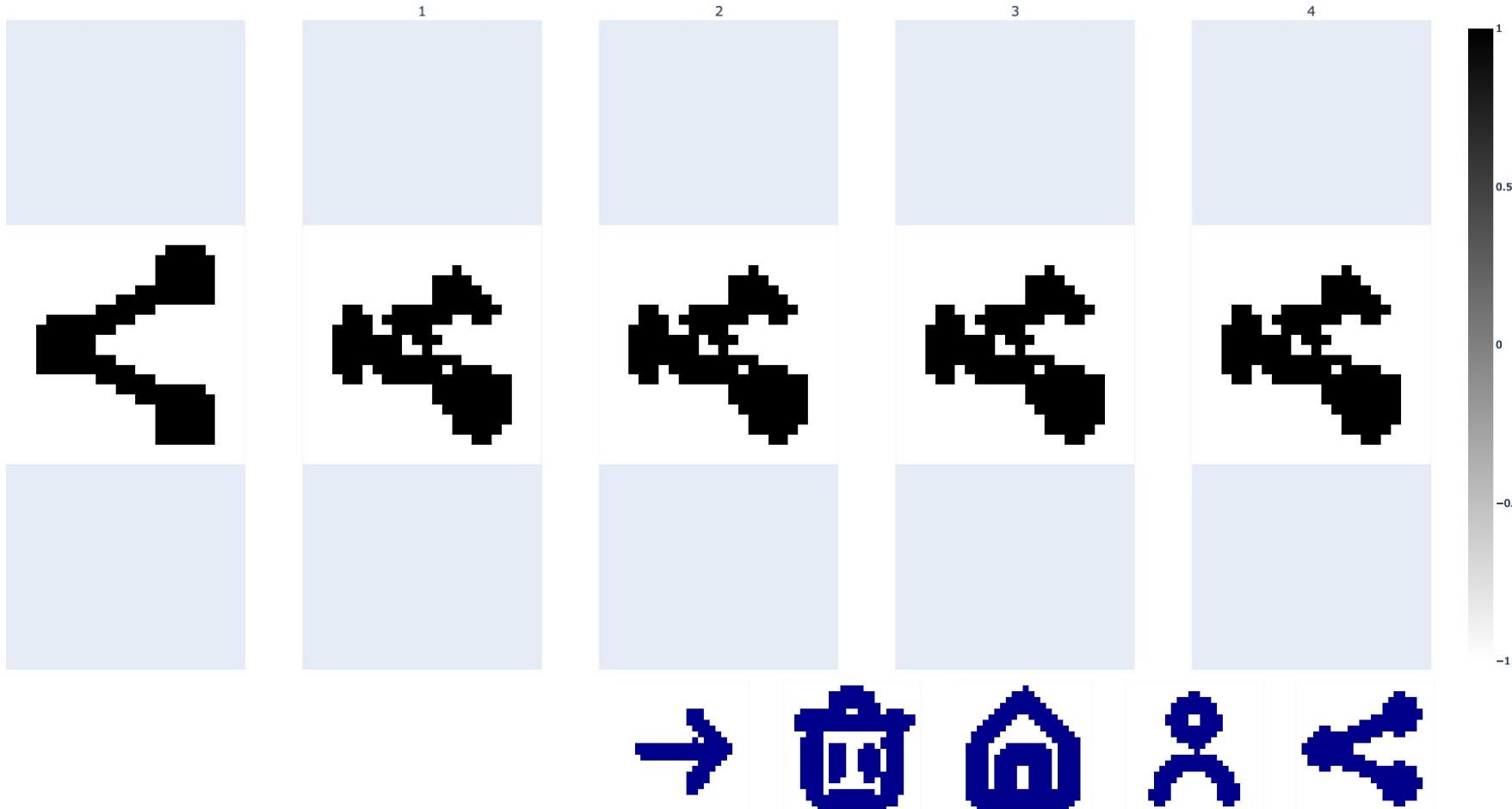


# Combinando distintos

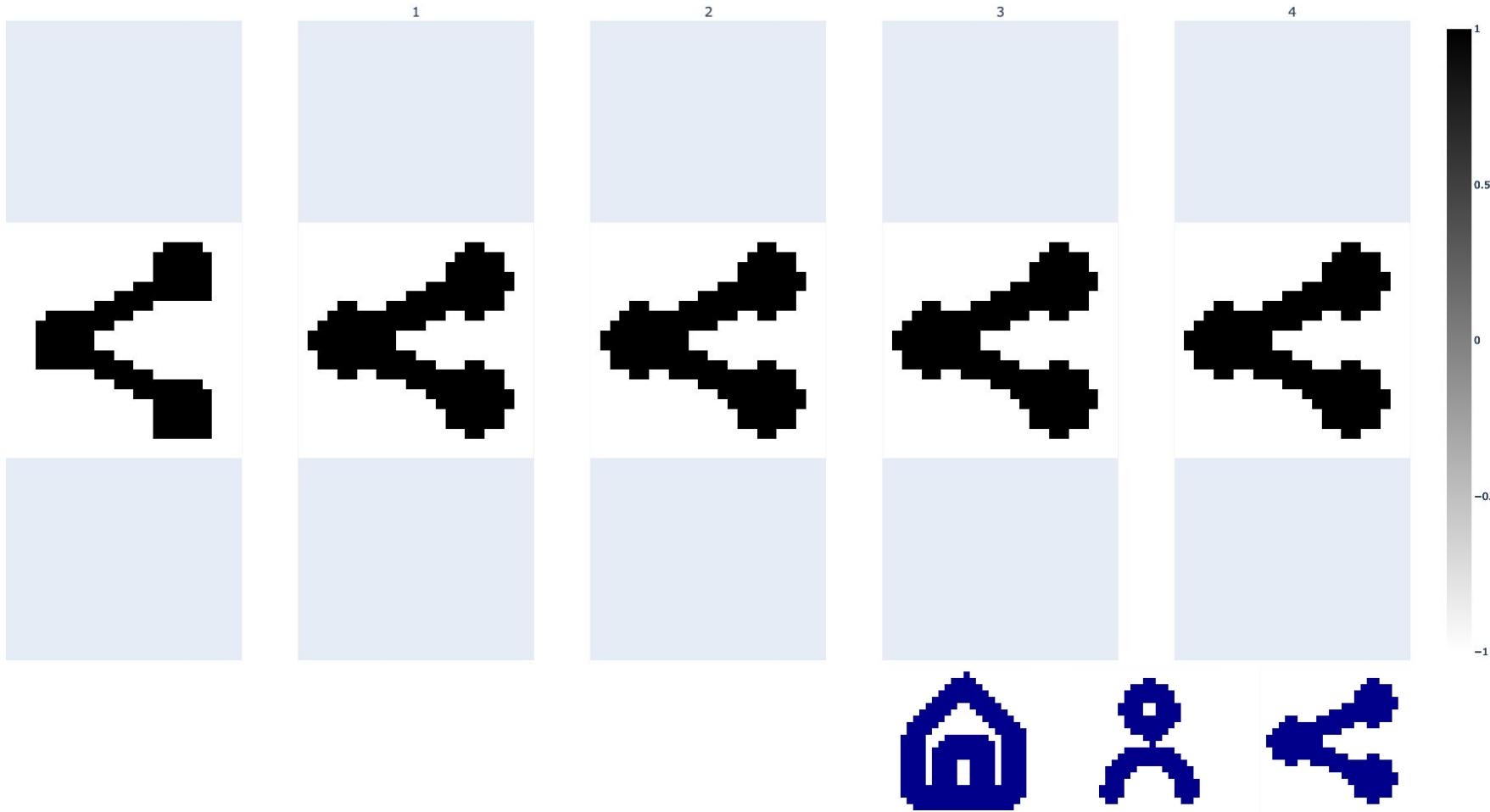
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- Lucide**: A dark-themed website for "Beautiful & consistent icons". It features a grid of icons at the top, a search bar, and sections for "Lightweight & Scalable" and "Clean & consistent" icons. It also includes a "Material Symbols" section and a "UI actions" section at the bottom.
- Google Fonts**: A dark-themed interface for "Eva Icons". It shows a list of resources including "Design guide", "Figma Plugin", "GitHub repo", "Apache license", and "Developer guide". It also includes a "UI actions" section at the bottom.
- Material Symbols**: A dark-themed interface for "Introducing Material Symbols". It features a large central image with the text "Introducing Material Symbols" and a list of resources on the right side.

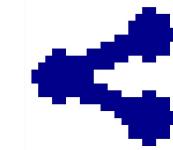
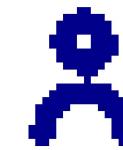
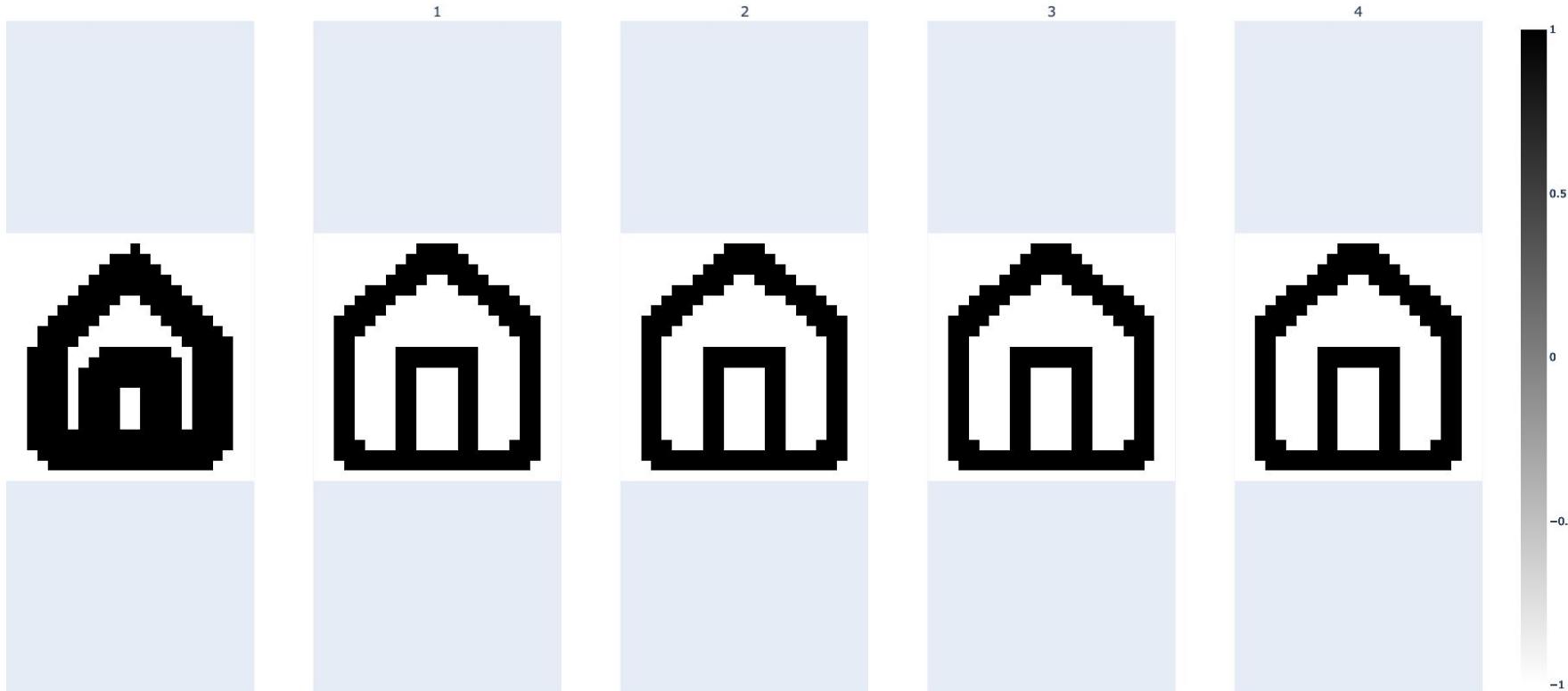
Neuron states by epochs (noise ratio = 1e-07)



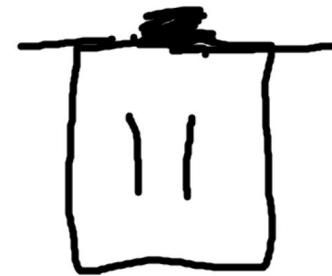
Neuron states by epochs (noise ratio = 1e-07)

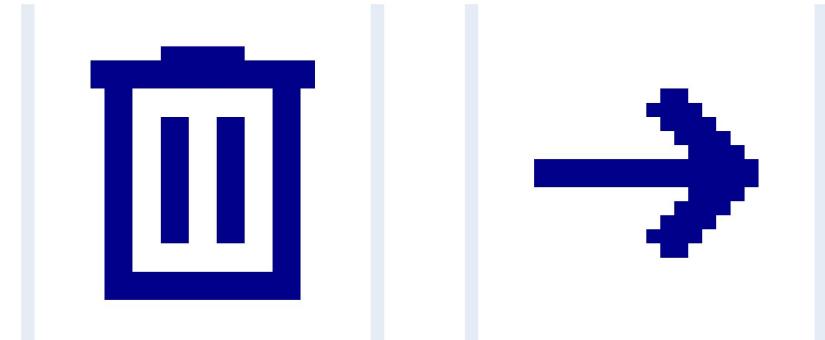
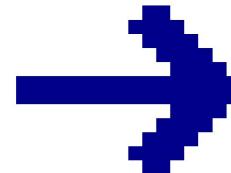
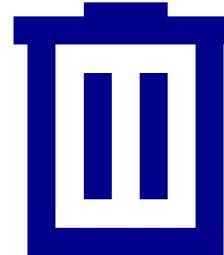
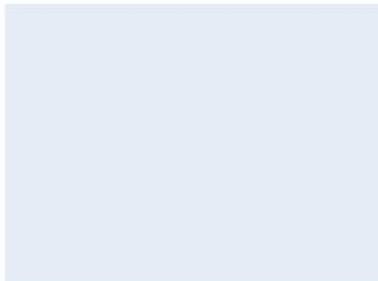
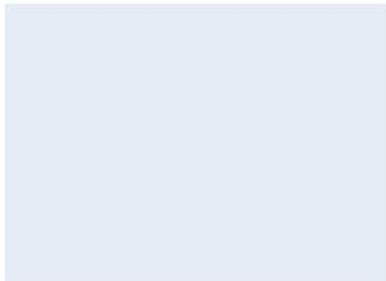
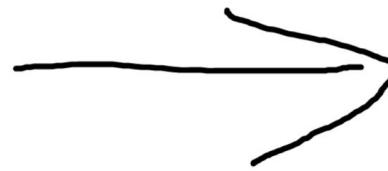
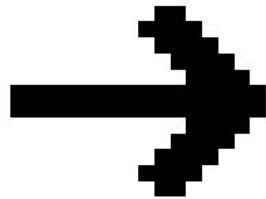
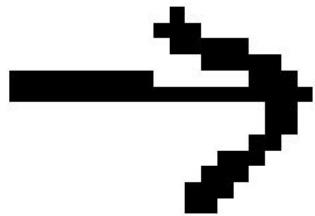
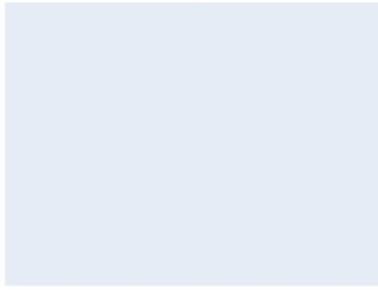
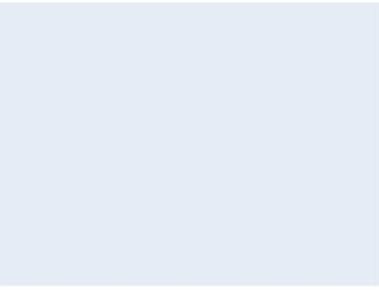


Neuron states by epochs (noise ratio = 1e-07)

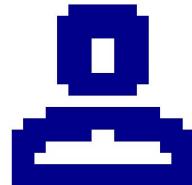
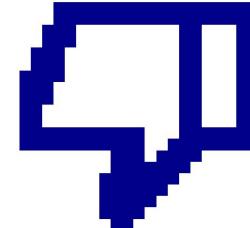
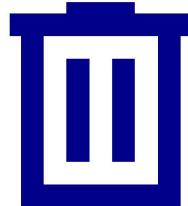
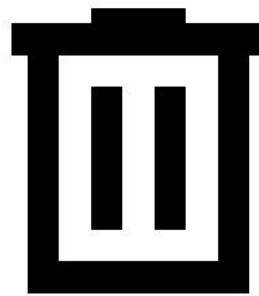
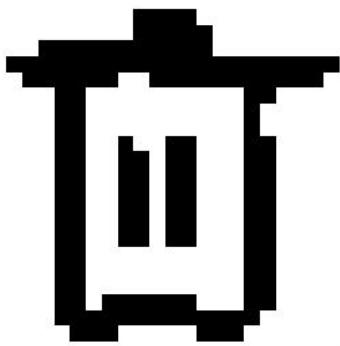


# Escrito a mano





1



**¡Muchas gracias!**

## **Integrantes:**

- **Nicolás Matías Margenat, 62028**
  - **Martín Hecht, 62041**
  - **Juan Burda, 62094**
  - **Lautaro Hernando, 62329**
- **Saul Ariel Castañeda, 62493**
  - **Elian Paredes, 62504**