

DATA science in TOPOLOGY

Mathematical
modeling



2^x



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Yazmin Cote

$x + y$

2^x





2^x

$x+y$

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Medicine

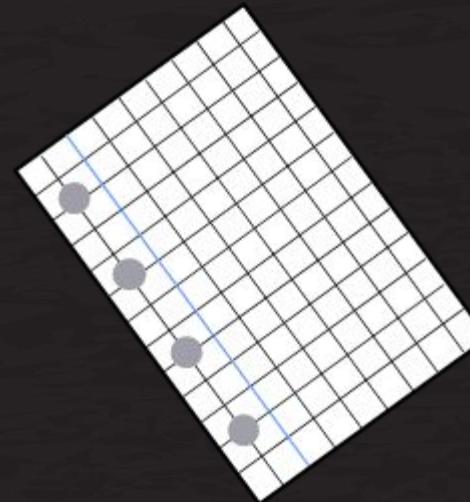
$x+y$



01

IMAGE PROCESSING

$x+y$



$x+y$



2^x

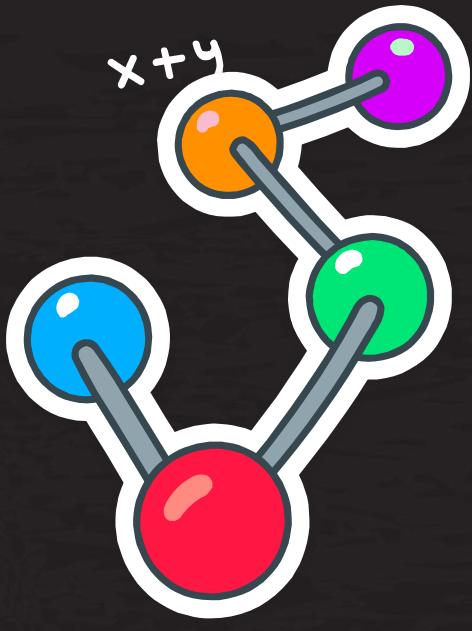
IMAGE PROCESSING

First criterion is based on the visual part or observation

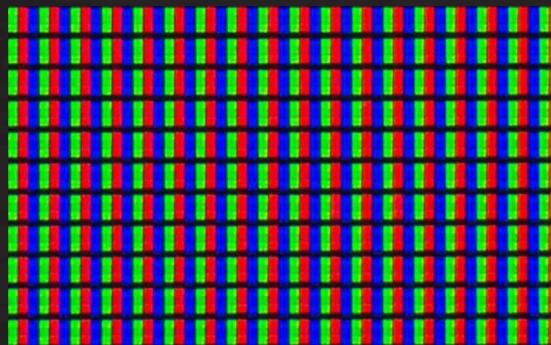
2^x



$x+y$



IMAGE



Computationally an image is a matrix of pixels of colors Red, Green and Blue or RGB

2^x

$x+y$

$x+y$

AI OR ARTIFICIAL INTELLIGENCE

2^x

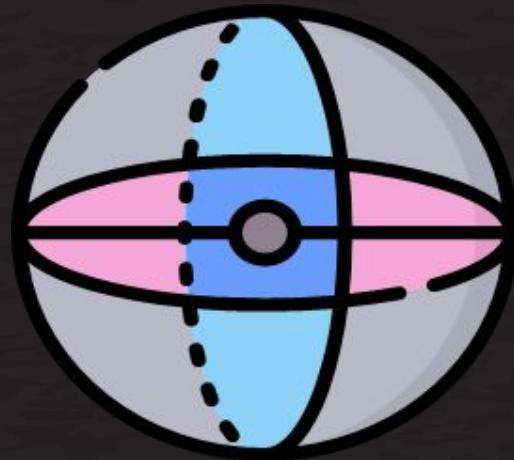
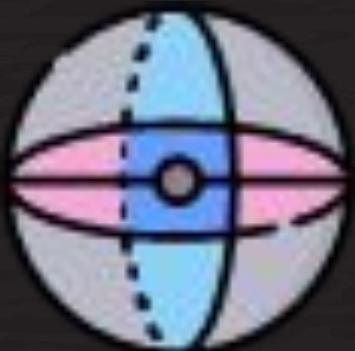


Train the computer for image recognition

$x+y$

$x+y$

SUPER RESOLUTION

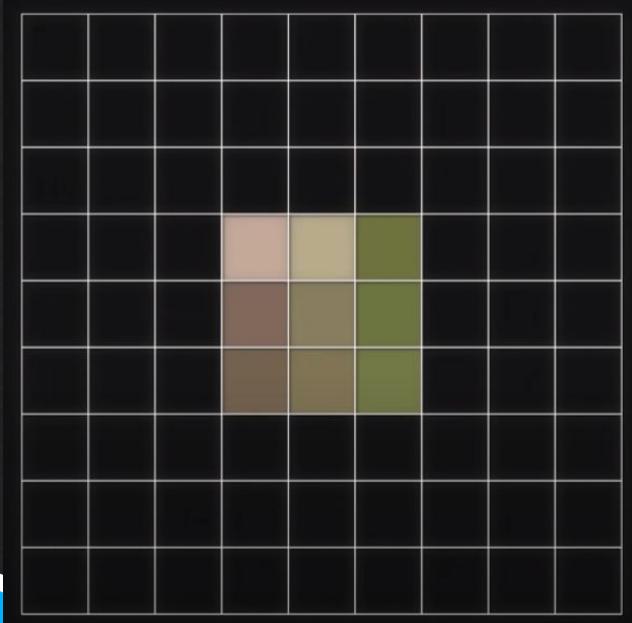


2^x

$x+y$

$x+y$

SUPER RESOLUTION

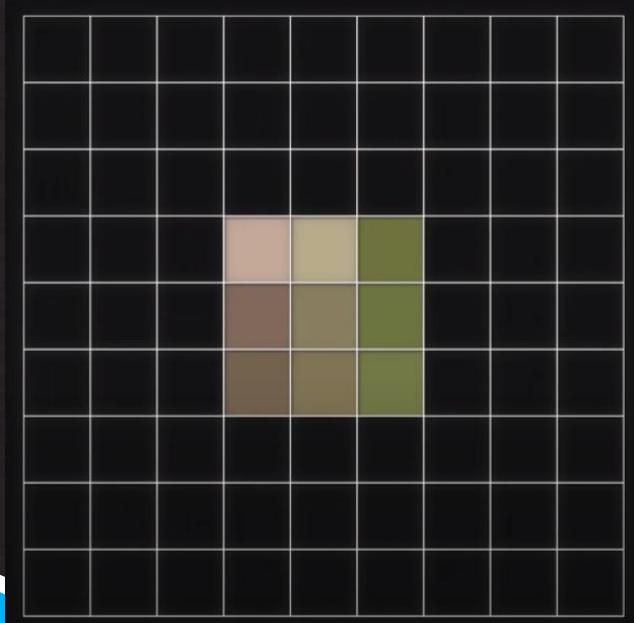


2^x

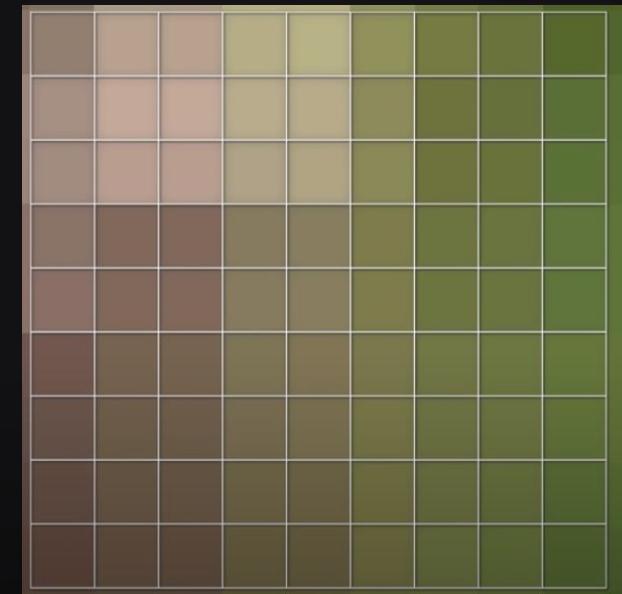
$+y$

$x+y$

SUPER RESOLUTION



Rescaled bineal

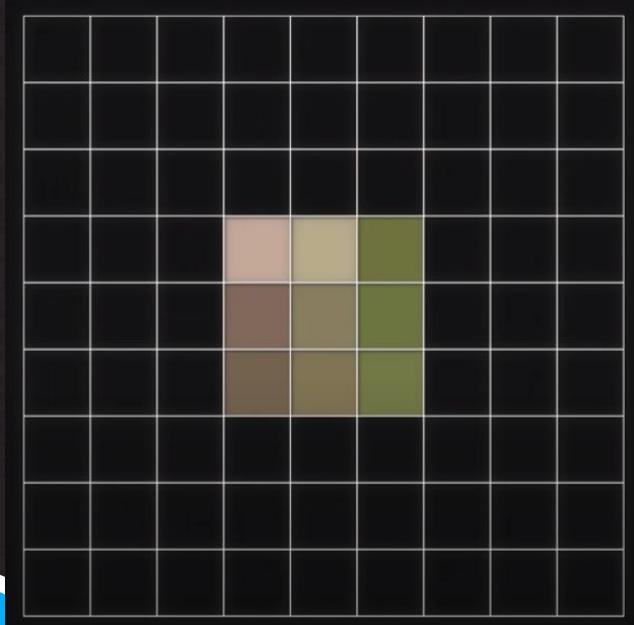


2^x

$+y$

$x+y$

SUPER RESOLUTION



NEAREST NEIGHBOR



2^x

$x+y$

$x+y$

SUPER RESOLUTION



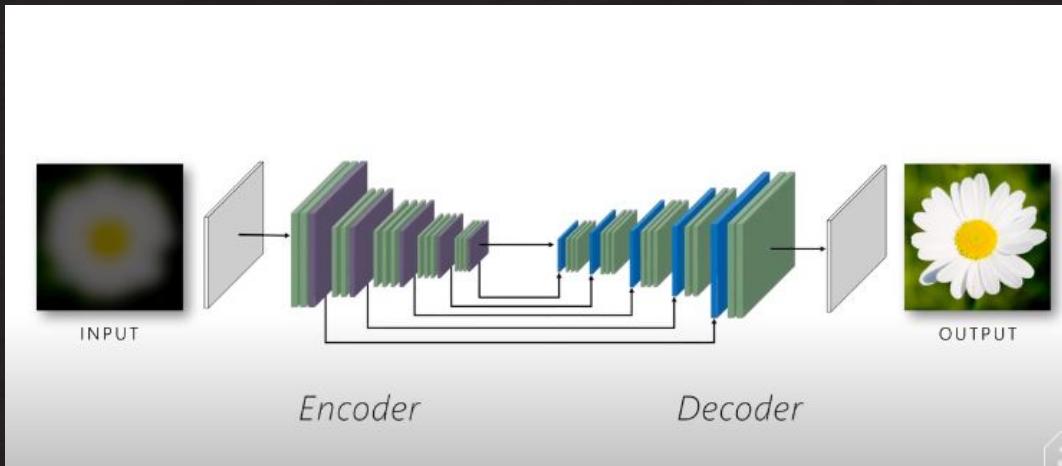
2^x



$x+y$

$x+y$

SUPER RESOLUTION



Redes convolucionales

Imagenes tomadas de
<https://www.youtube.com/watch?v=dPYwrx8f+YH0&t=618s>

$x+y$



TOPOLOGY DIGITAL



$x+y$

TOPOLOGY DIGITAL

2^x

Digital topology deals with the topological properties of digital image and provides a sound mathematical basis for image processing operations such as image thinning, border following and connected component labelling (shao and Li,1992)

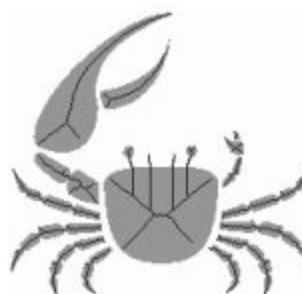
Shao,J & LI, D. (Ed.). (1992). DIGITAL TOPOLOGICAL AND MATRIX STRUCTURED IMAGE PROCESSING (Vol. 17). ISPRS Congress, Comm. ill , Washington D. C.

$x+y$

EXAMPLE OF IMAGE THINNING USING TOPOLOGICAL ALGORITHMS

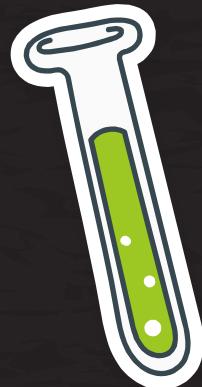


(a) Imagen original



(b) Esqueleto

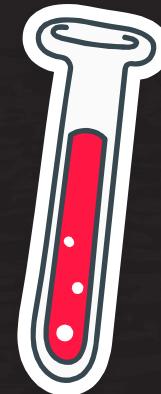
Camara, A. (2016, junio). Algoritmos topológicos de adelgazamiento de imágenes digitales.

$x+y$  2^x

03

ALGEBRAIC TOPOLOGY

Applied in the fields of medicine, in concrete traumatic cerebral injuries and traumatic spinal cord injuries

 $x+y$

TOPOLOGICAL ANALYSIS RESEARCH



ARTICLE

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OPEN

Topological data analysis for discovery in preclinical spinal cord injury and traumatic brain injury

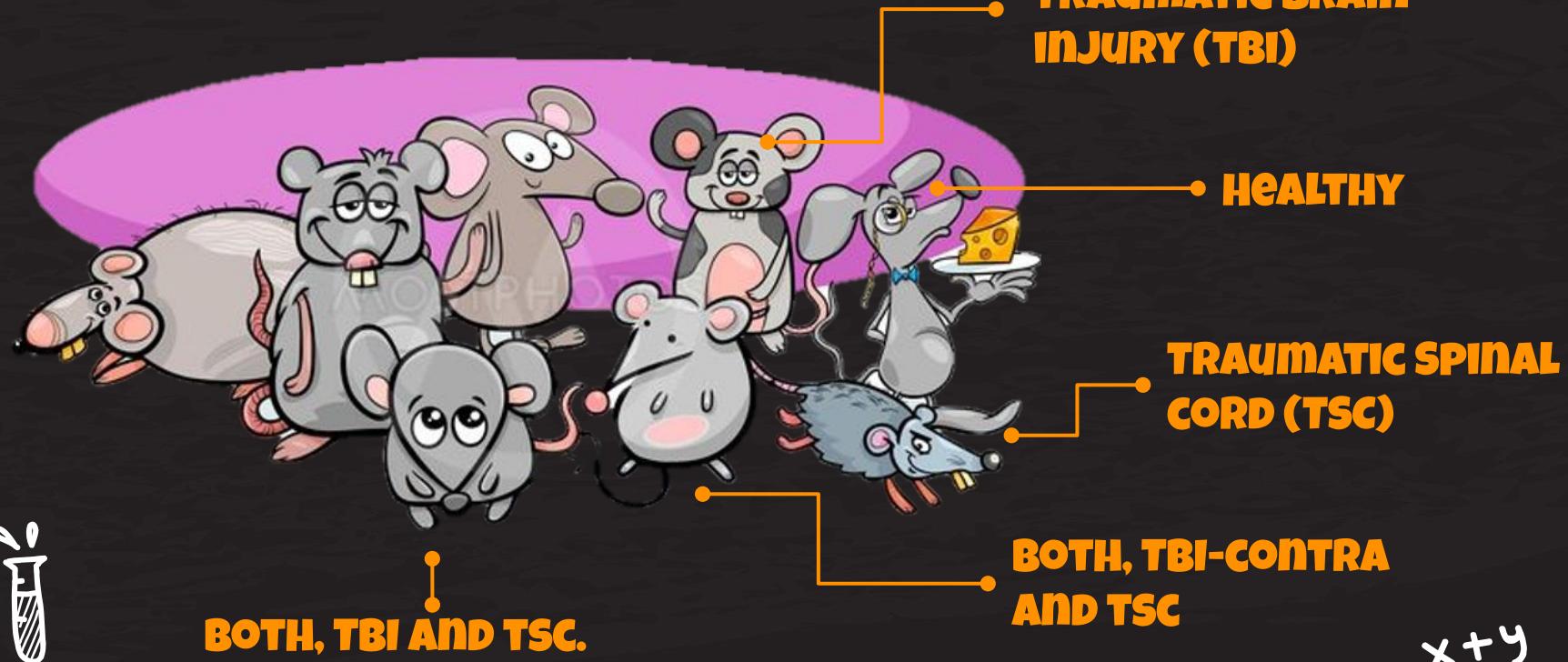
Jessica L. Nielson¹, Jesse Paquette², Aiwen W. Liu¹, Cristian F. Guandique¹, C. Amy Tovar³, Tomoo Inoue⁴, Karen-Amanda Irvine⁵, John C. Gensel⁶, Jennifer Kloke⁷, Tanya C. Petrossian⁸, Pek Y. Lum⁹, Gunnar E. Carlsson^{7,10}, Geoffrey T. Manley¹, Wise Young¹¹, Michael S. Beattie¹, Jacqueline C. Bresnahan¹ & Adam R. Ferguson^{1,12}

Data-driven discovery in complex neurological disorders has potential to extract meaningful syndromic knowledge from large, heterogeneous data sets to enhance potential for precision medicine. Here we describe the application of topological data analysis (TDA) for data-driven discovery in preclinical traumatic brain injury (TBI) and spinal cord injury (SCI) data sets



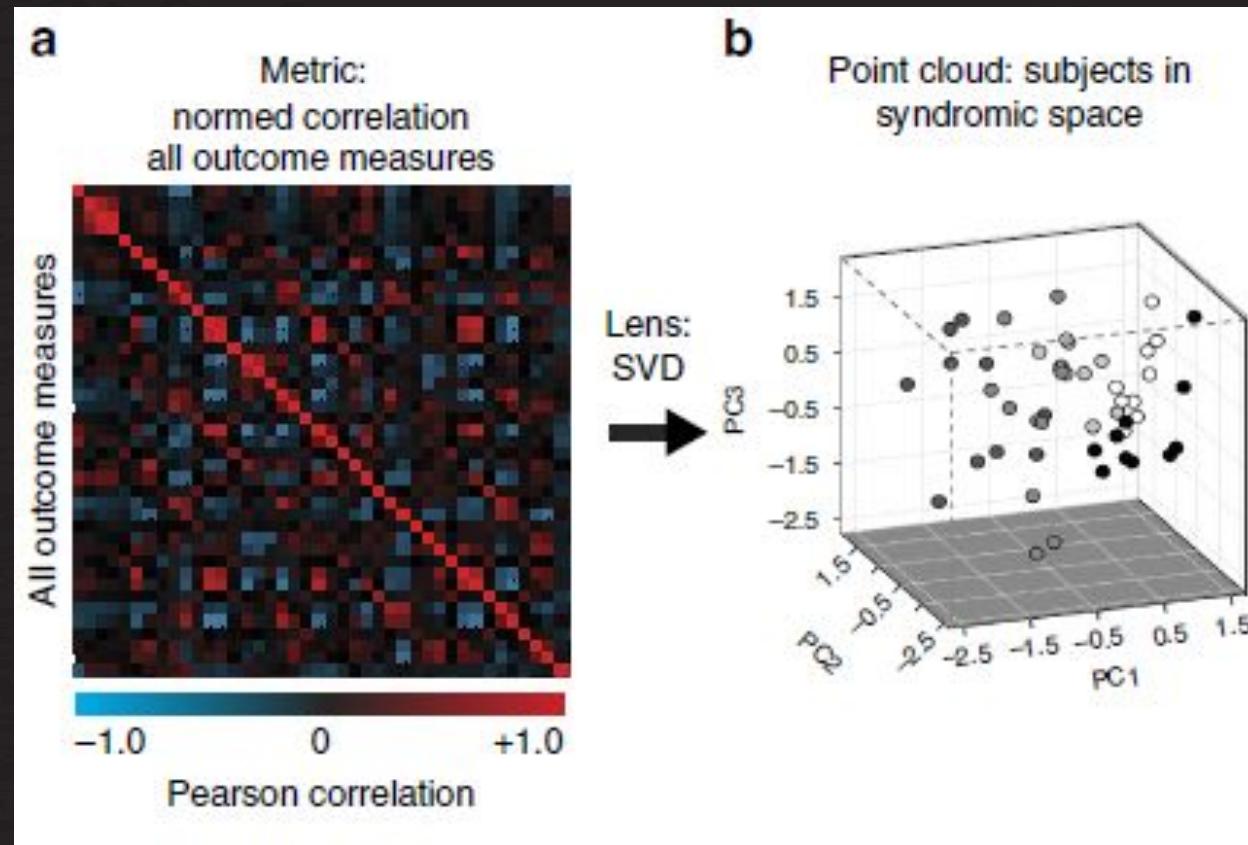
MICE SAMPLING

2^x



$x+y$

MULTIVARIATE METHODS



x+y

2^x

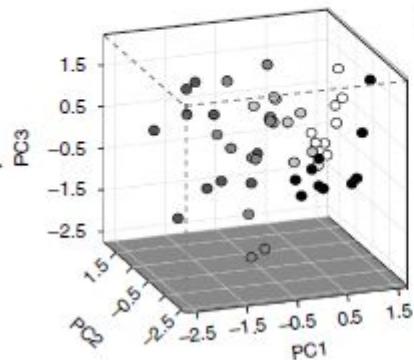
SYNDROMIC NETWORK TOPOLOGY

$x + y$

2^x

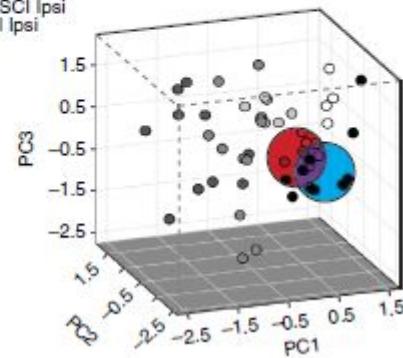
b

Point cloud: subjects in syndromic space



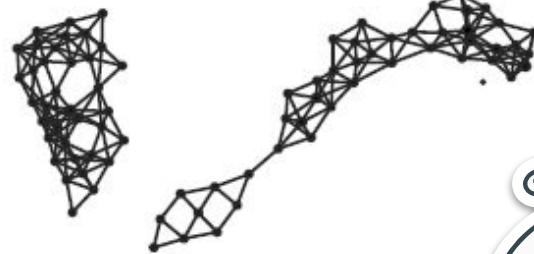
c

Topological resampling:



d

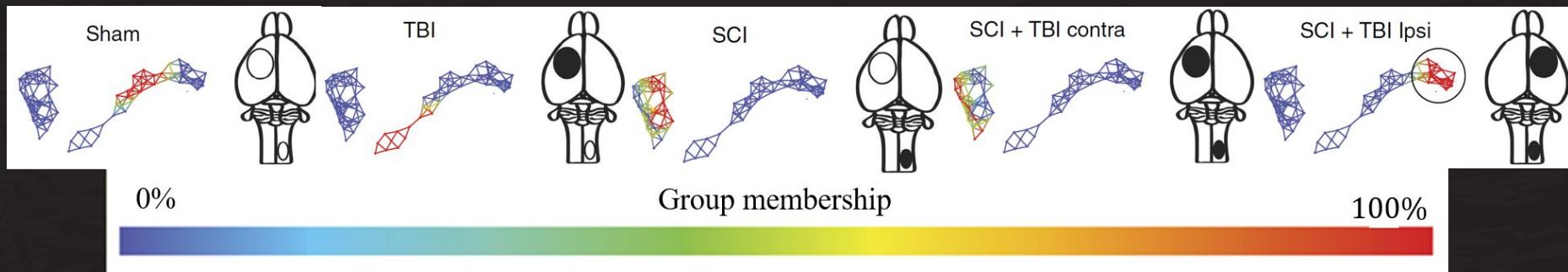
Extracted syndromic network topology



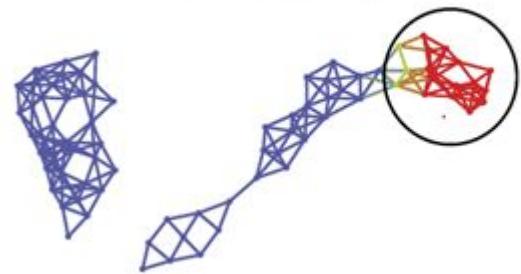
CLASSIFICATION

2^x

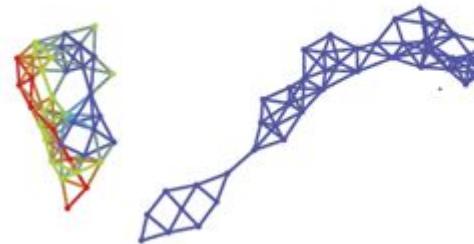
$x+y$



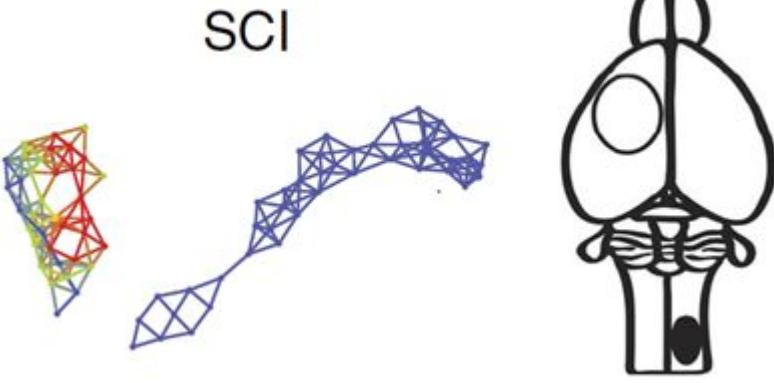
SCI + TBI Ipsi



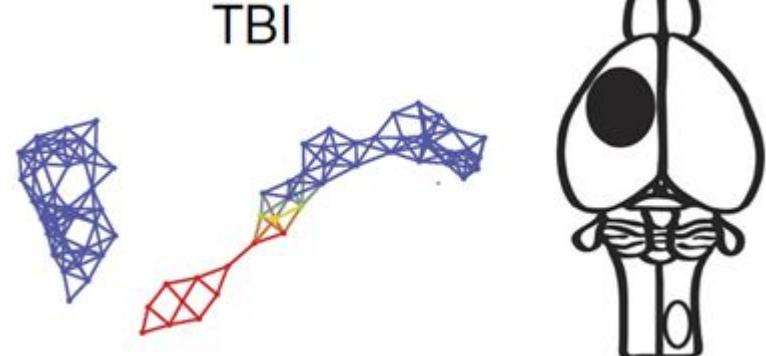
SCI + TBI contra



SCI



TBI



2^x



EXPERIMENTS AND SYNDROMIC FUNCTIONAL RECOVERY

$x+y$



2^x

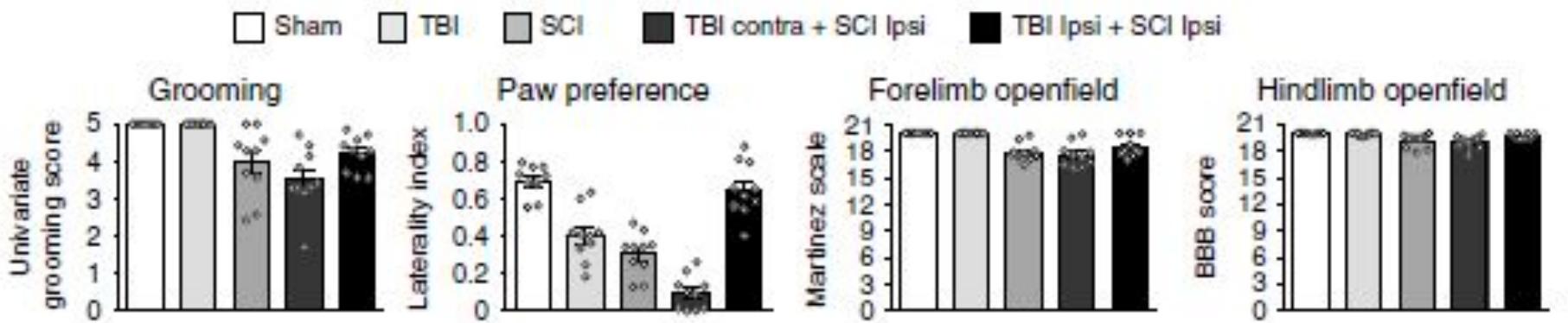


2*

IMPORTANCE AND UTILITY



BEHAVIORAL OUTCOMES



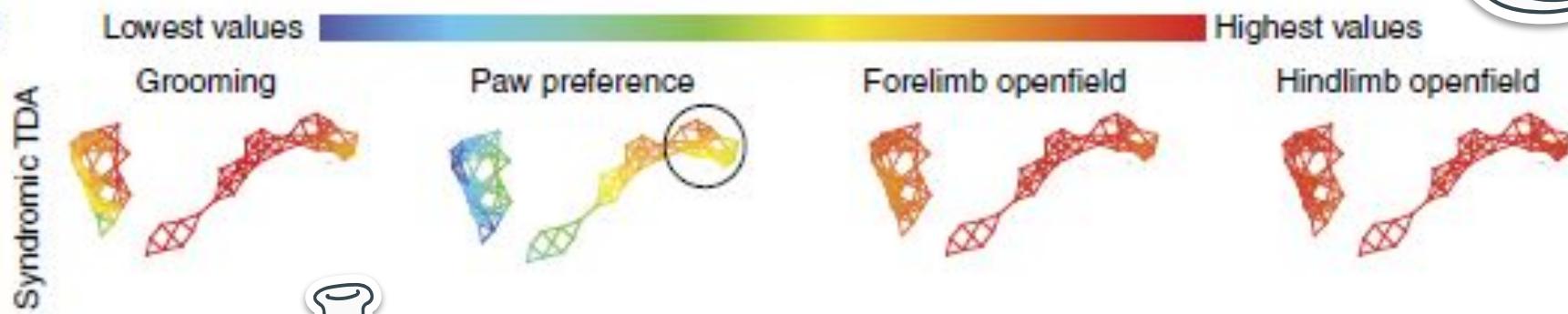
*†

$x+y$

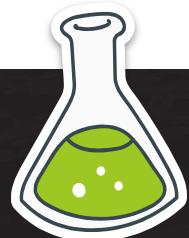
RESULTS



b



2^x



2^x

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[http://sea-entomologia.org/PDF/Boletin53/443464BSEA53BinarizacionRMagro.pdf.](http://sea-entomologia.org/PDF/Boletin53/443464BSEA53BinarizacionRMagro.pdf)

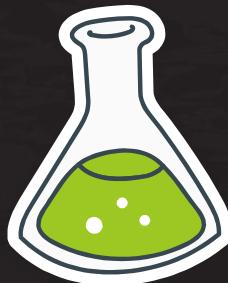




REFErences



- [5] Nielson, J., Paquette, J., Liu., A., & Guandique., C. et al. (2015). Topological data analysis for discovery in preclinical spinal cord injury and traumatic brain injury. Nature Communications, 6 (8581). <https://doi.org/10.1038/ncomms9581> 2*



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