Spatialdata 101
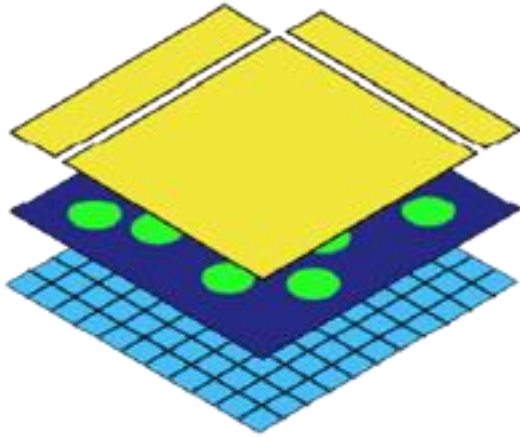
Technical Intro to the
scVerse framework

Teach + Learn Session MannLabs
2025

Why spatialdata?
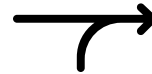

Integrated modalities

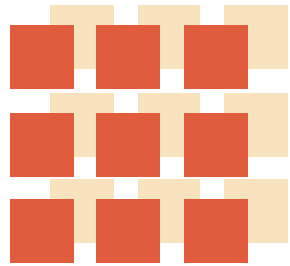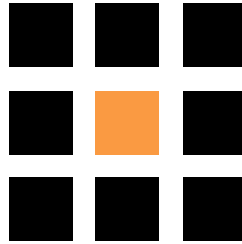**Unified** data storage

Scalable

Compatible with many packages

Spatial modalities

Images	Rasterized annotation	Vectorized annotation	Tables

$c \times y \times x$

$y \times x$

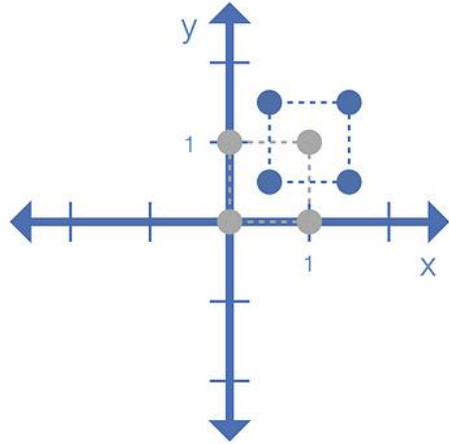xarray

xarray

GeoPandas
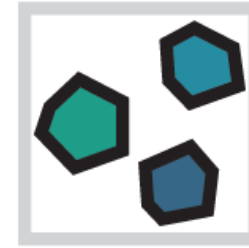
AnnData

+ Shapely

Knowing the fundamental packages is often helpful for debugging/troubleshooting

Transformations
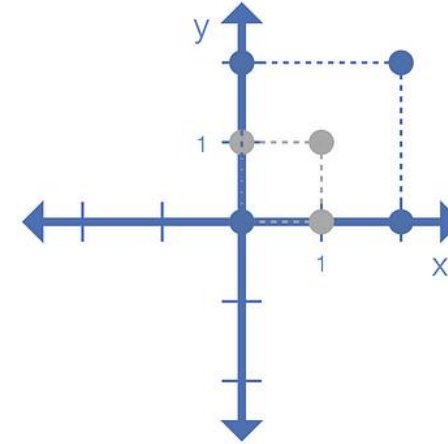## SpatialData encodes spatial transformations as matrix operations

Translate

$$\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$
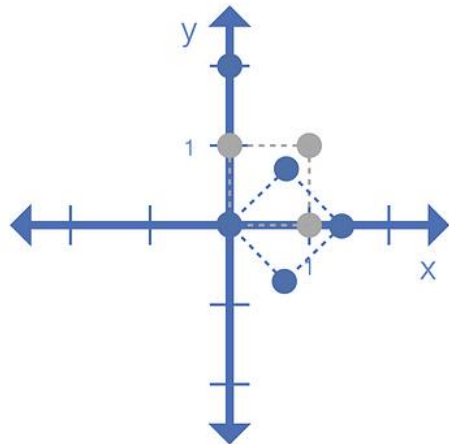
Scale

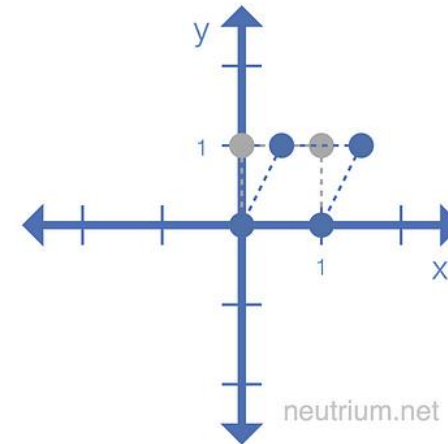$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Rotate

$$\begin{bmatrix} c & s & 0 \\ -s & c & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$c = s = \sin(45°)$

Shear

$$\begin{bmatrix} 1 & 0.5 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

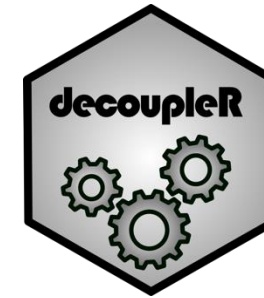neutrium.net

The spatial ecosystem

scRNAseq analysis

Spatial analysis

TF activity

Cell-cell-communication

Image analysis
(Cell segmentation + featurization)

HE Stains

Trajectory Inference

Optimal transport

Tutorial

See GitHub

- https://github.com/lucas-diedrich/spatialdata-learning.git

References

- Marconato, L. *et al.* SpatialData: an open and universal data framework for spatial omics. *Nat Methods* 1–5 (2024) doi:10.1038/s41592-024-02212-x.

- Virshup, I. *et al.* The scverse project provides a computational ecosystem for single-cell omics data analysis. *Nat Biotechnol* **41**, 604–606 (2023).