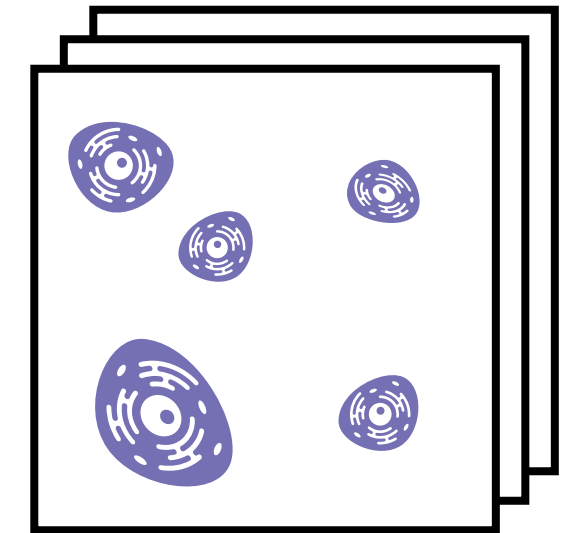
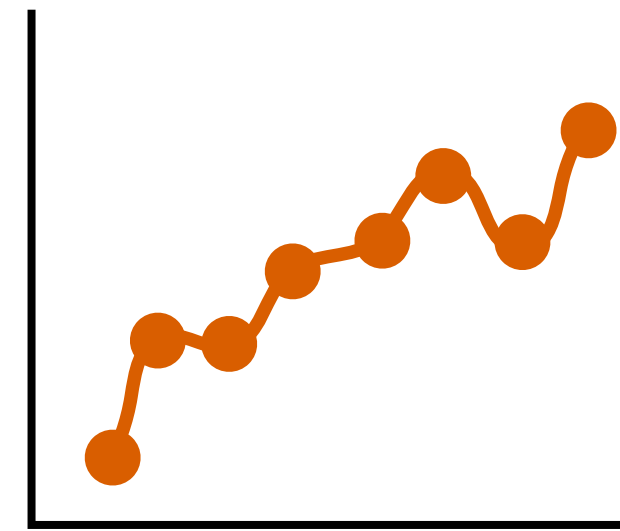
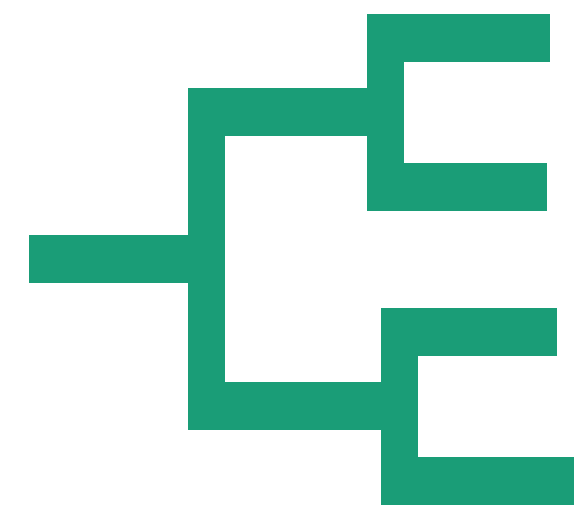
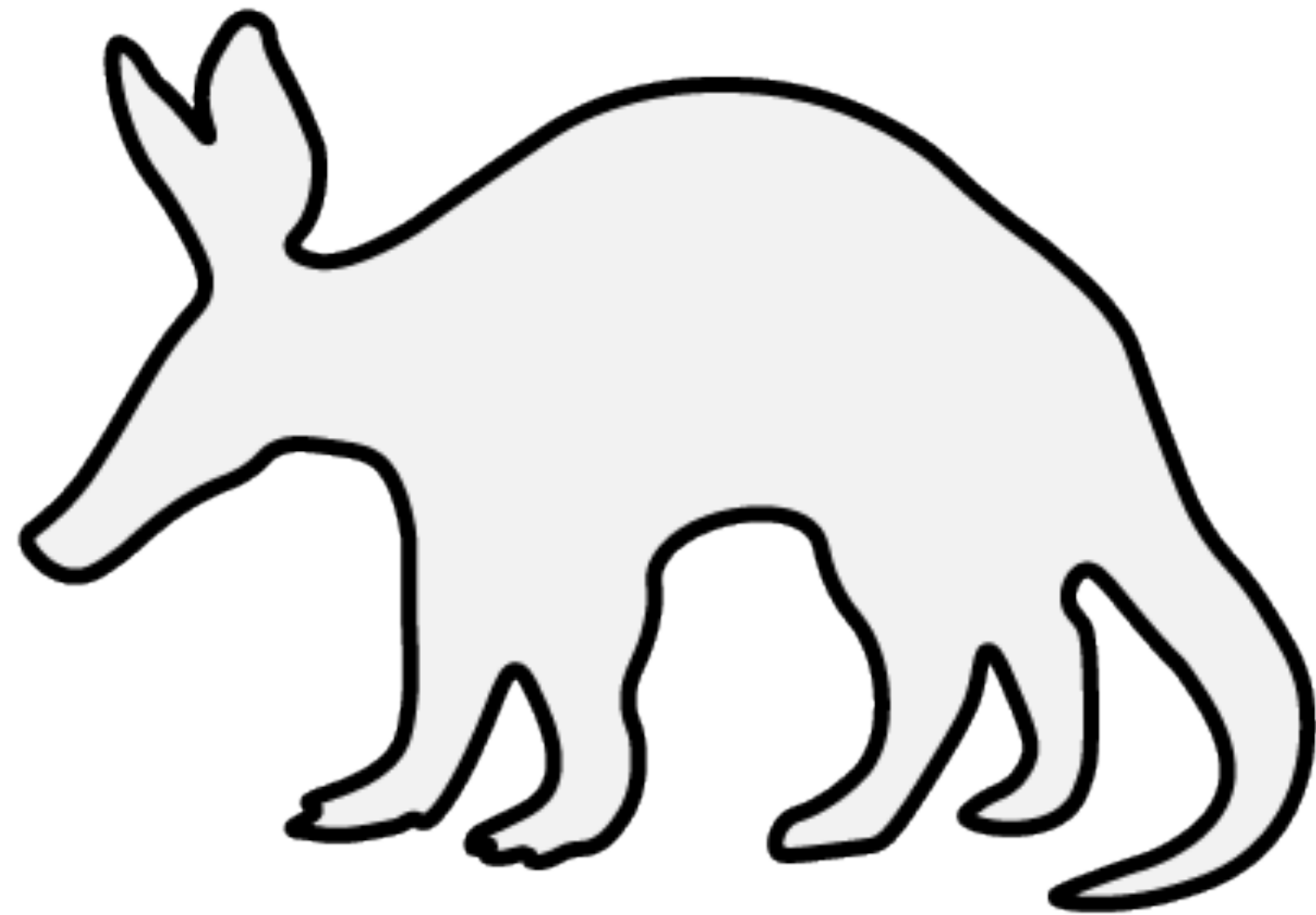
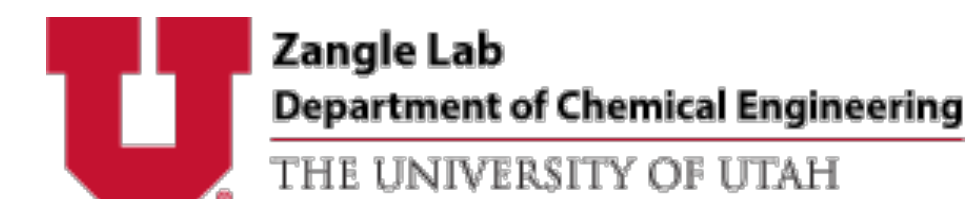


Aardvark:

Composite Visualizations of Trees, Time-Series, and Images

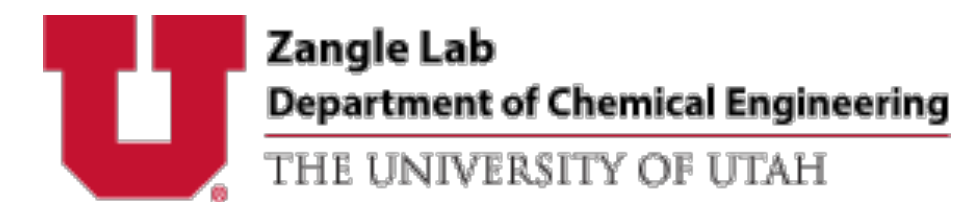


Devin Lange, Robert Judson-Torres, Thomas A. Zangle, and Alexander Lex





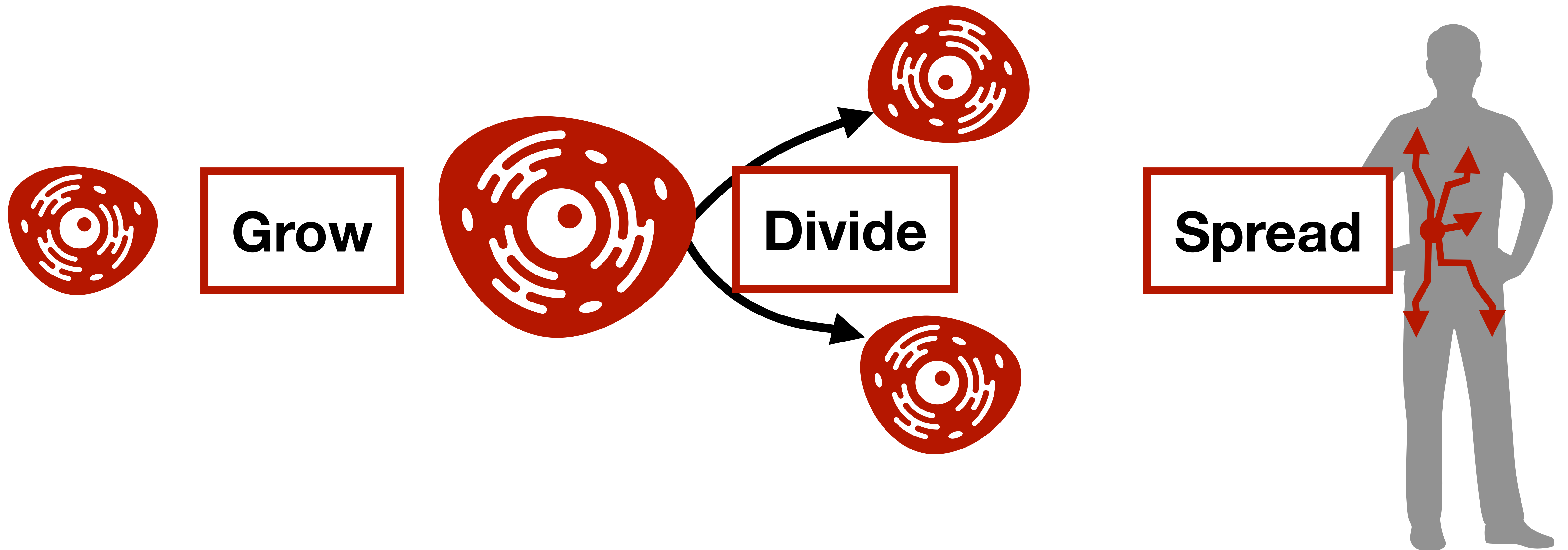
Robert Judson-Torres



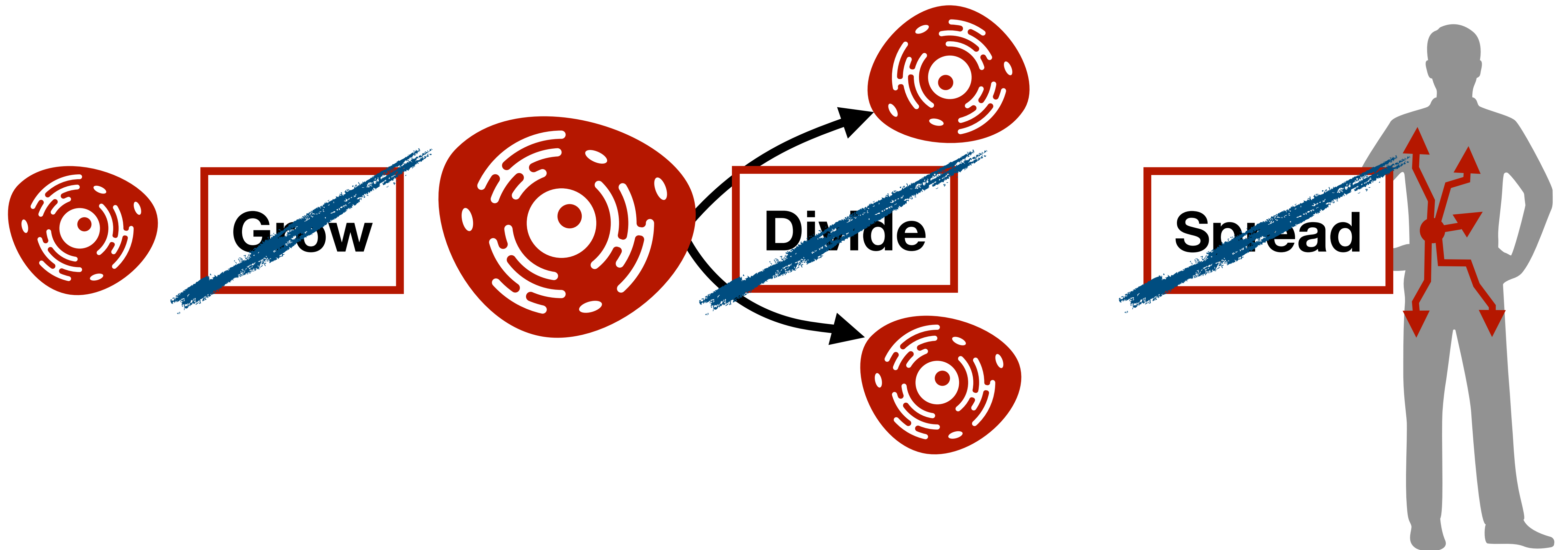
Thomas A. Zangle

Understand Cancer Cell Development

Understand Cancer Cell Development



Prevent Cancer Cell Development



How?

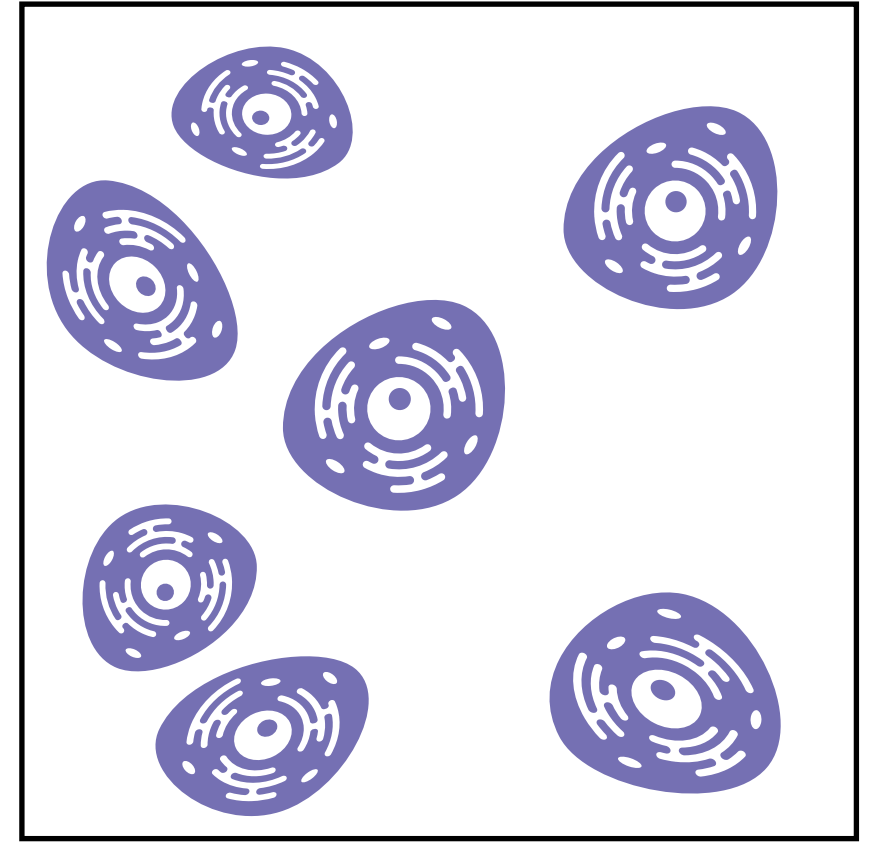
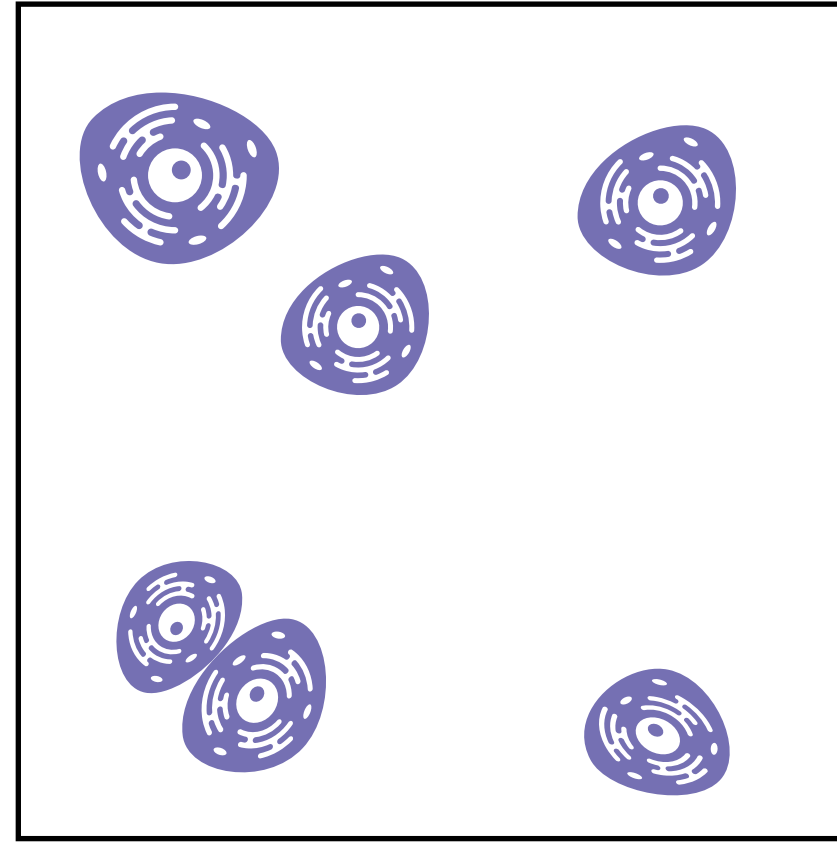
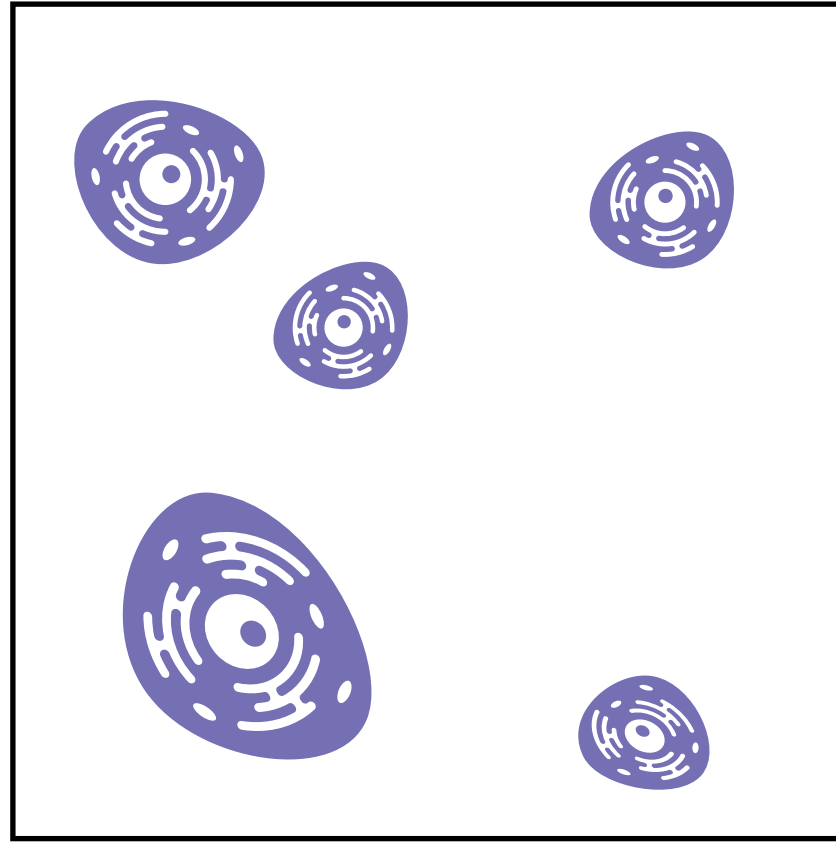
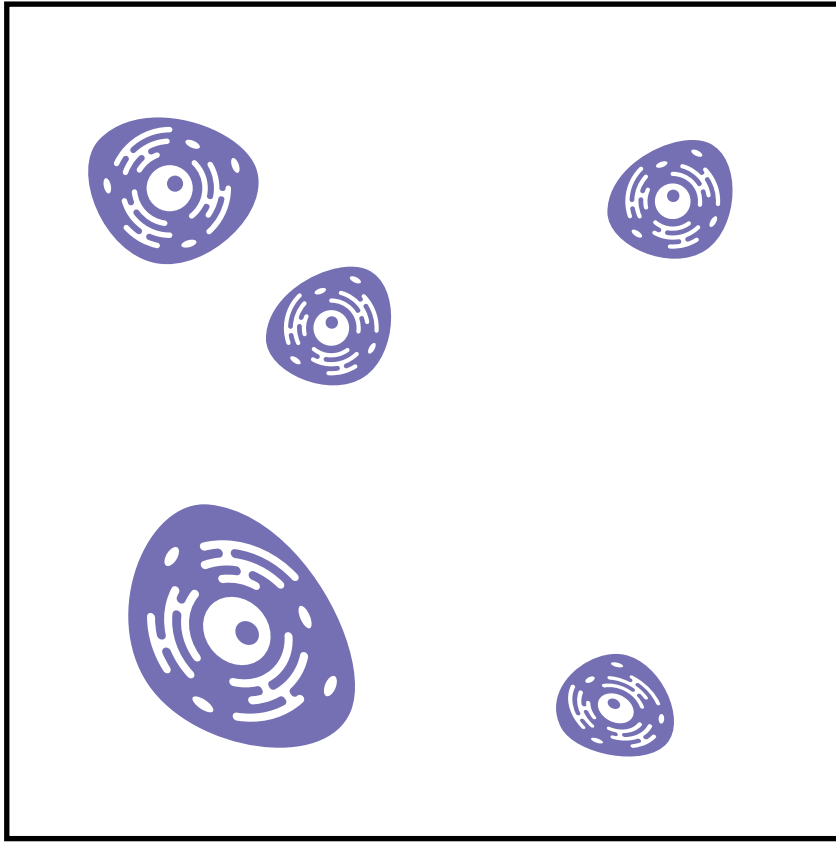
Understand Cancer Cell Development

How?

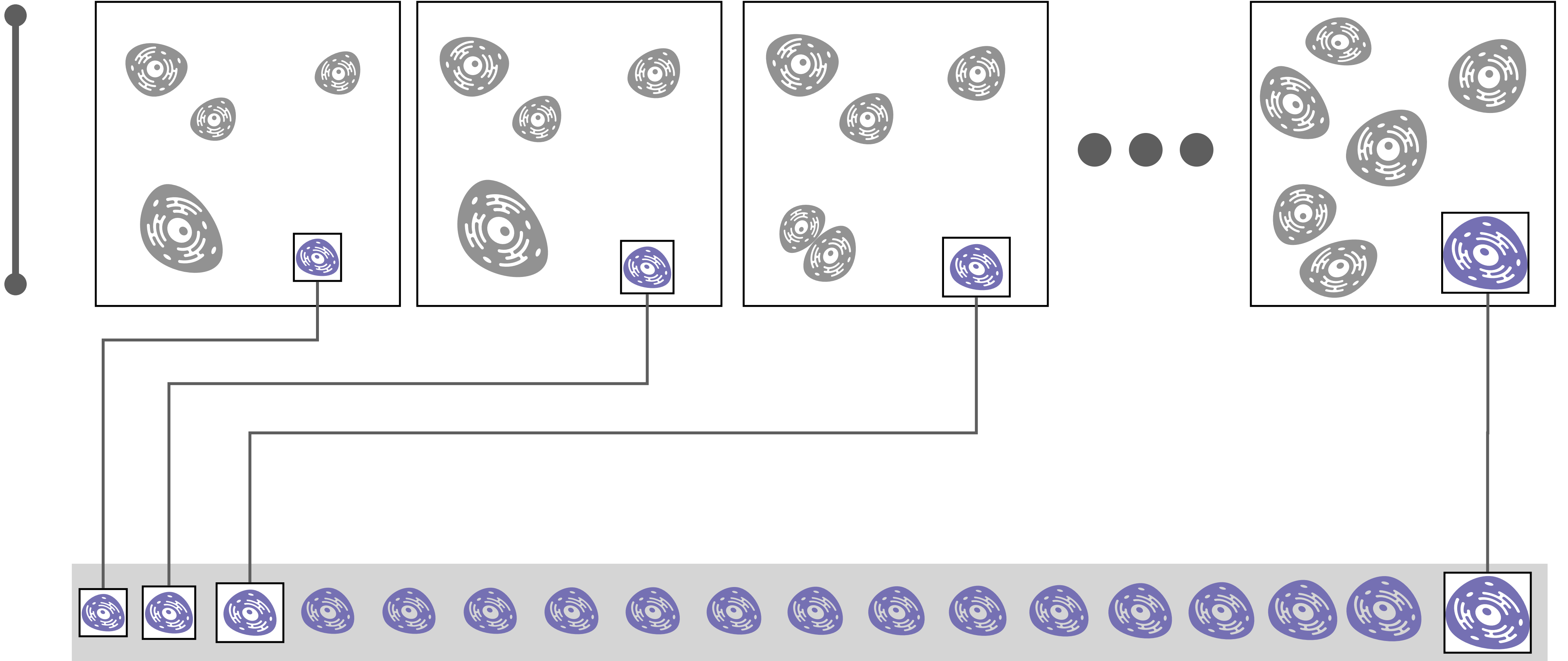
Understand Cancer Cell Development

With Data

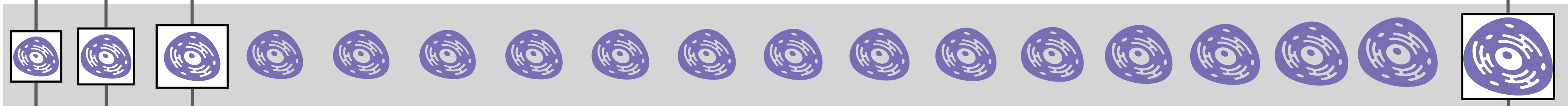
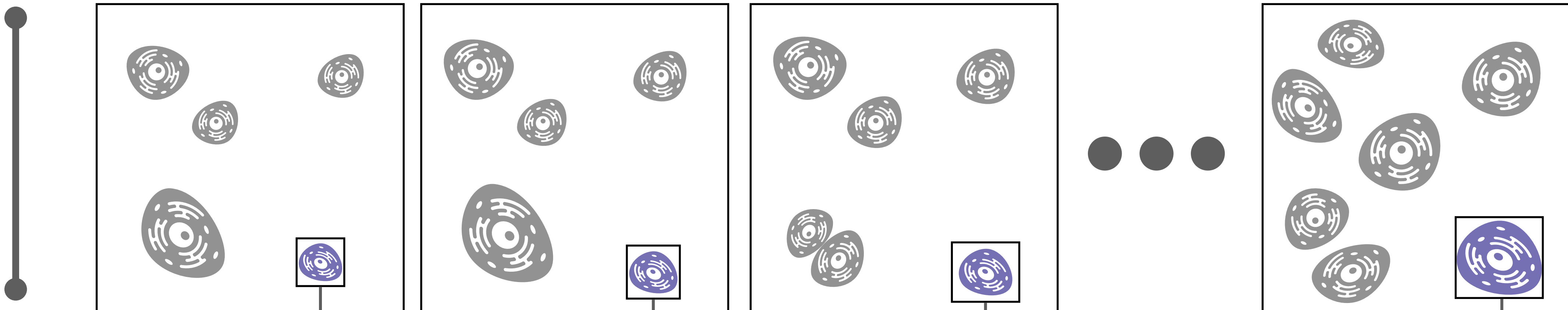
Images



Images



Images

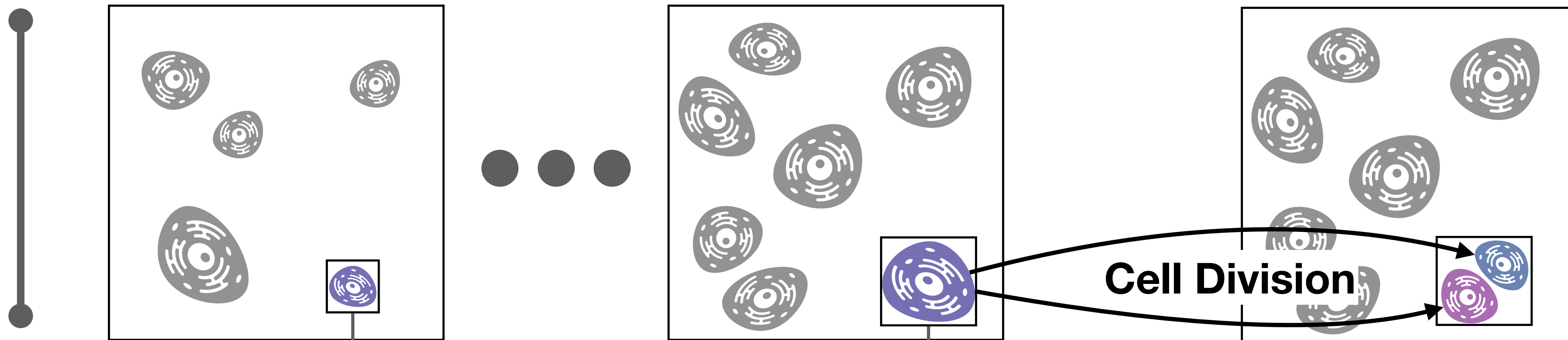


Derived Attributes
(e.g., Mass, Size, and Circularity)

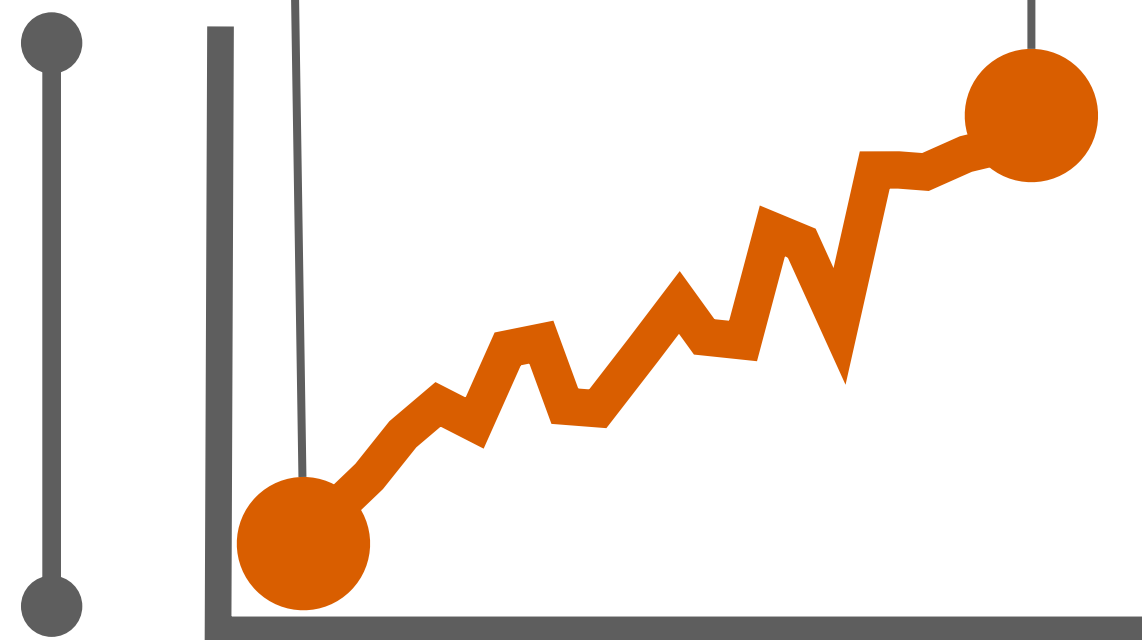
Time-Series



Images

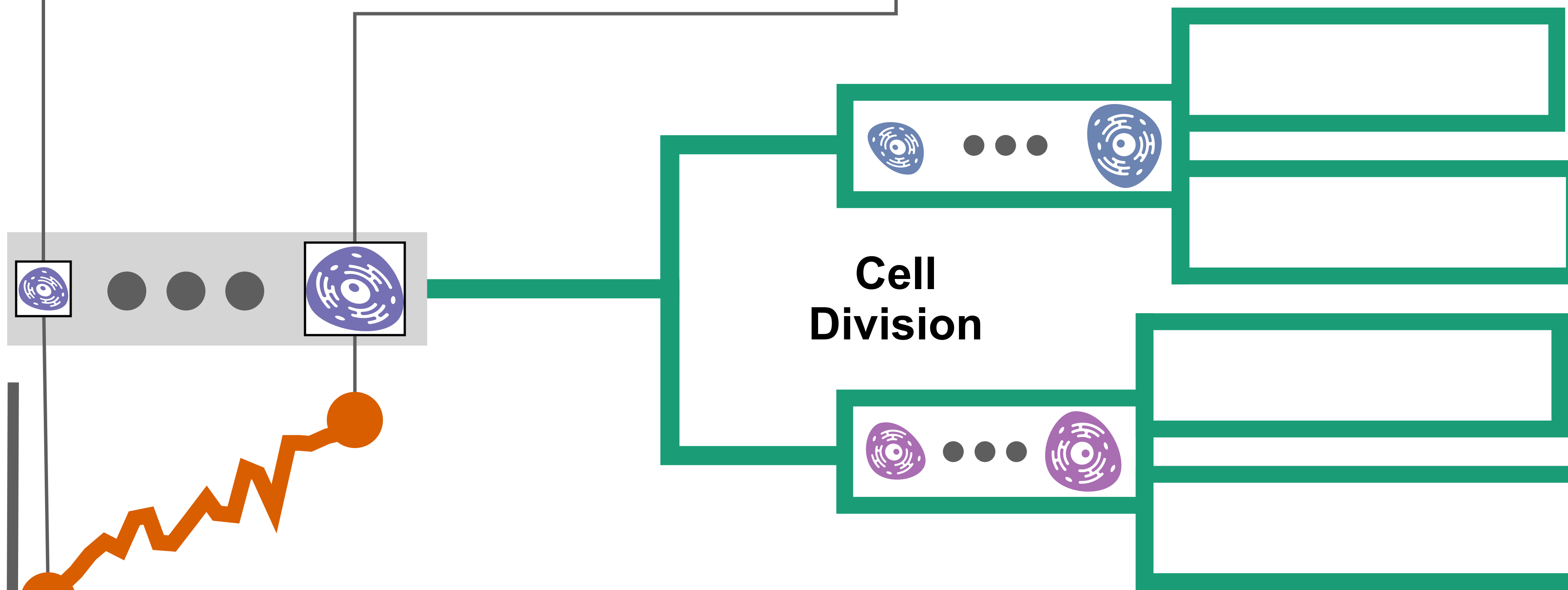


Time-Series

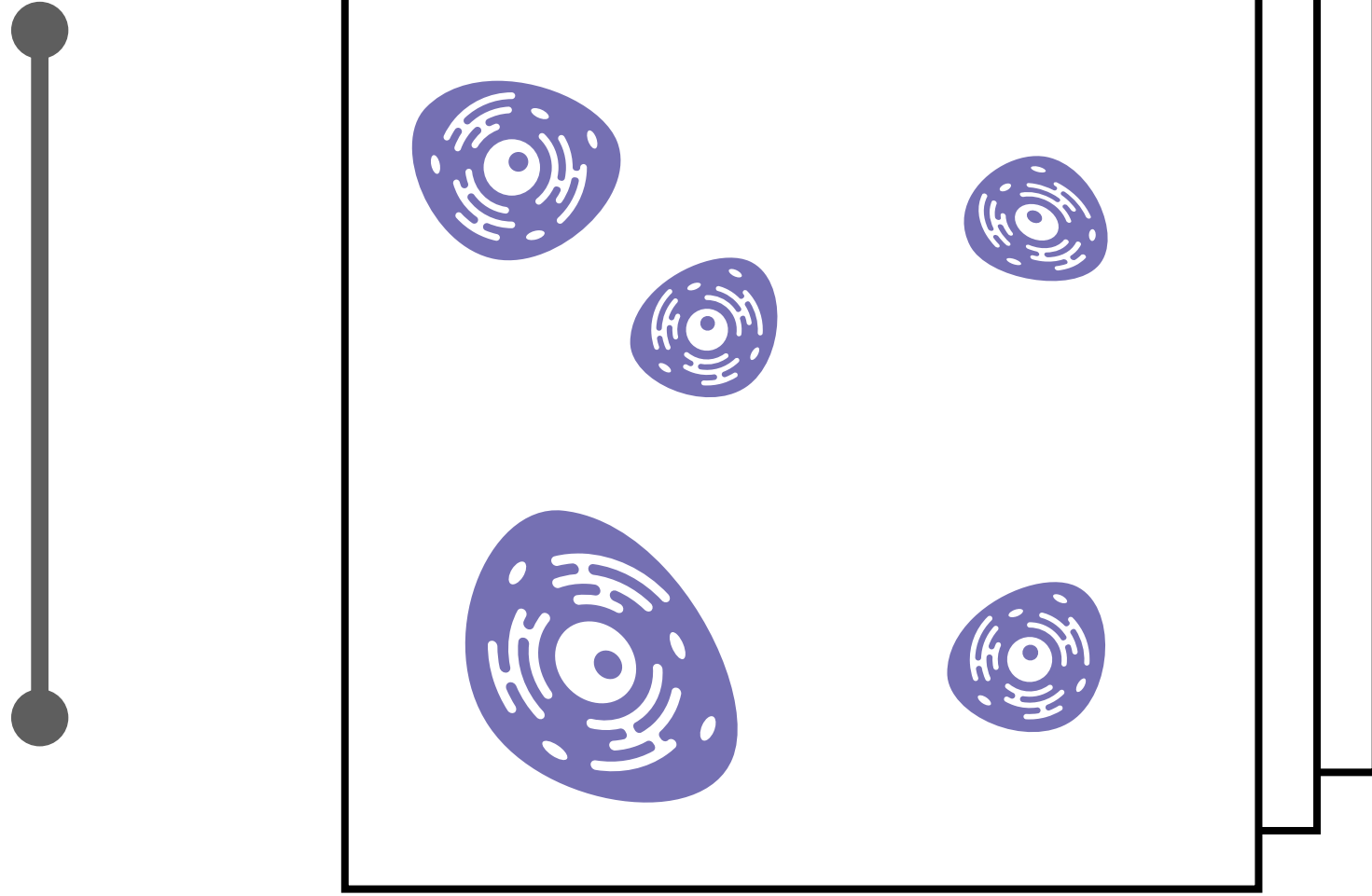


Cell Division

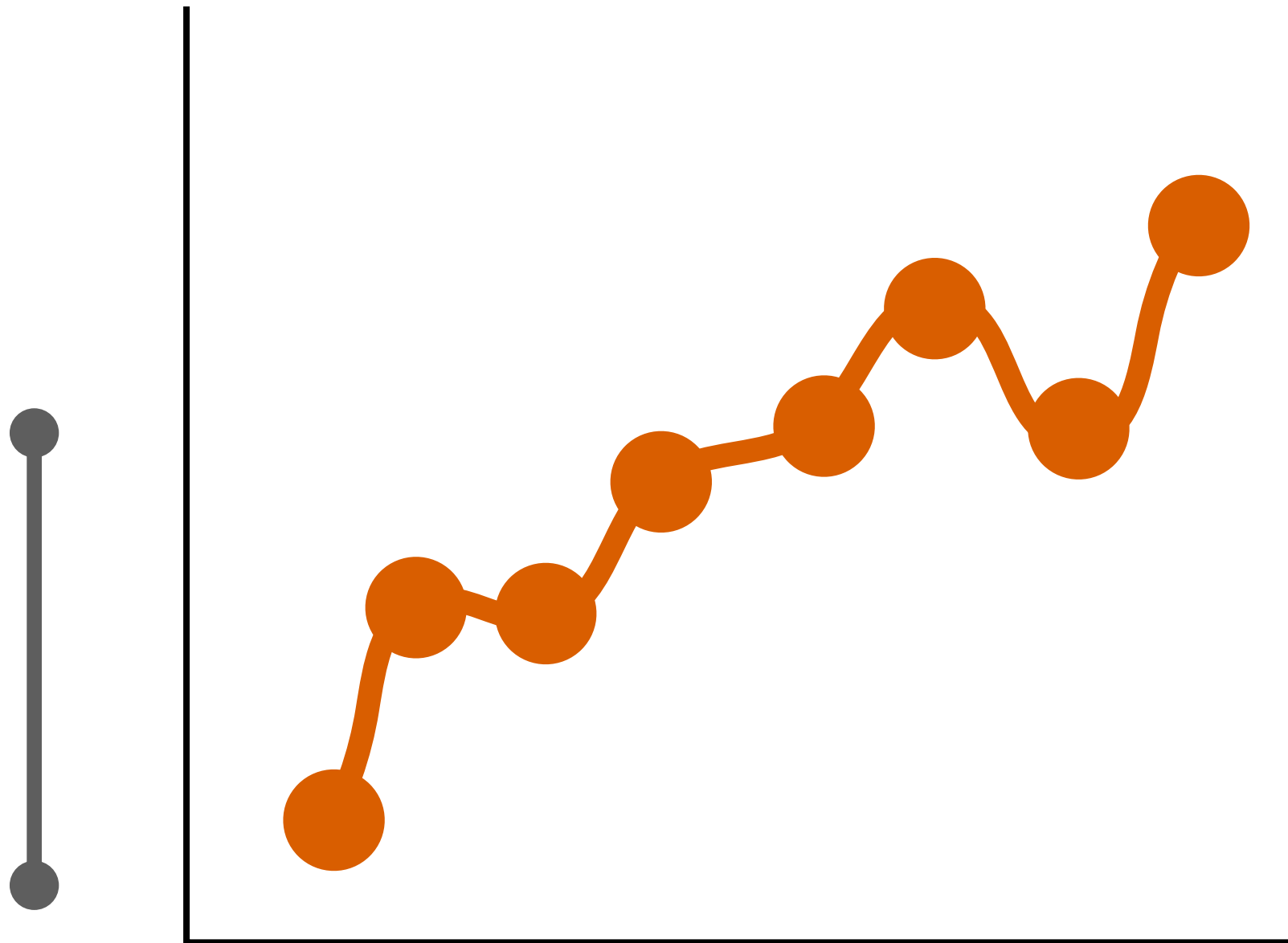
Tree



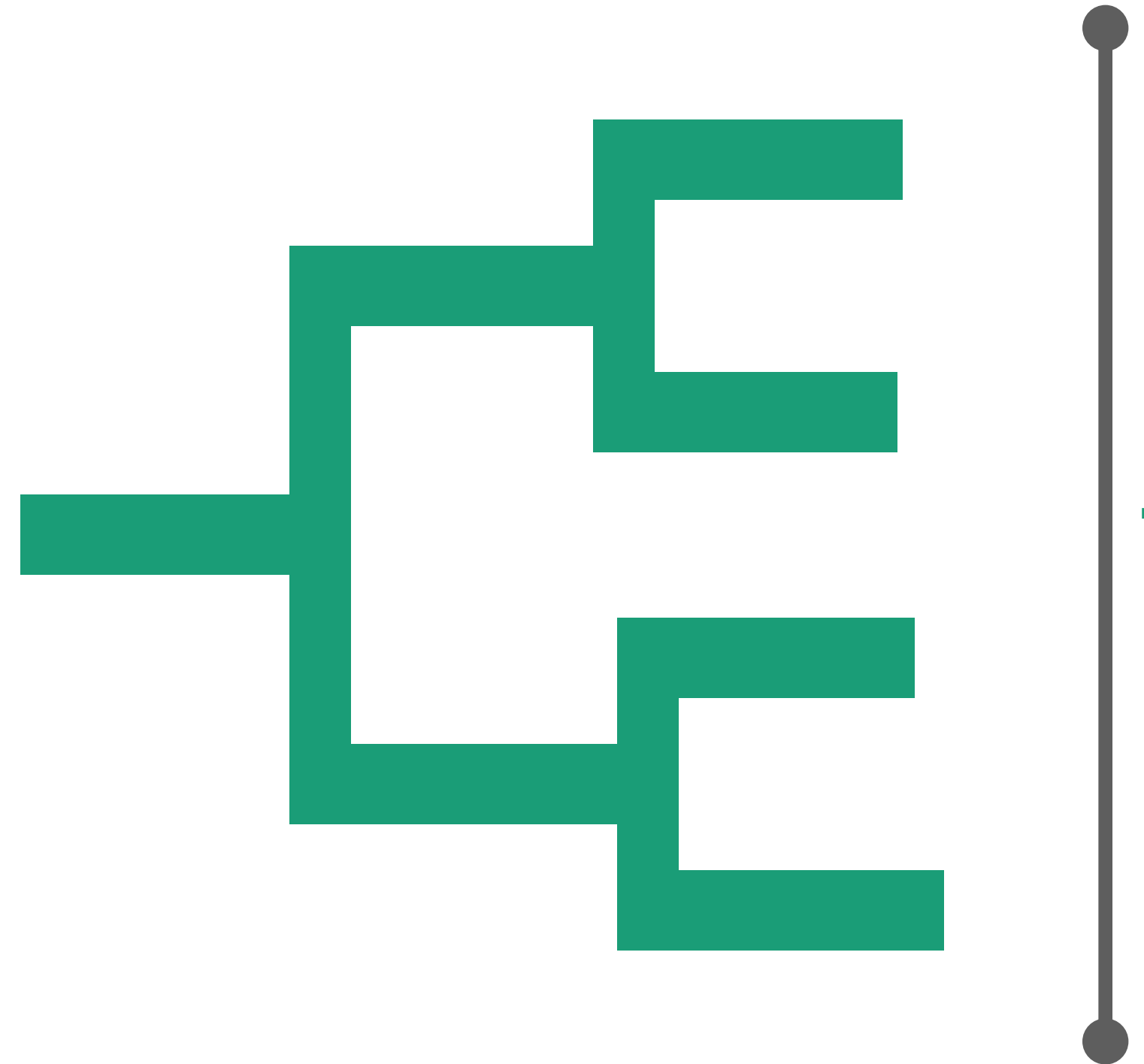
Images

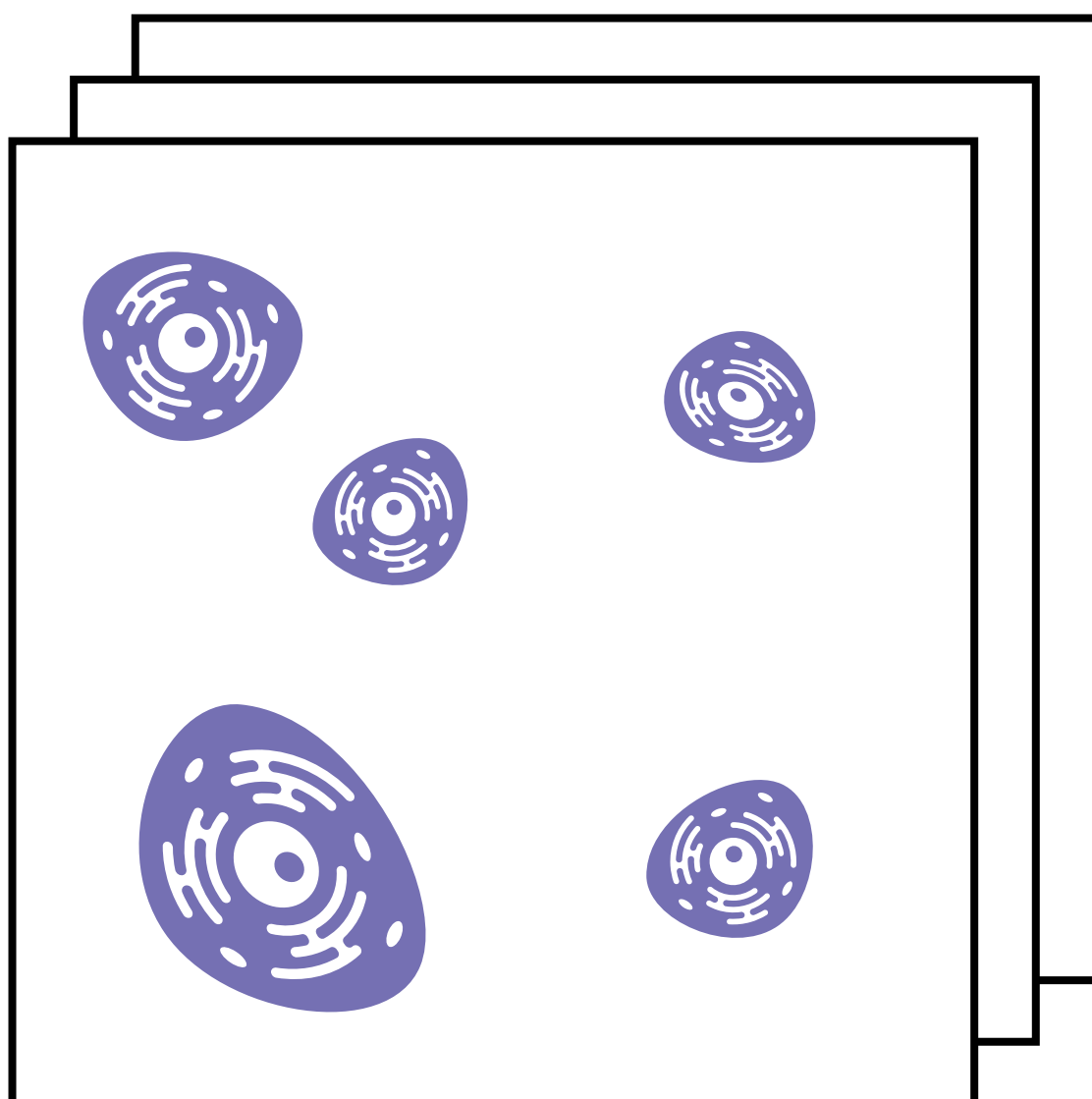


Time-Series

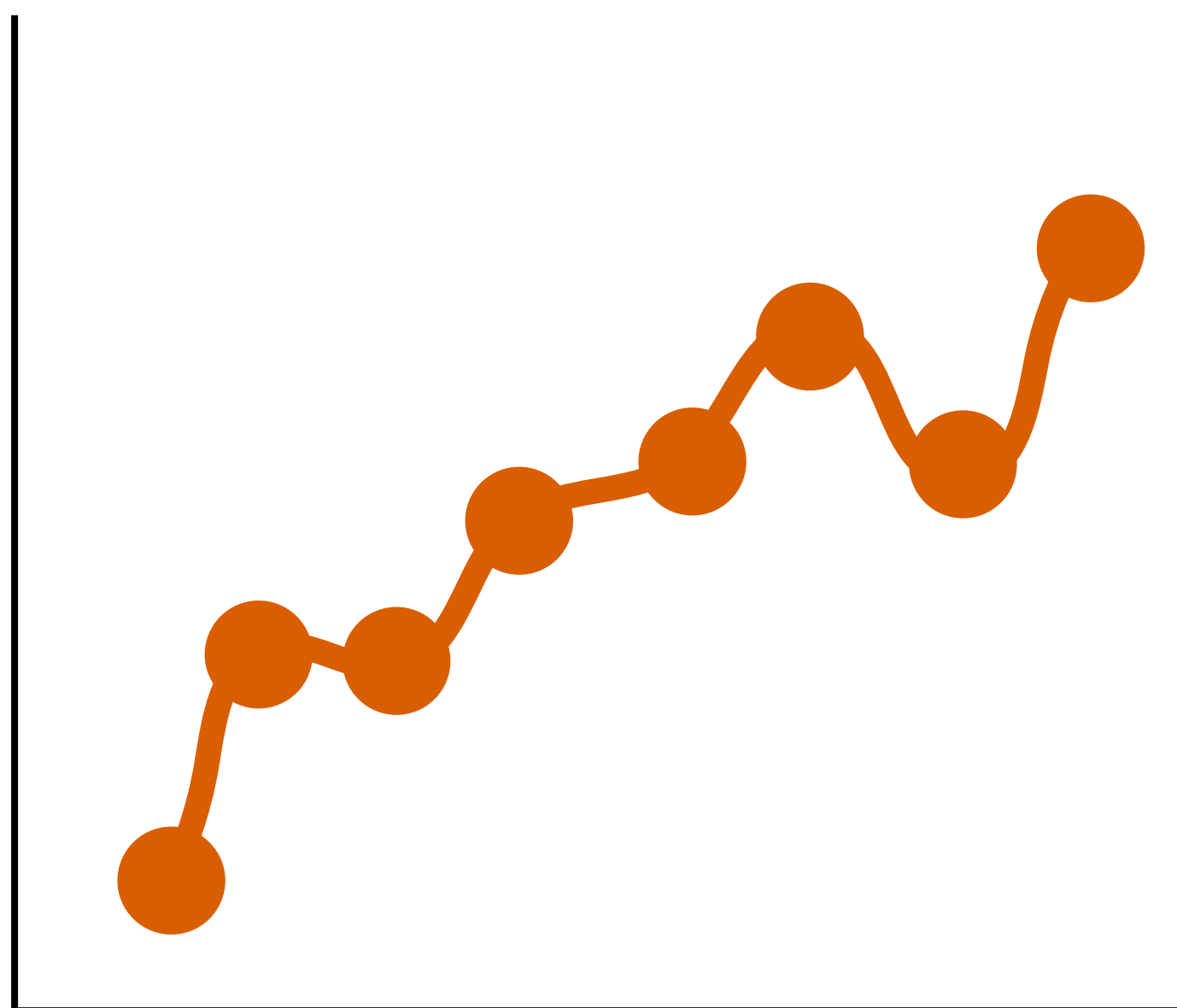


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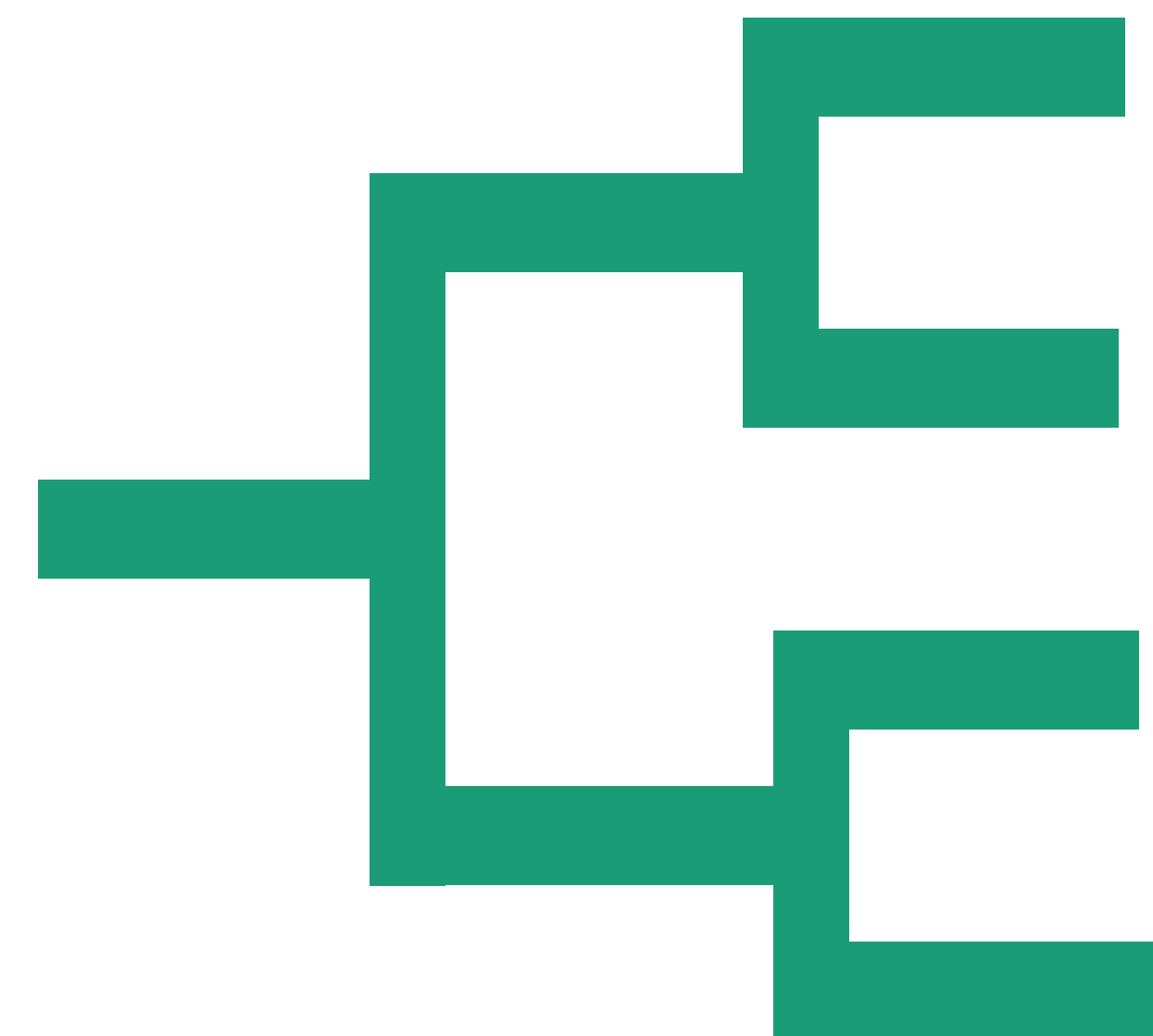




Images

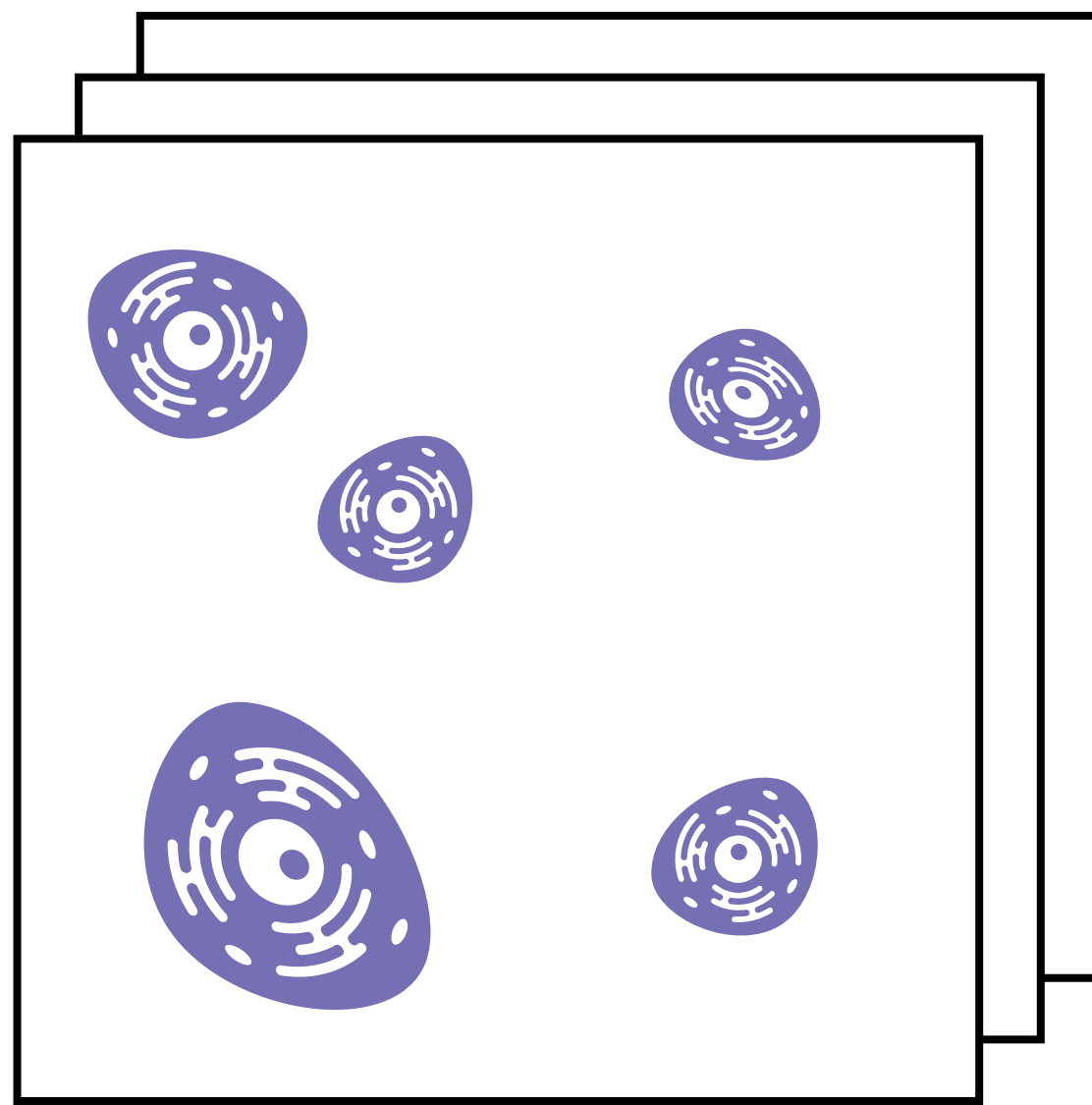


Time-Series

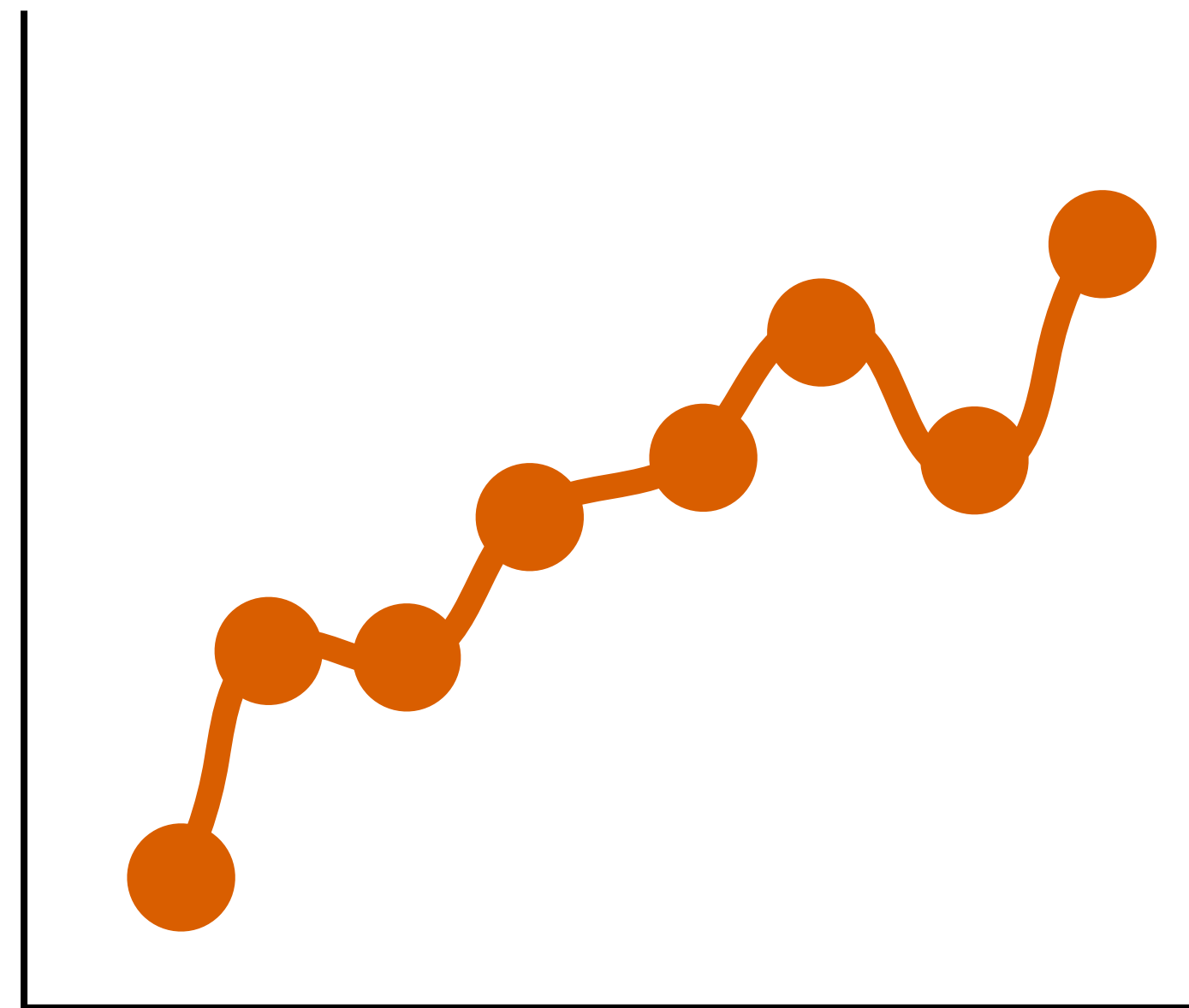


Tree

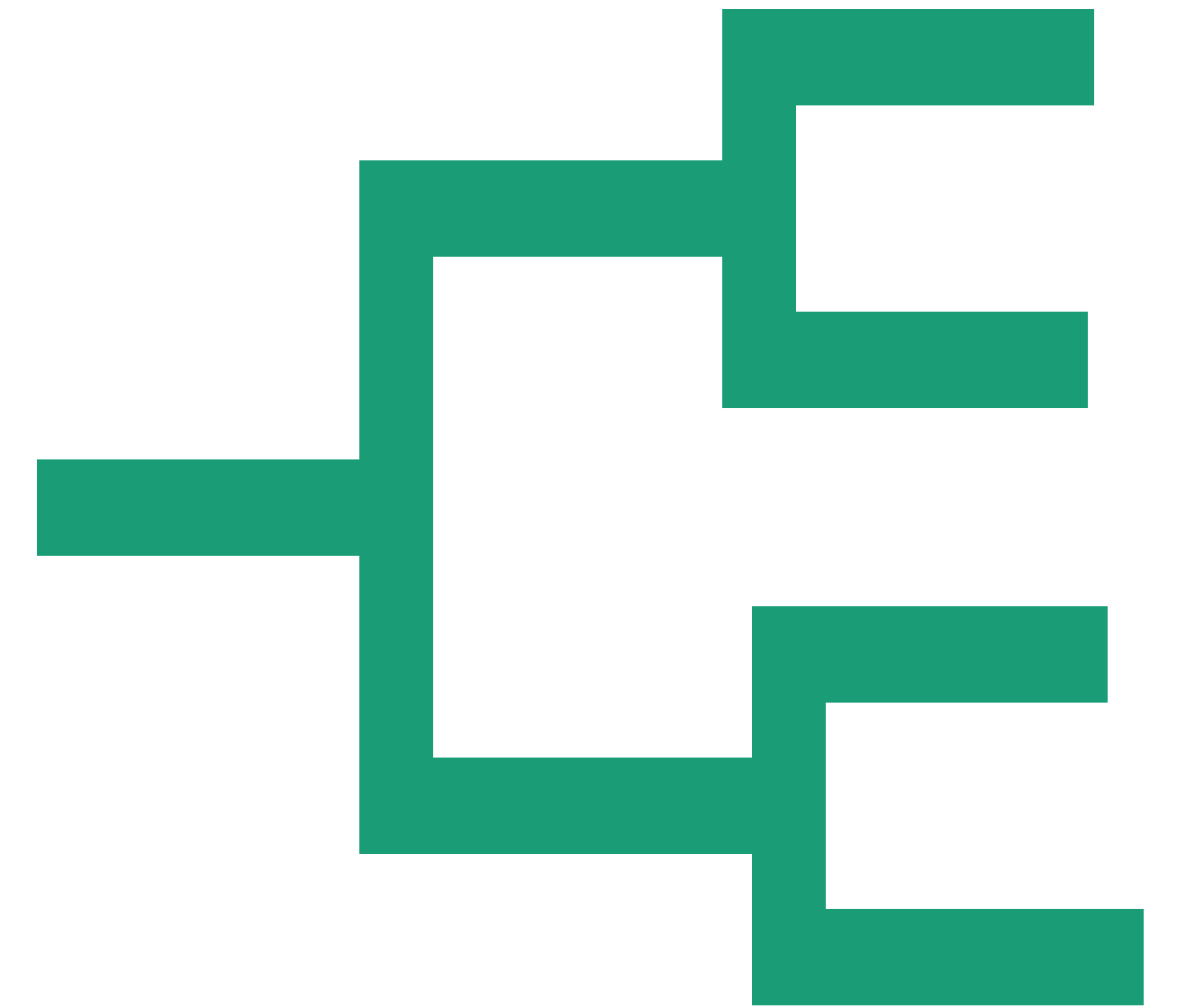
Understand Cancer Cell Development With Data



Images



Time-Series



Tree

Identified 11 Domain Tasks

Trust

Propagation

Lineage

Changes

Cell Cycle

Segmentation

Synchrony

Comparison

Explain

Tracking

Attributes

Domain Tasks

Quality Control

Segmentation

Attributes

Tracking

Lineage

Discovery

Propagation

Cell Cycle

Changes

Comparison

Synchrony

Communication

Explain

Trust

Task Abstraction

**Spatial
Relationships**

Trends

**Topological
Structure**

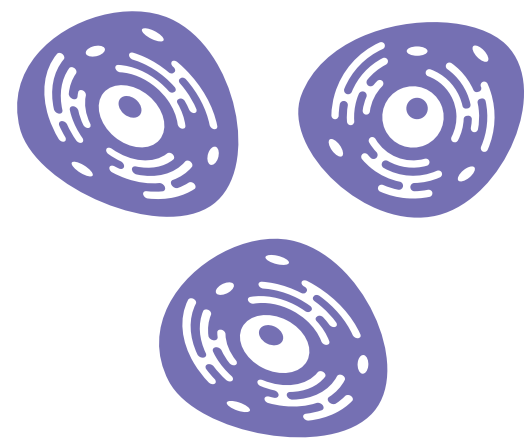
Task Abstraction

**Spatial
Relationships**



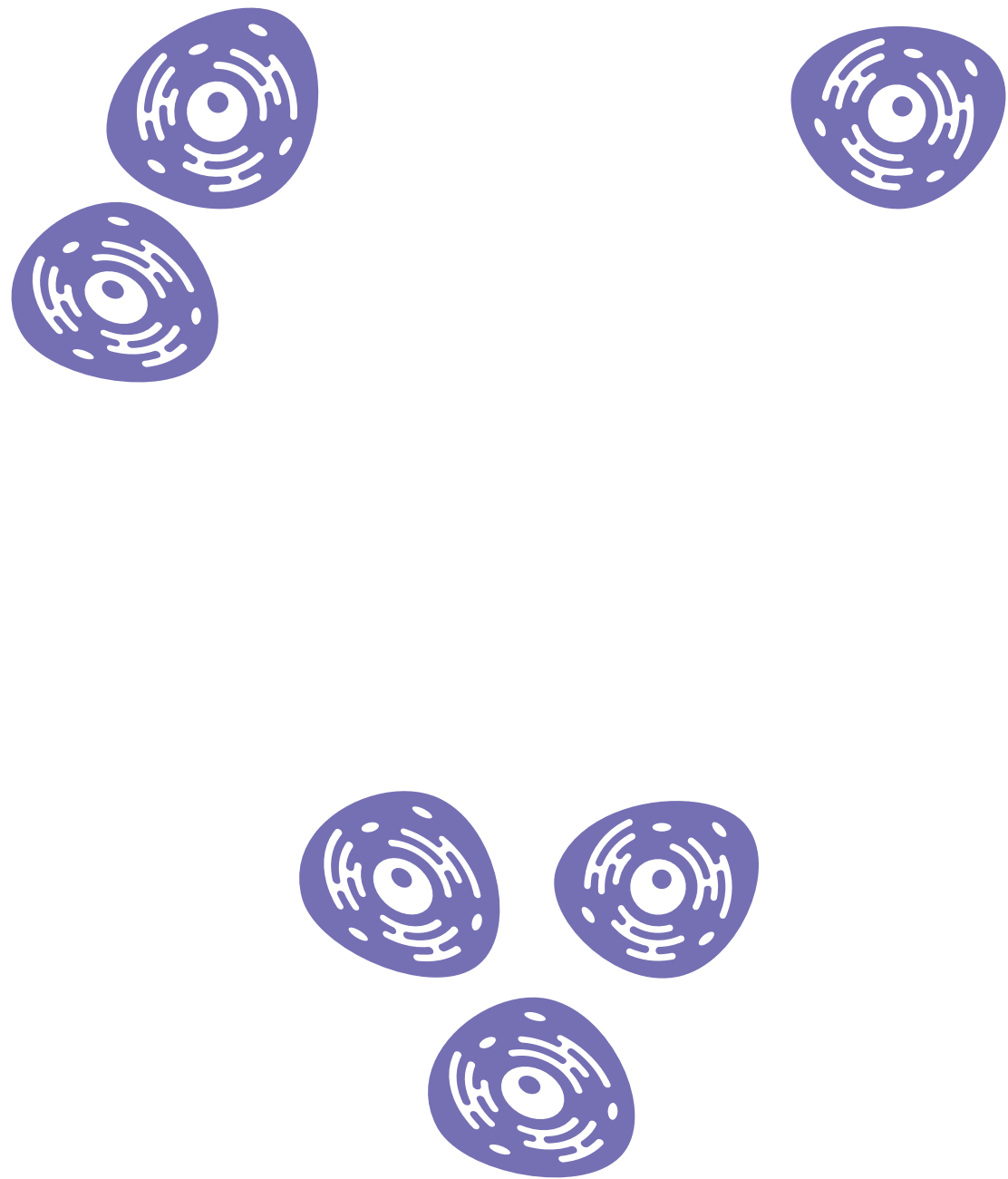
Trends

**Topological
Structure**

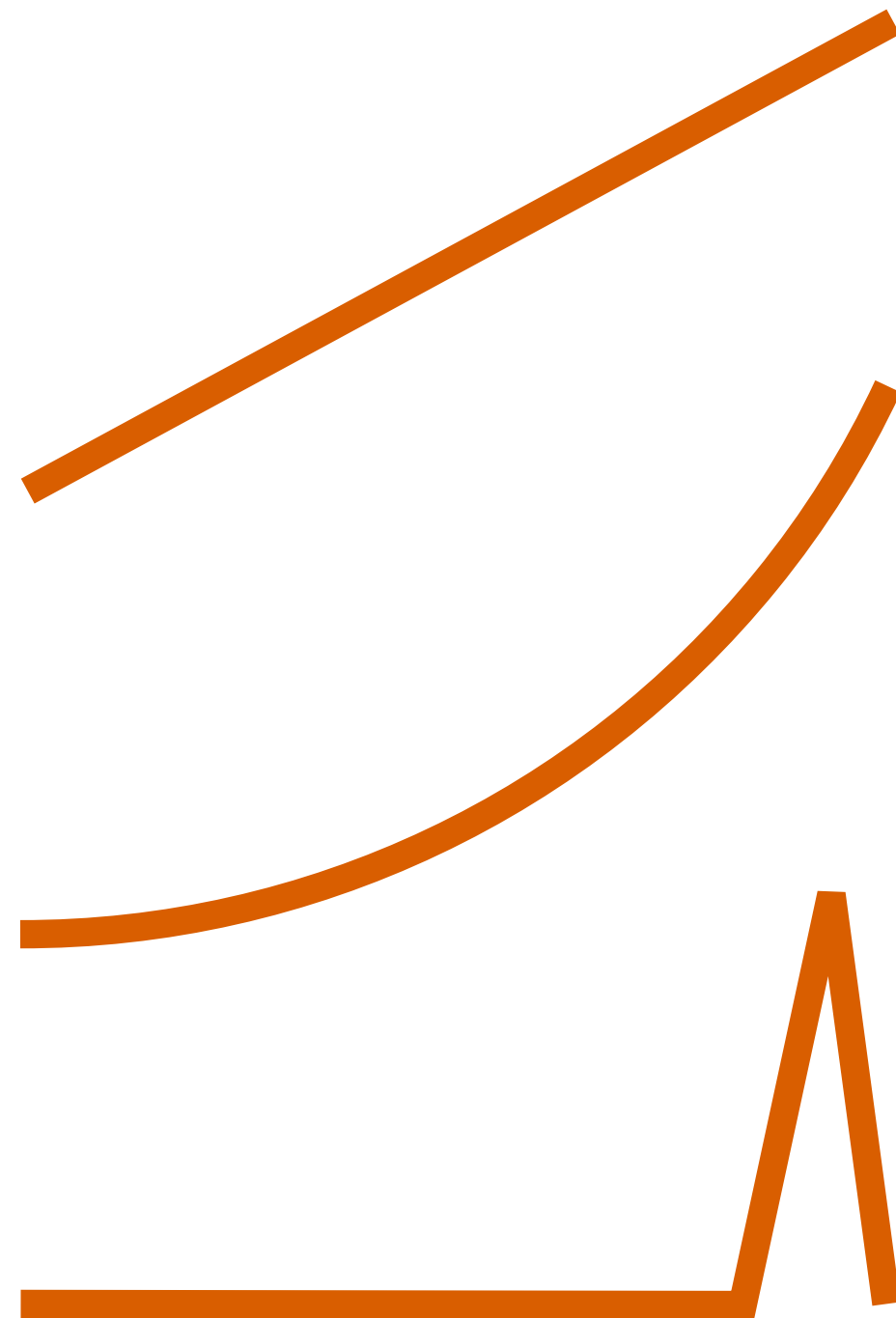


Task Abstraction

**Spatial
Relationships**



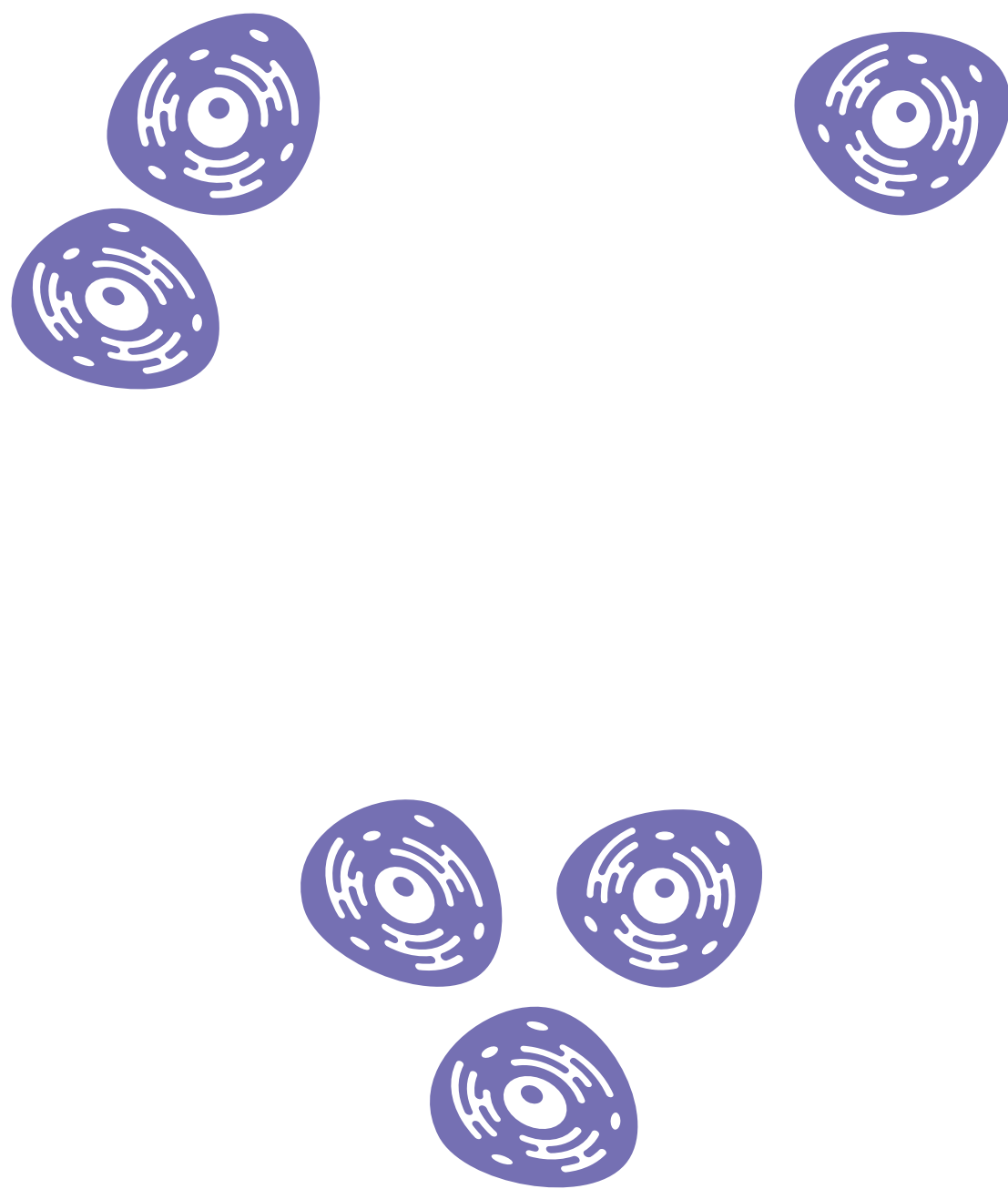
Trends



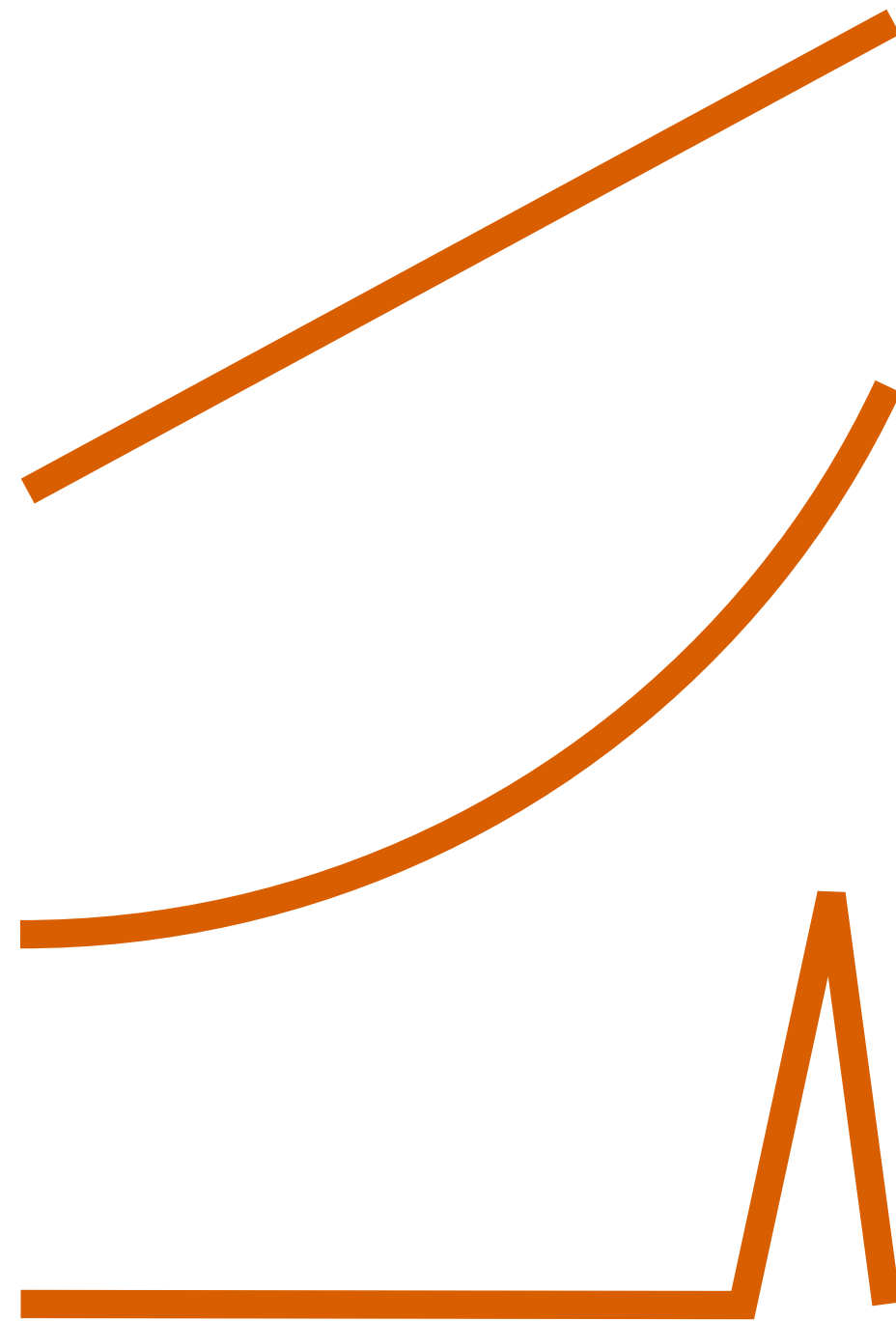
**Topological
Structure**

Task Abstraction

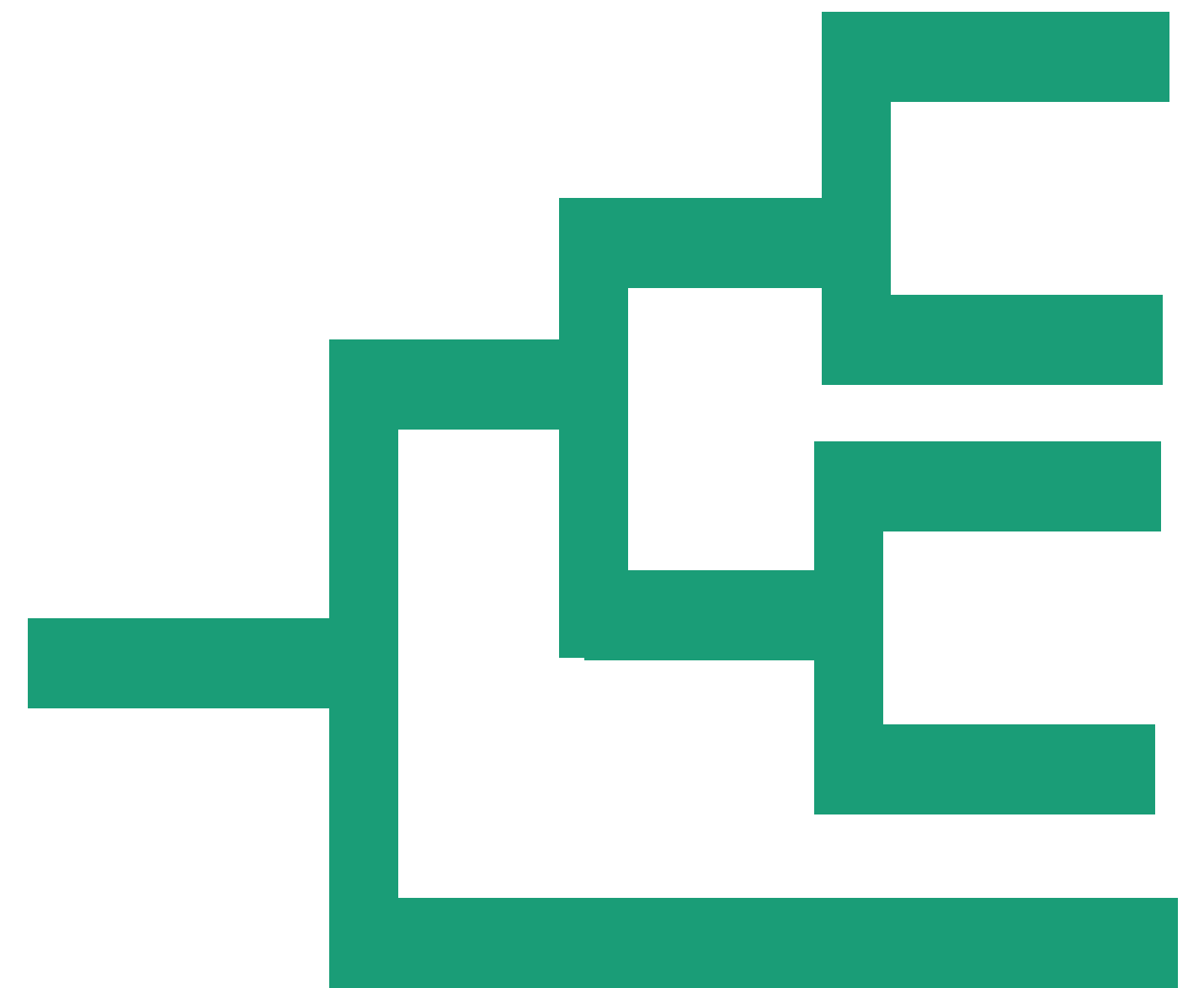
**Spatial
Relationships**



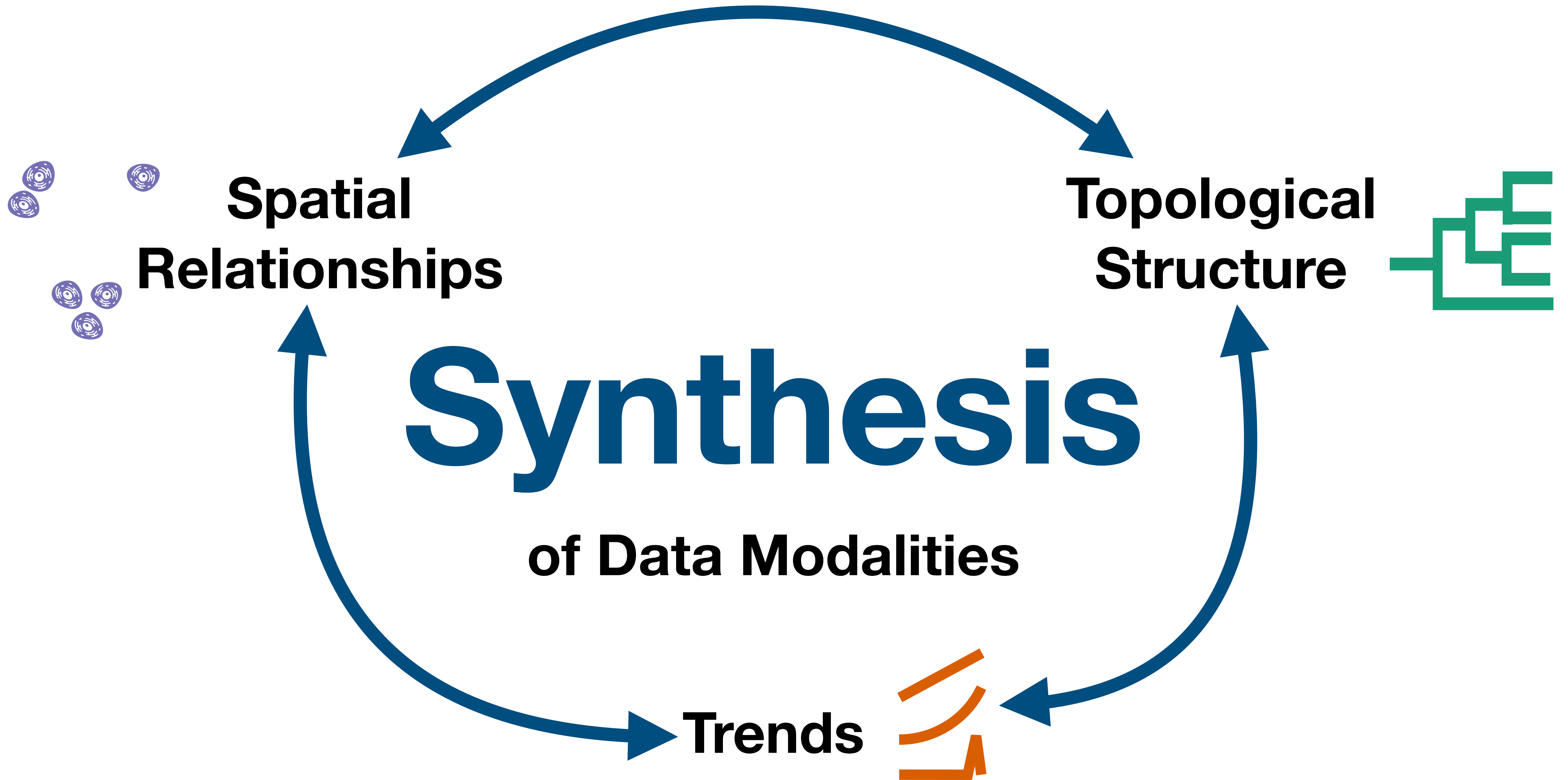
Trends

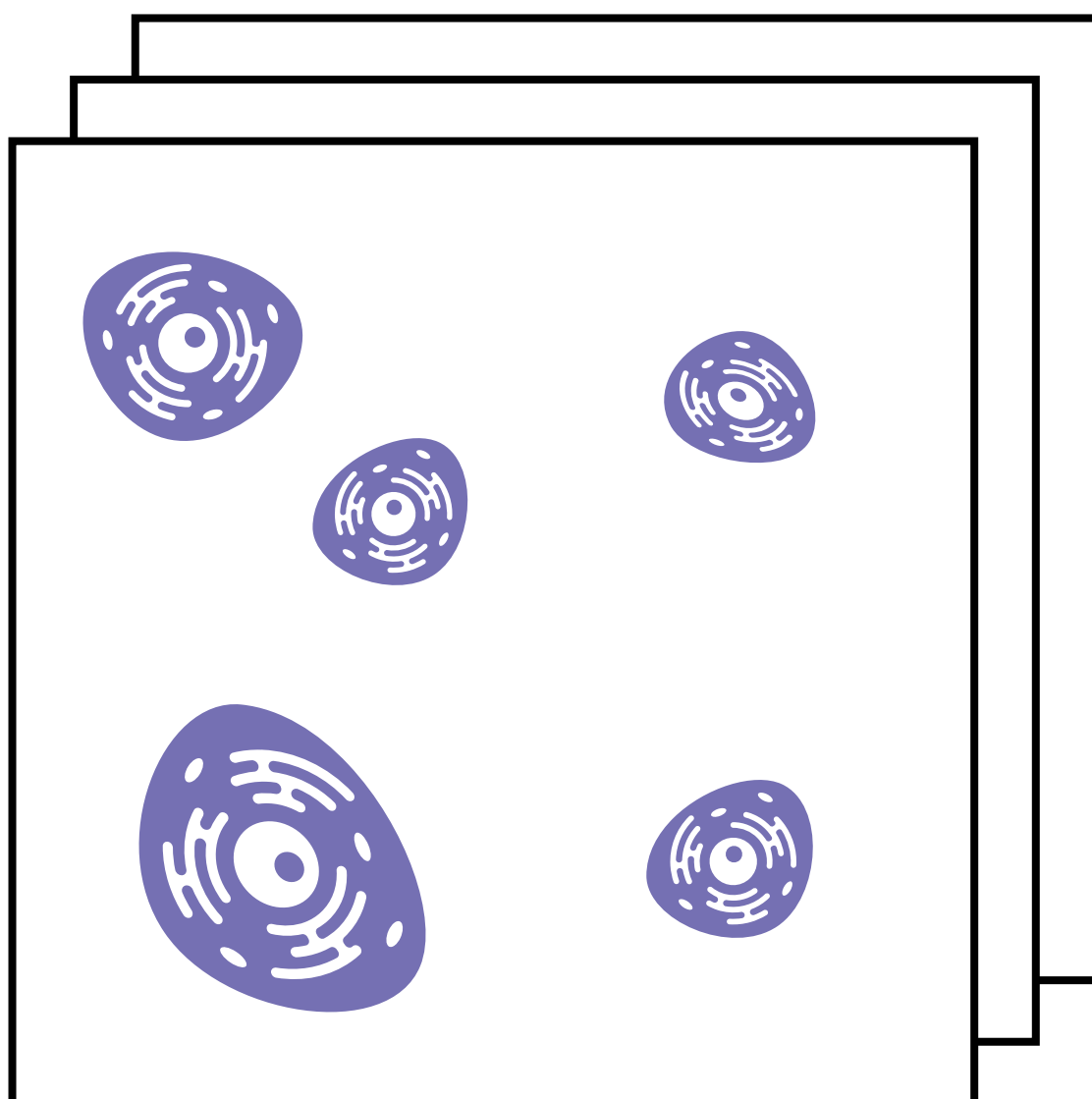


**Topological
Structure**

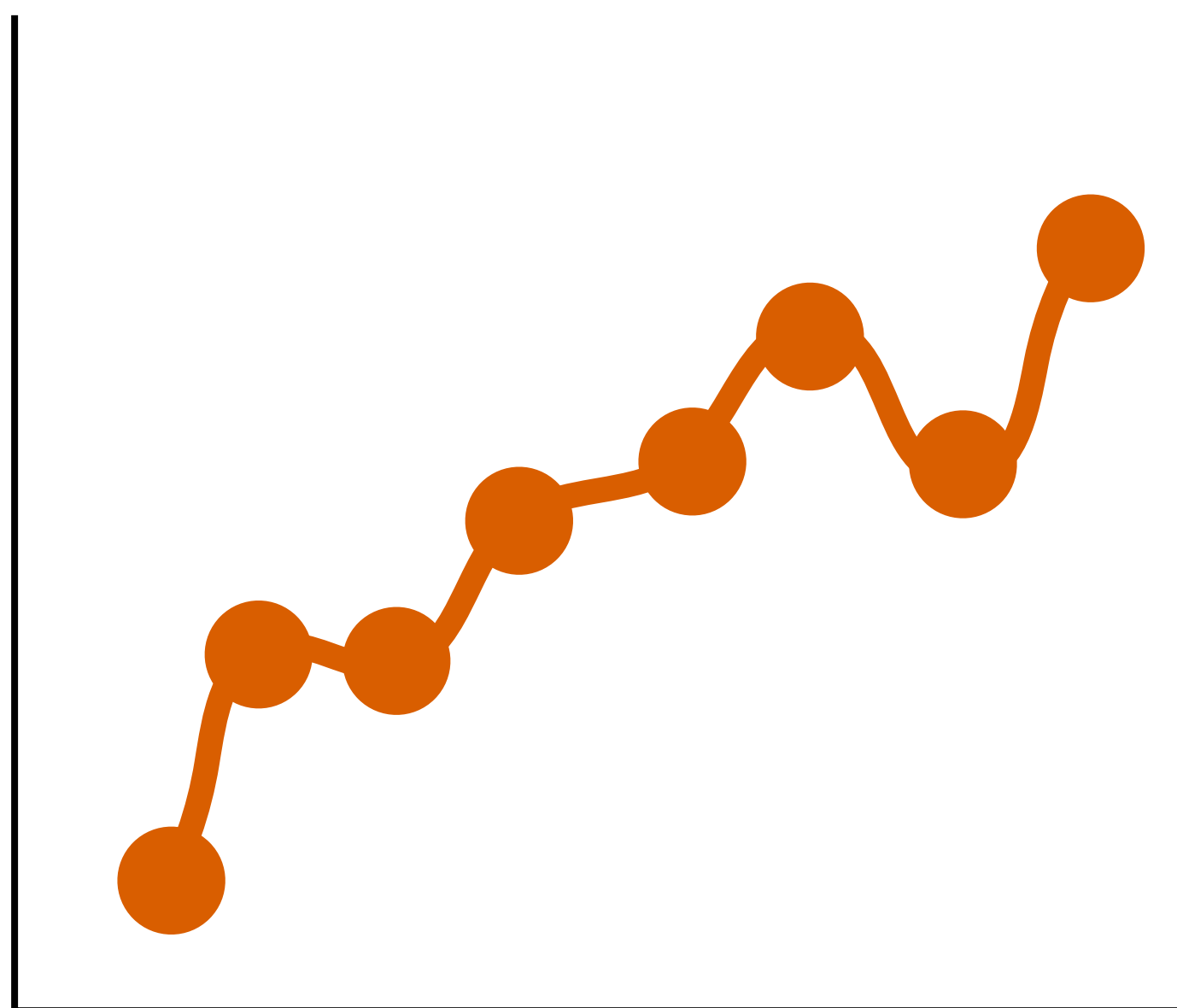


Task Abstraction

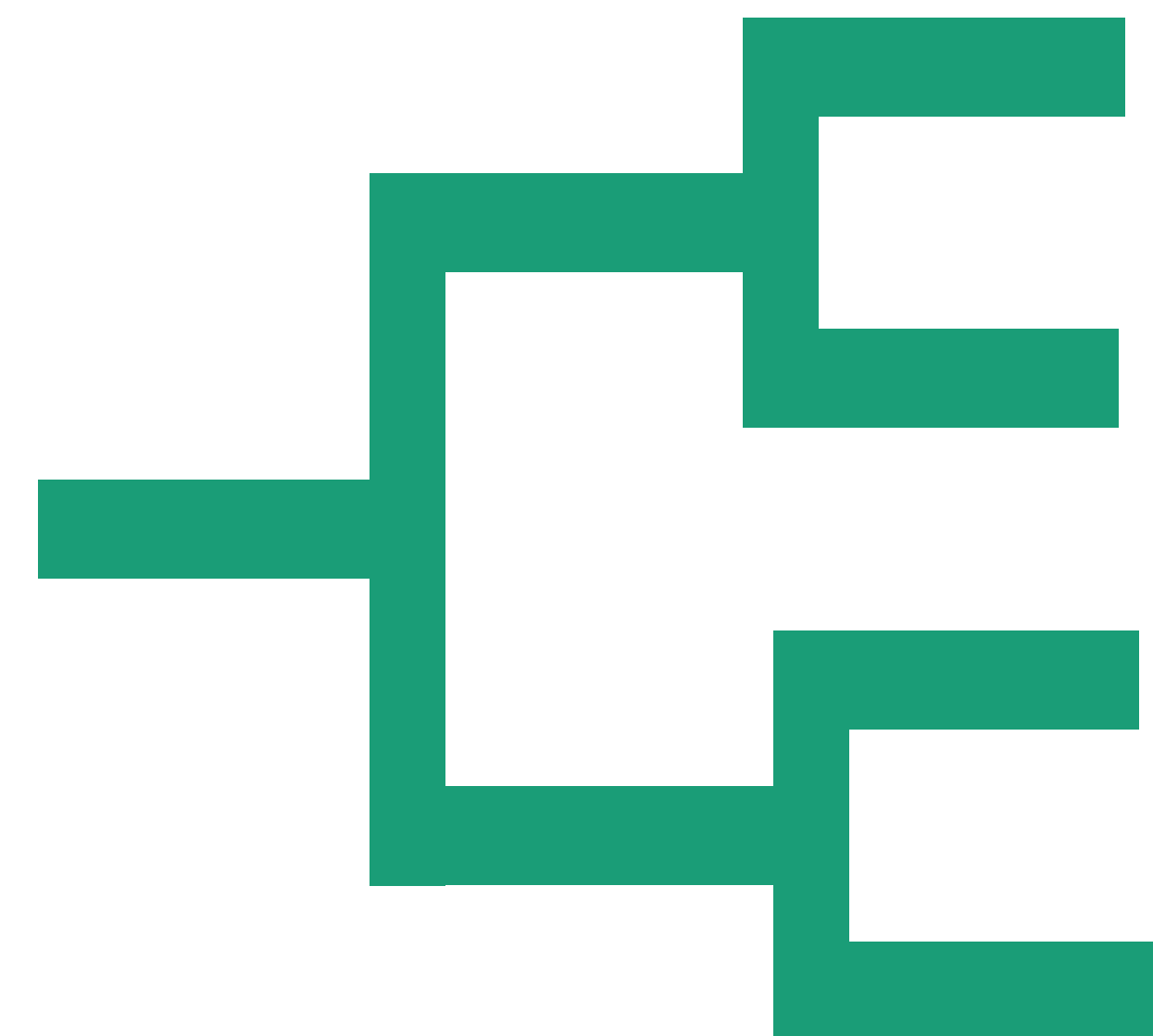




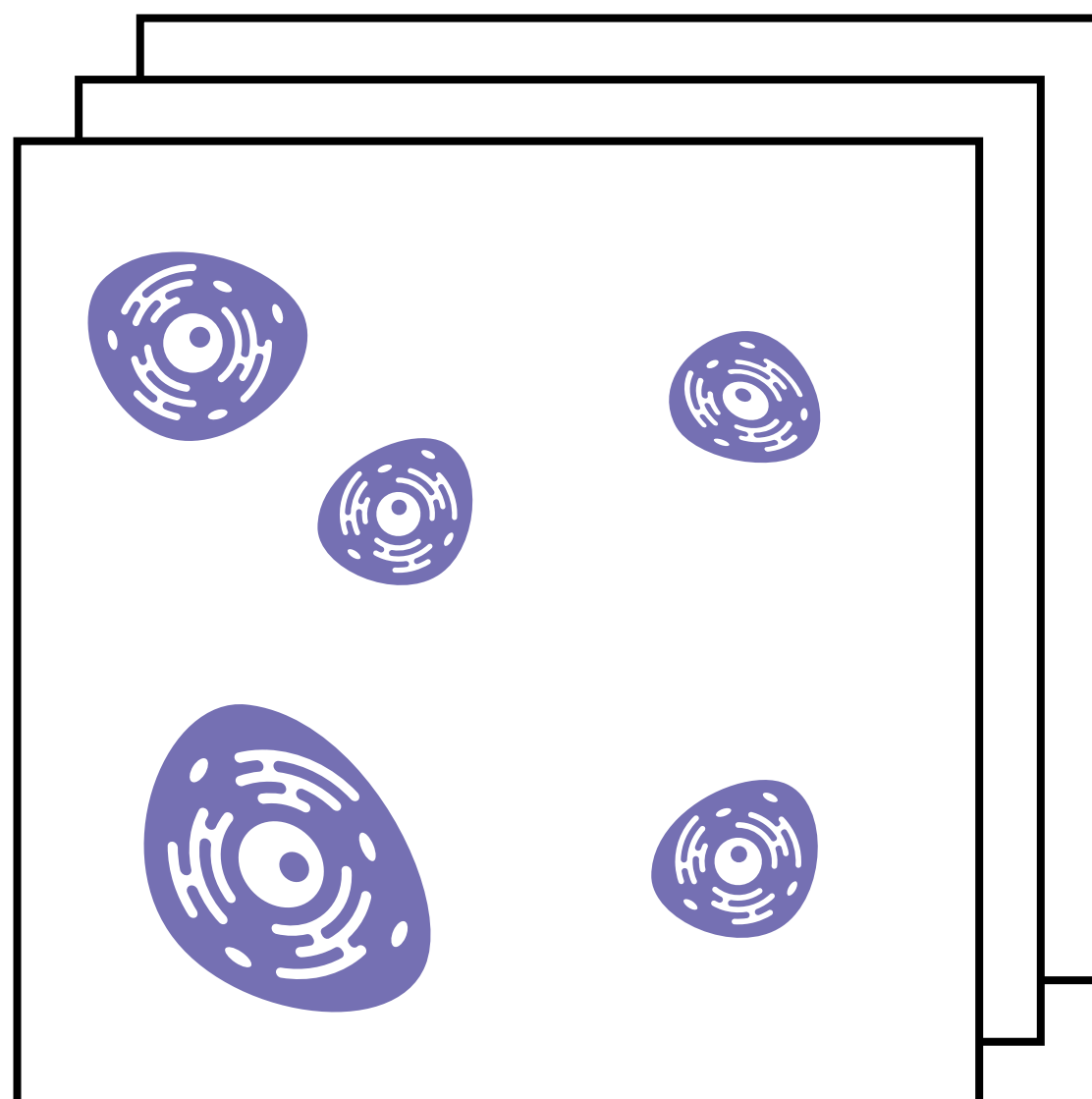
Images



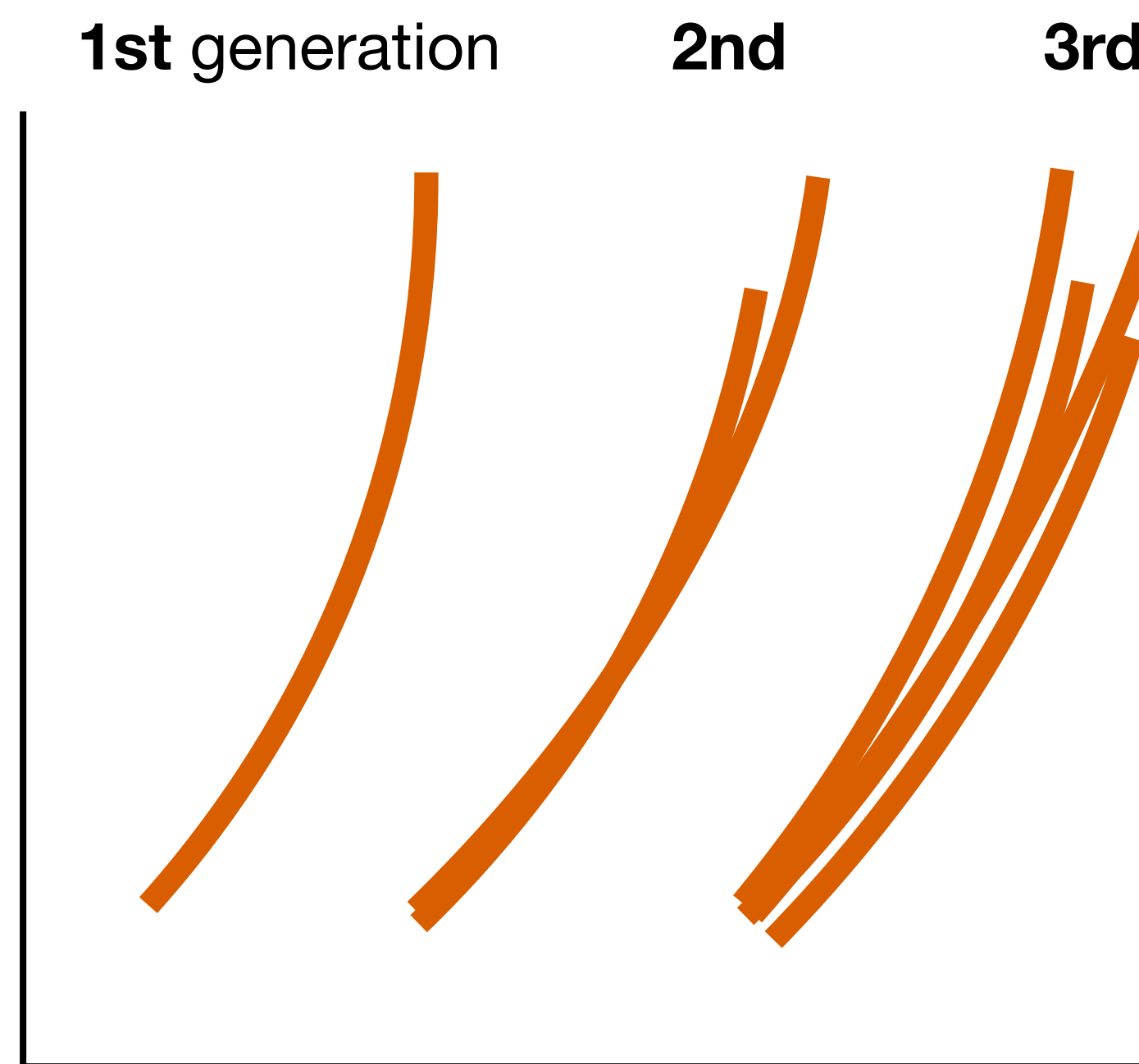
Time-Series



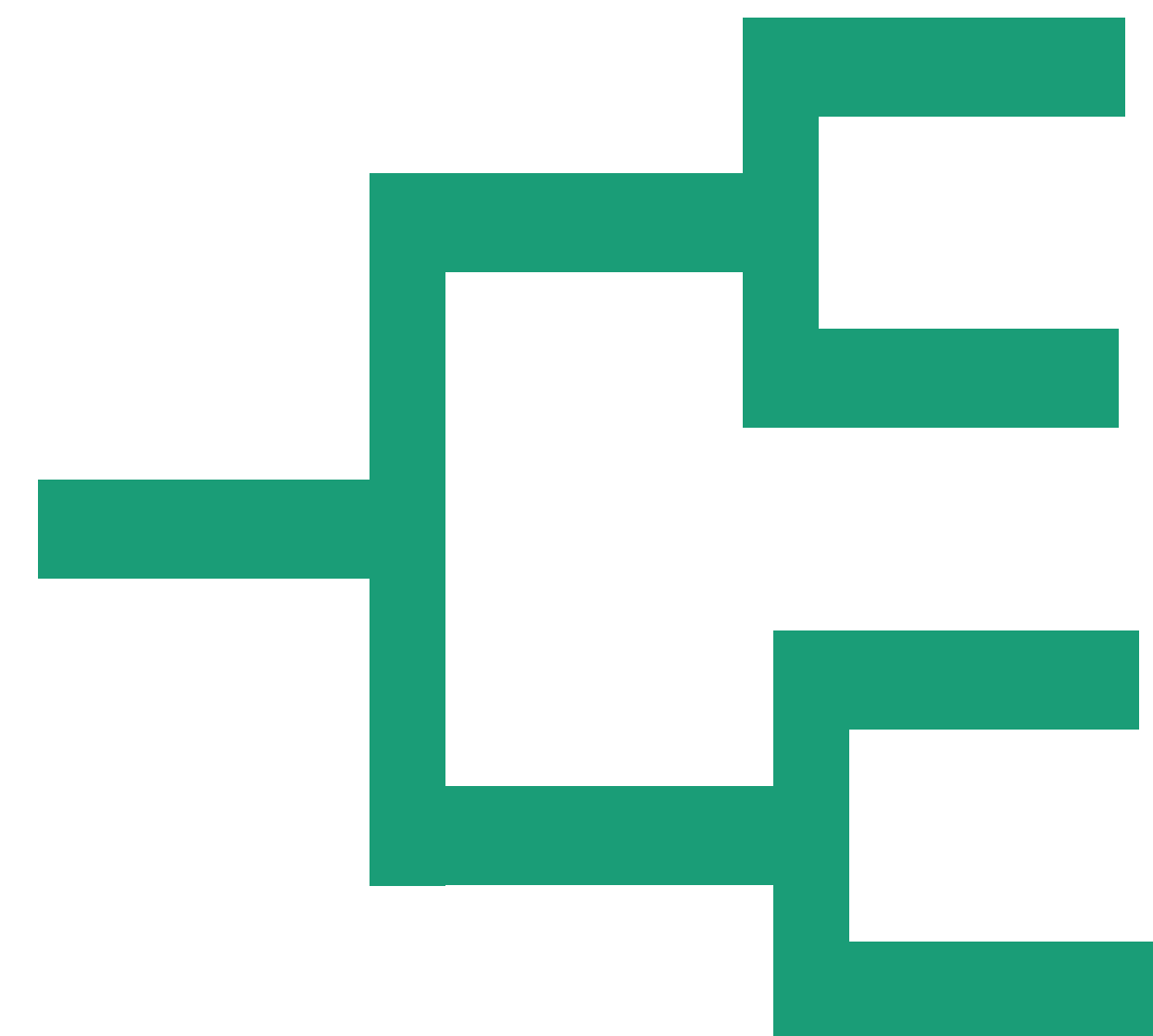
Tree



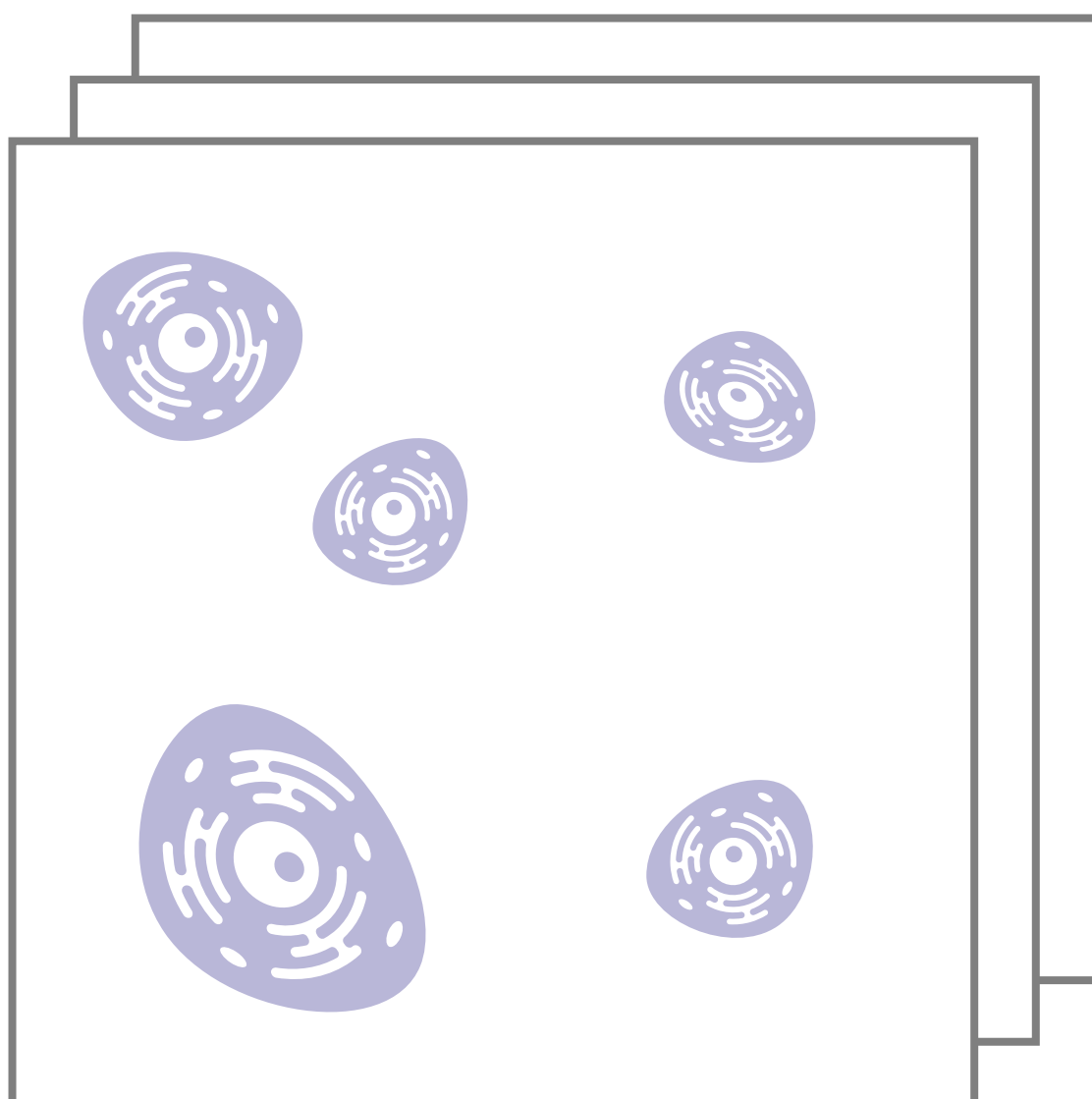
Images



Time-Series



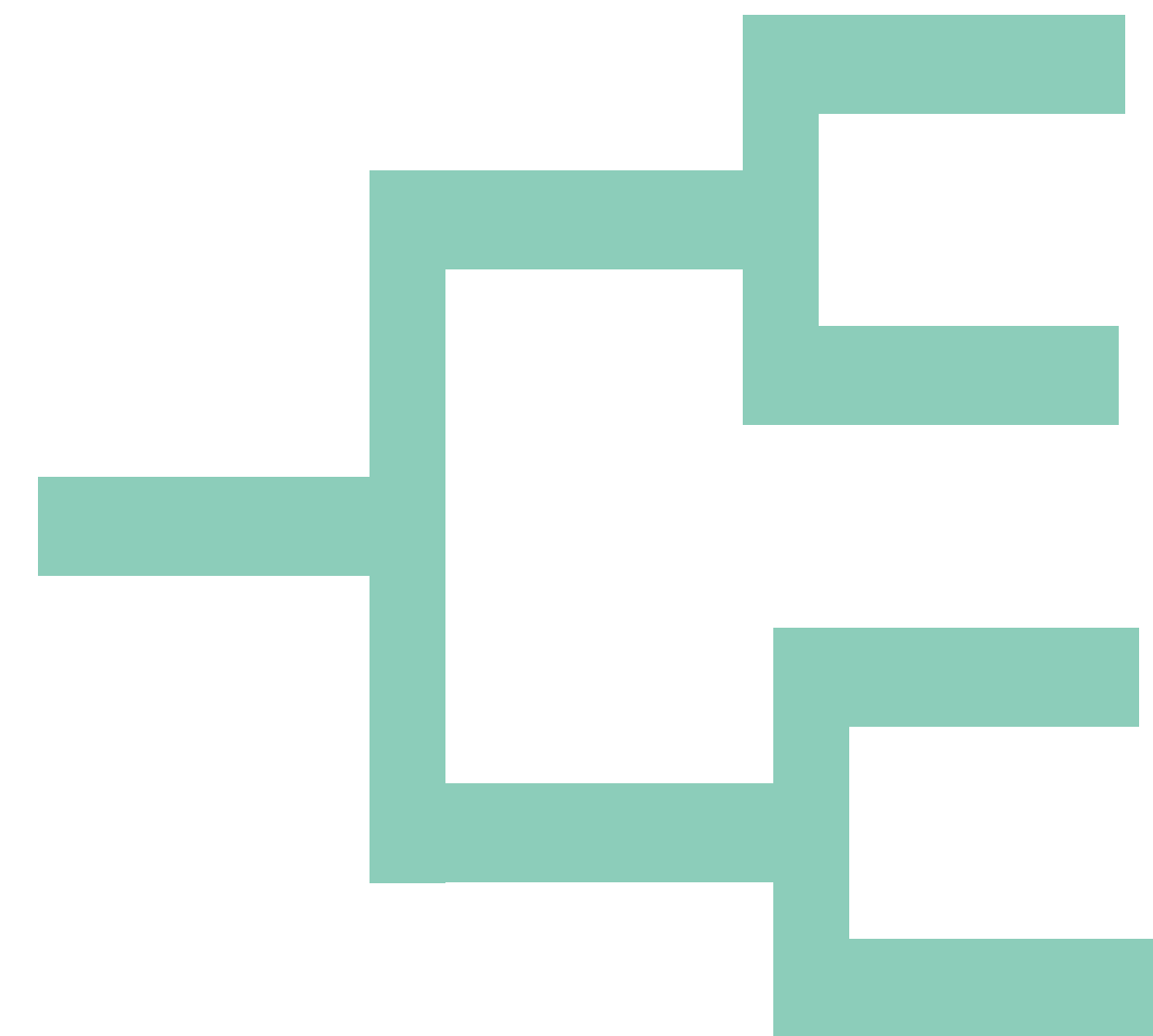
Tree



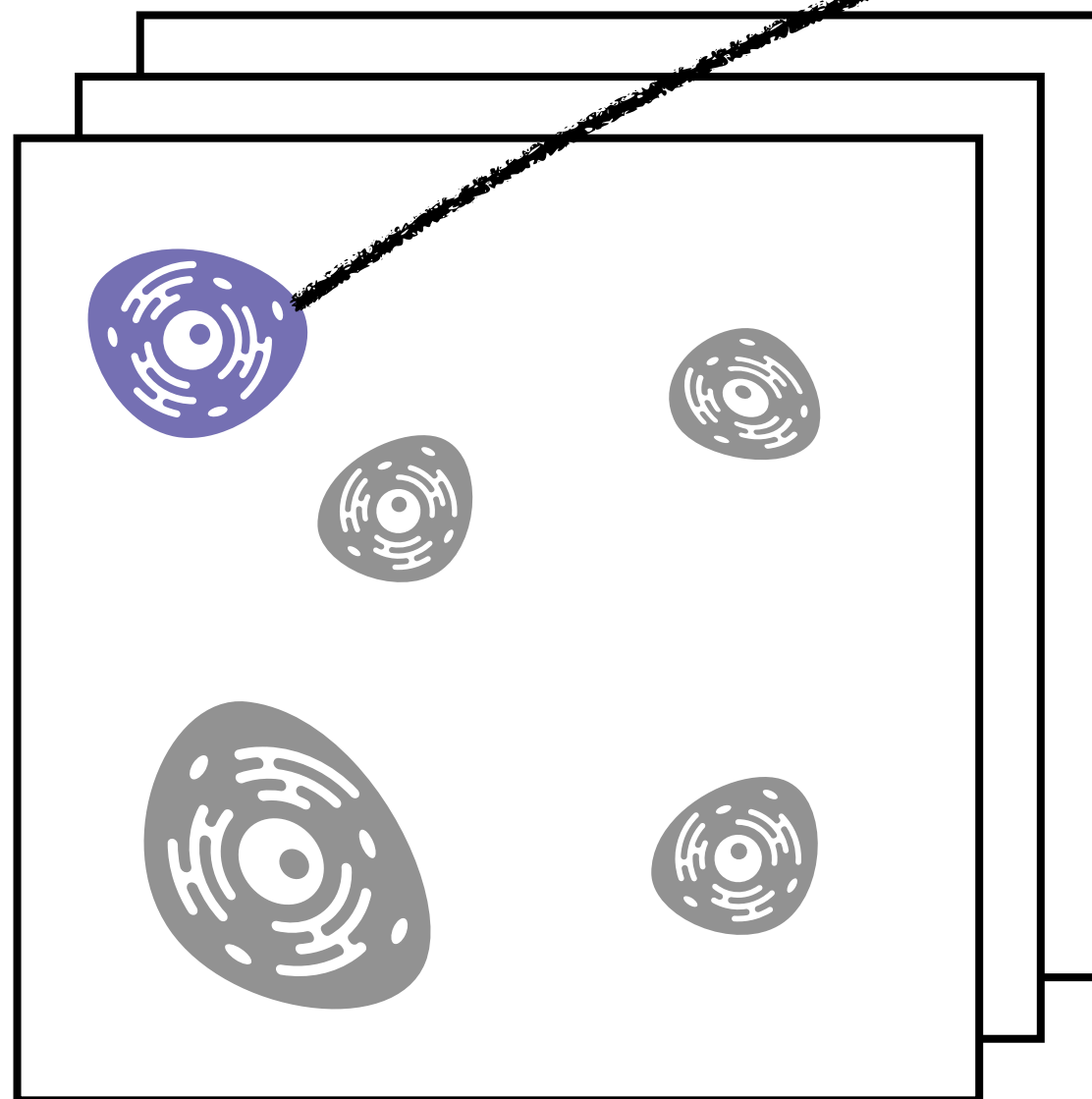
Images



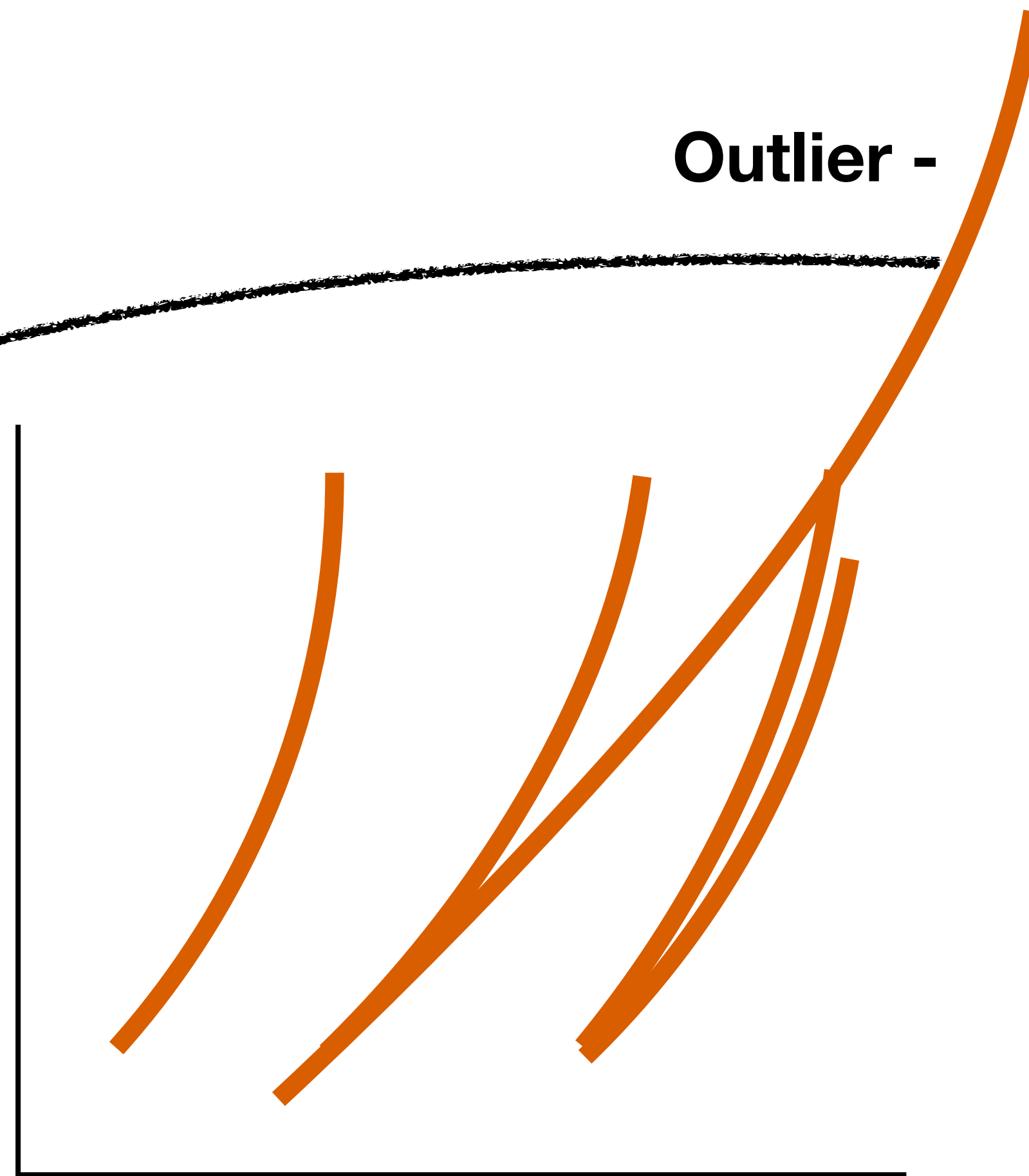
Time-Series



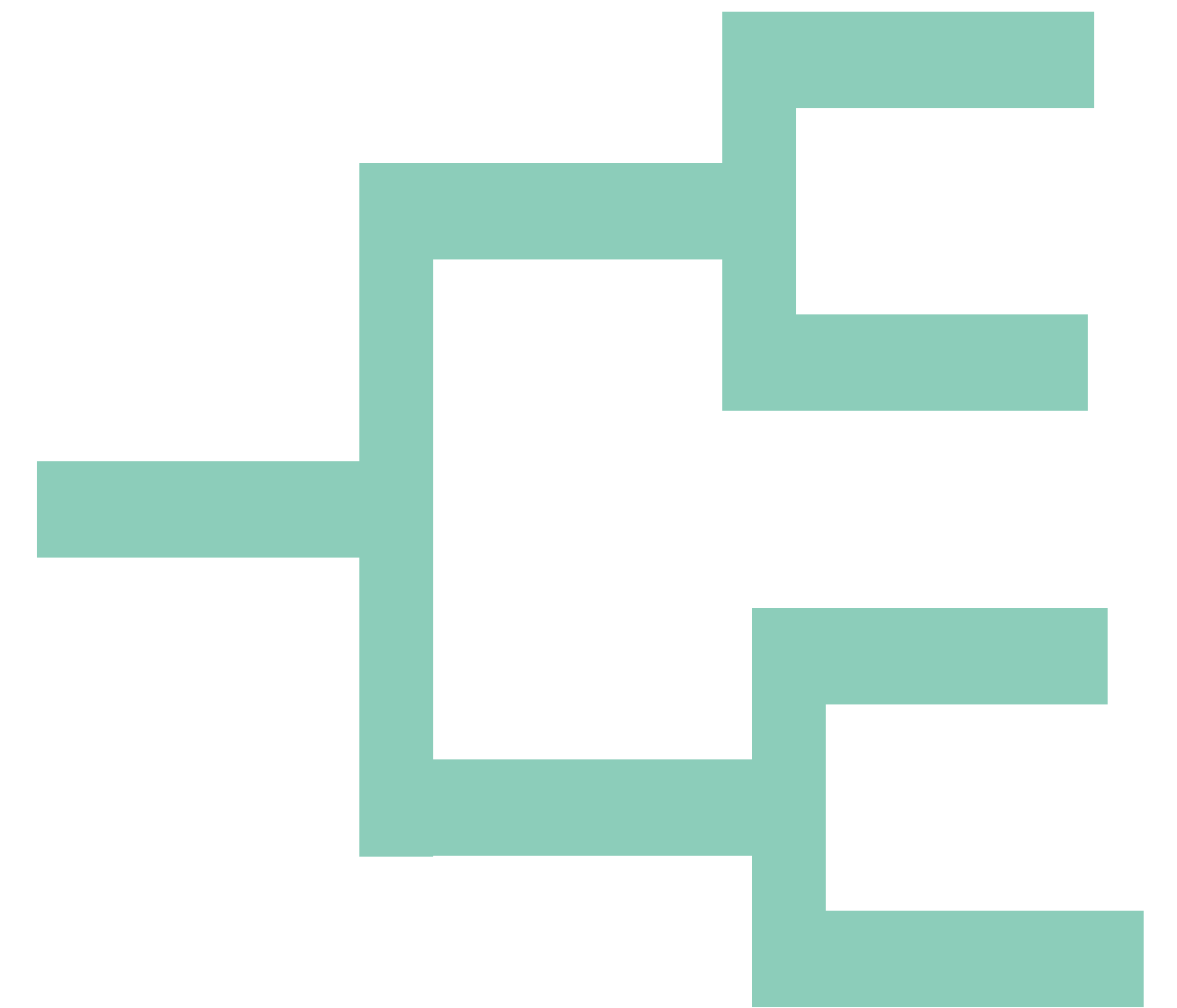
Tree



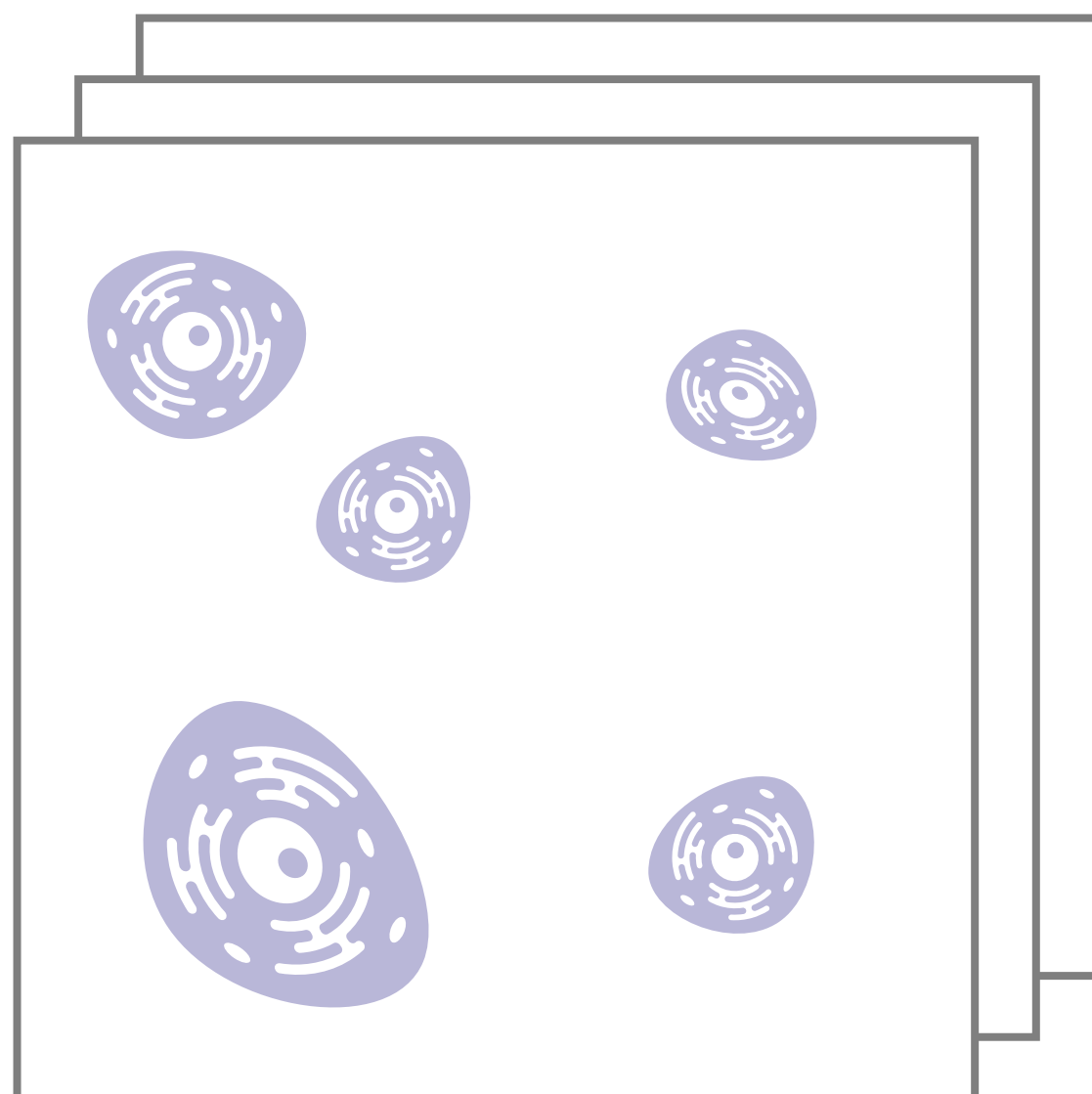
Images



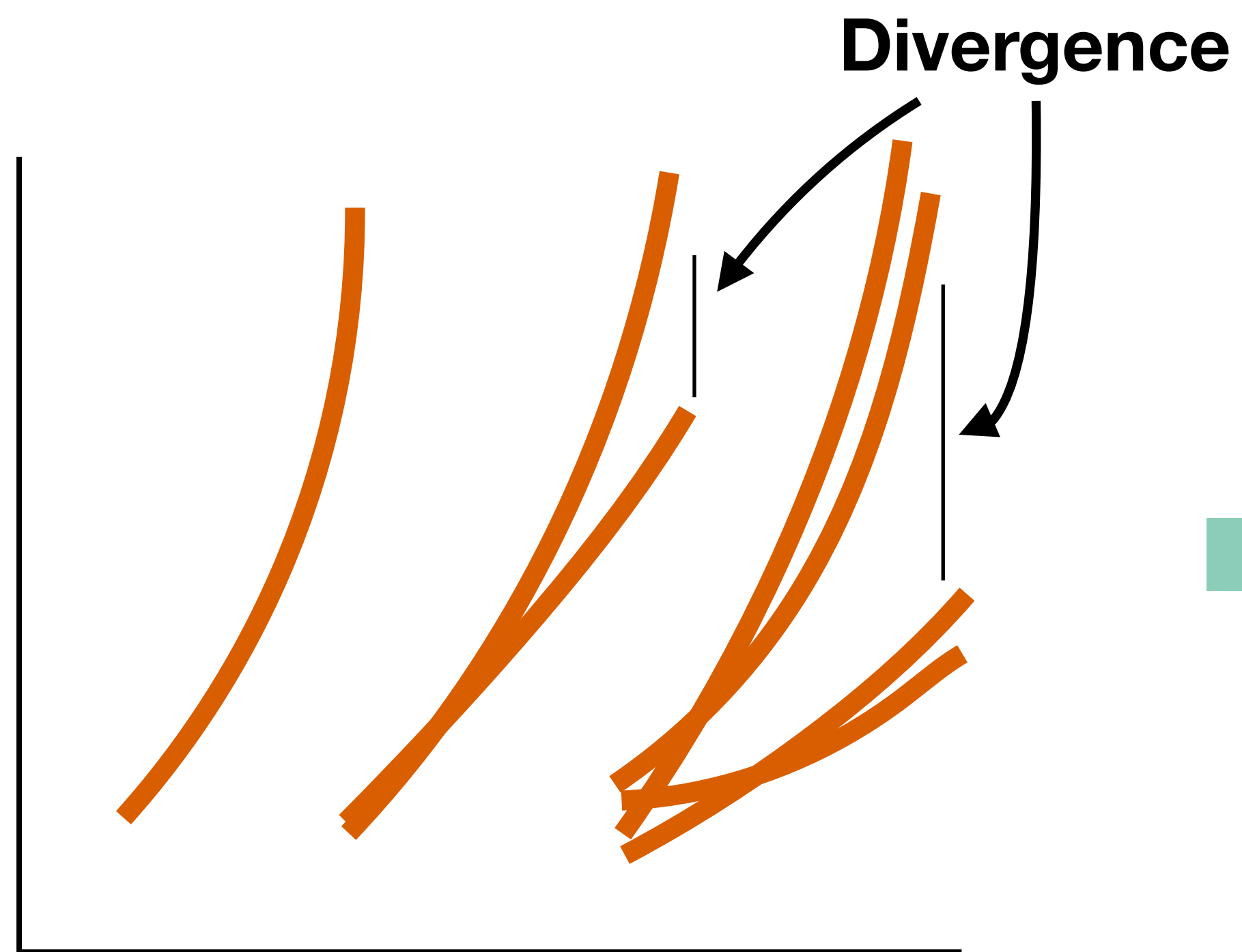
Time-Series



Tree



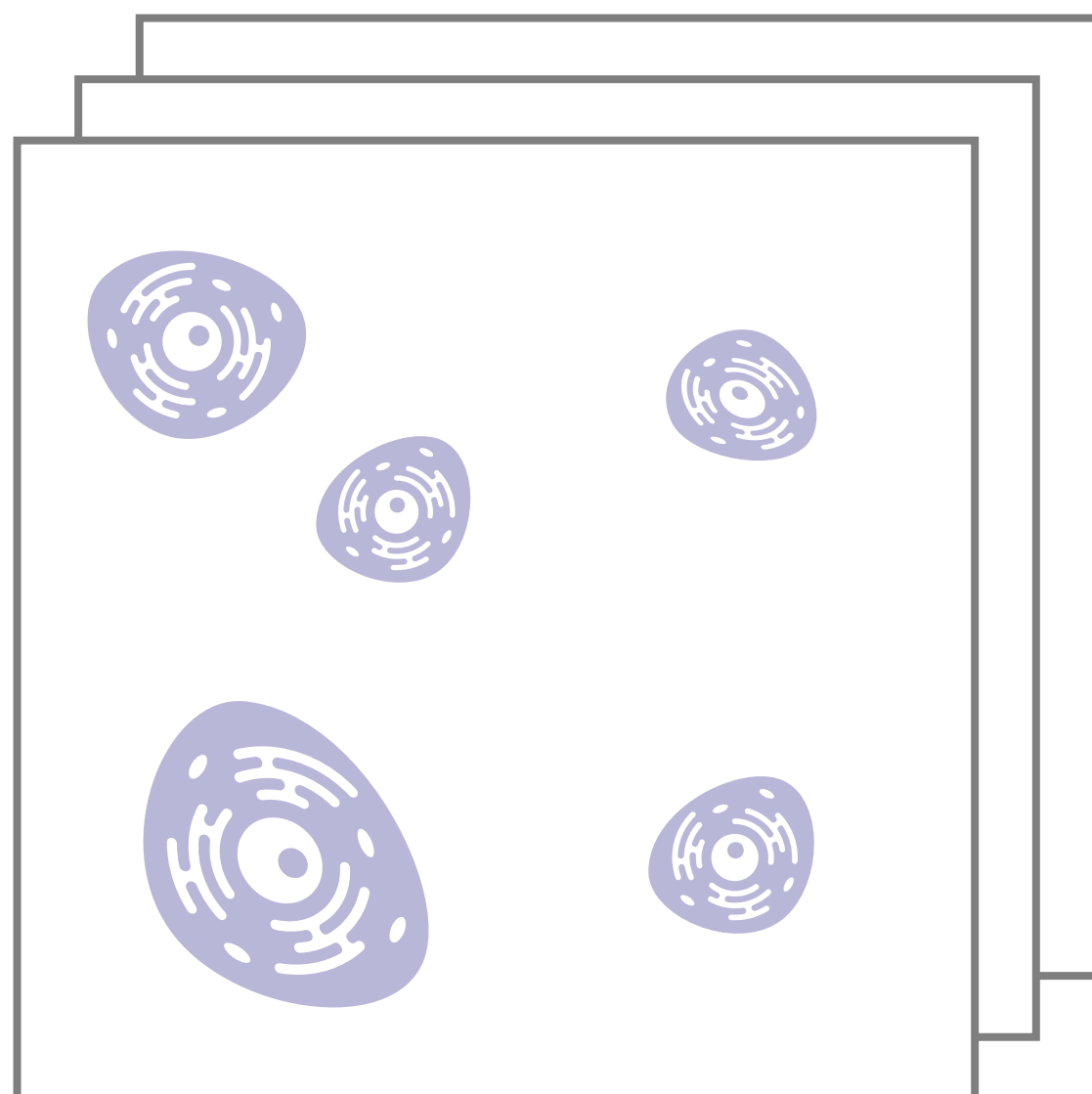
Images



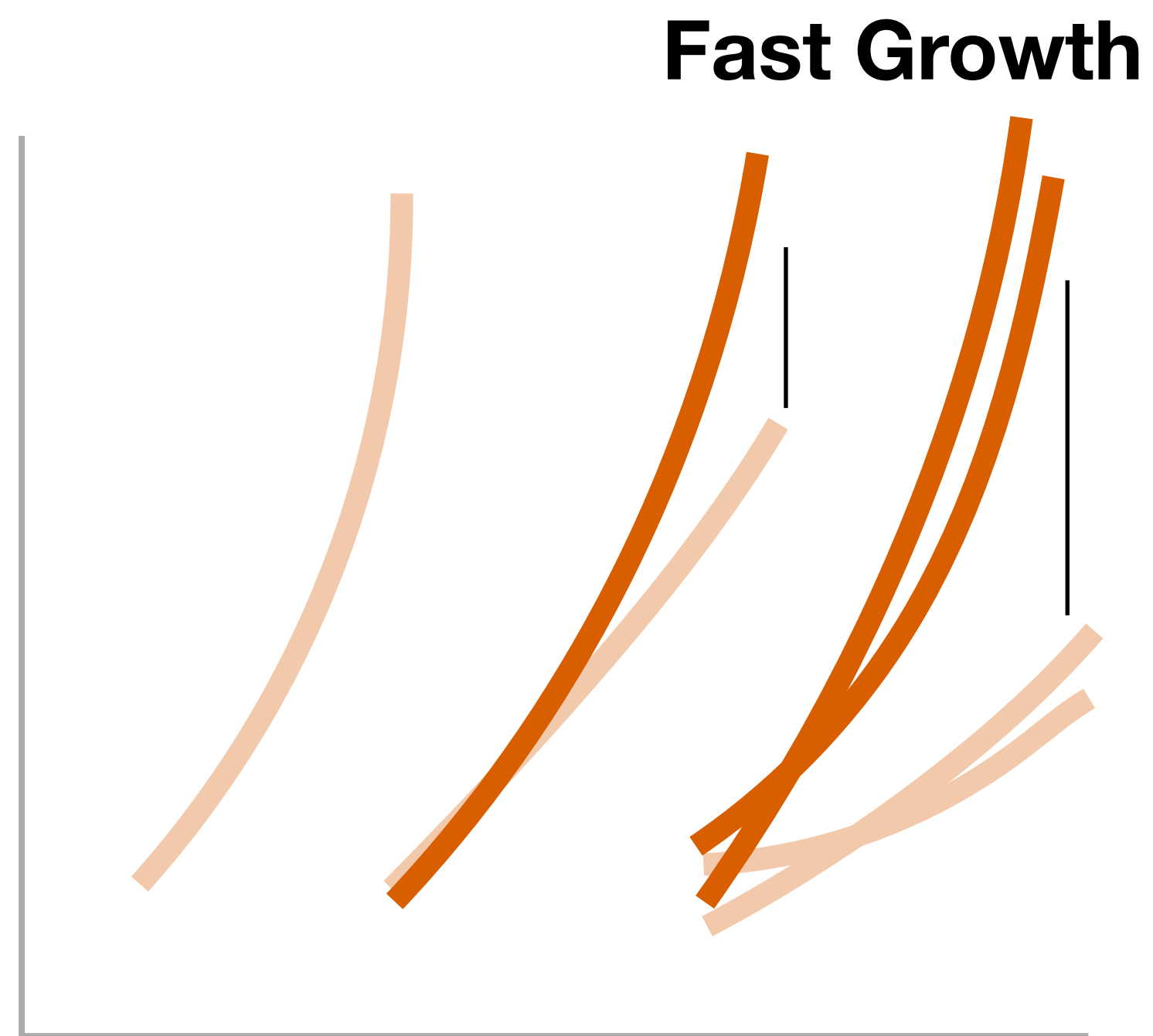
Time-Series



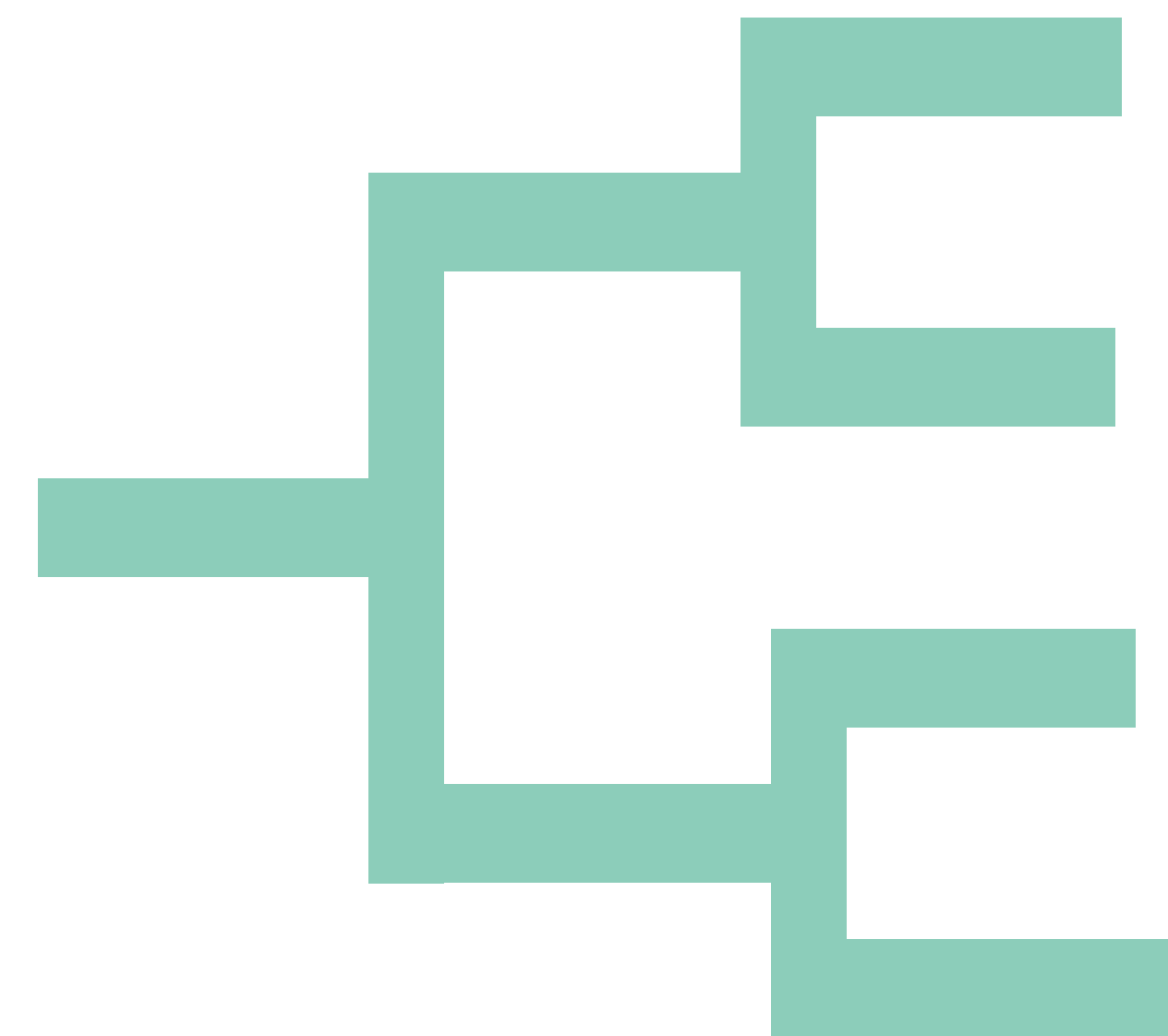
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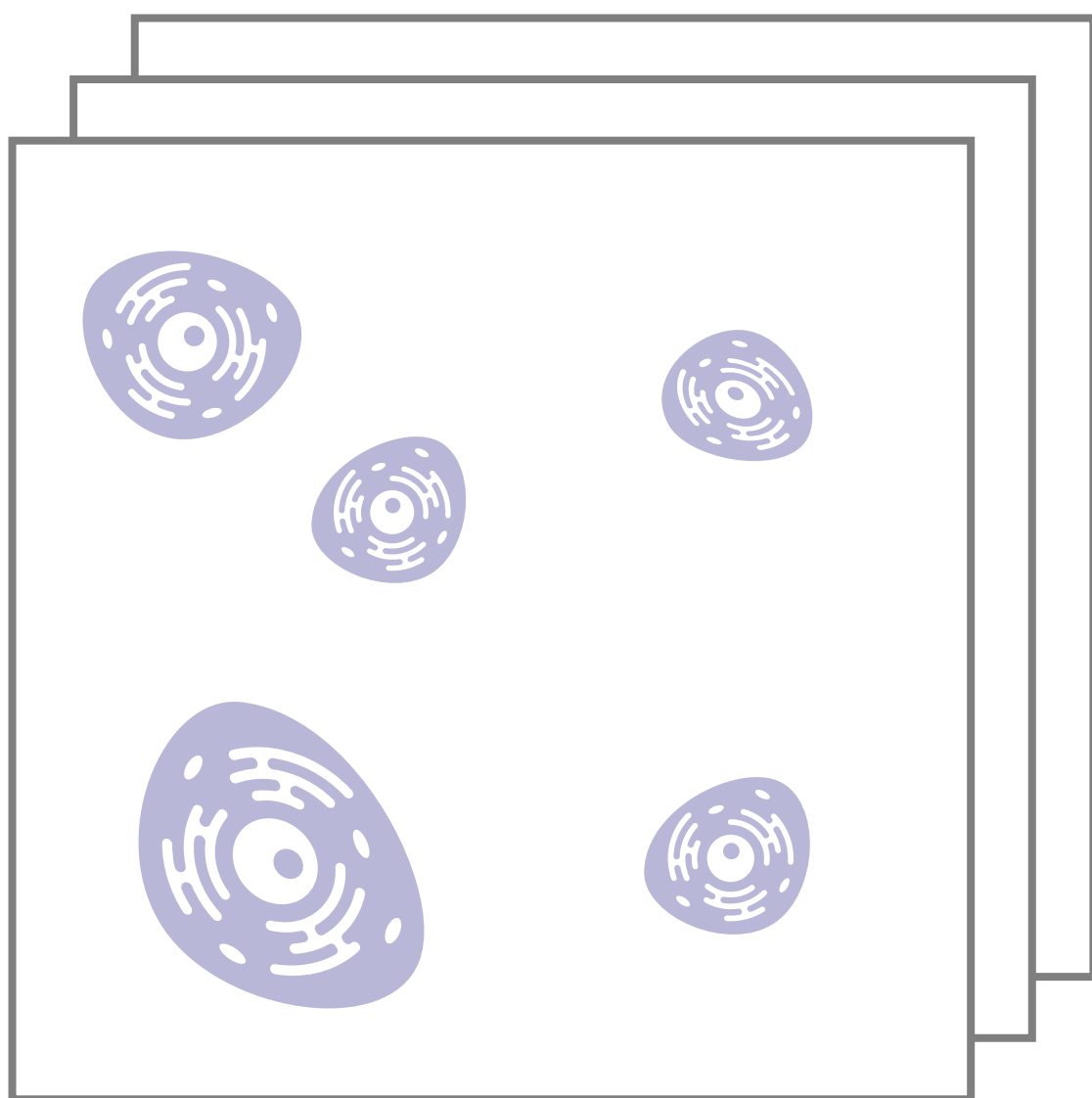
Images



Time-Series



Tree

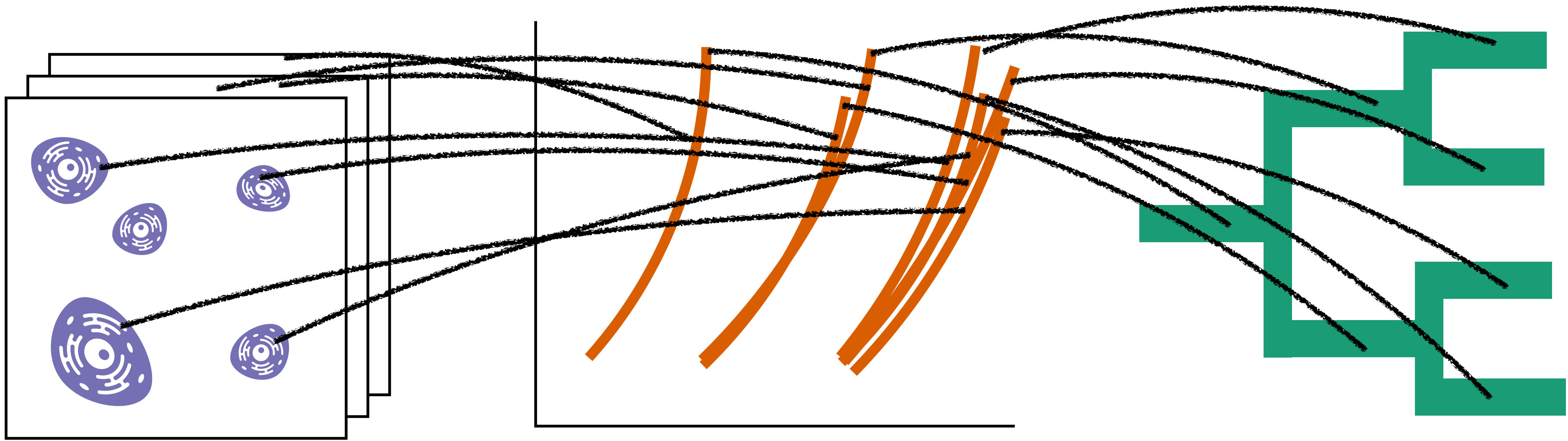


Images



Time-Series

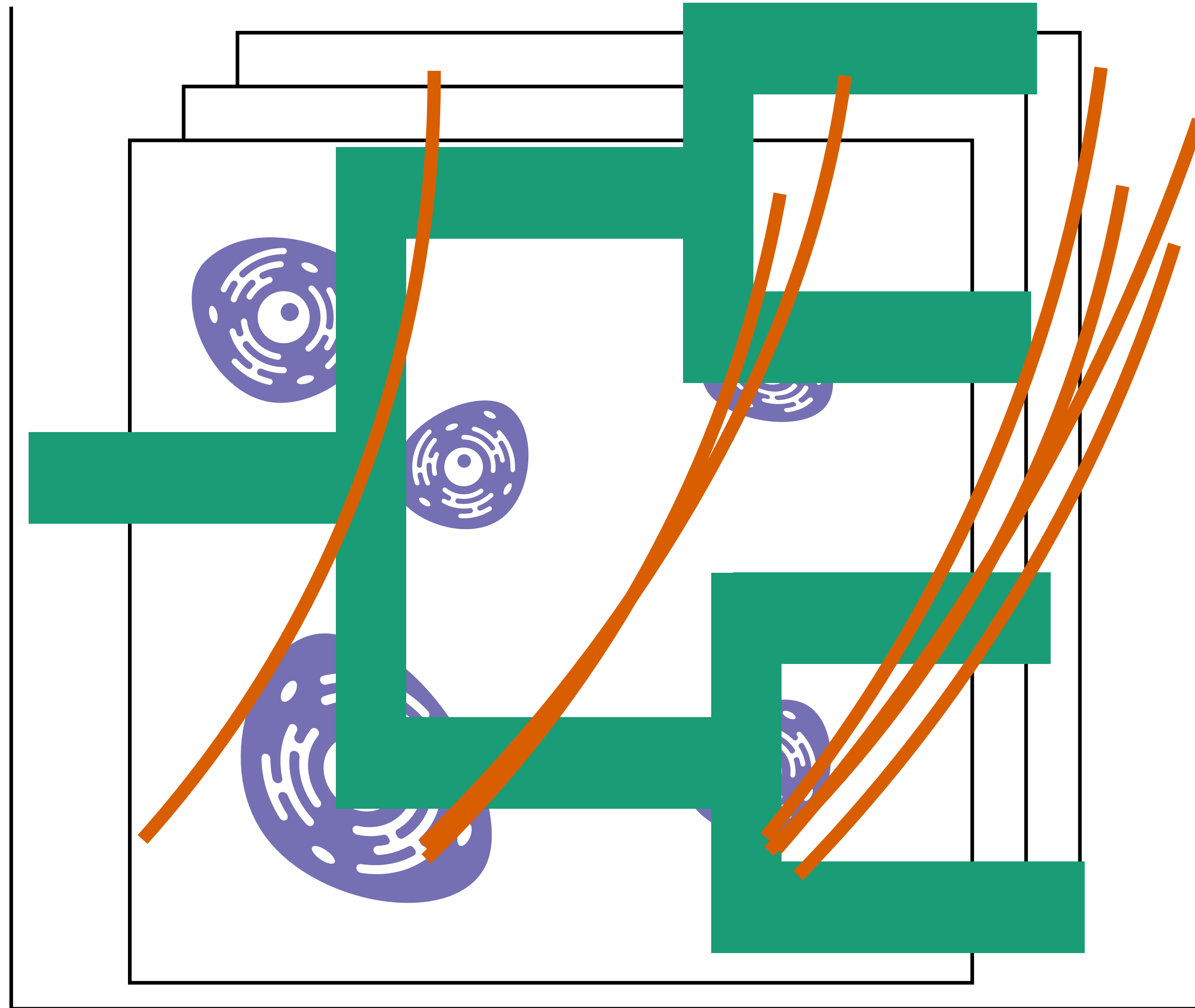
Tree



Images

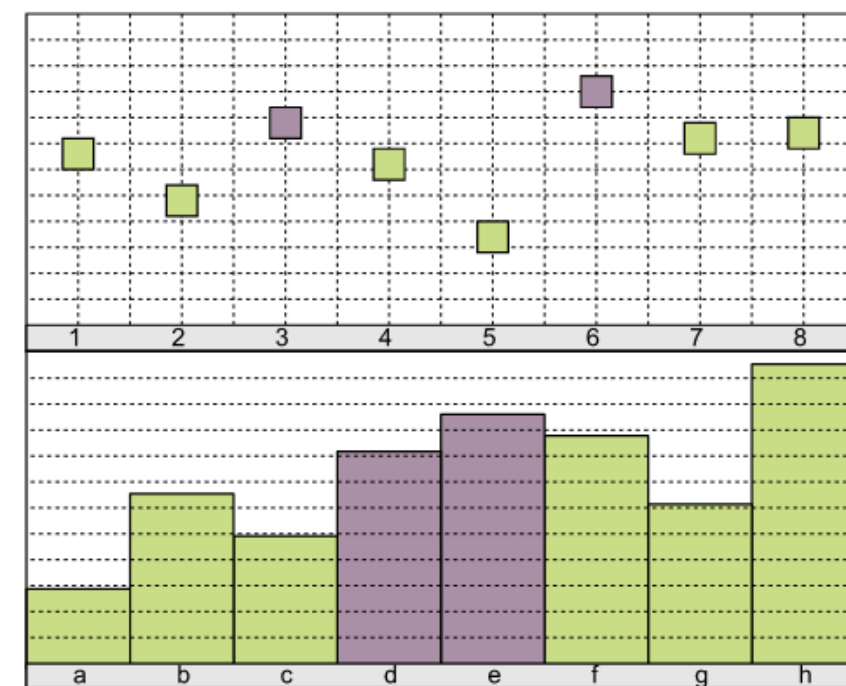
Time-Series

Tree

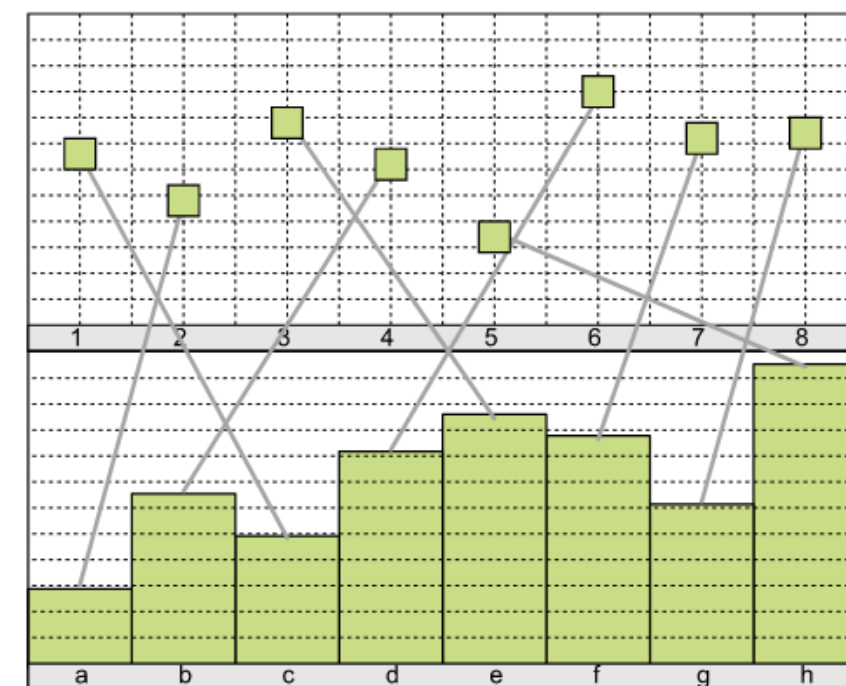


Composite Visualization

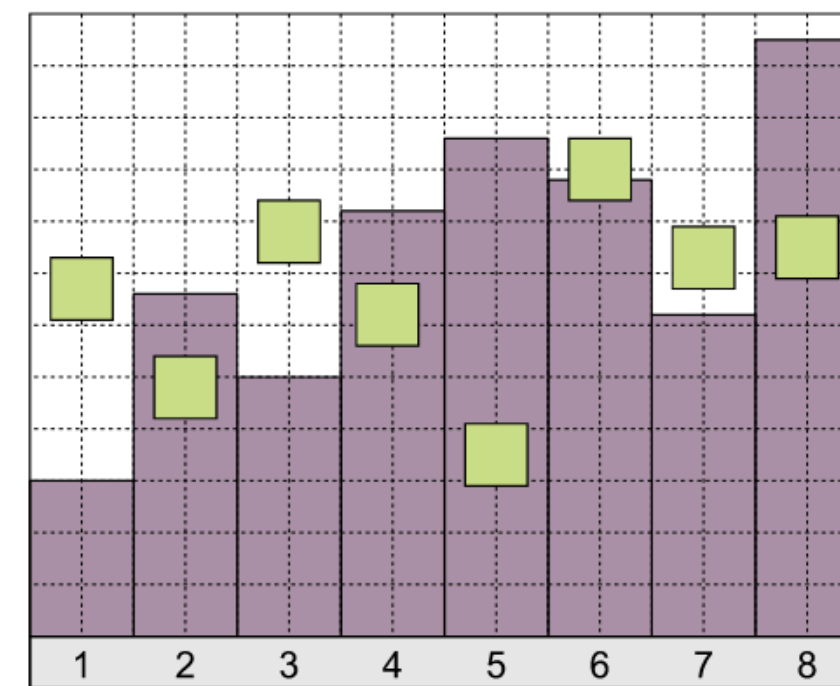
Composite Visualization Design Space



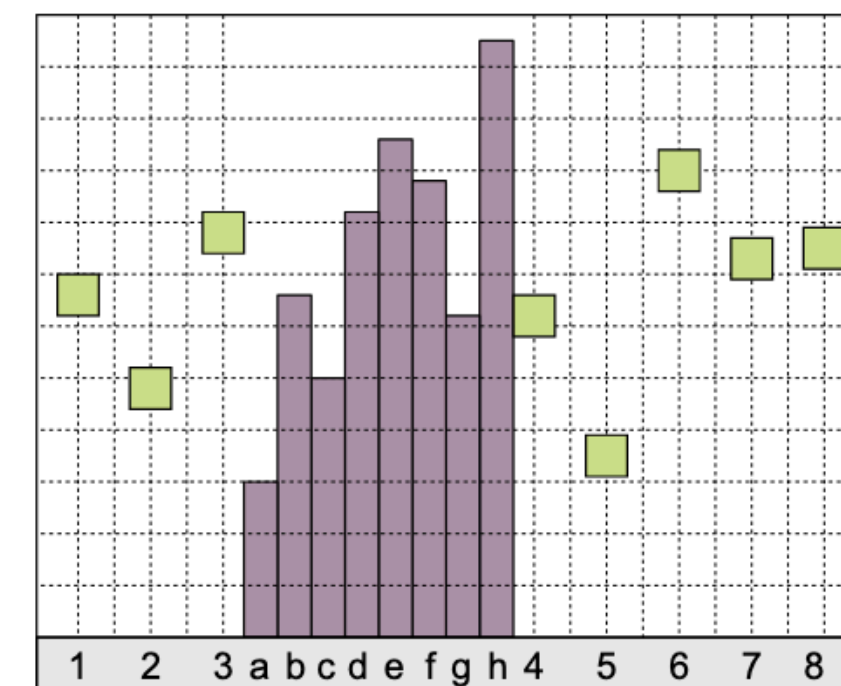
(a) Juxtaposed views.



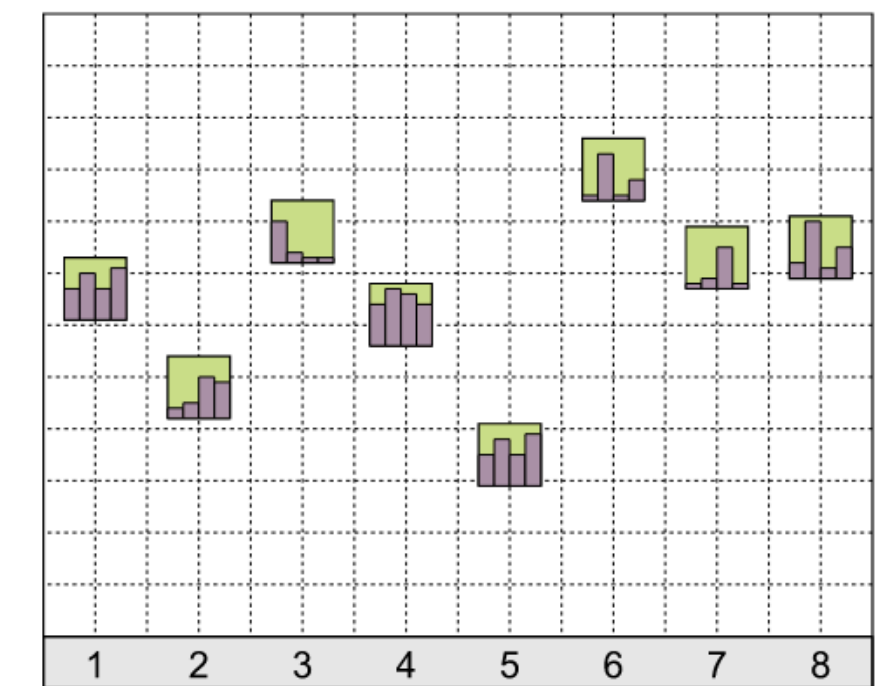
(b) Integrated views.



(c) Superimposed views.



(d) Overloaded views.



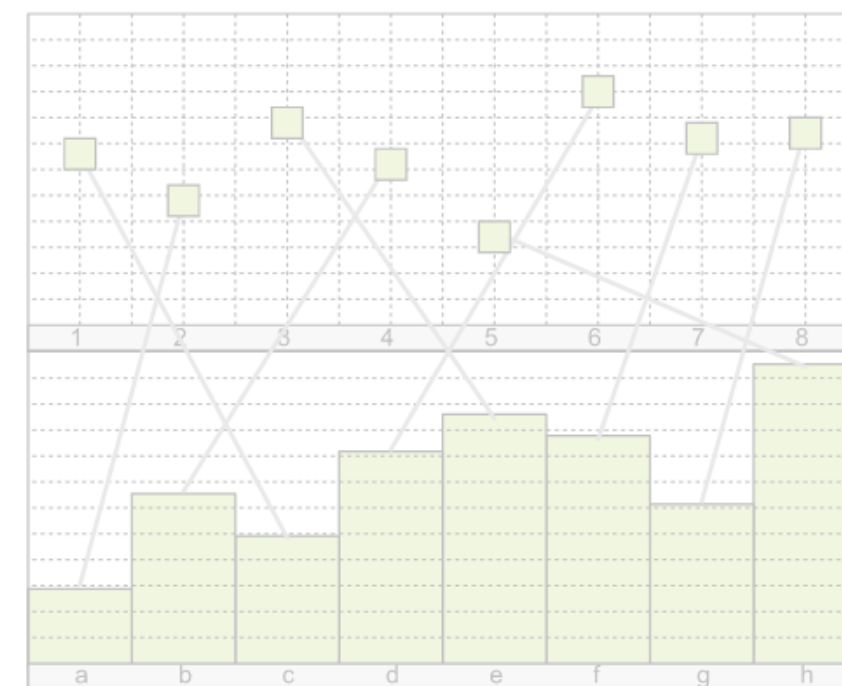
(e) Nested views.

W. Javed and N. Elmqvist, “Exploring the design space of composite visualization,”
in *Proceedings of the IEEE Pacific Visualization Symposium*, IEEE, 2012, pp. 1–8. doi: [10.1109/PacificVis.2012.6183556](https://doi.org/10.1109/PacificVis.2012.6183556).

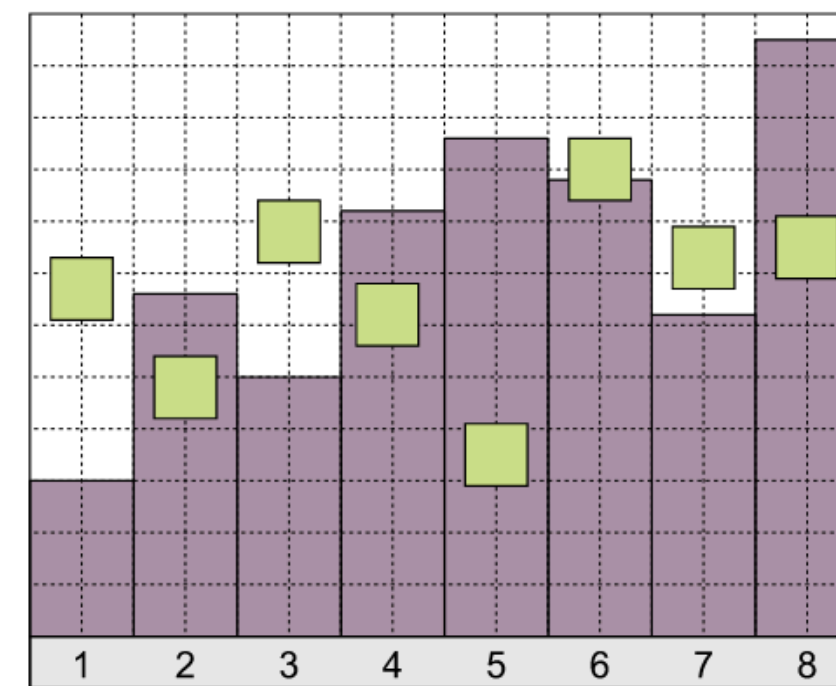
Composite Visualization Design Space



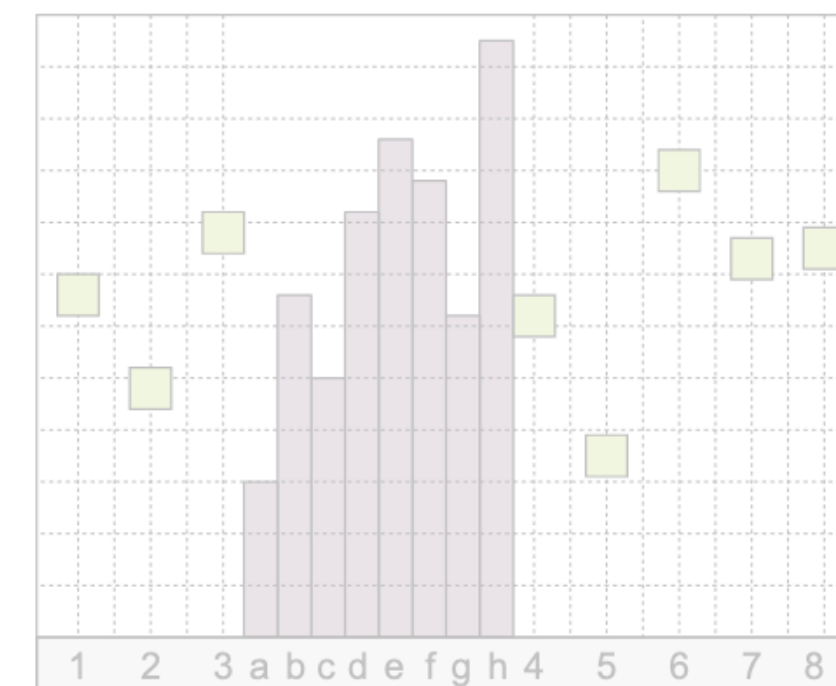
(a) Juxtaposed views.



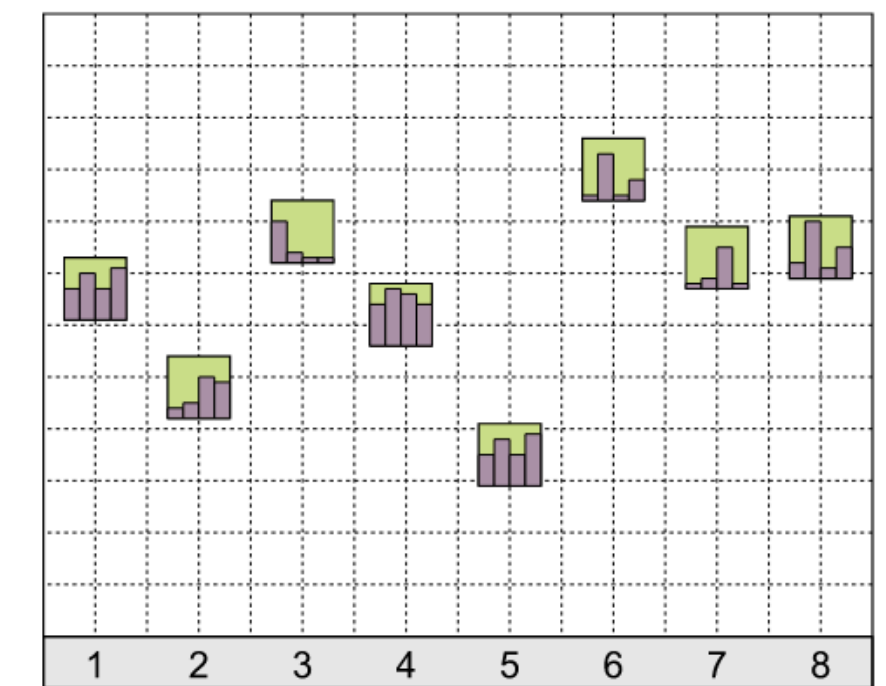
(b) Integrated views.



(c) Superimposed views.



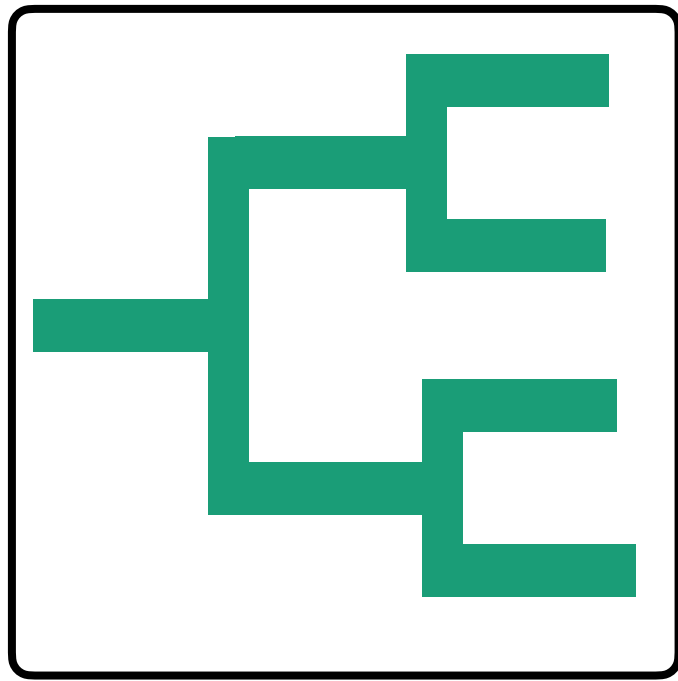
(d) Overloaded views.



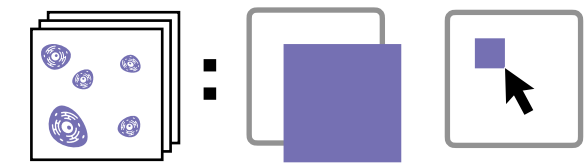
(e) Nested views.

W. Javed and N. Elmqvist, “Exploring the design space of composite visualization,” in *Proceedings of the IEEE Pacific Visualization Symposium*, IEEE, 2012, pp. 1–8. doi: [10.1109/PacificVis.2012.6183556](https://doi.org/10.1109/PacificVis.2012.6183556).

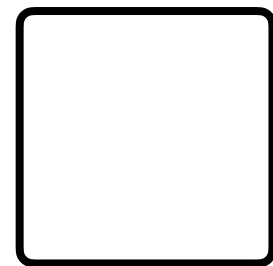
Tree with



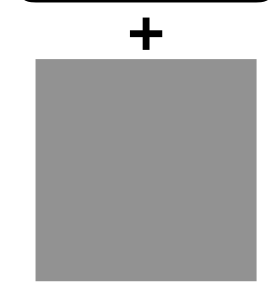
Time-Series Nested



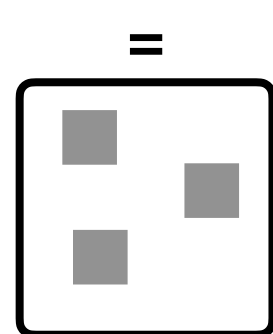
Images Superimposed



Primary
(Host Visualization)



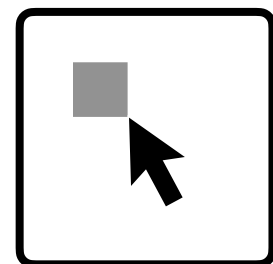
Secondary
(Client Visualization)



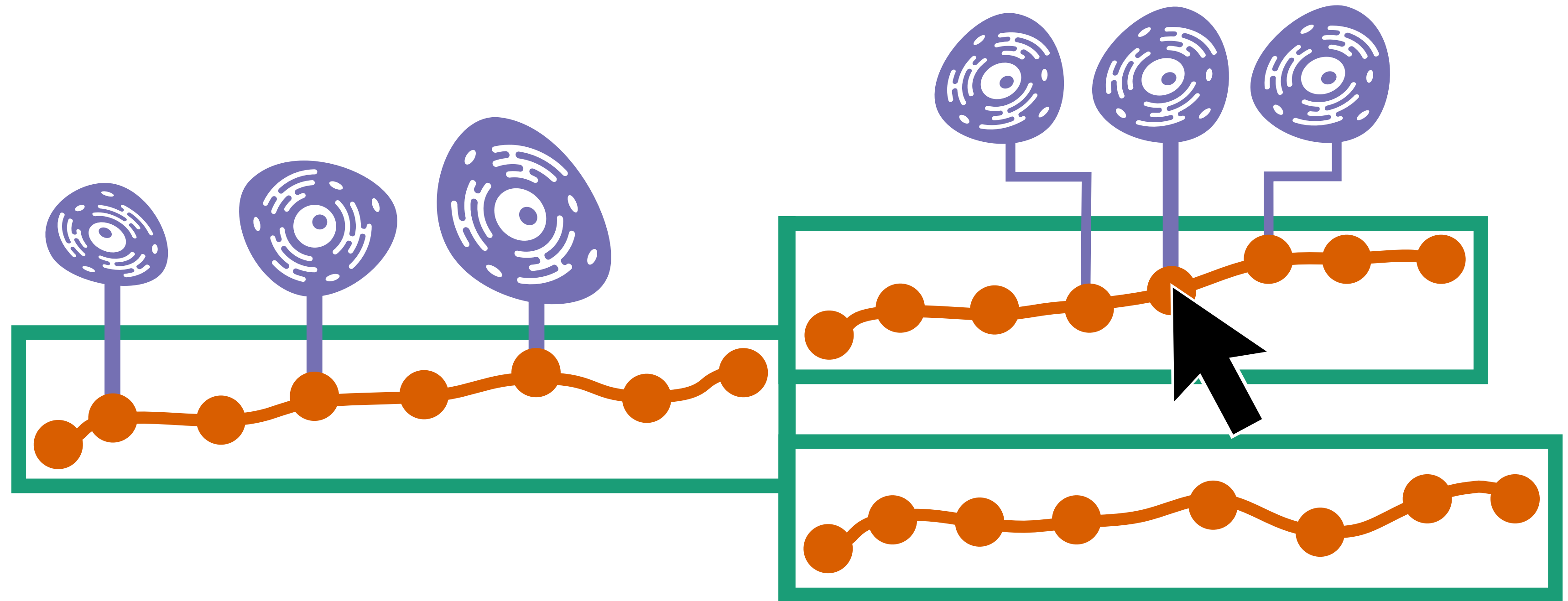
Nested



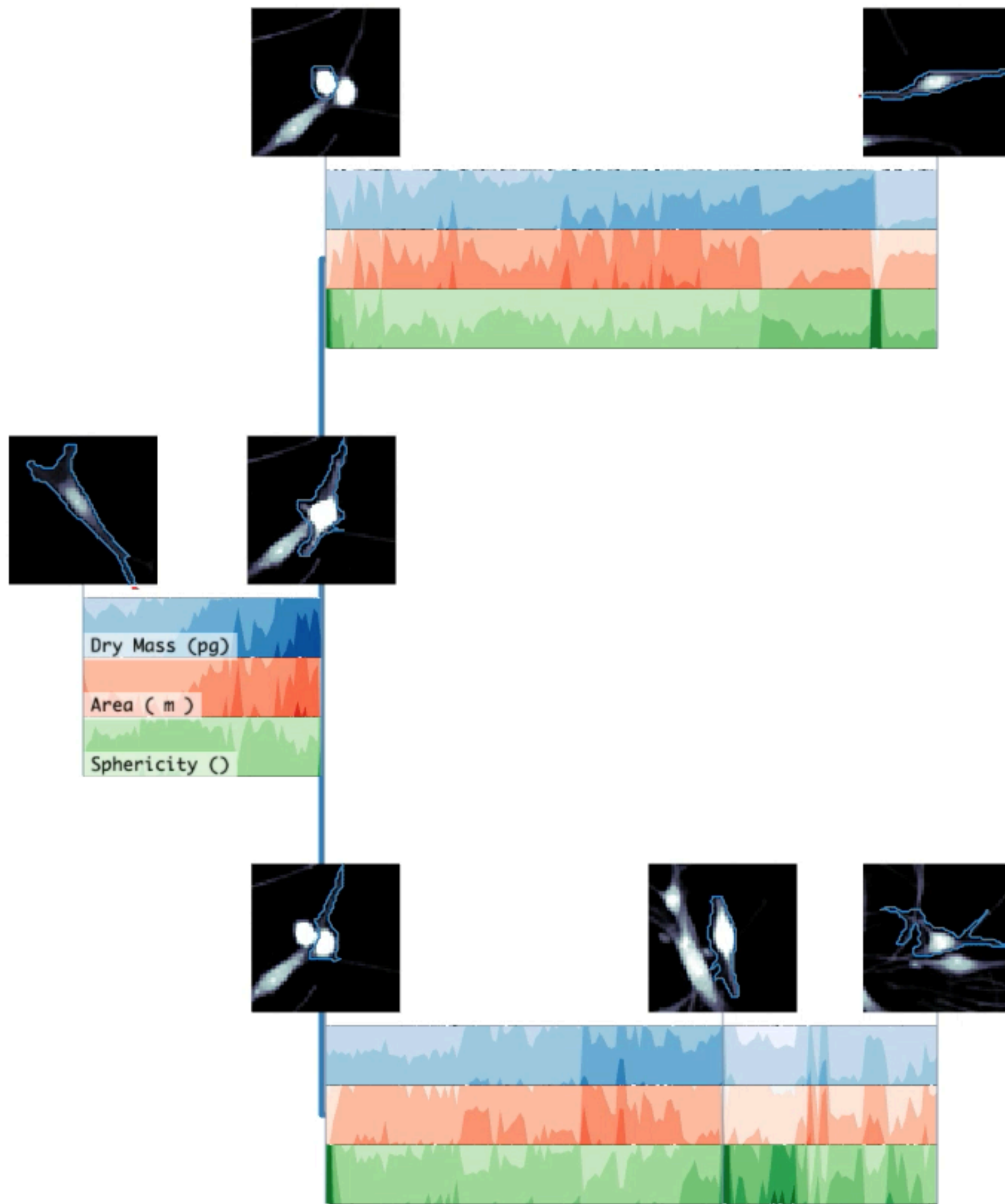
Superimposed



**Superimposed
on Demand**



Tree-First



Time-Series-First

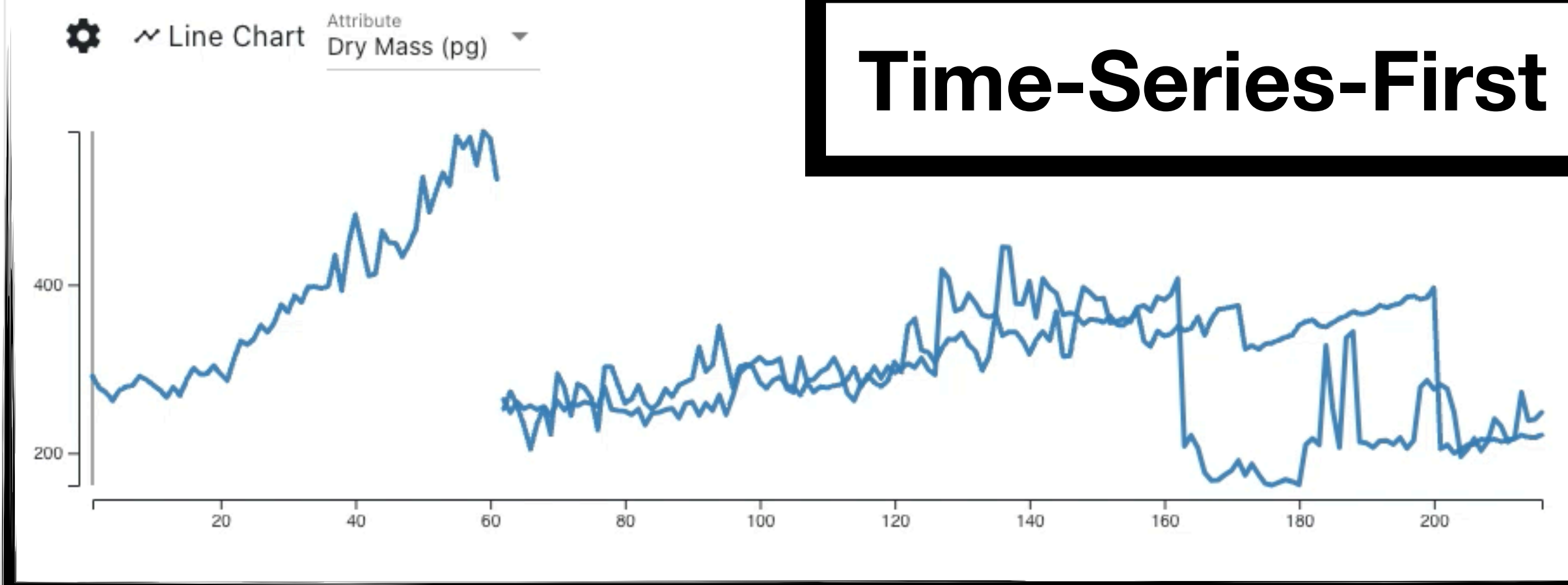
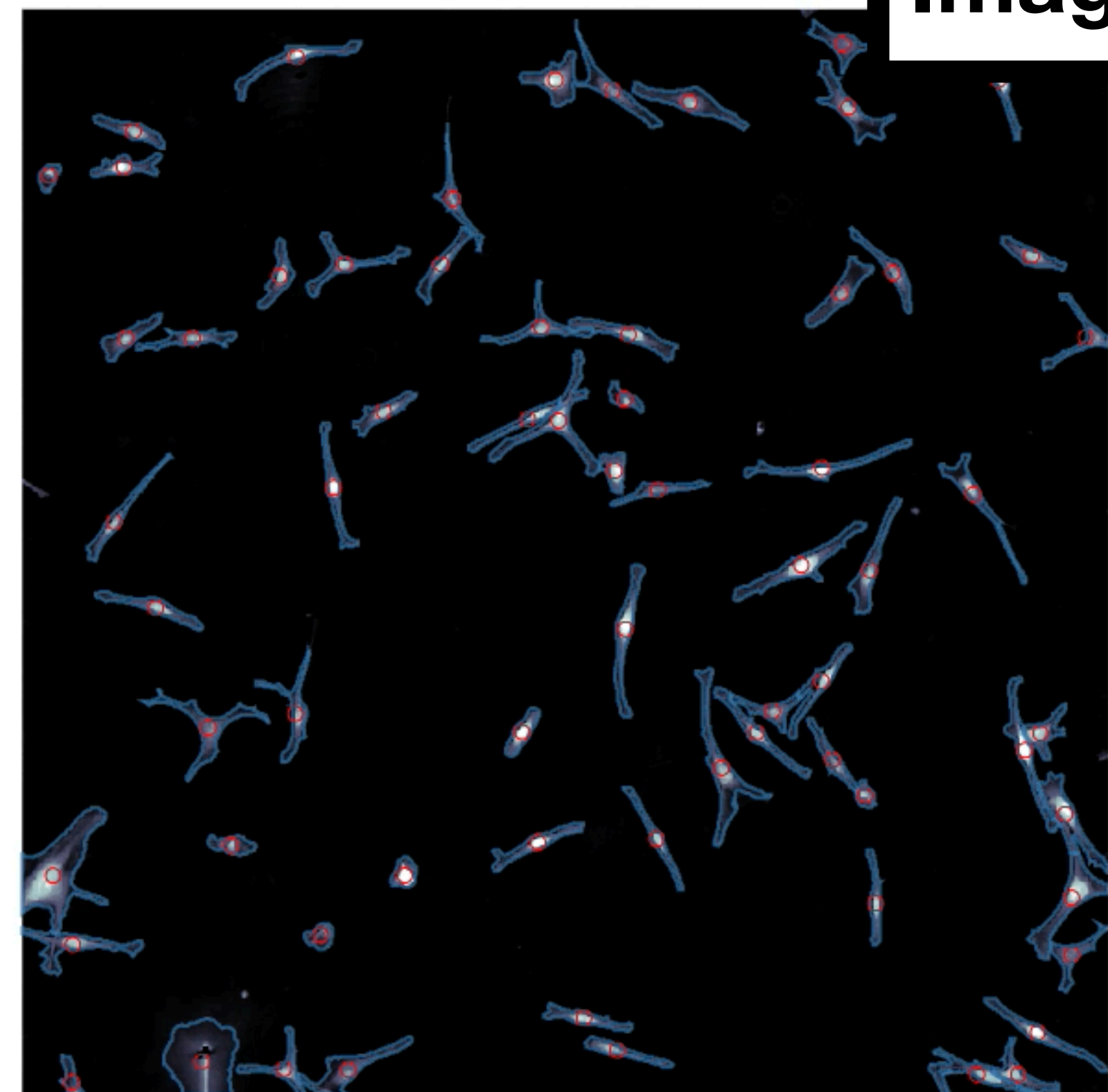
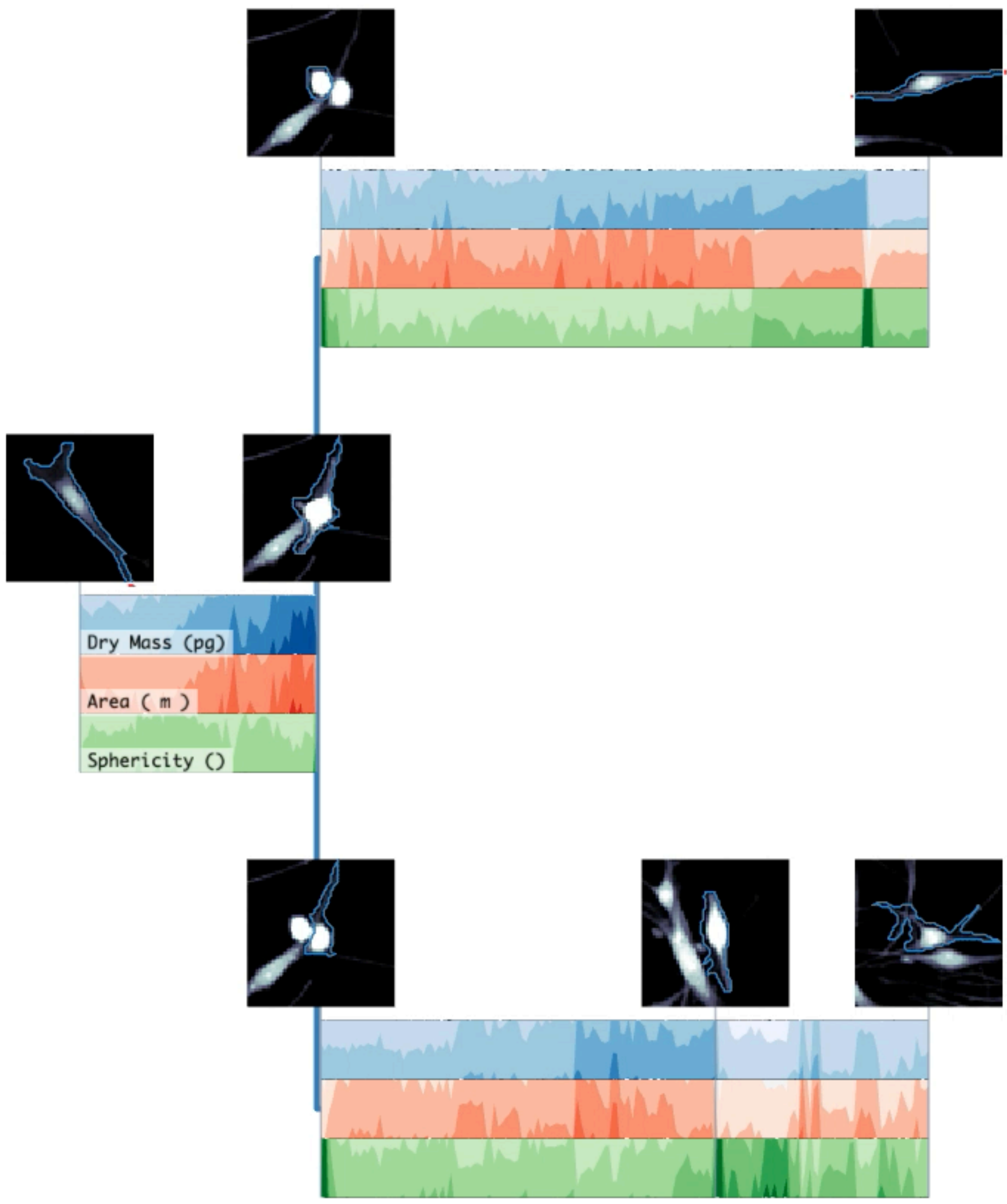


Image-First

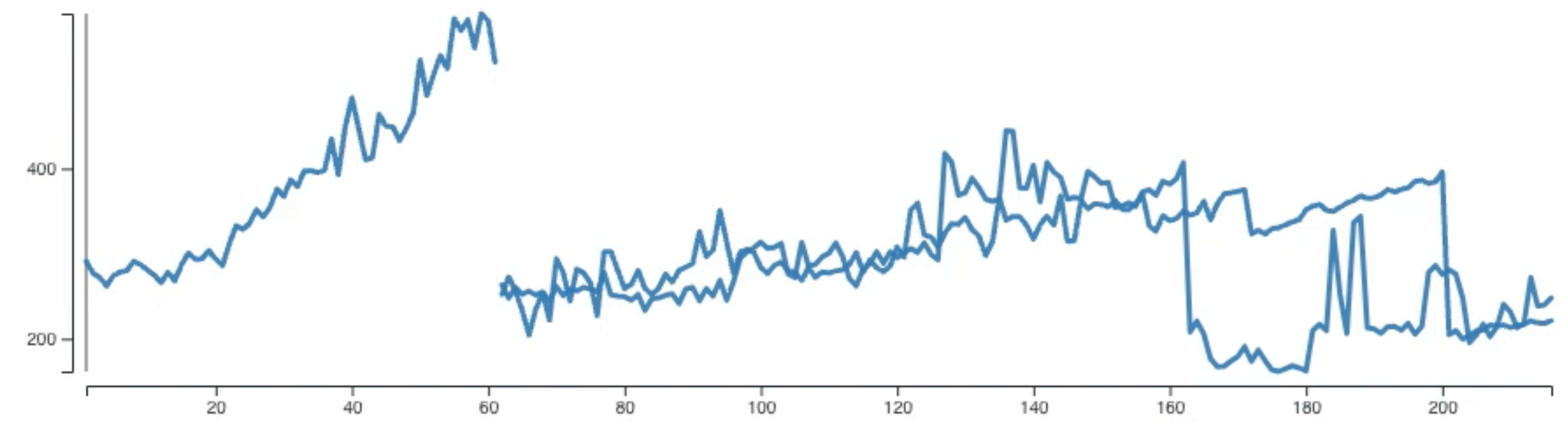




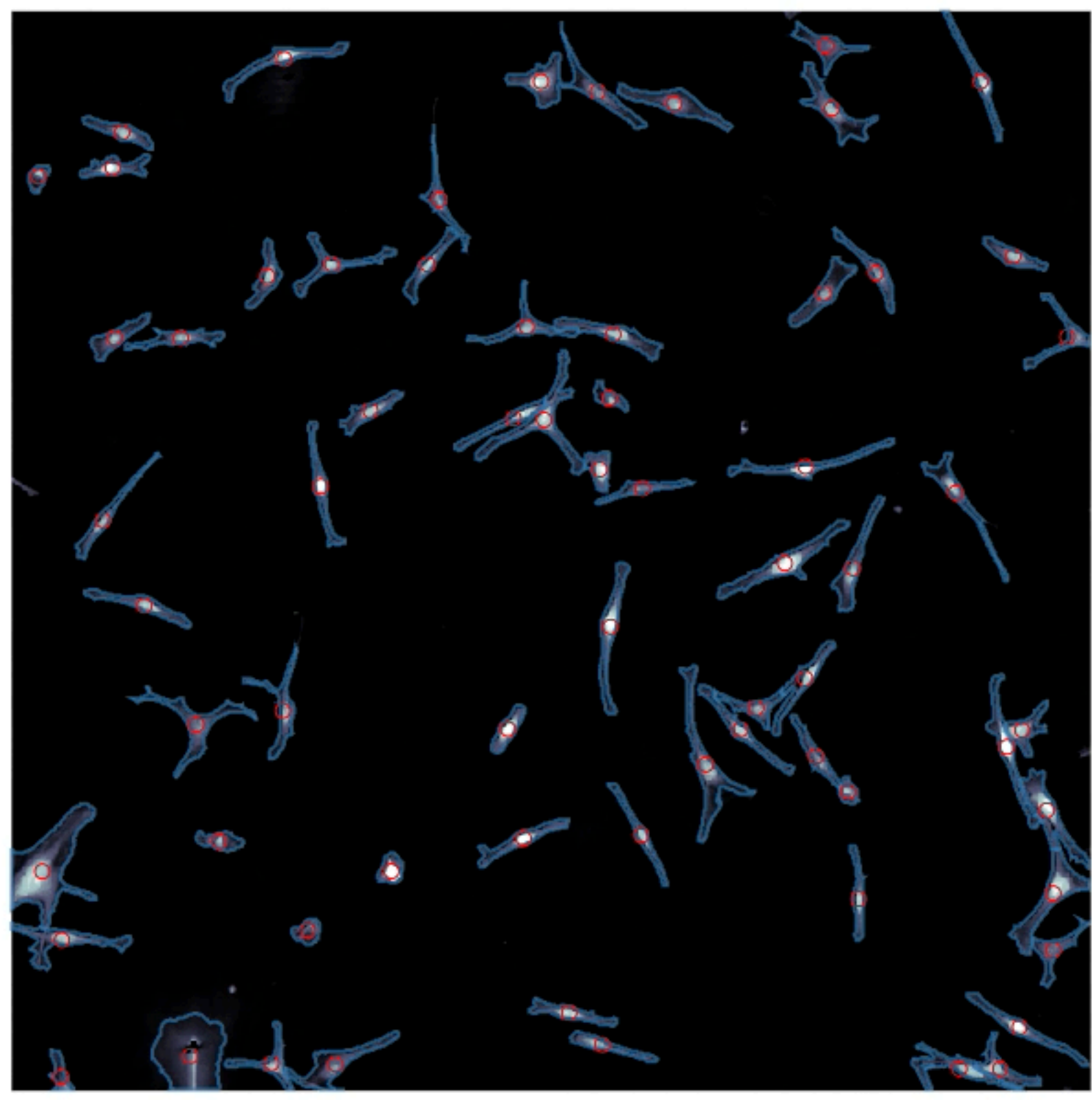
Looneage Height:



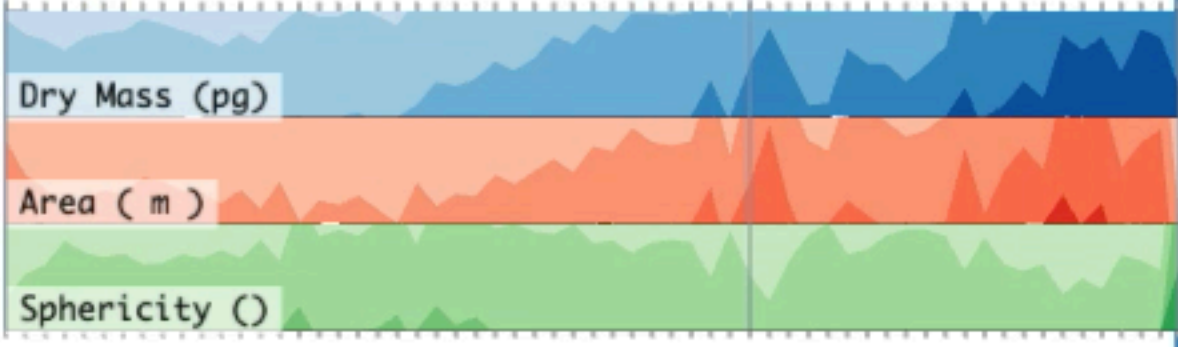
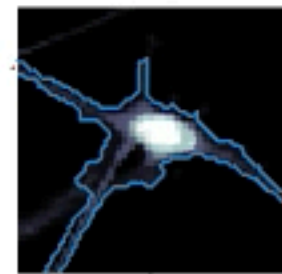
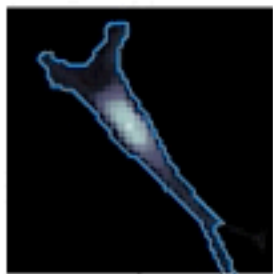
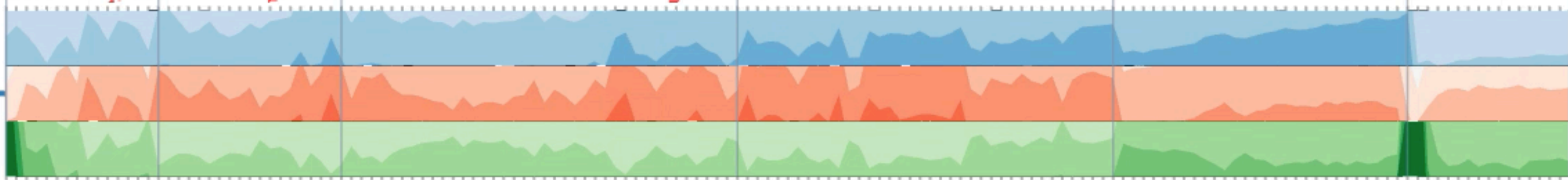
Line Chart Attribute Dry Mass (pg)



Images 1 / 216



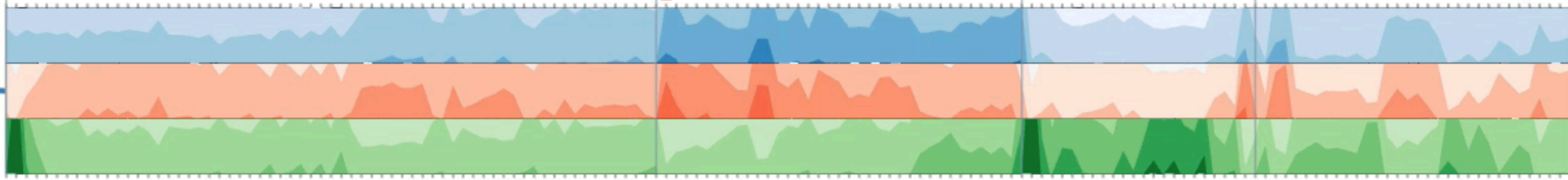
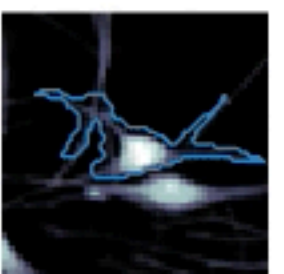
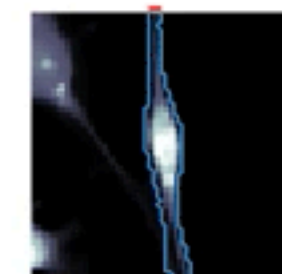
Press `esc` to exit full screen



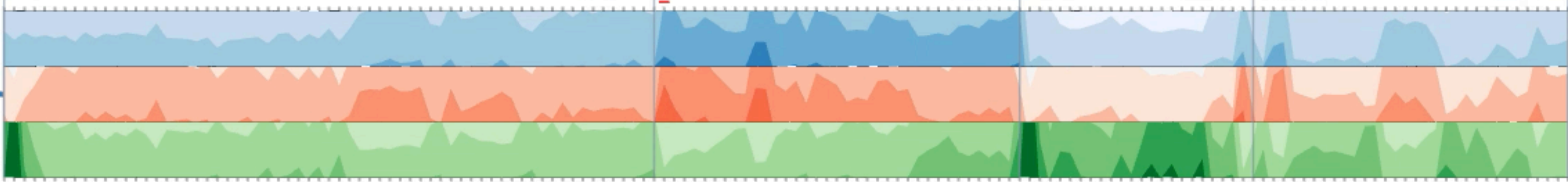
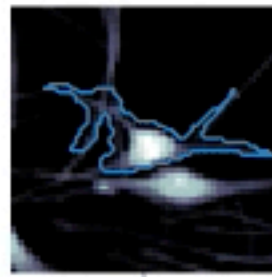
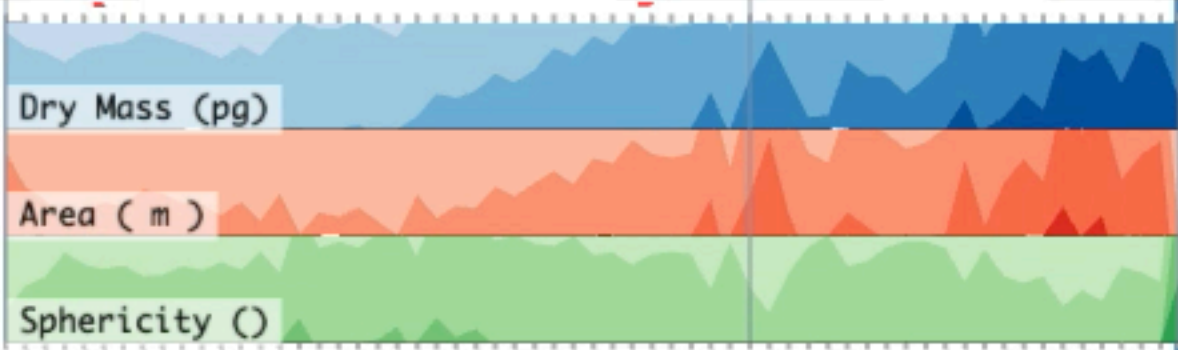
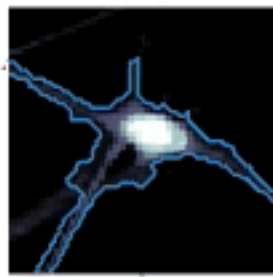
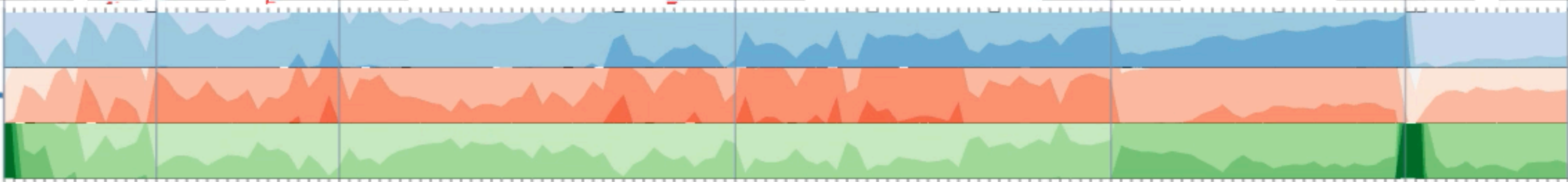
Mass

Area

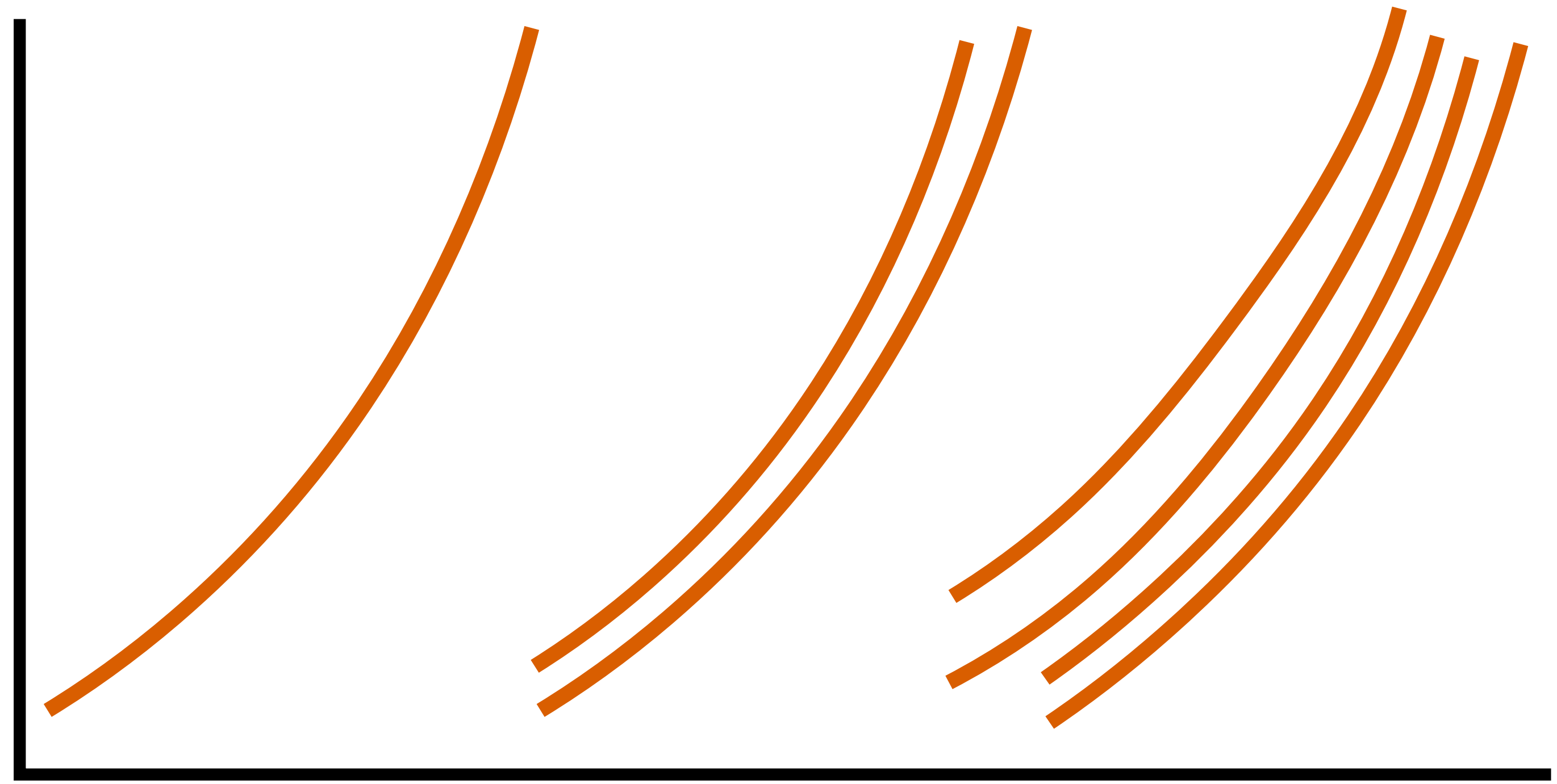
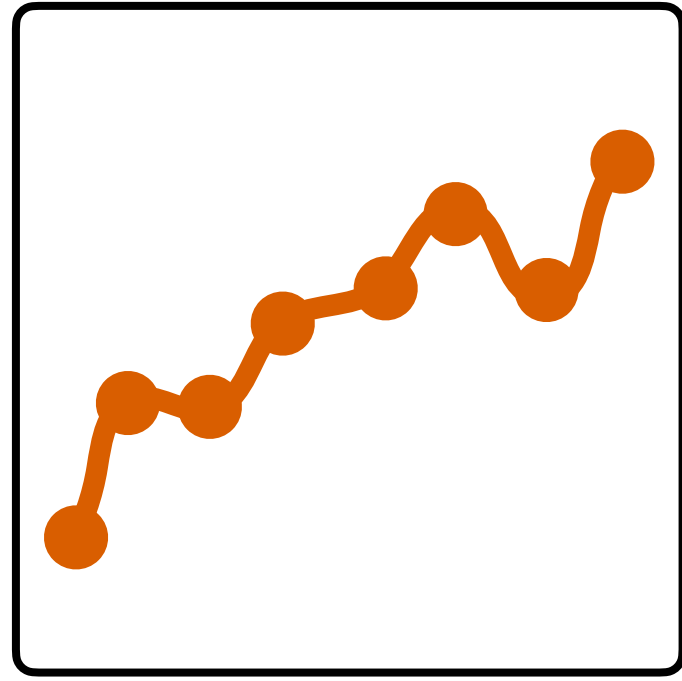
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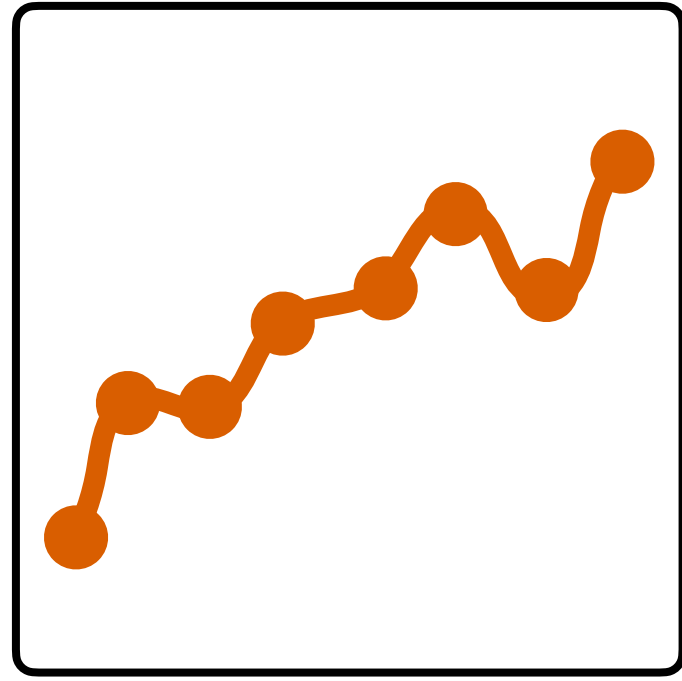
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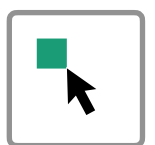


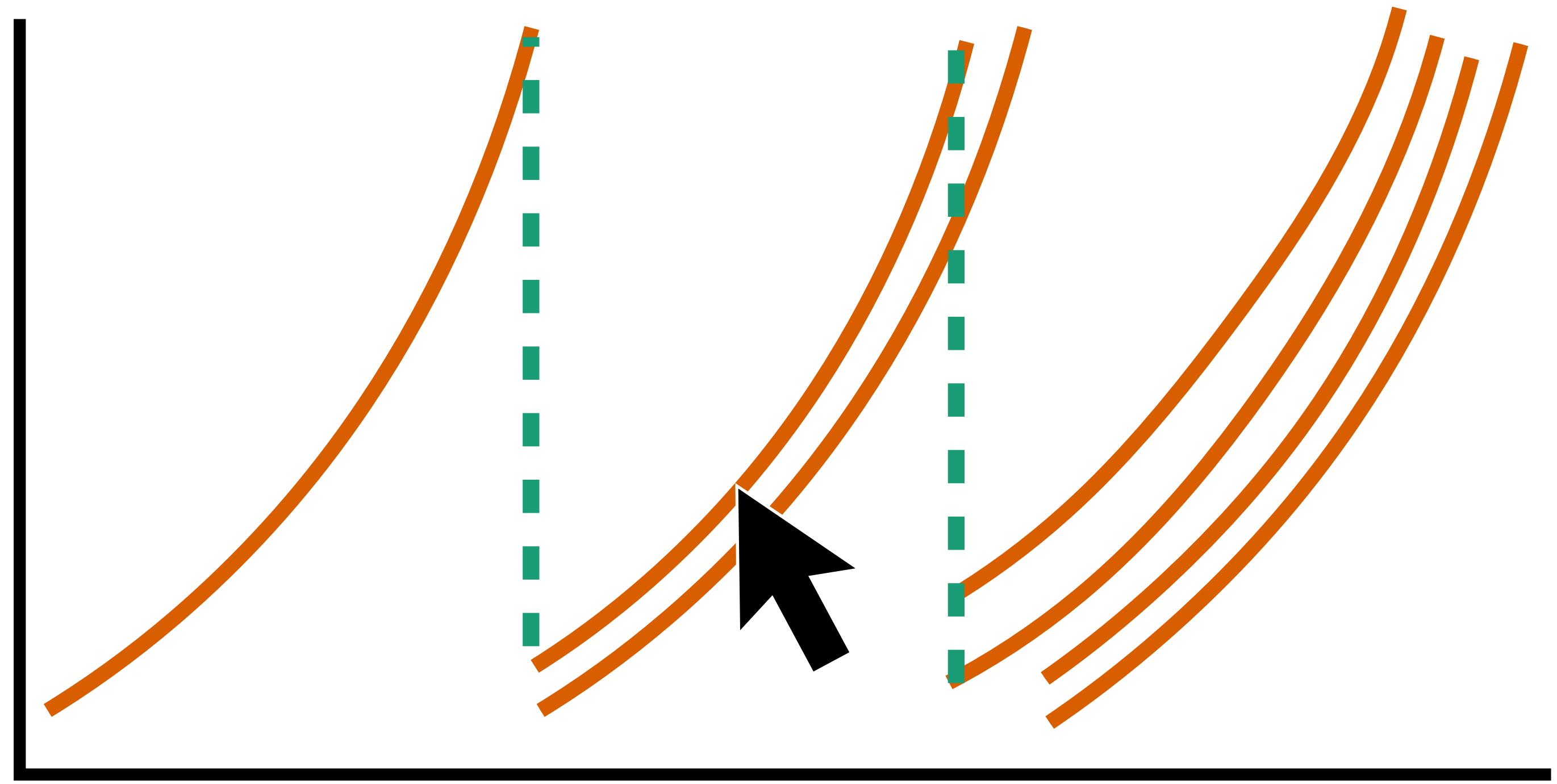
Time-Series with



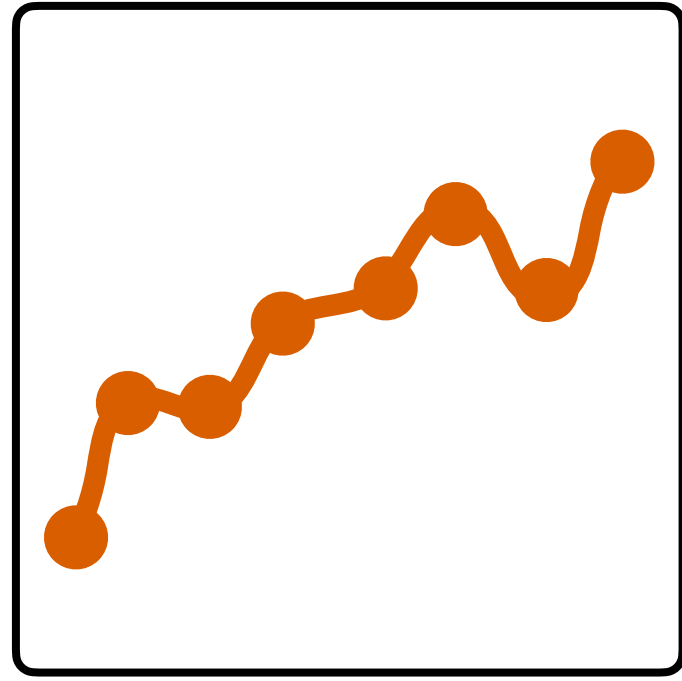
Time-Series with

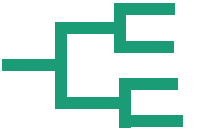



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Tree On Demand

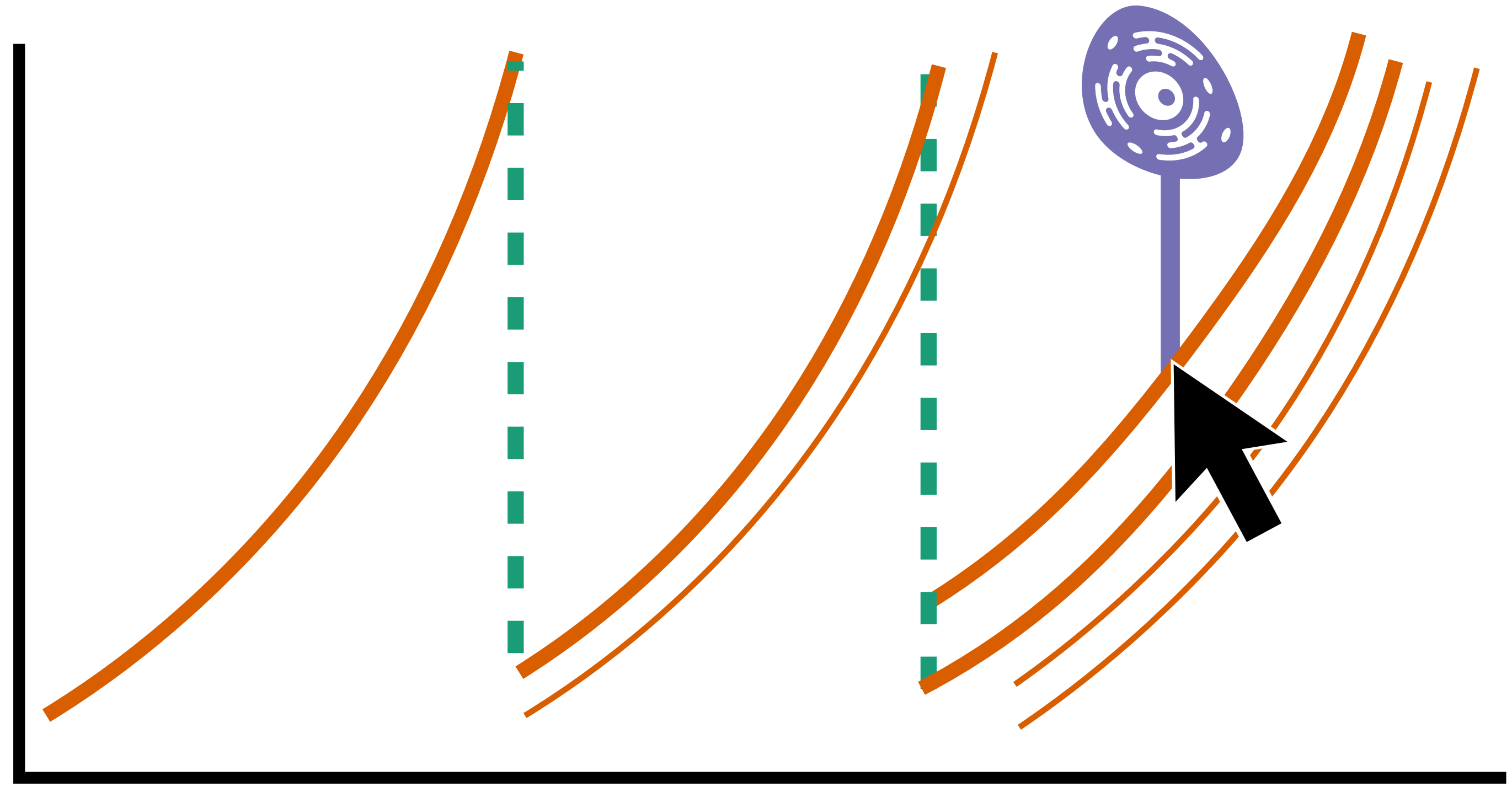


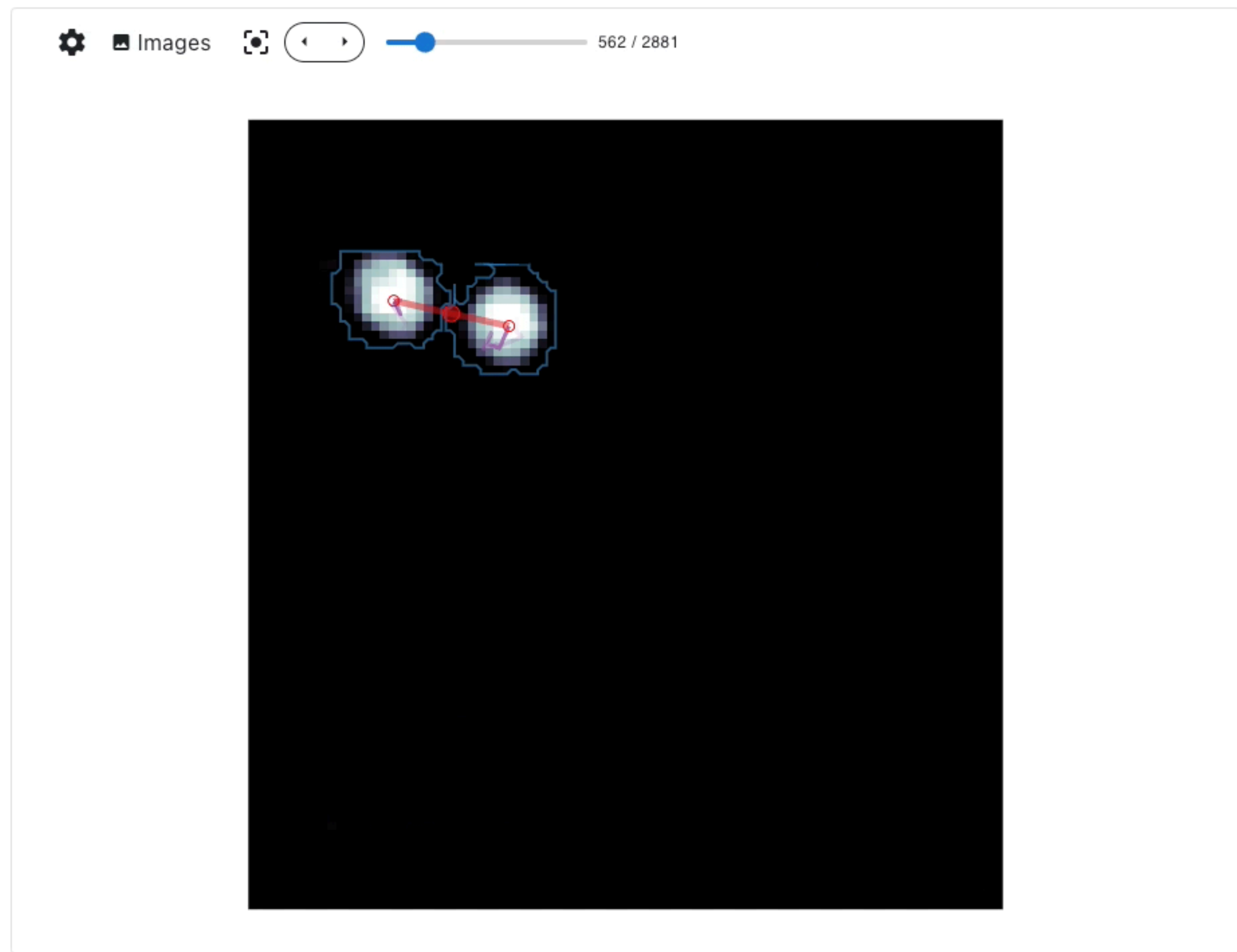
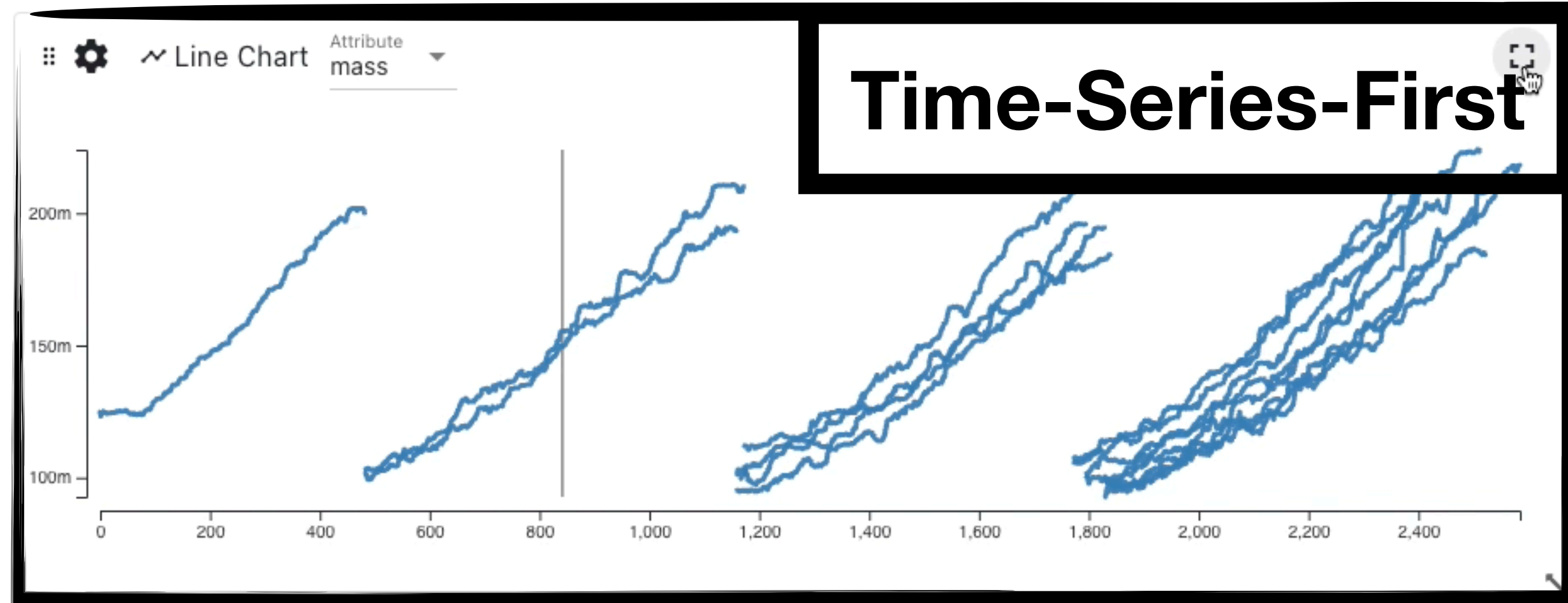
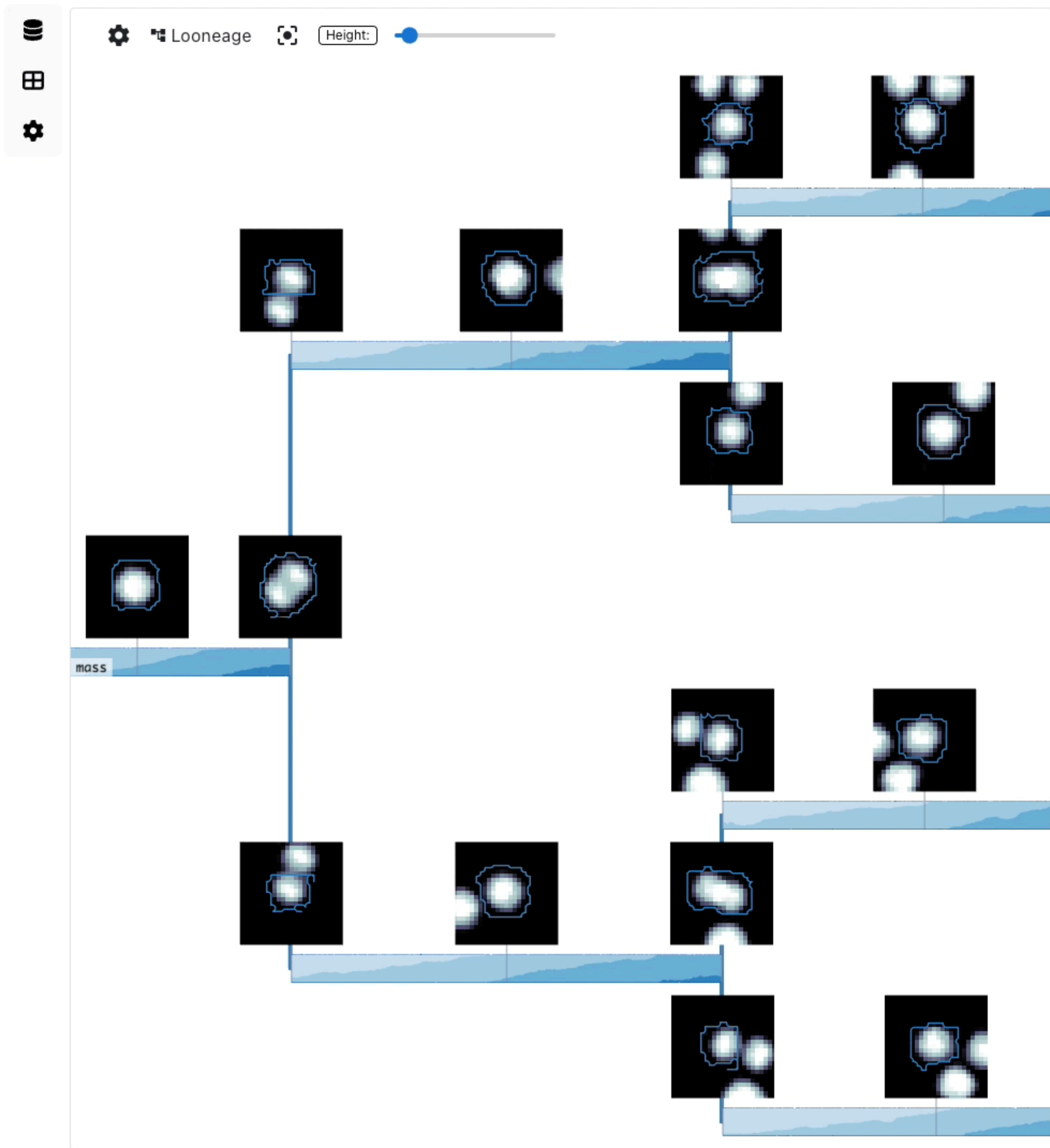
Time-Series with



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Tree On Demand

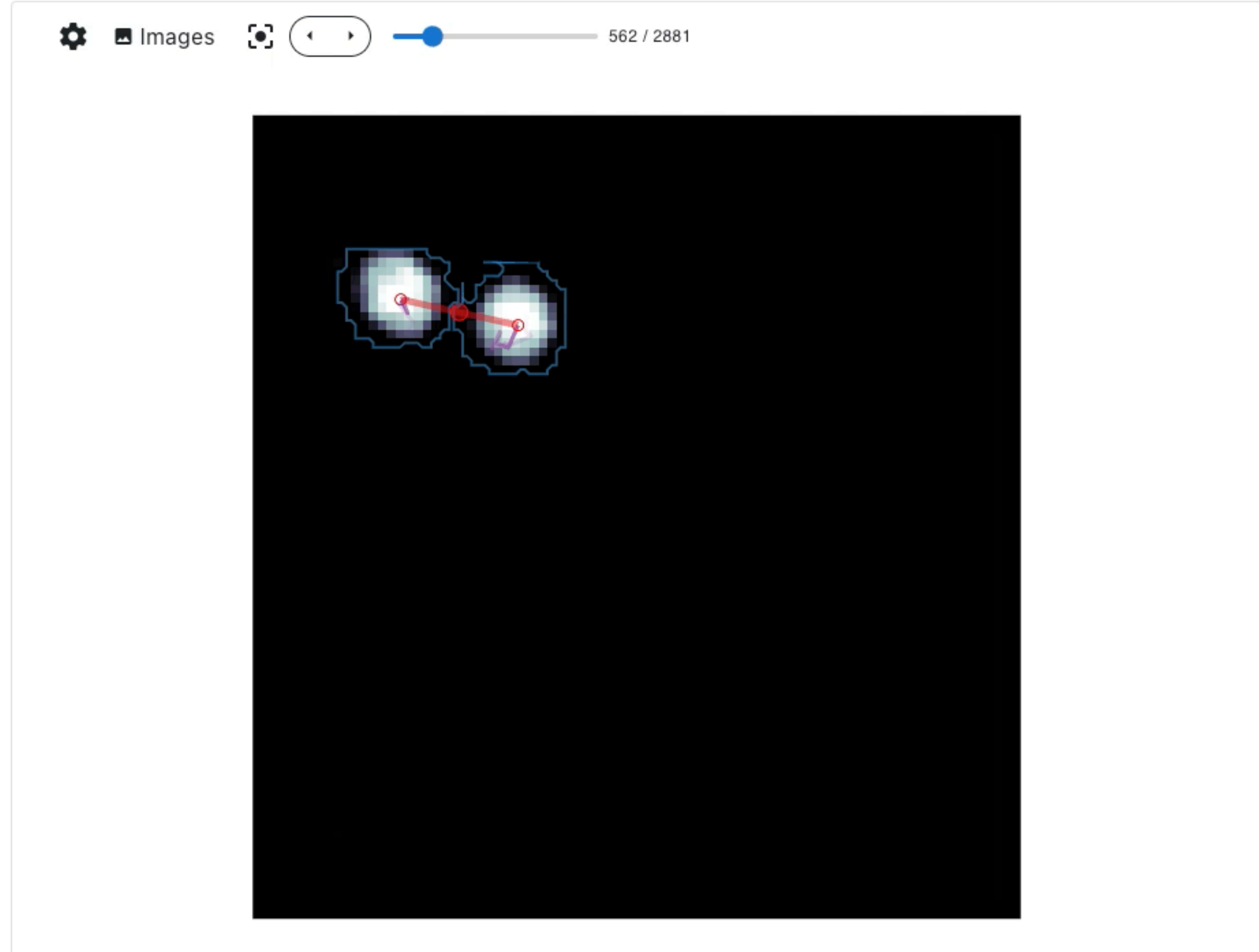
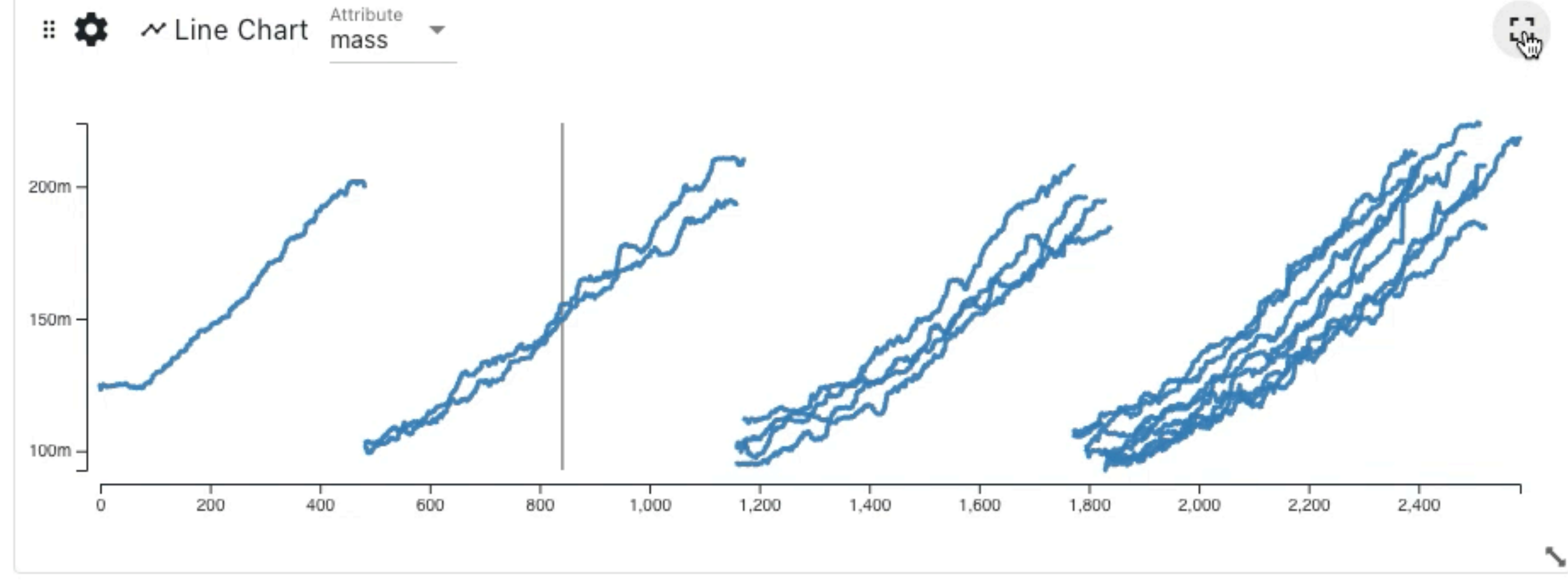
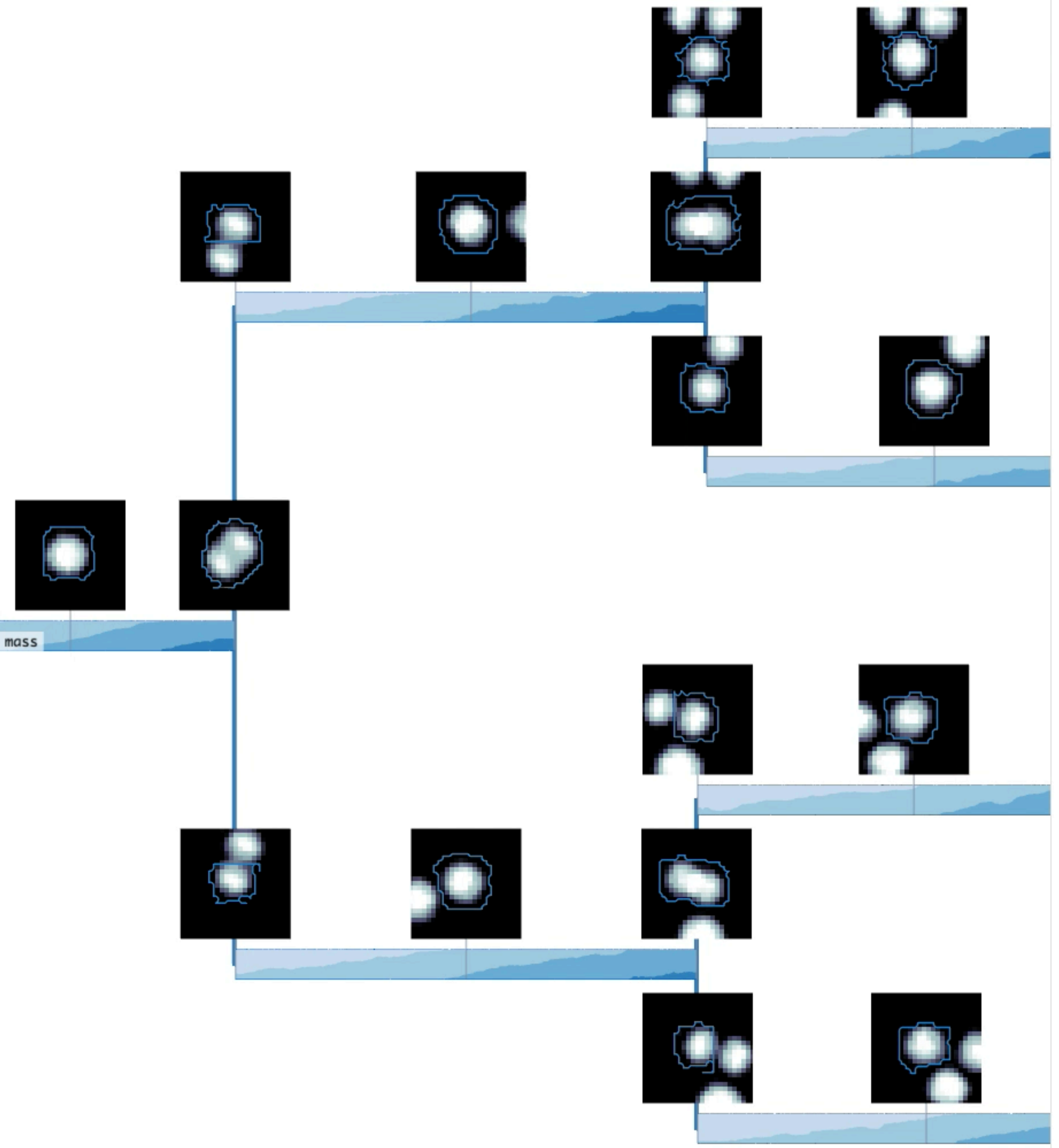
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Images On demand



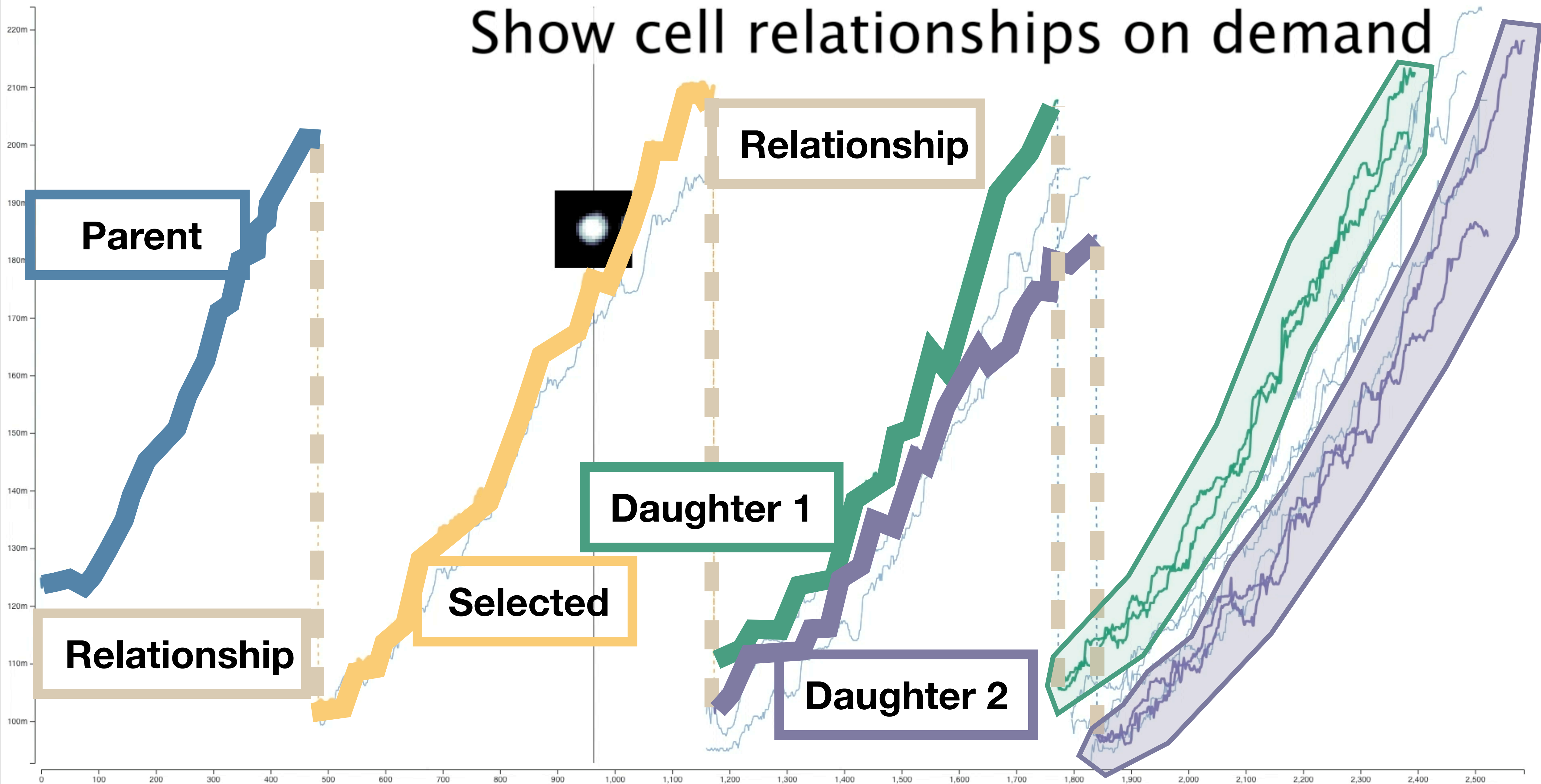




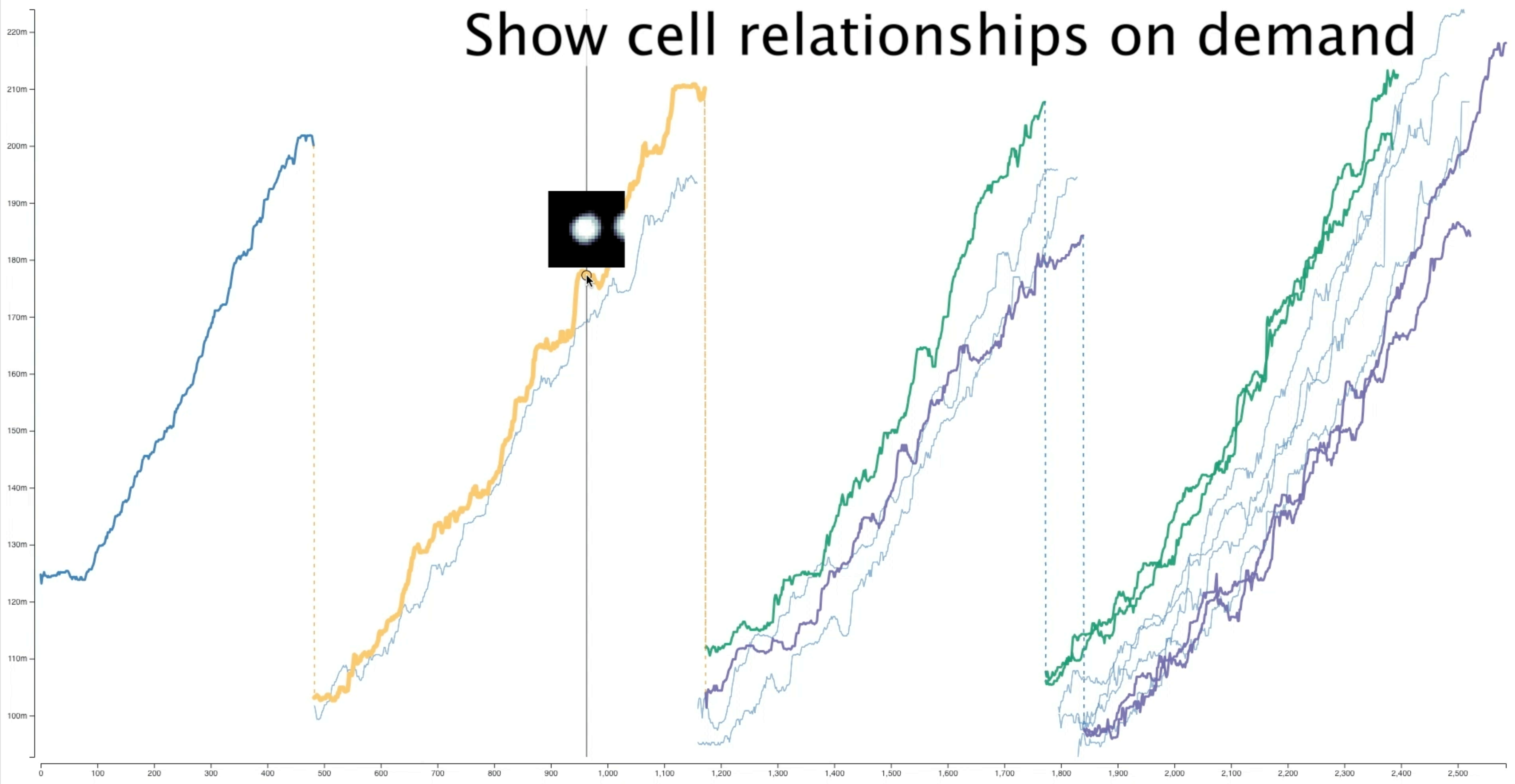
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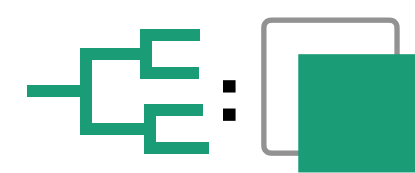
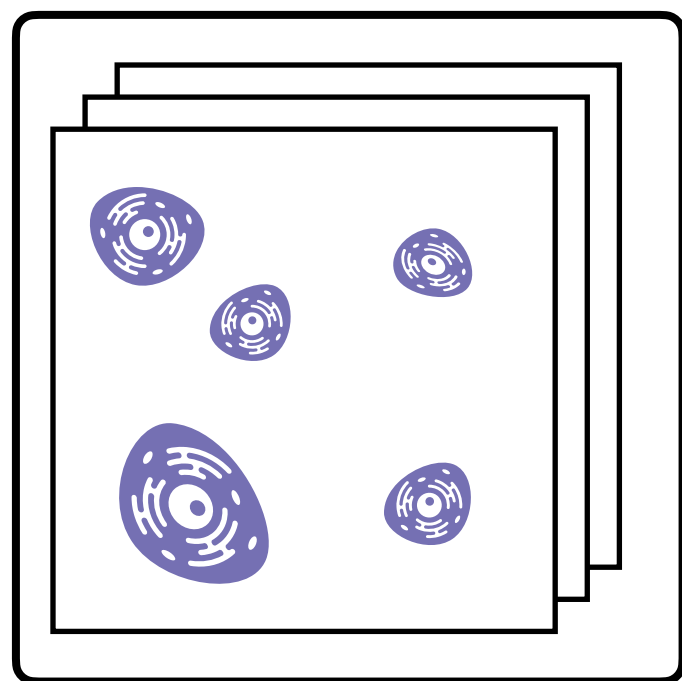
Show cell relationships on demand



Show cell relationships on demand



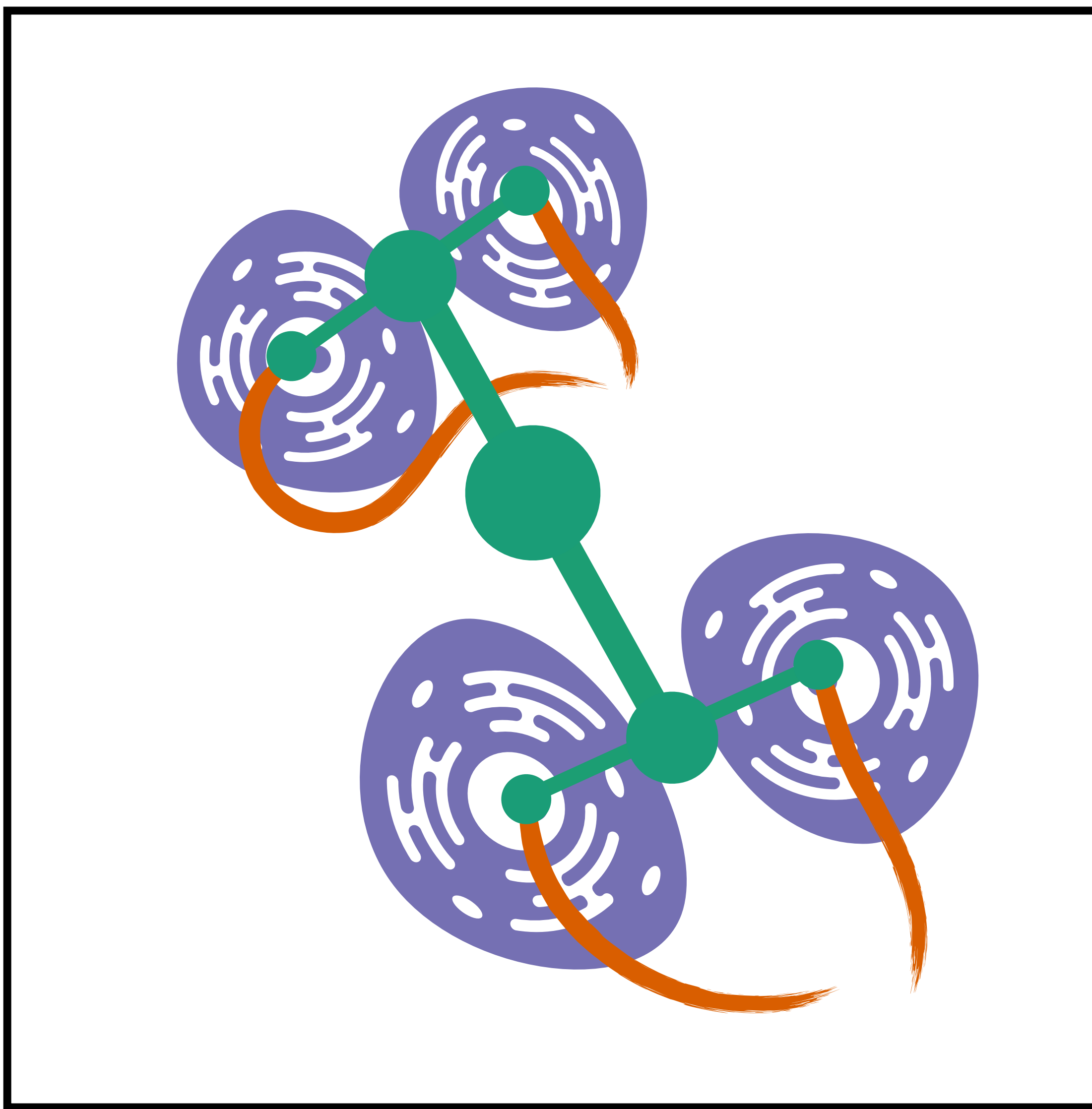
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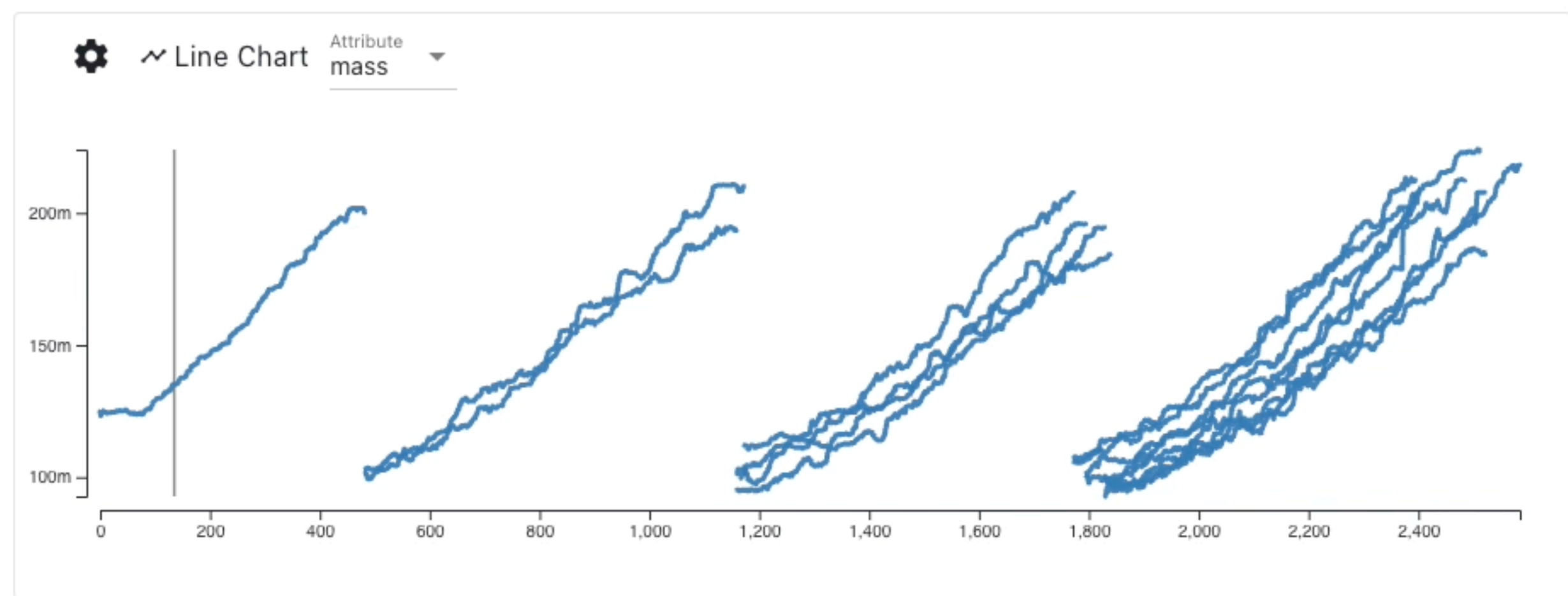
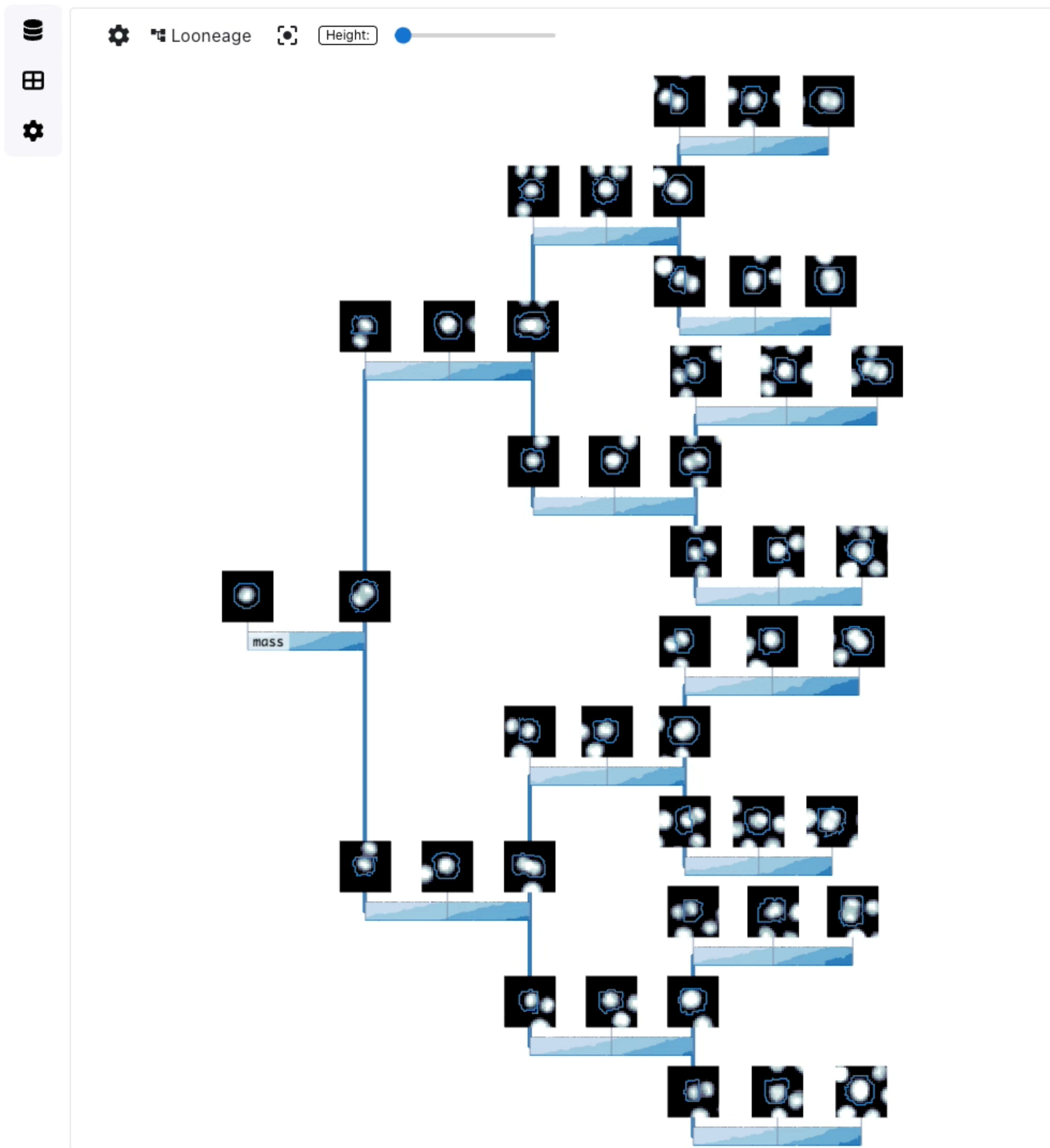


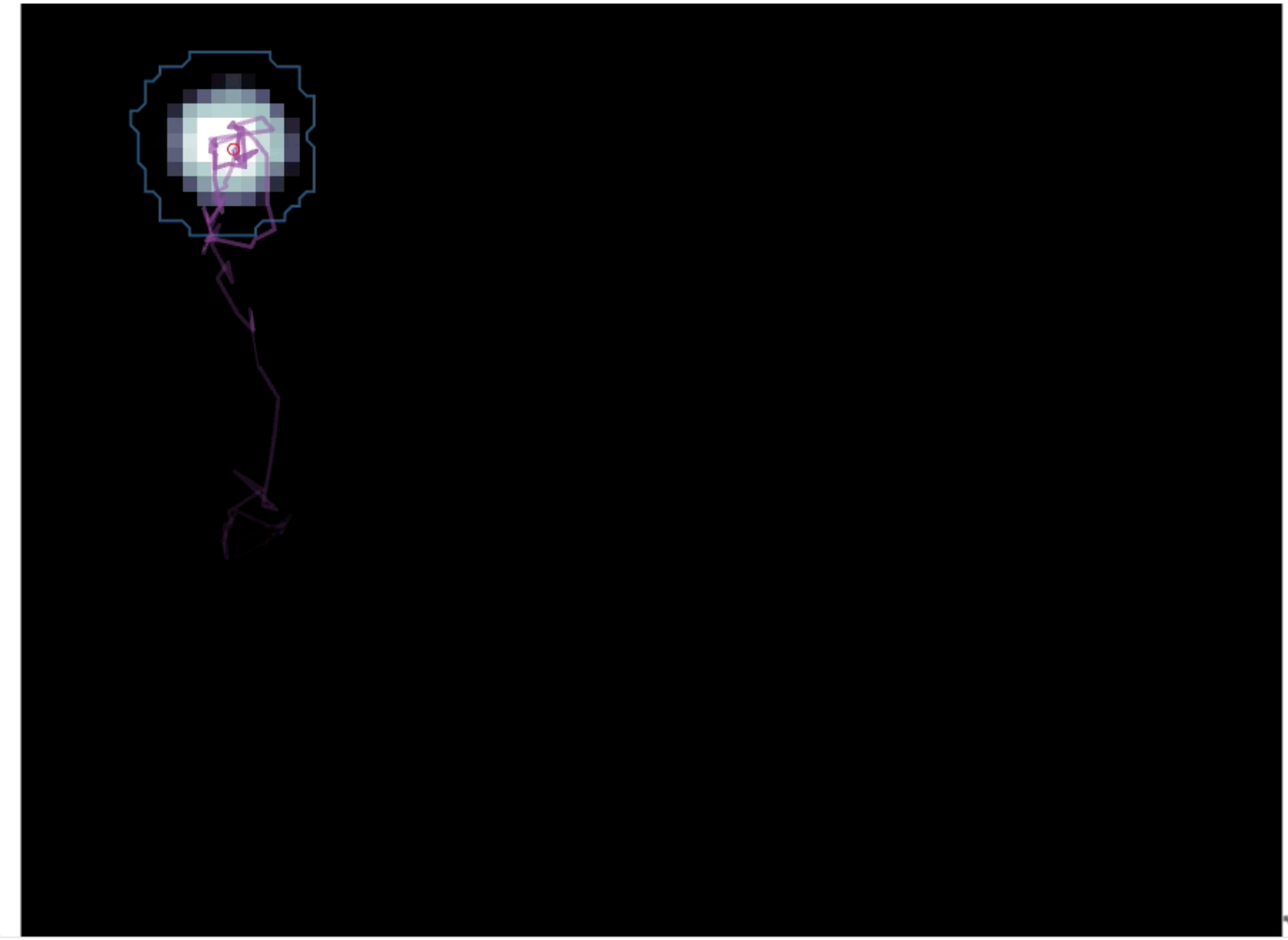
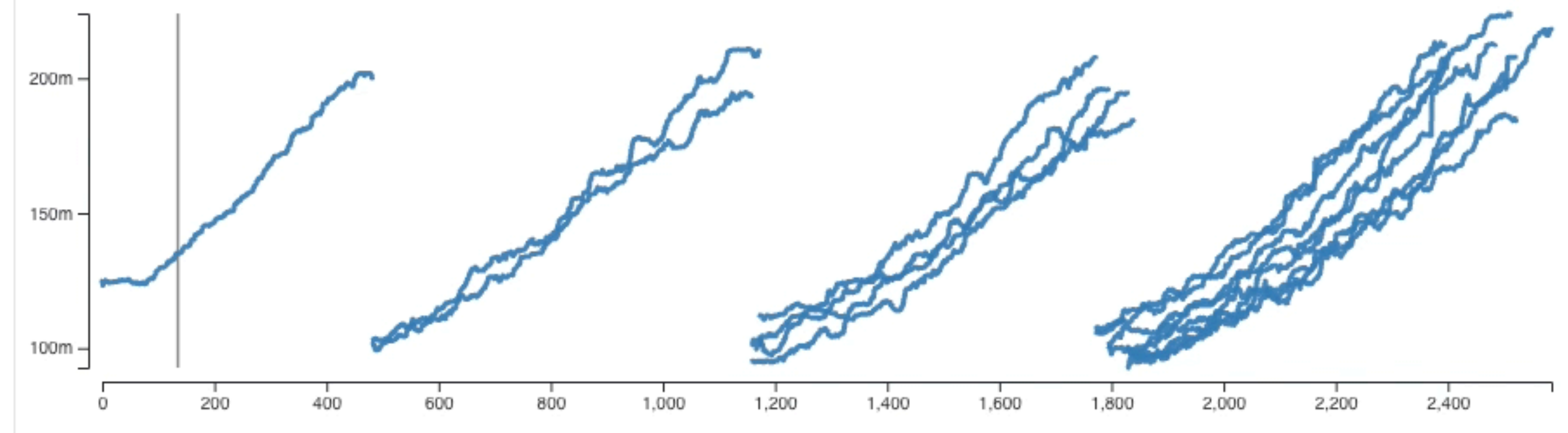
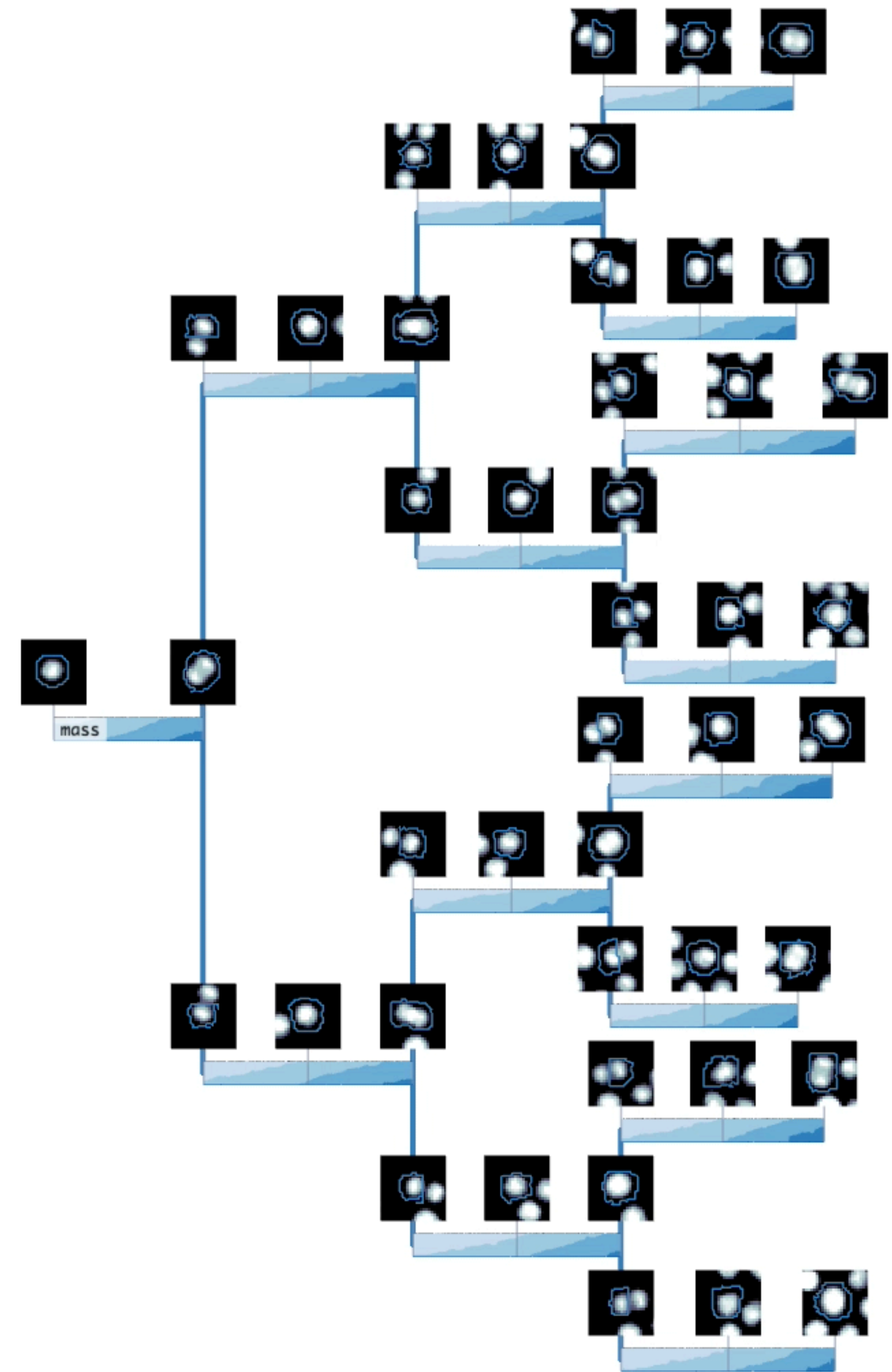
Tree Superimposed



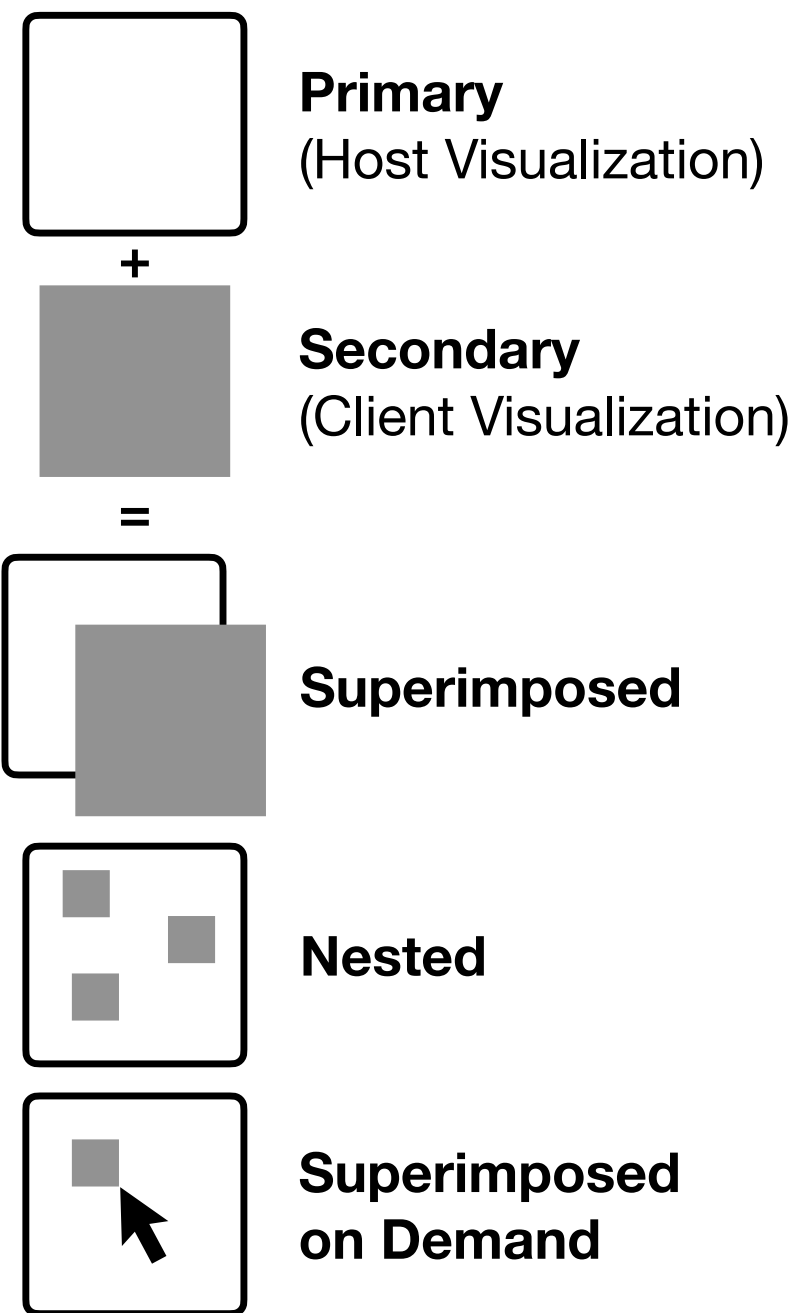
Time-Series Superimposed



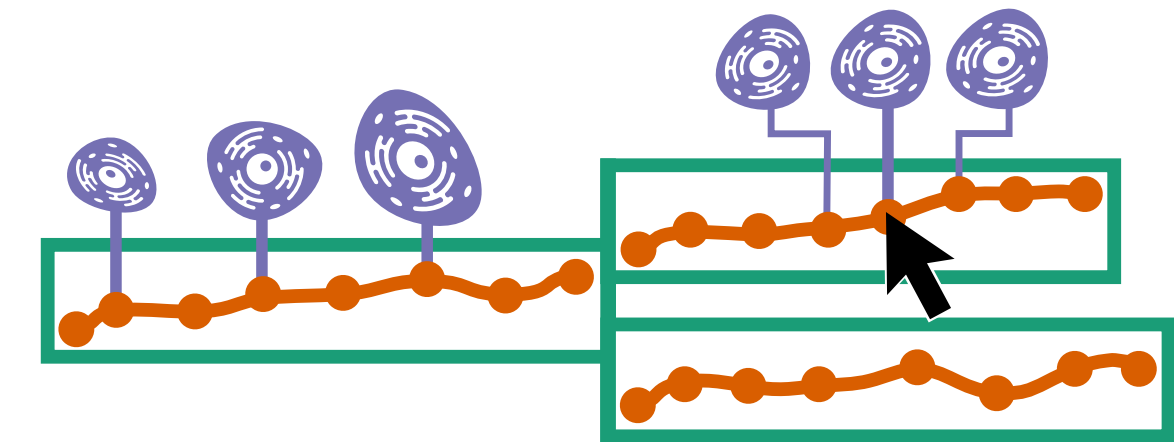
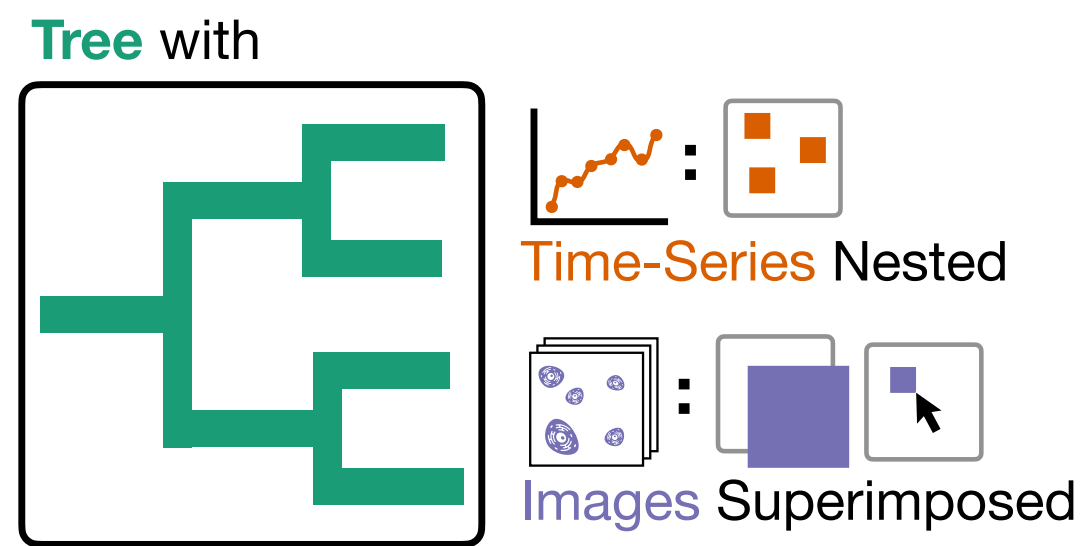




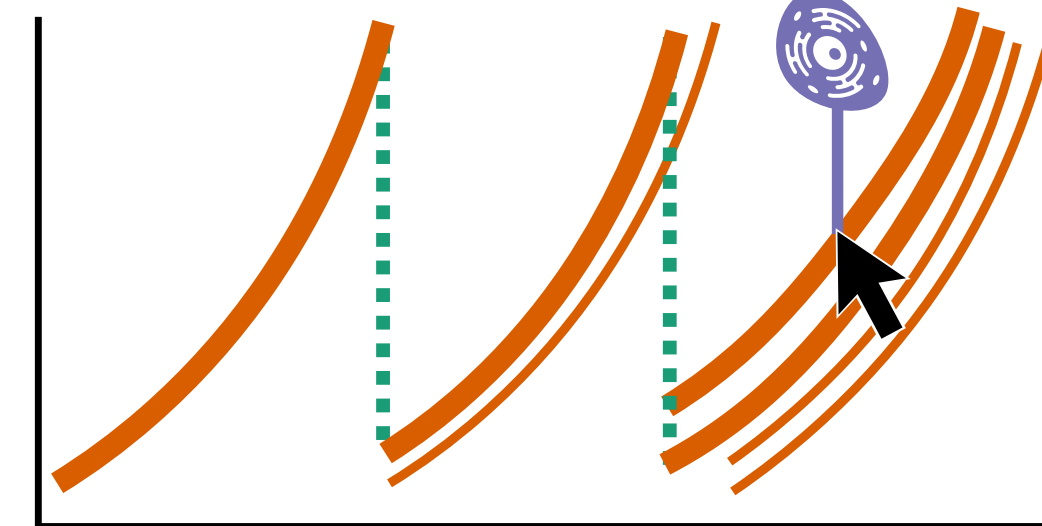
Composite Visualization Designs



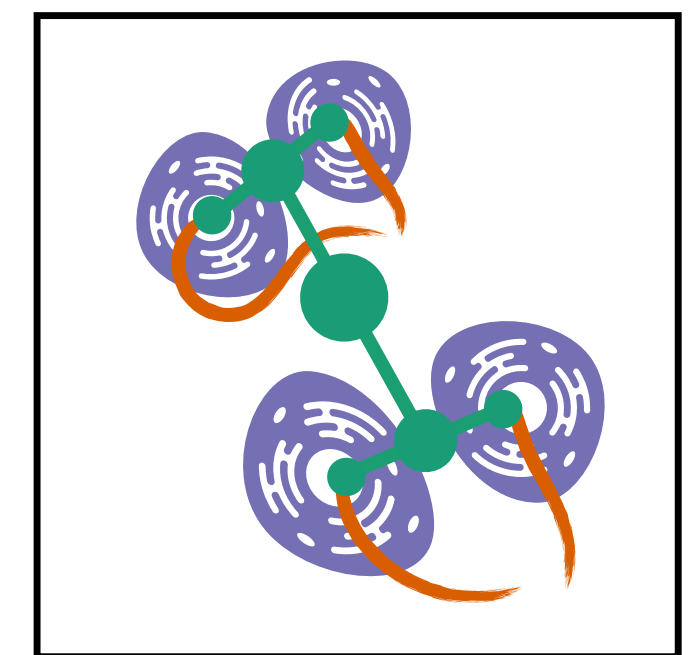
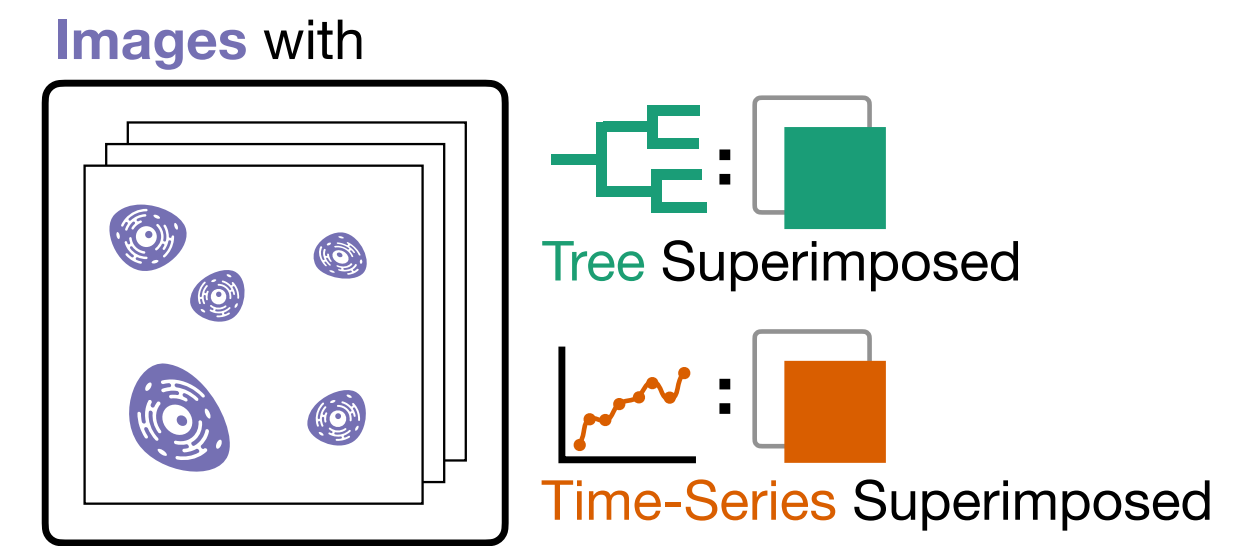
(a) Composition Options



(b) Tree-First Design



(c) Time-Series-First Design



(d) Image-First Design

Lessons Learned

Designing Composite Visualizations

Data Modality

DM₁

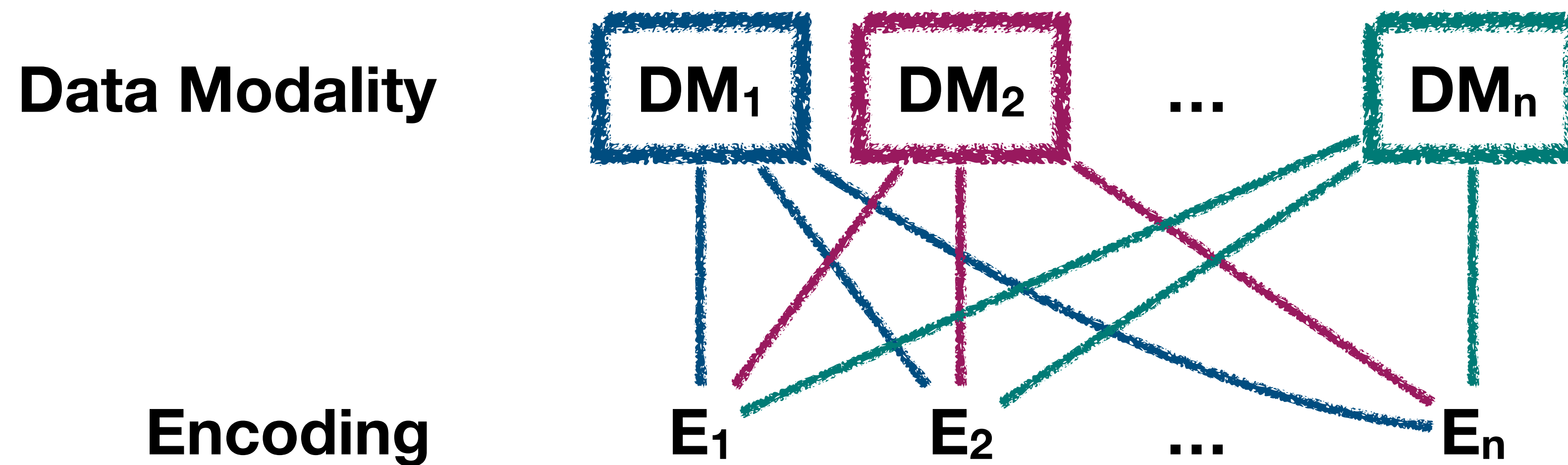
DM₂

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DM_n

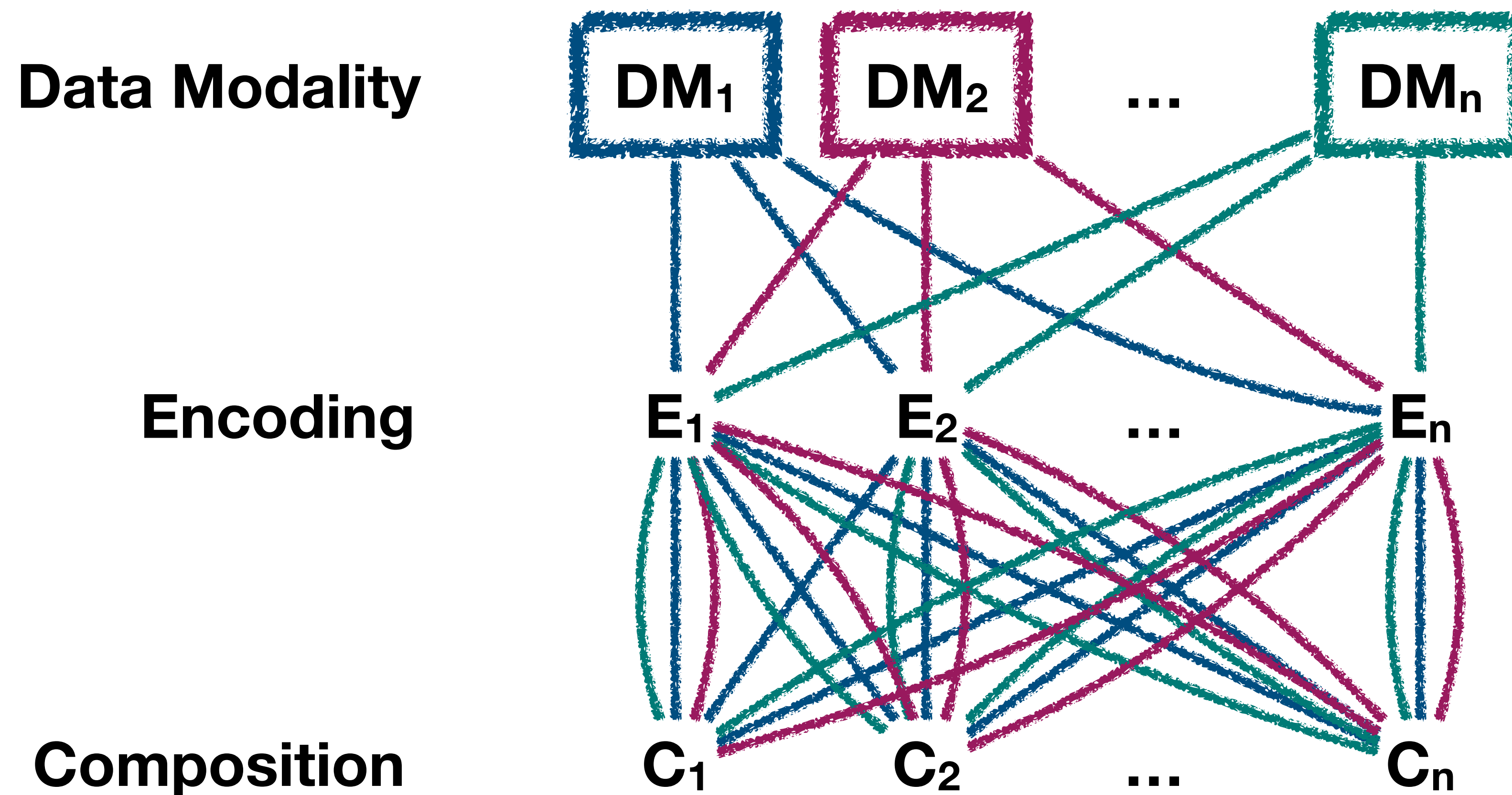
Lessons Learned

Designing Composite Visualizations



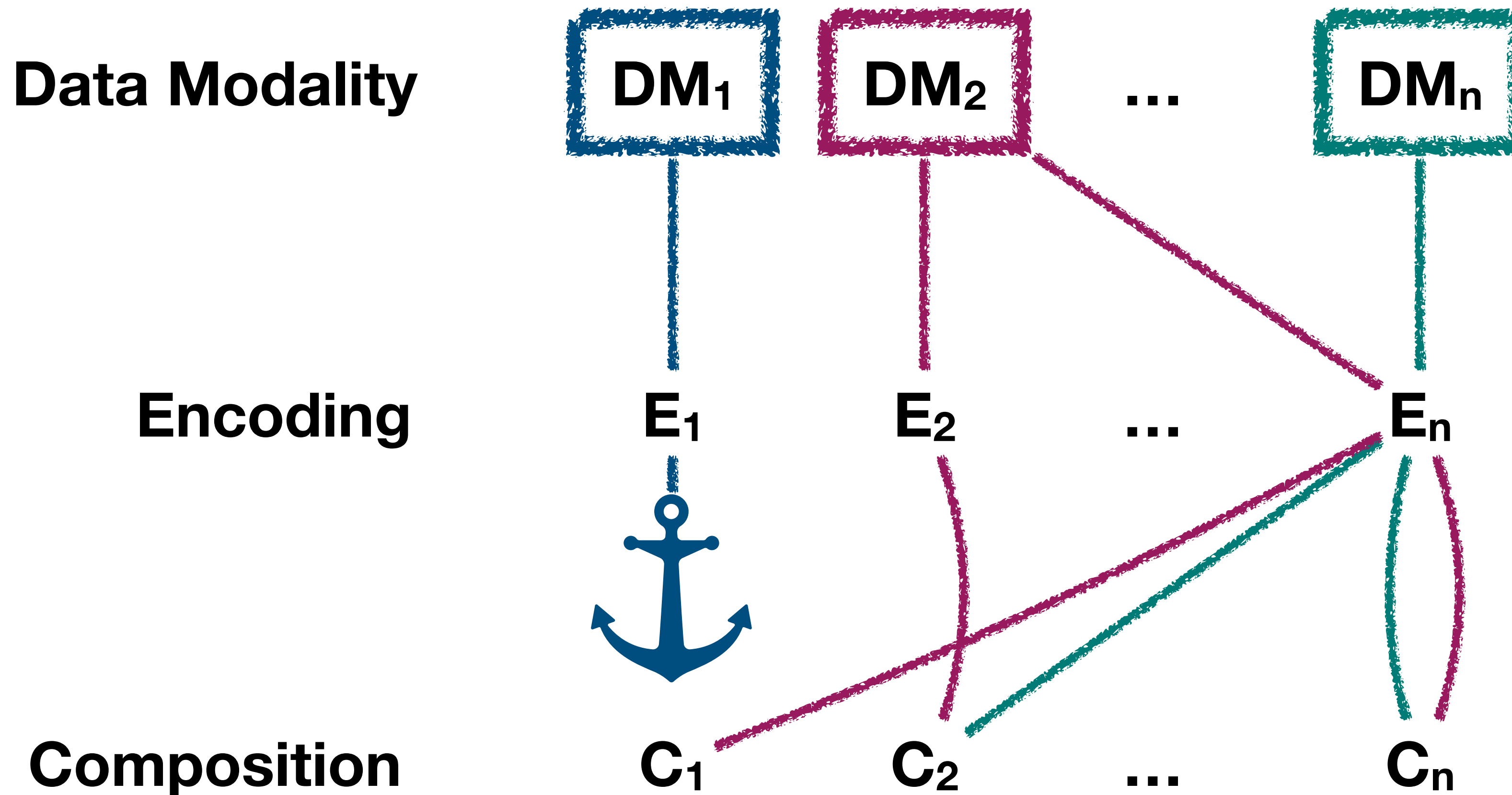
Lessons Learned

Designing Composite Visualizations

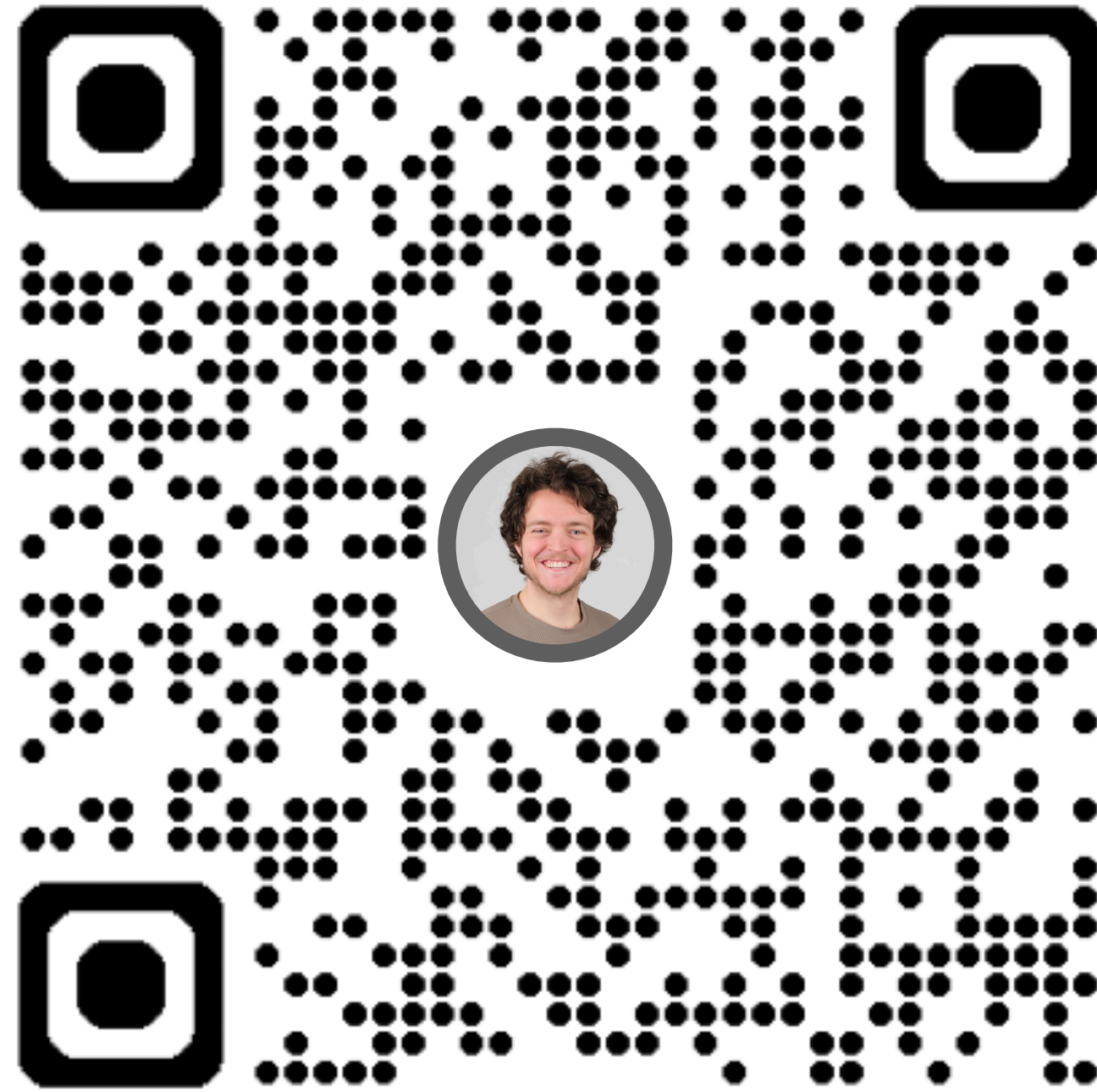


Advice

Start with a Primary Data Modality



🌟🌟 🌟 **Shameless Self Promotion** 🌟🌟



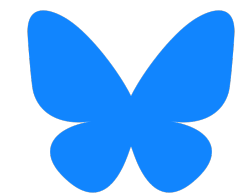
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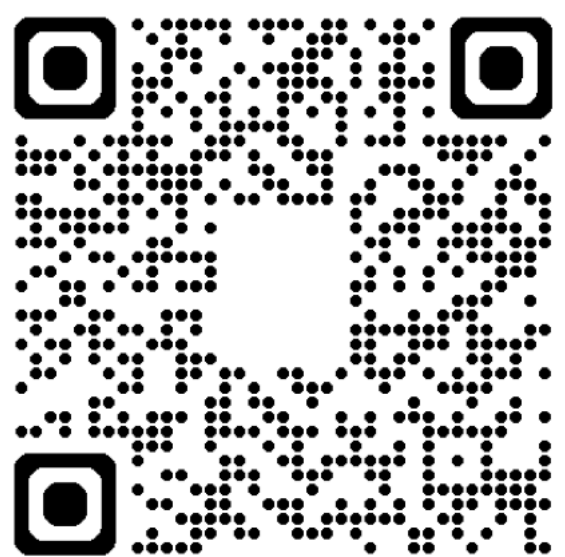
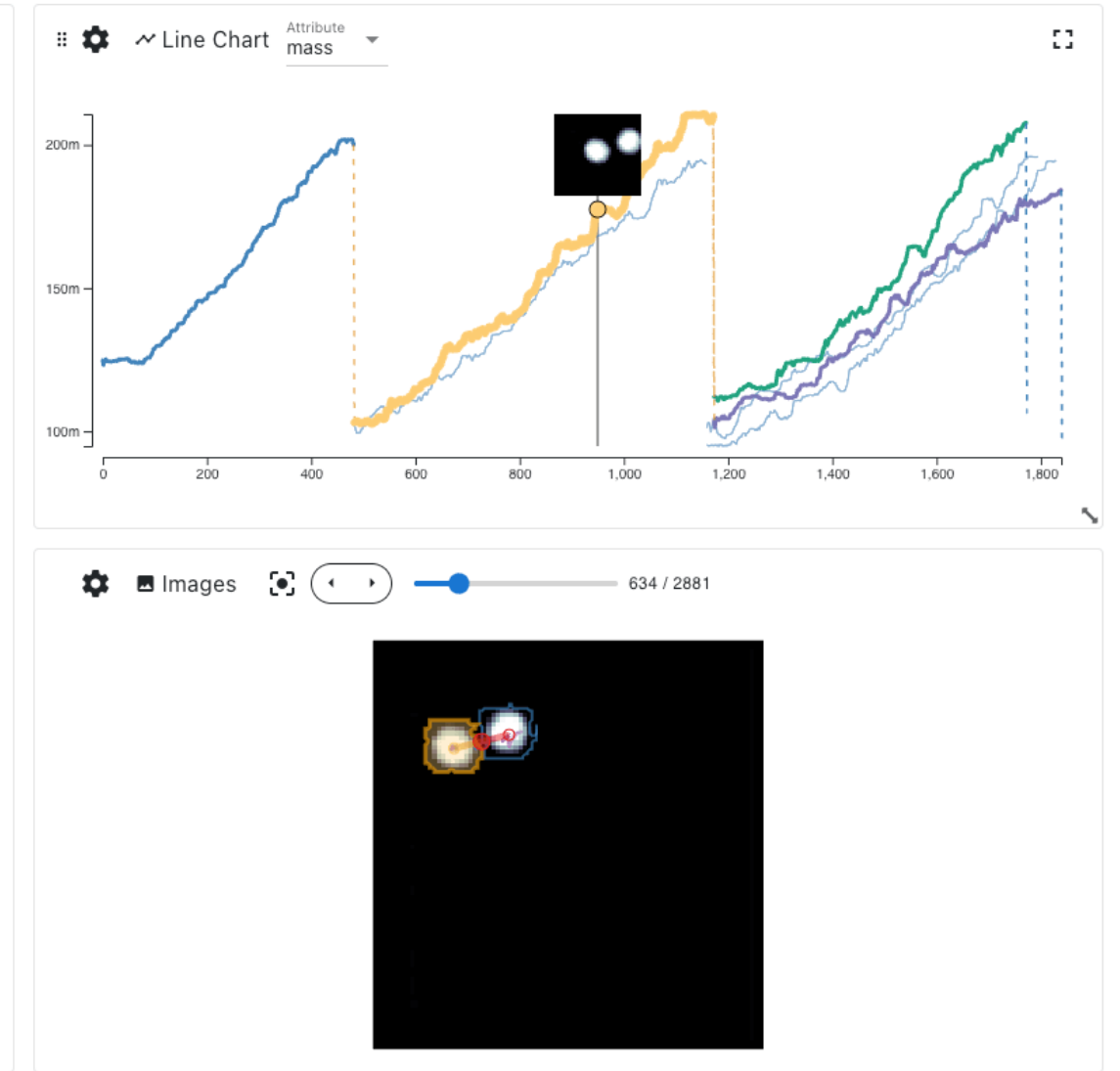
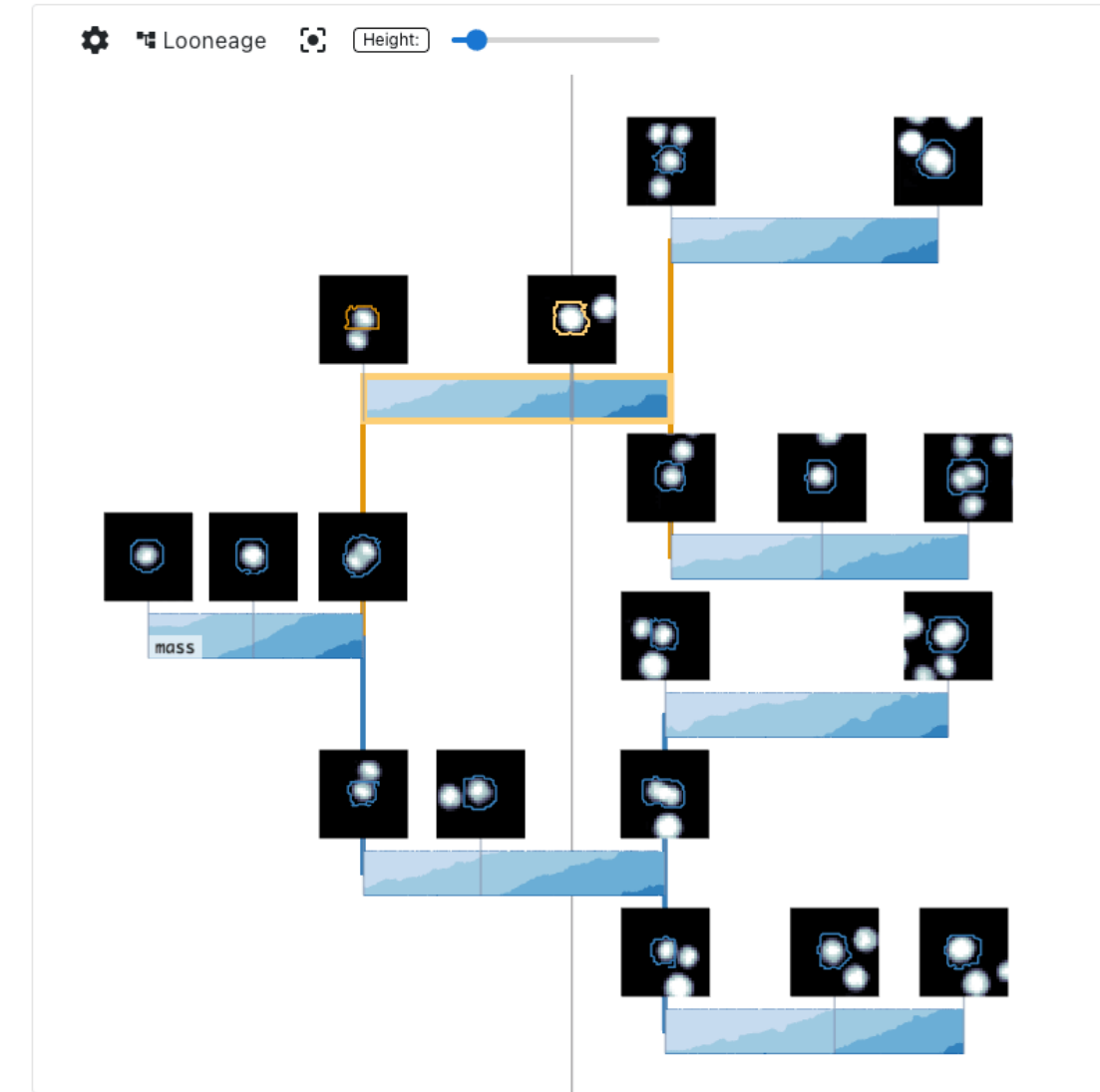
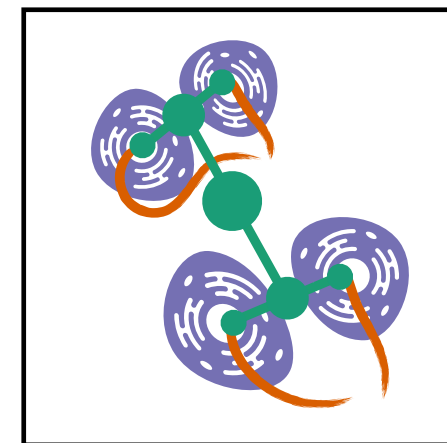
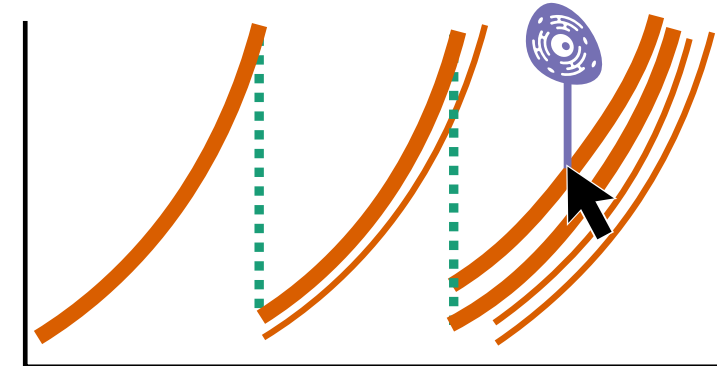
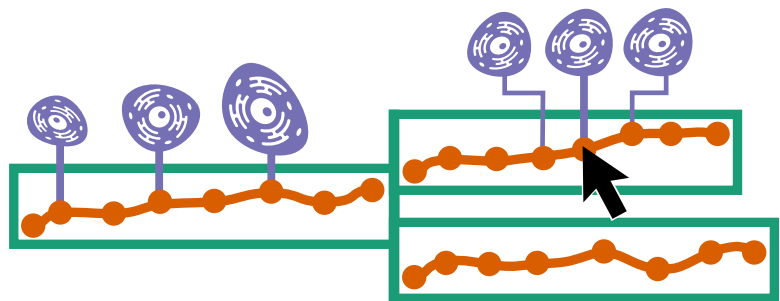
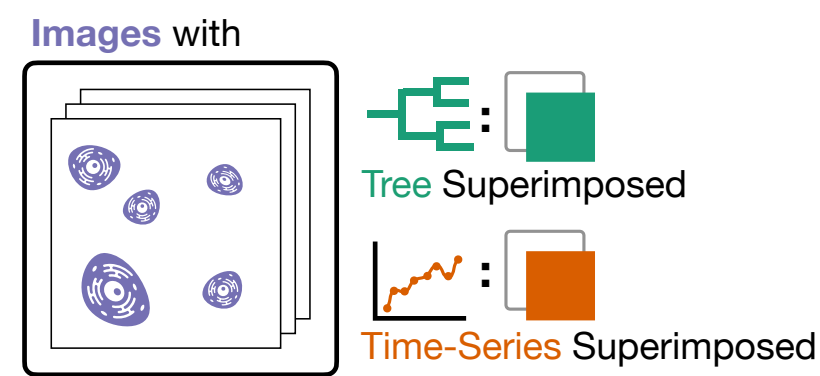
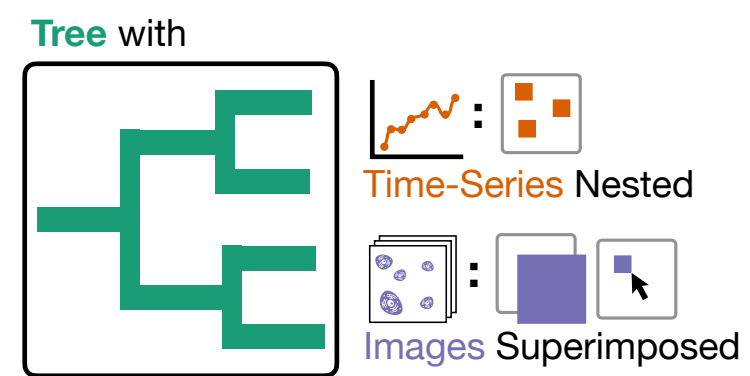
Aardvark: Composite Visualizations of Trees, Time-Series, and Images



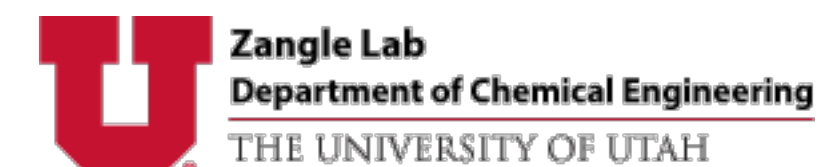
Devin Lange, Robert Judson-Torres, Thomas A. Zangle, and Alexander Lex



Aardvark: Composite Visualizations of Trees, Time-Series, and Images



Devin Lange, Robert Judson-Torres, Thomas A. Zangle, and Alexander Lex



Appendix

