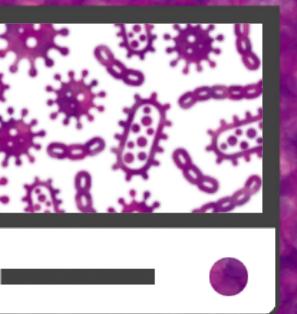


Focus+Context Exploration of Hierarchical Embeddings

T. Höllt^{1,2}, A. Vilanova², N. Pezzotti², B.P.F. Lelieveldt^{2,3}, and H. Hauser^{2,4}

1



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2



3



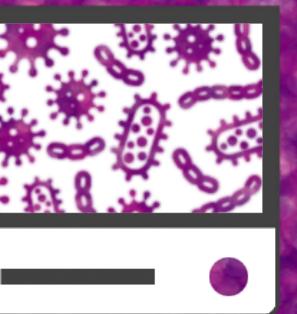
4



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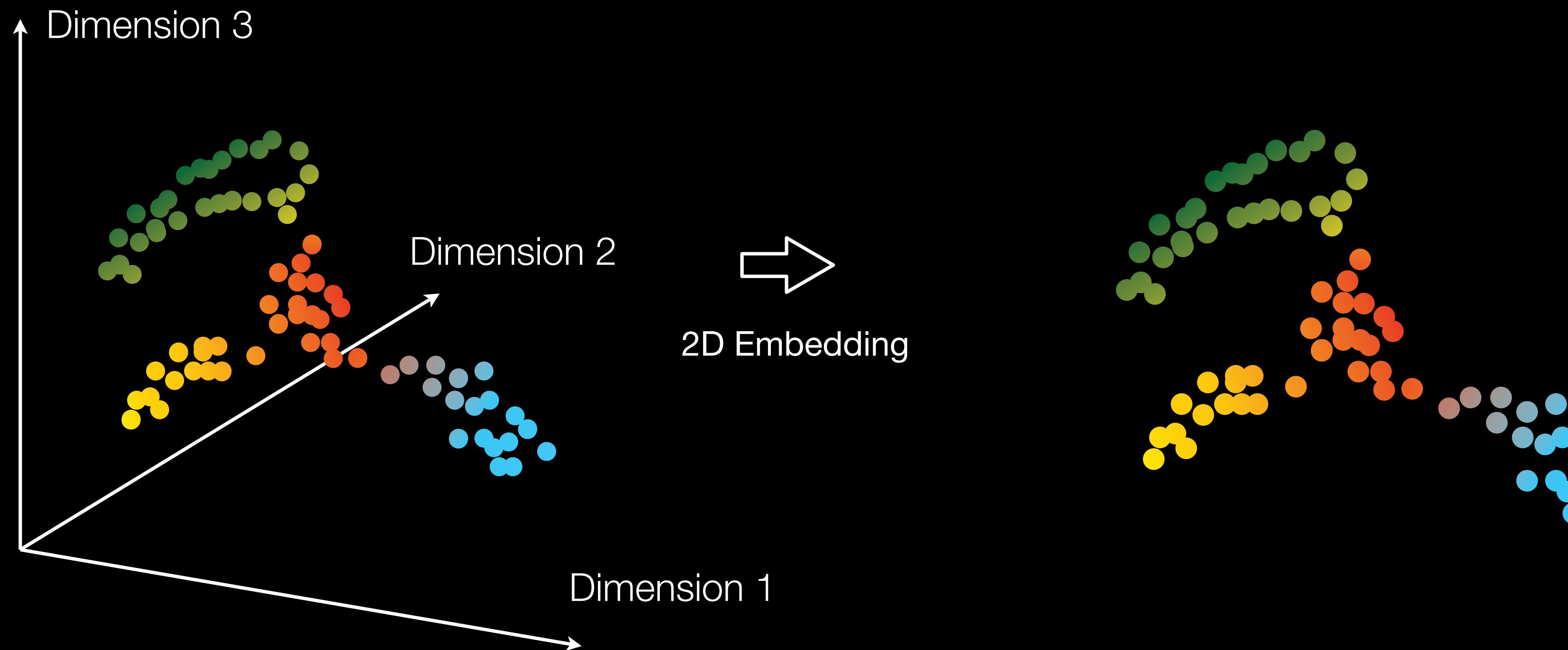
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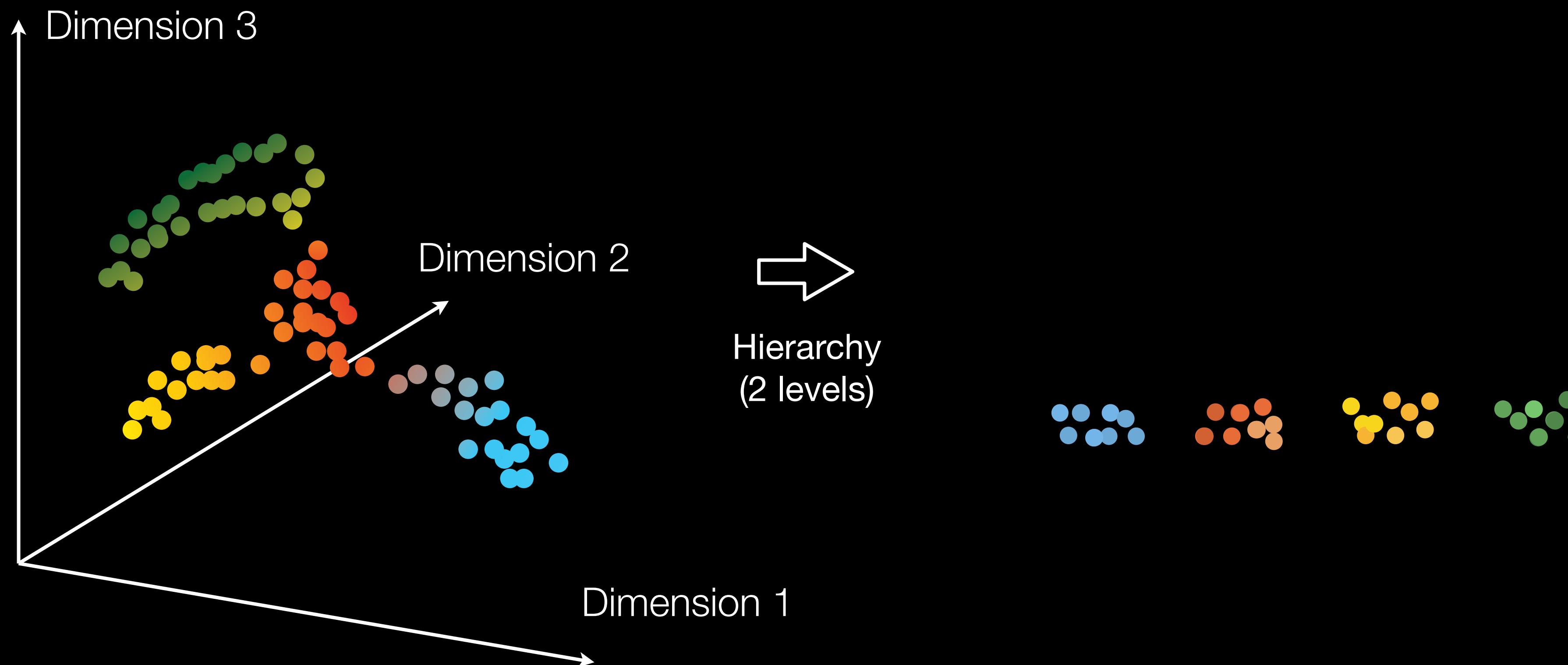
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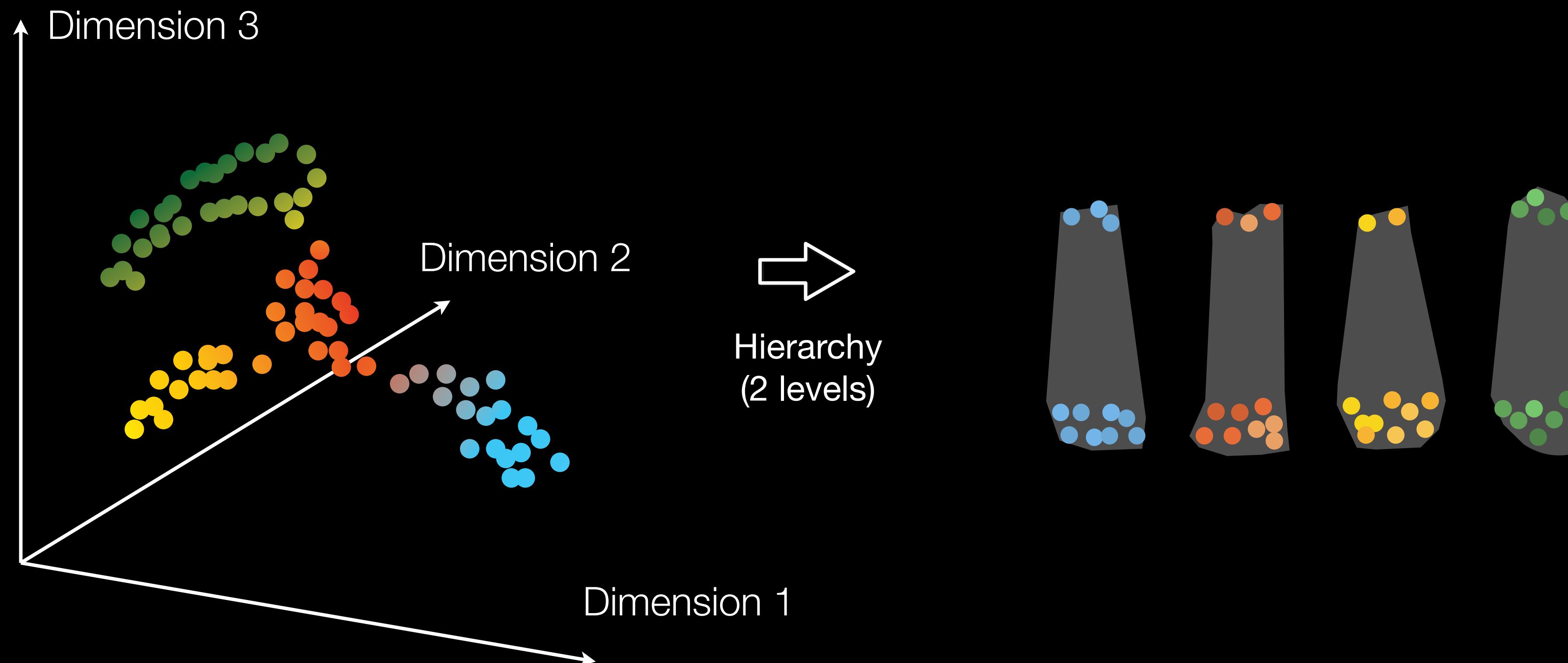
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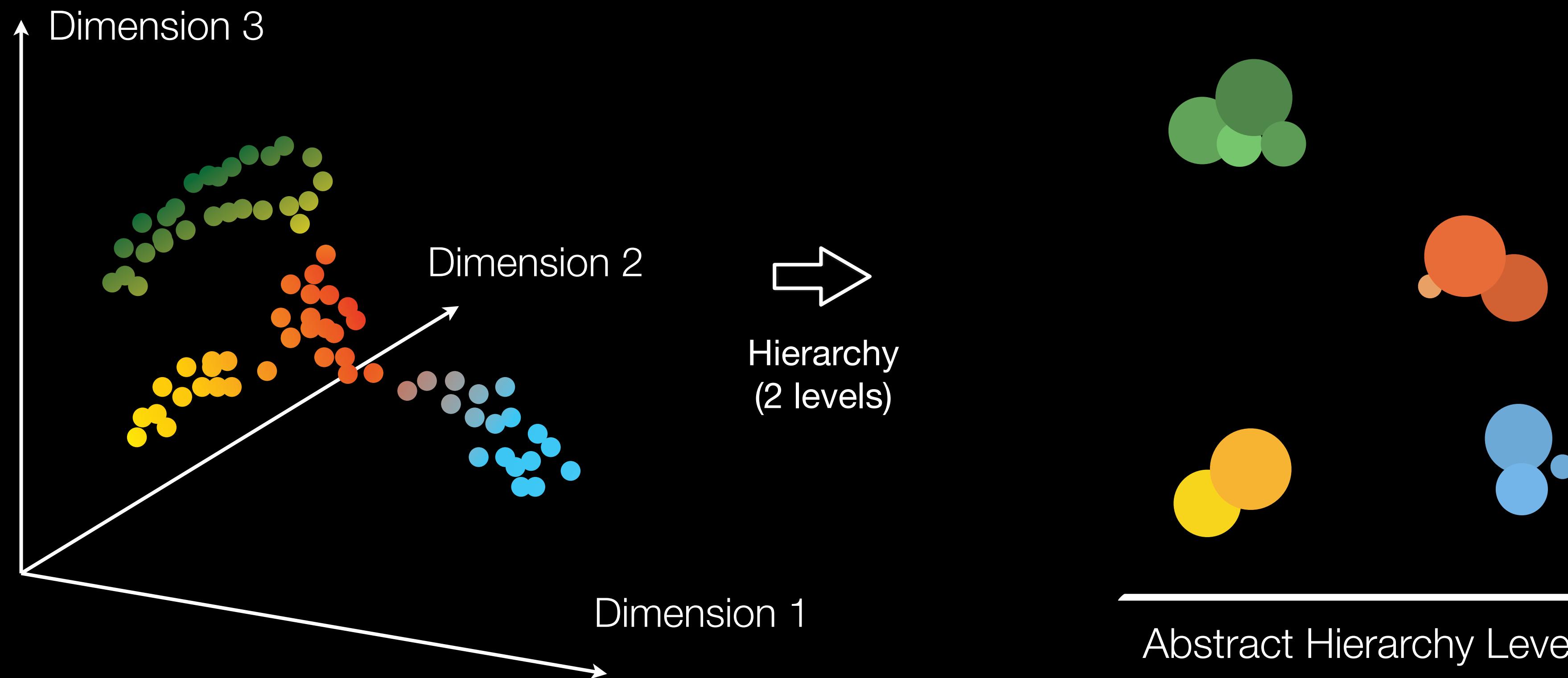
Hierarchical Embedding



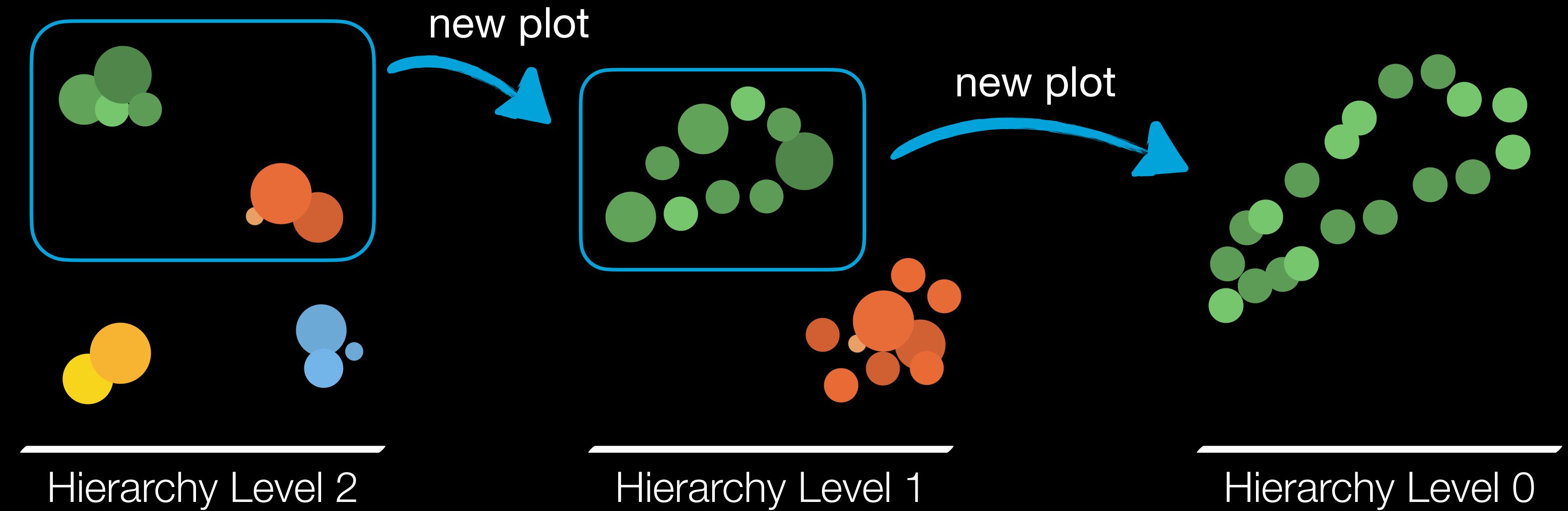
Hierarchical Embedding



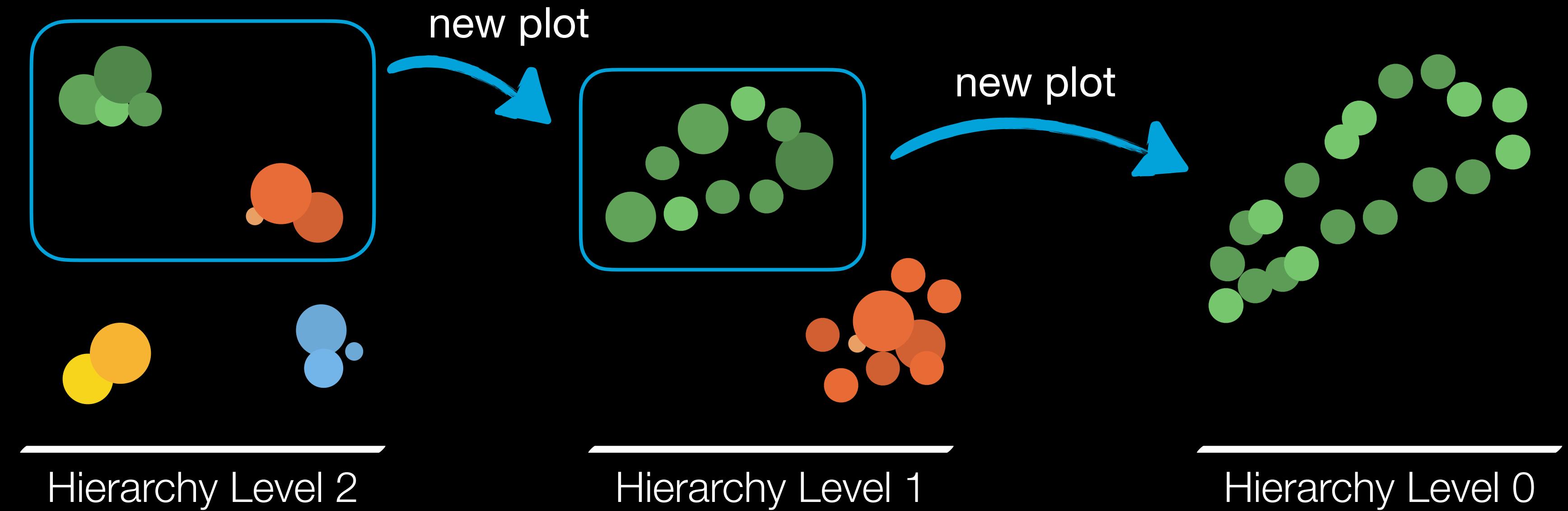
Hierarchical Embedding



Standard Exploration

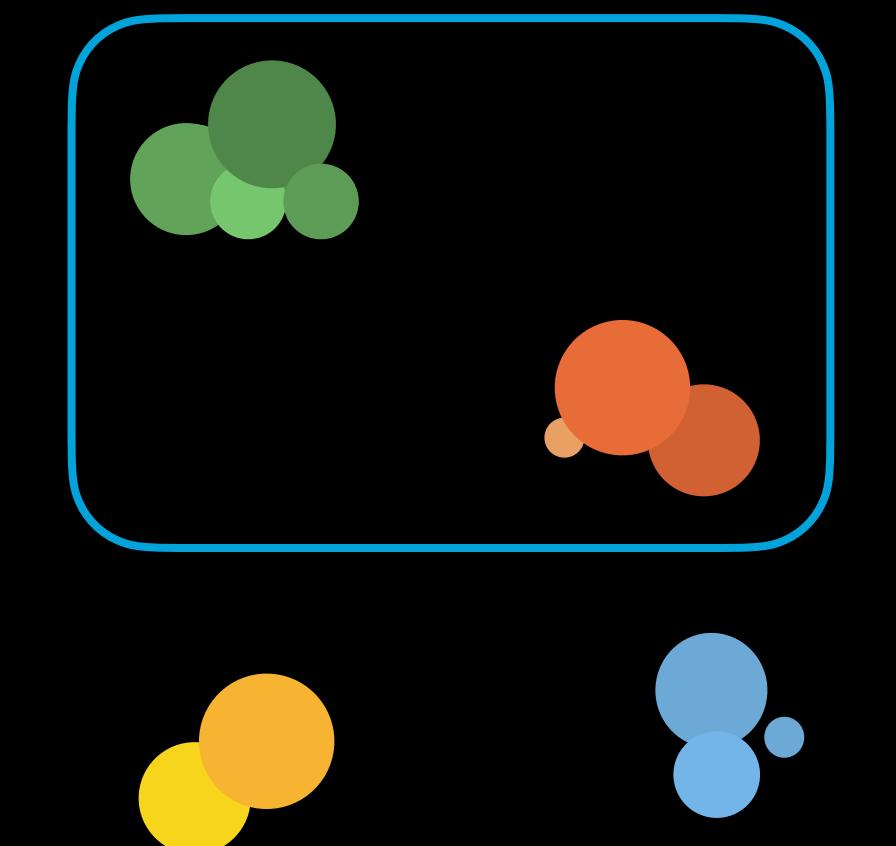


Standard Exploration

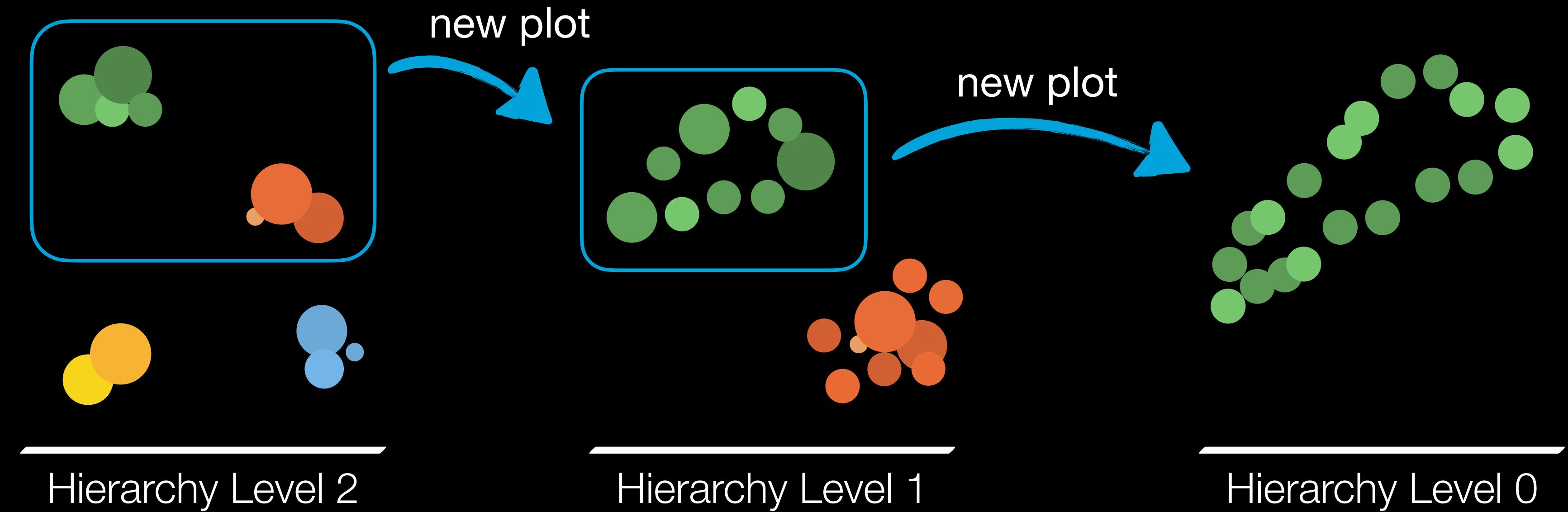


focus & differentiate

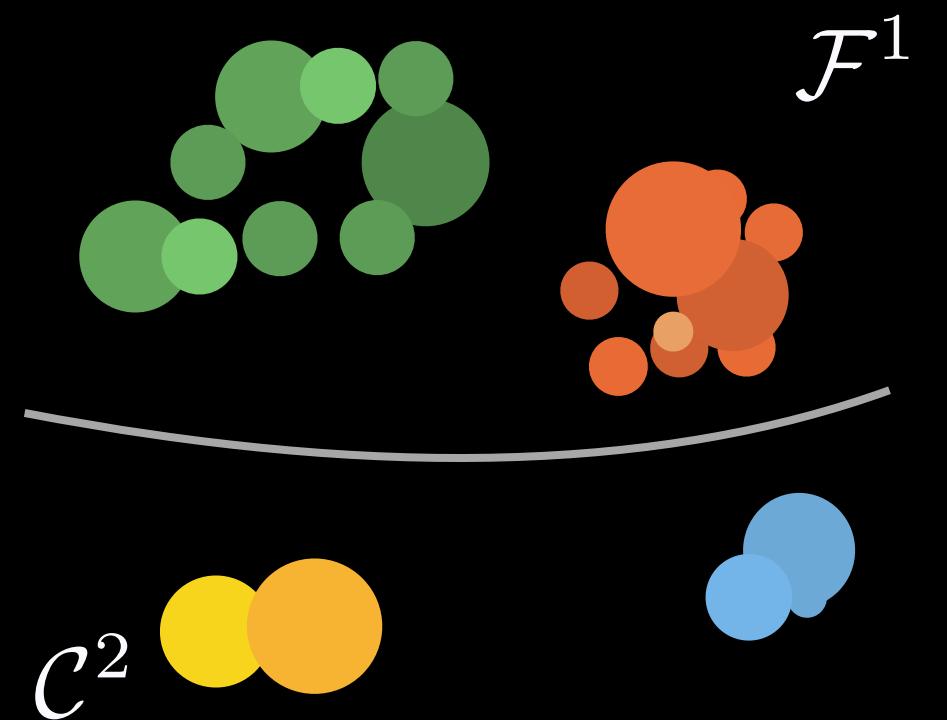
Focus+Context Exploration



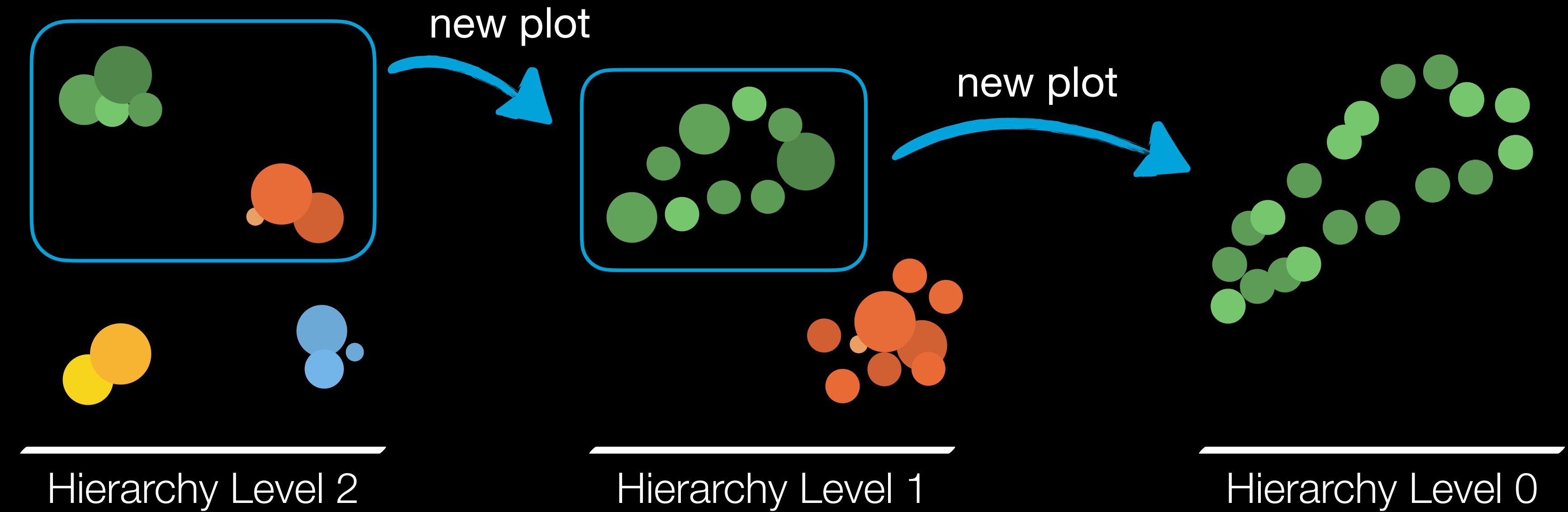
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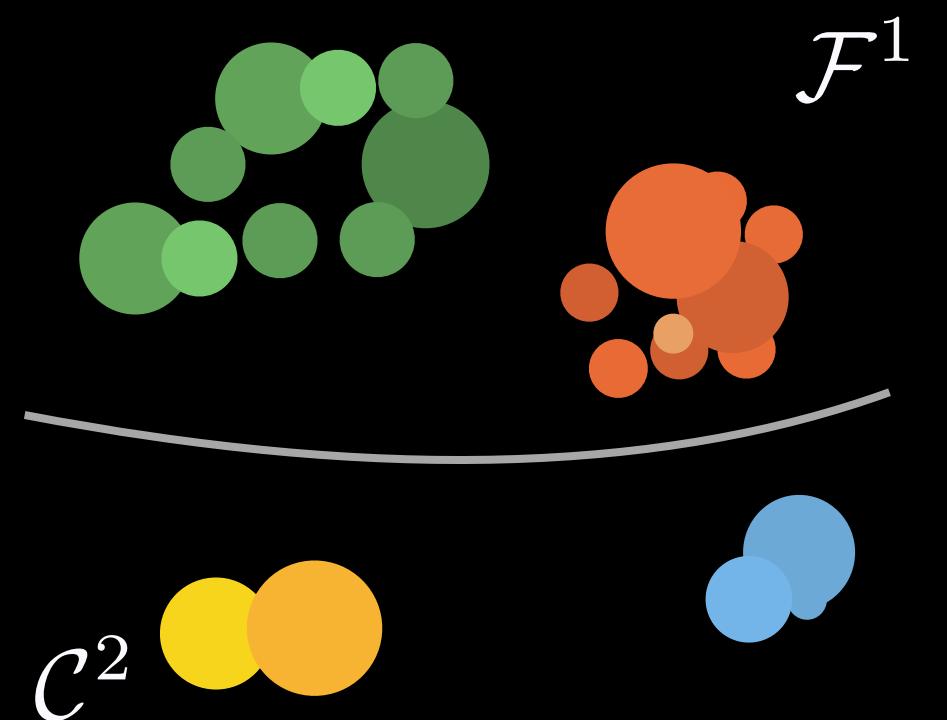
Focus+Context Exploration



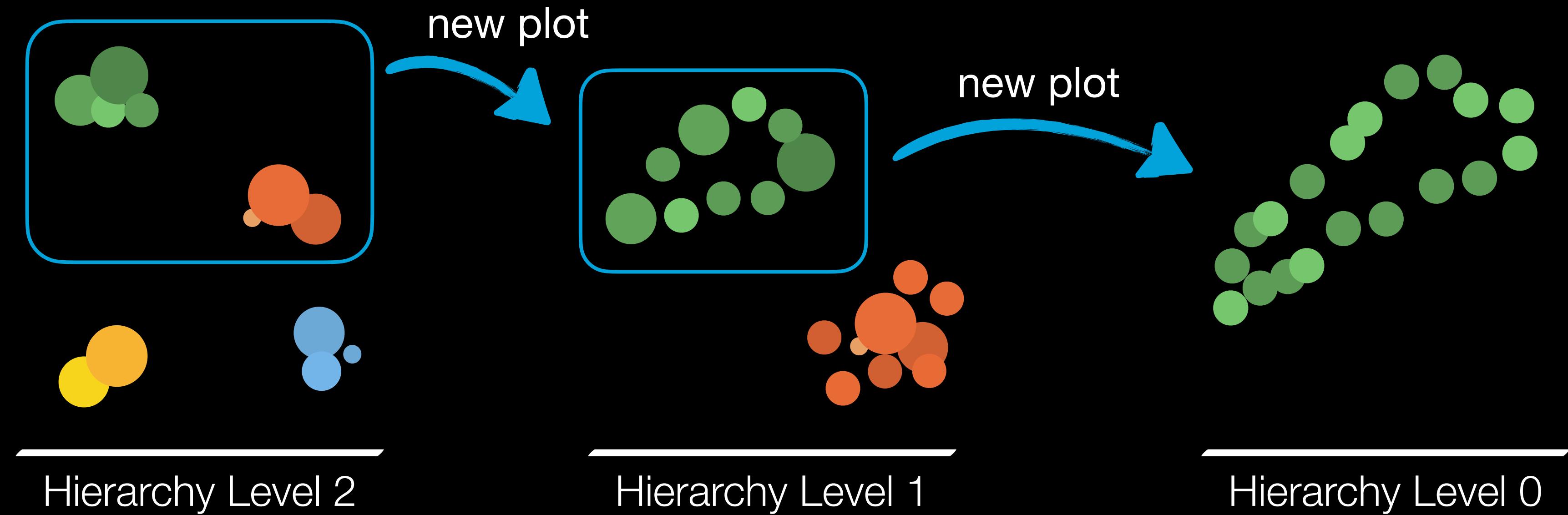
Standard Exploration



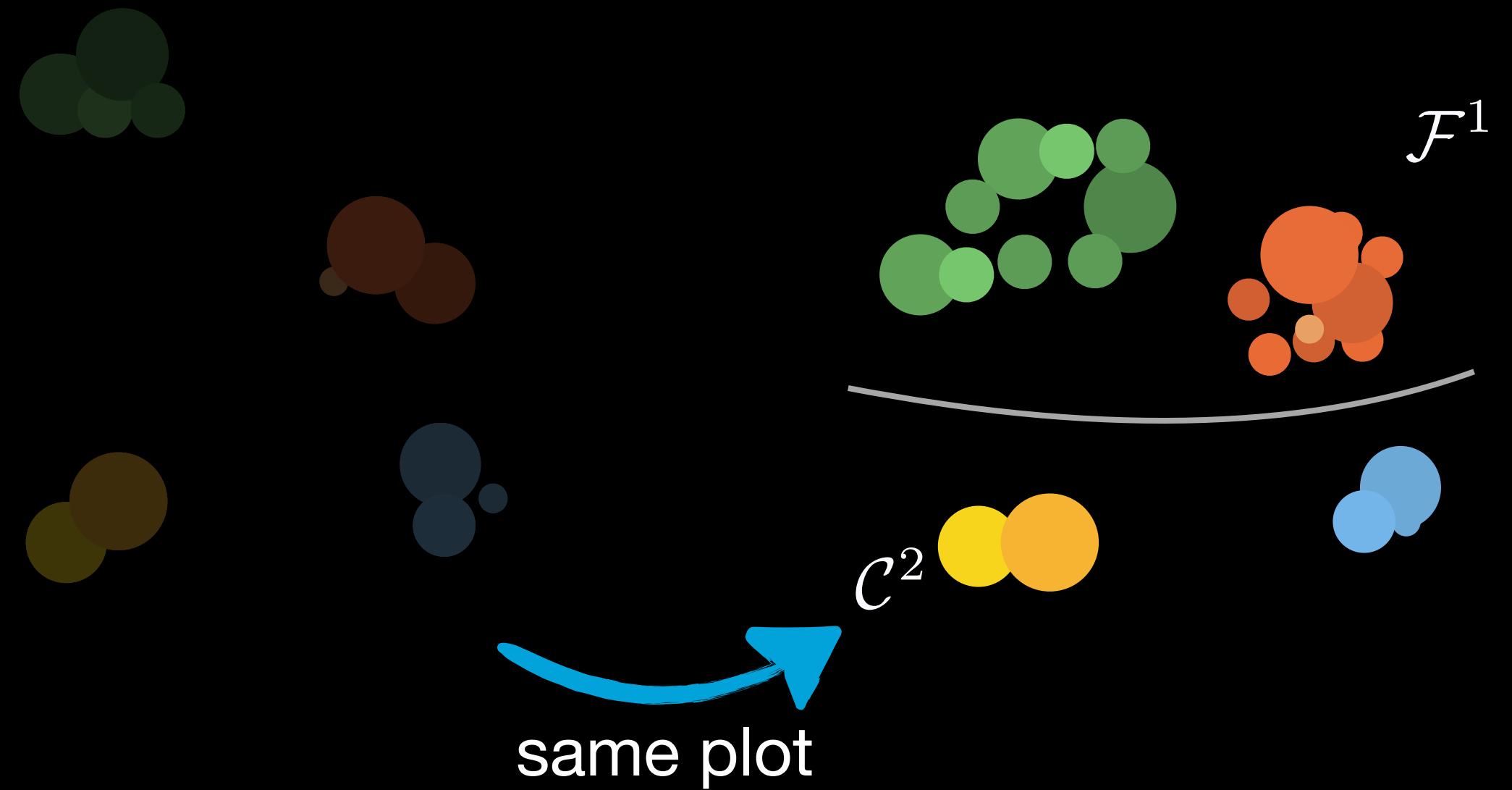
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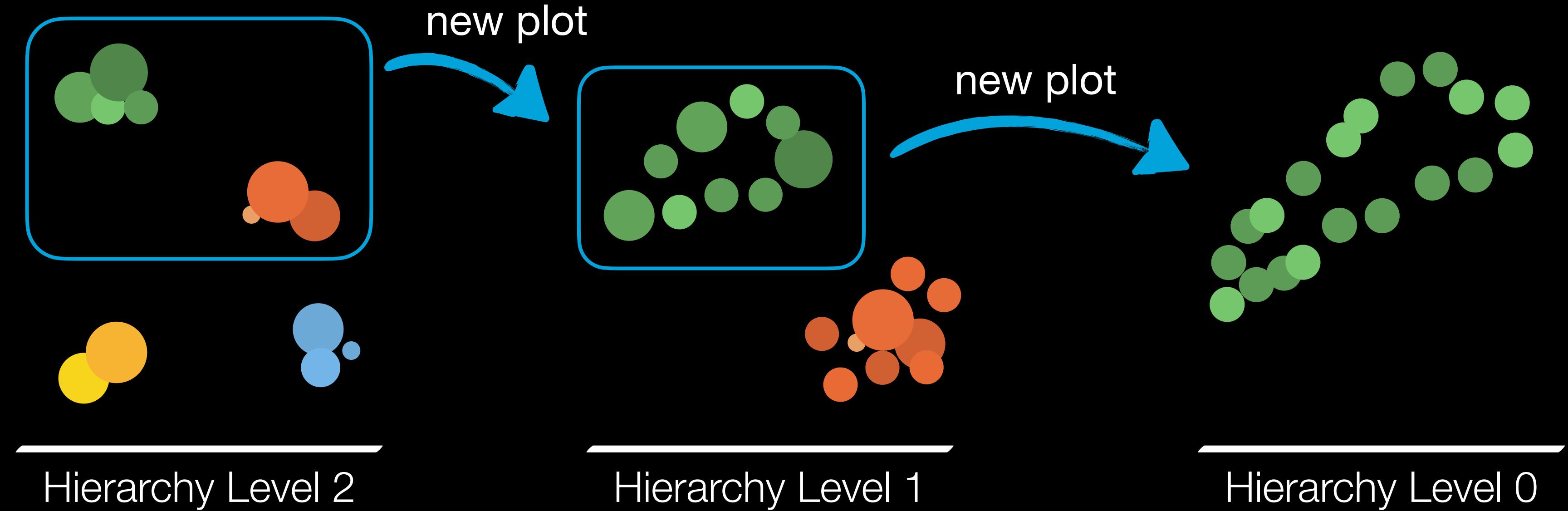
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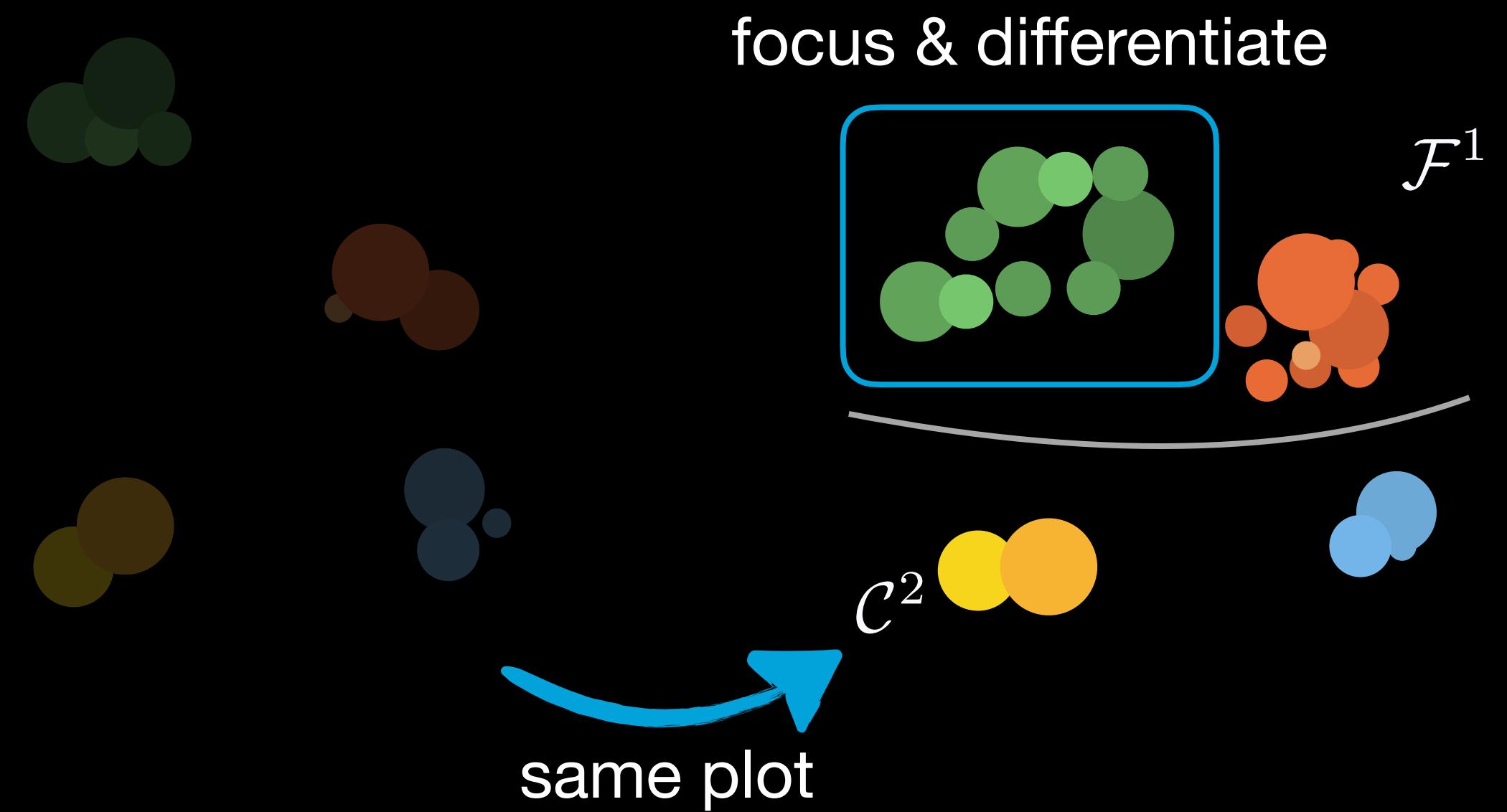
Focus+Context Exploration



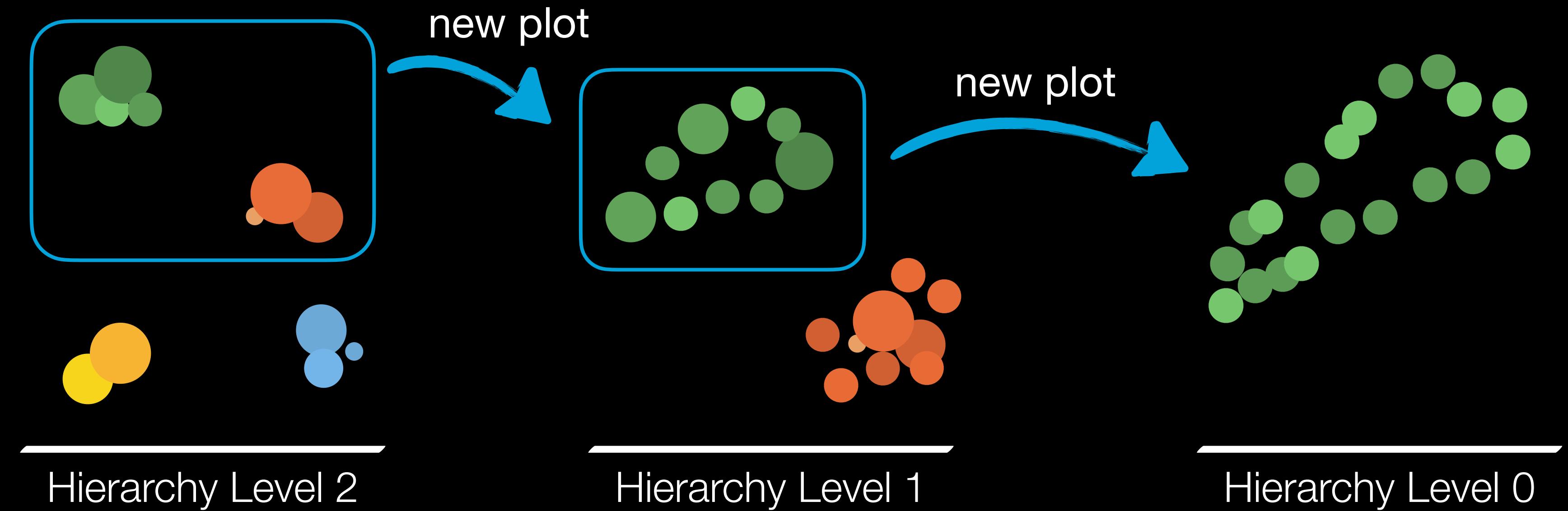
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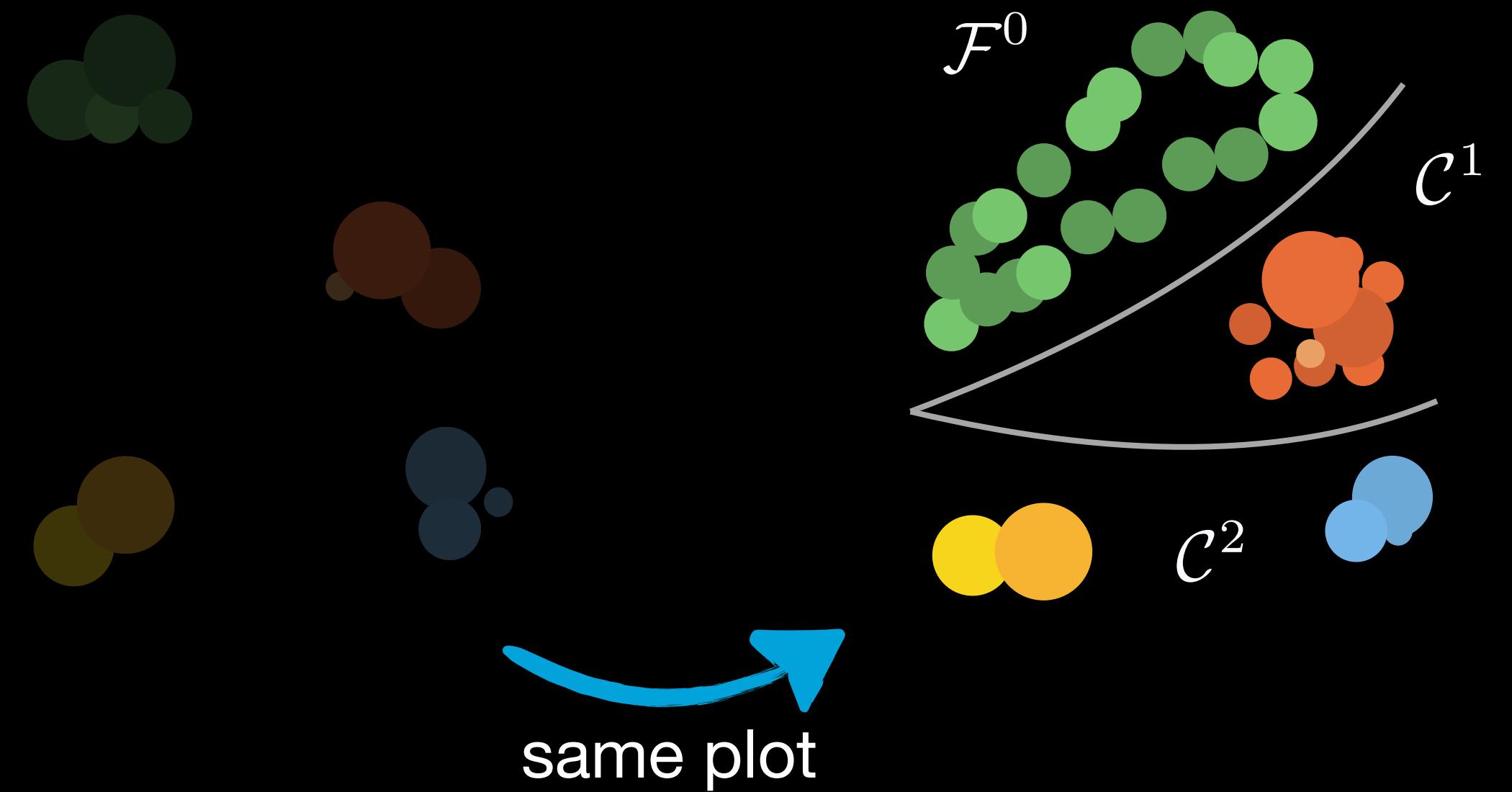
Focus+Context Exploration



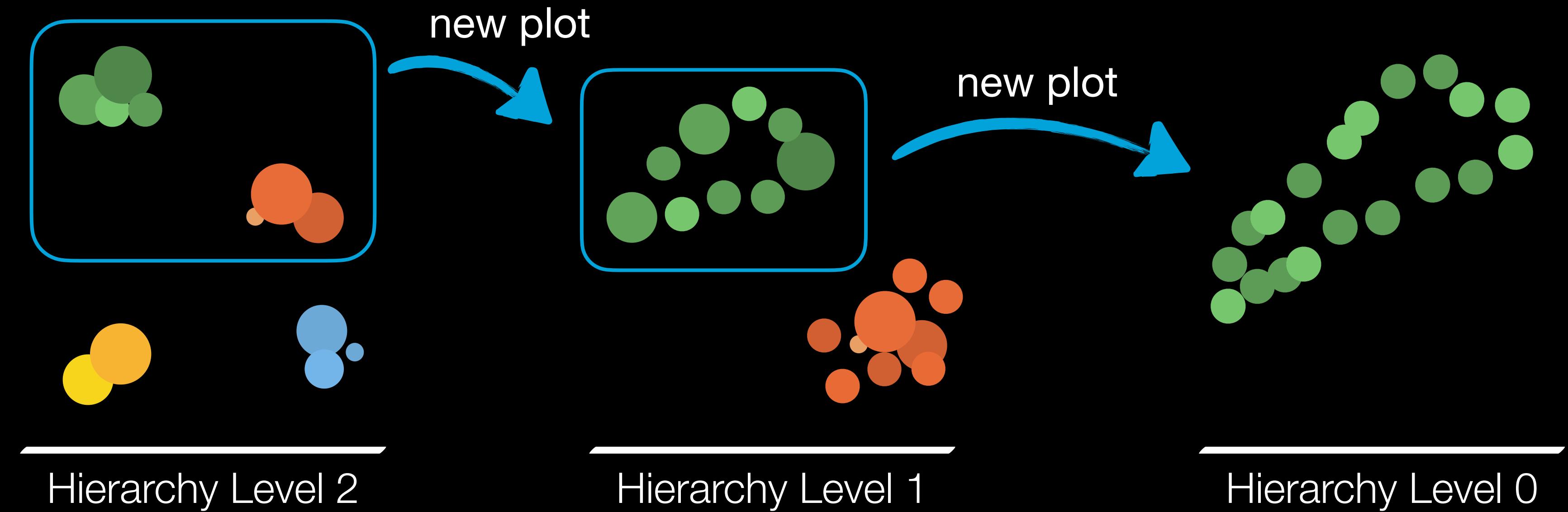
Standard Exploration



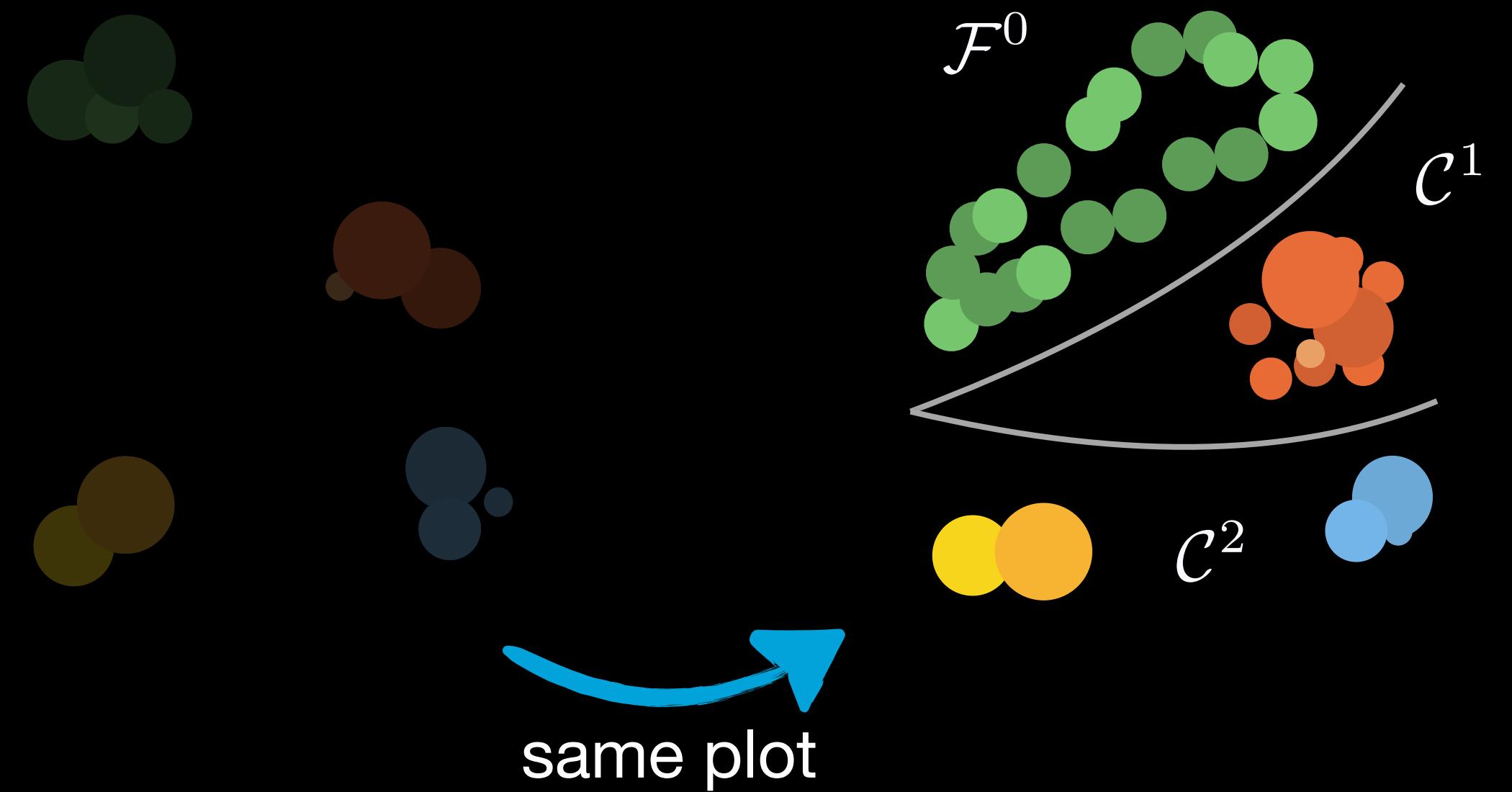
Focus+Context Exploration



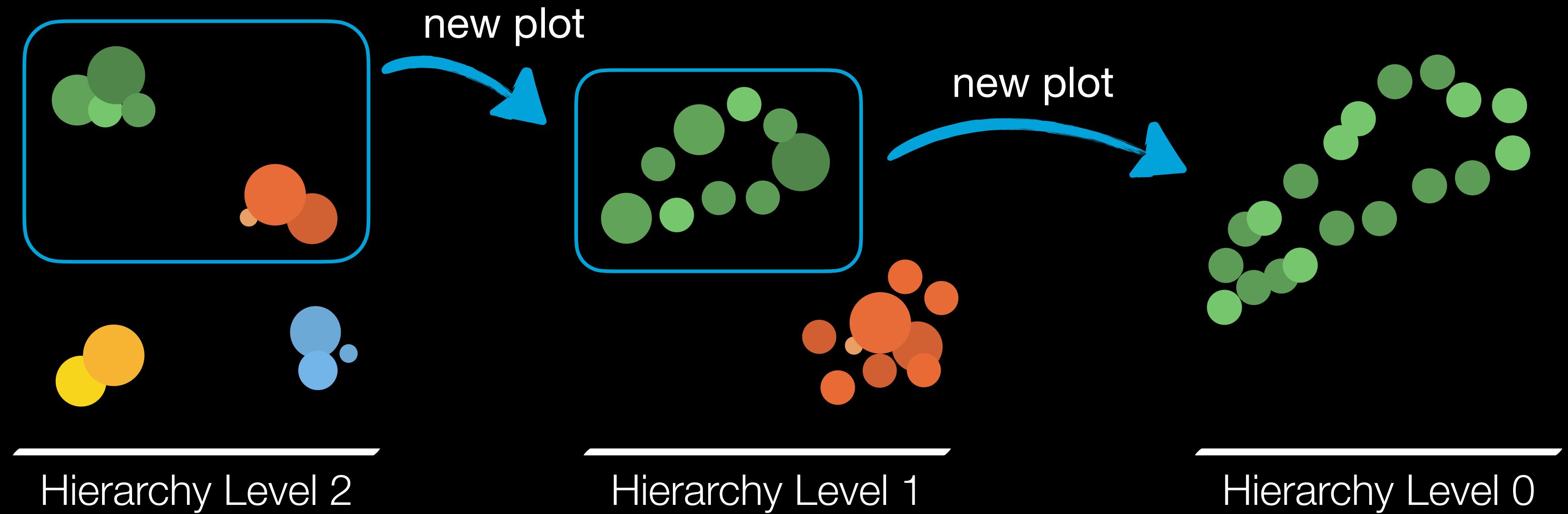
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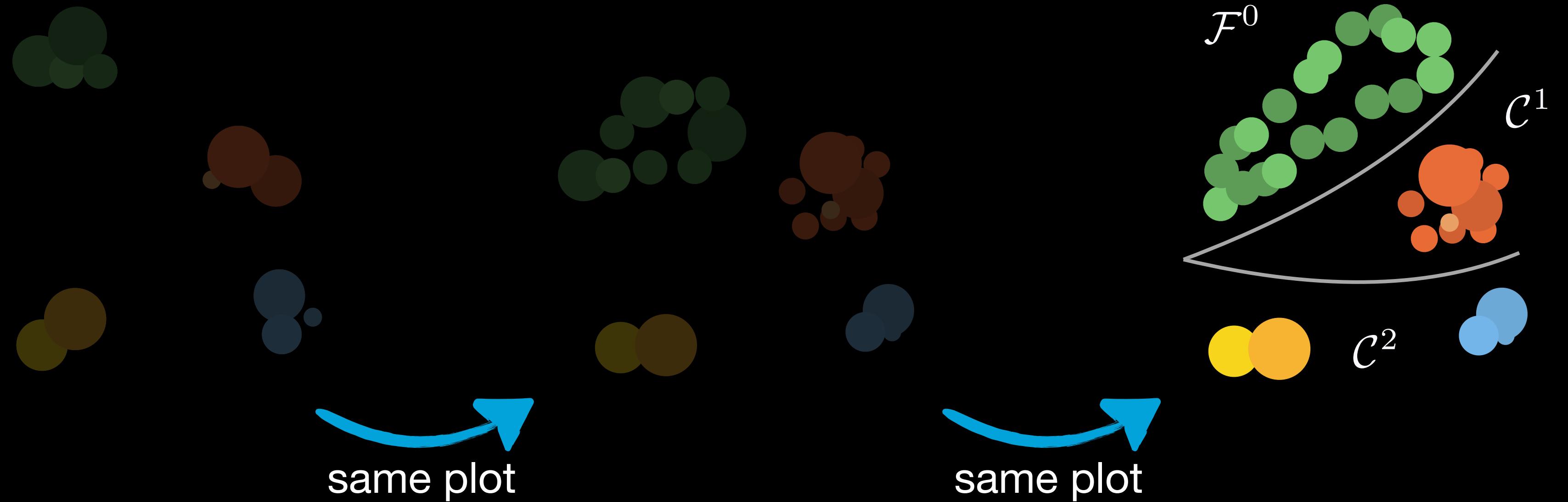
Focus+Context Exploration



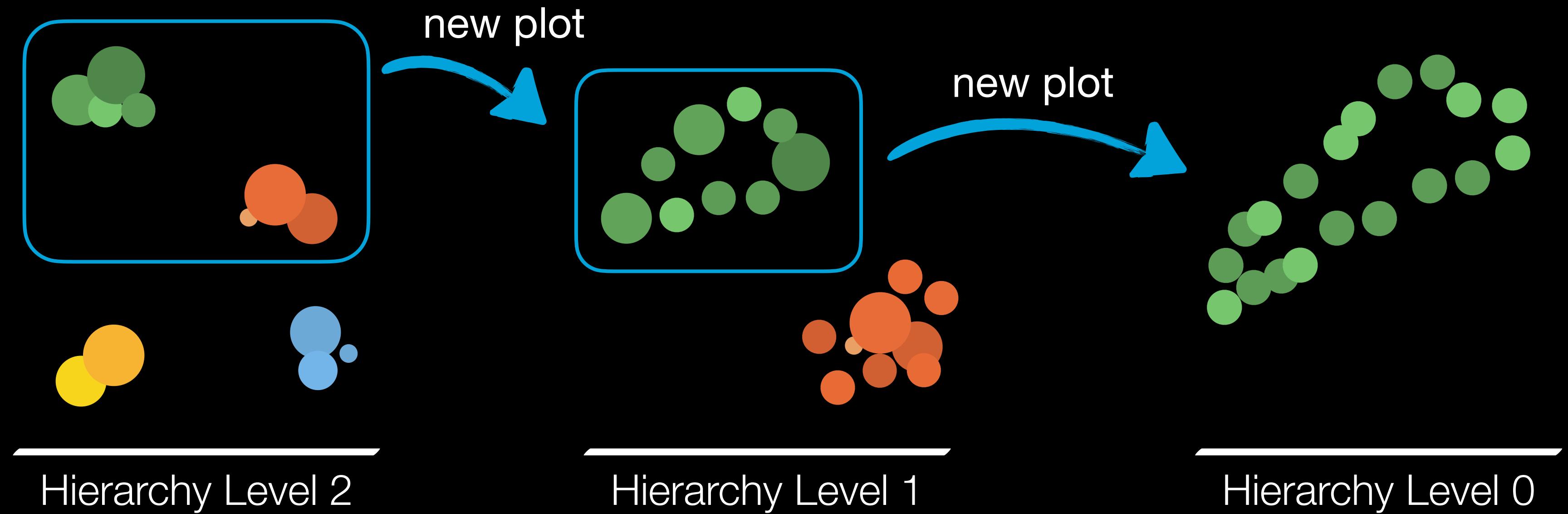
Standard Exploration



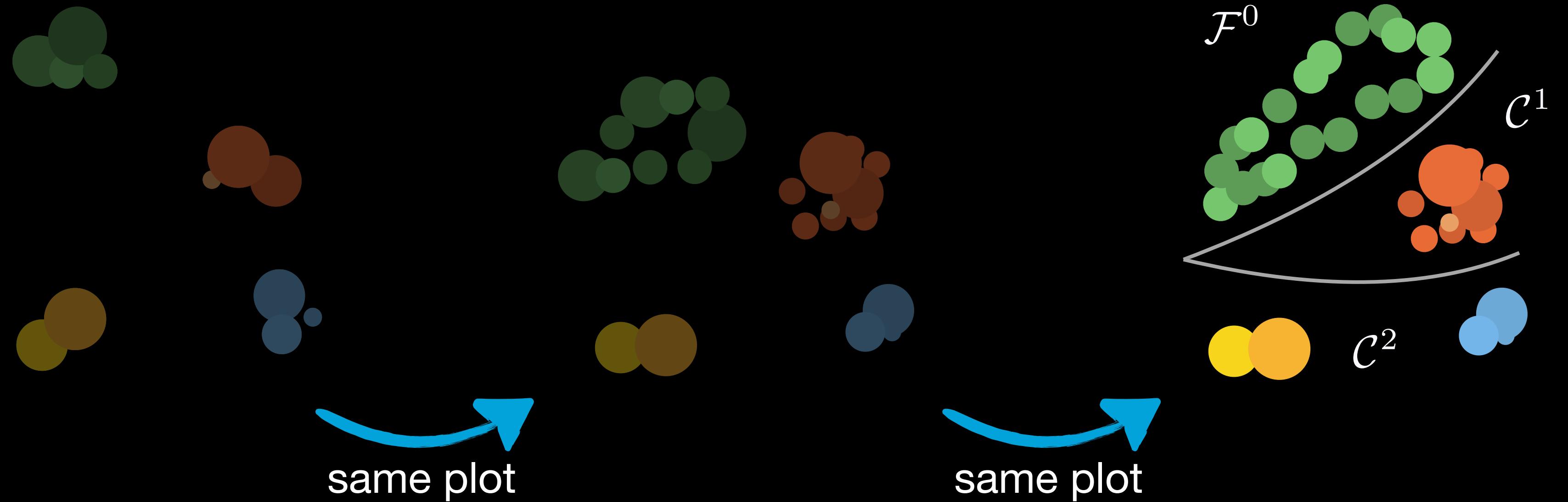
Focus+Context Exploration



Standard Exploration



Focus+Context Exploration



Focus+Context Embeddings

- Neighborhood-embeddings natural fit for F+C paradigm
 - Only preserve **local** neighborhoods
 - Axes/global distances have no meaning
 - **Global** distortion has little impact on interpretation
 - Distortion modeled in the embedding process!
 - Hierarchical Embedding: Add detail from the hierarchy!



Contributions

- Focus+Context for multi-LoD embeddings
 - Interaction design (+ implementation in HSNE*)
 - Visual representation
- Extended HSNE* to support Focus+Context exploration
 - Finer-grained, controllable levels
 - Traversal in both directions
 - Multi-level similarity matrices

* Pezzotti et al., Computer Graphics Forum, 2016

Van Unen, Höllt, Pezzotti, et al., Nature Communications, 2017

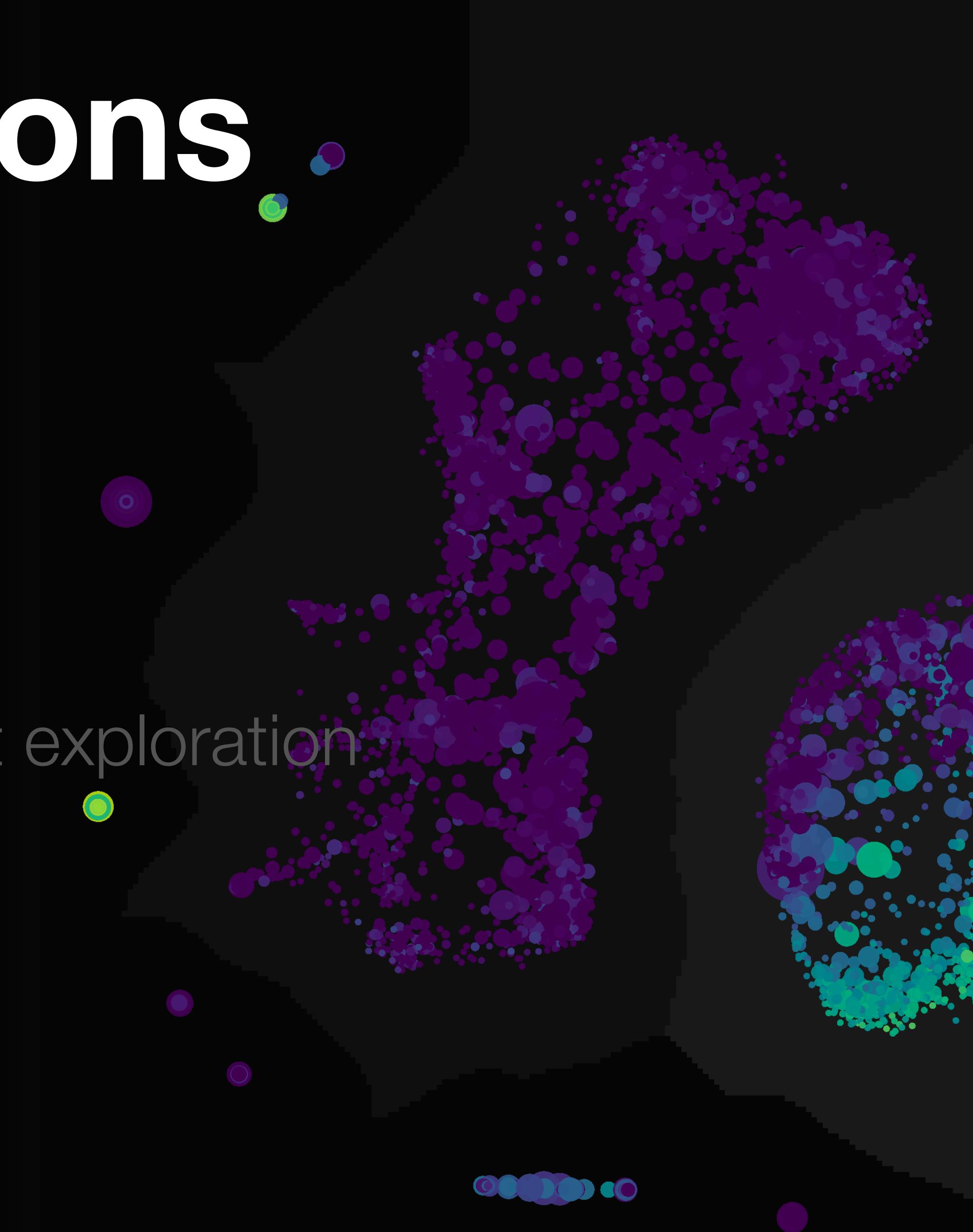


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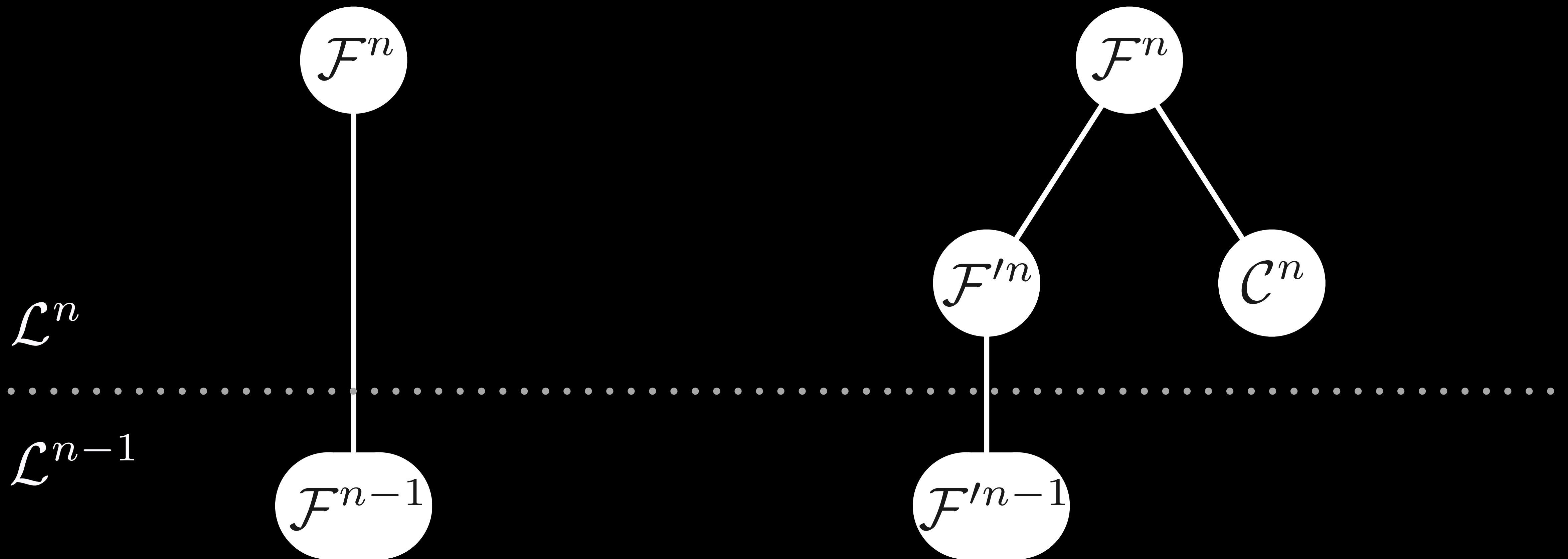
* Pezzotti et al., Computer Graphics Forum, 2016

Van Unen, Höllt, Pezzotti, et al., Nature Communications, 2017



Interactions & Implementation

Exploration – Tree of Sets



Interactions I – General

I1 request more detail for all data

I2 request less detail for all data

I3 return to the initial state

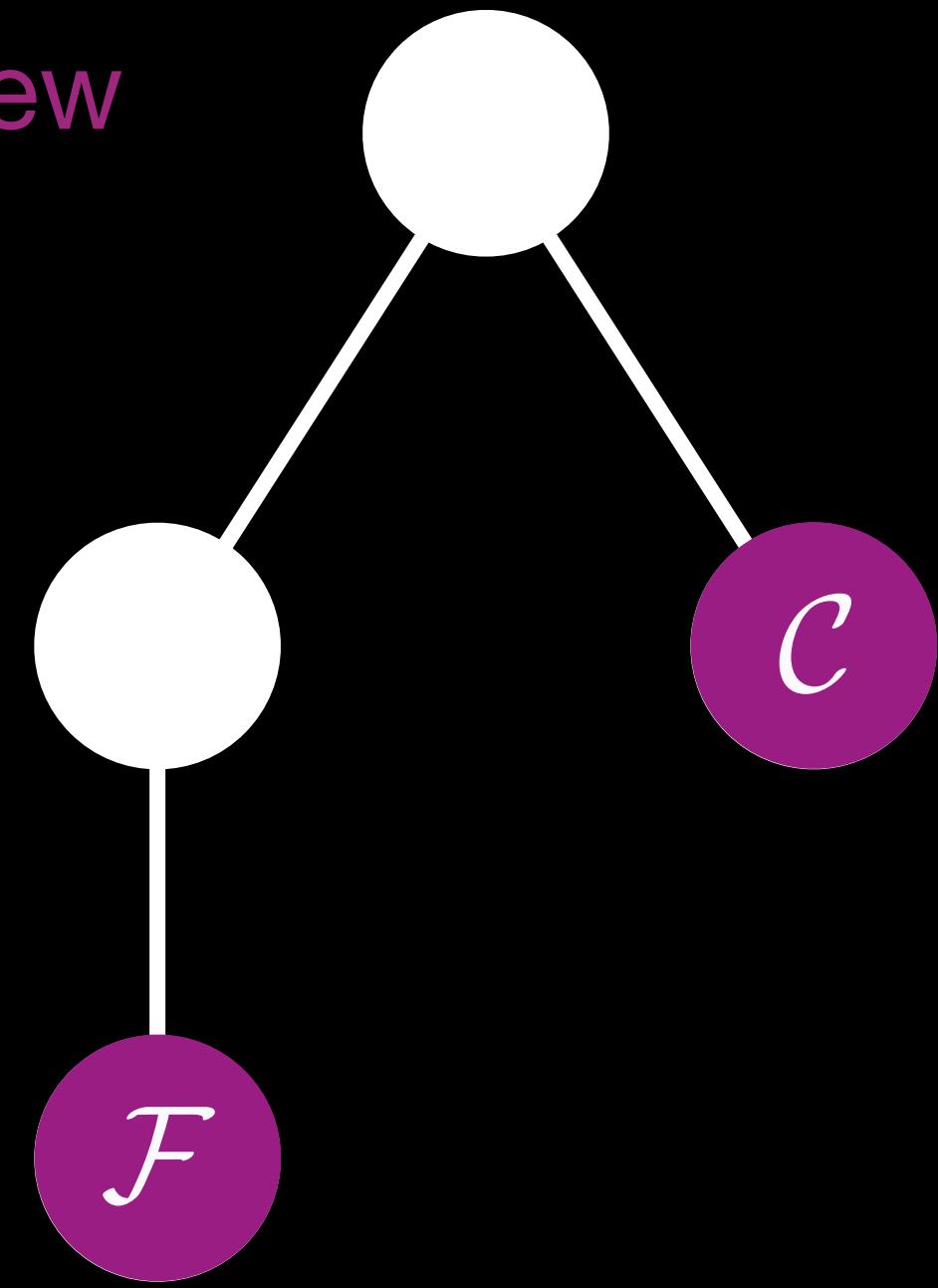
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Current View



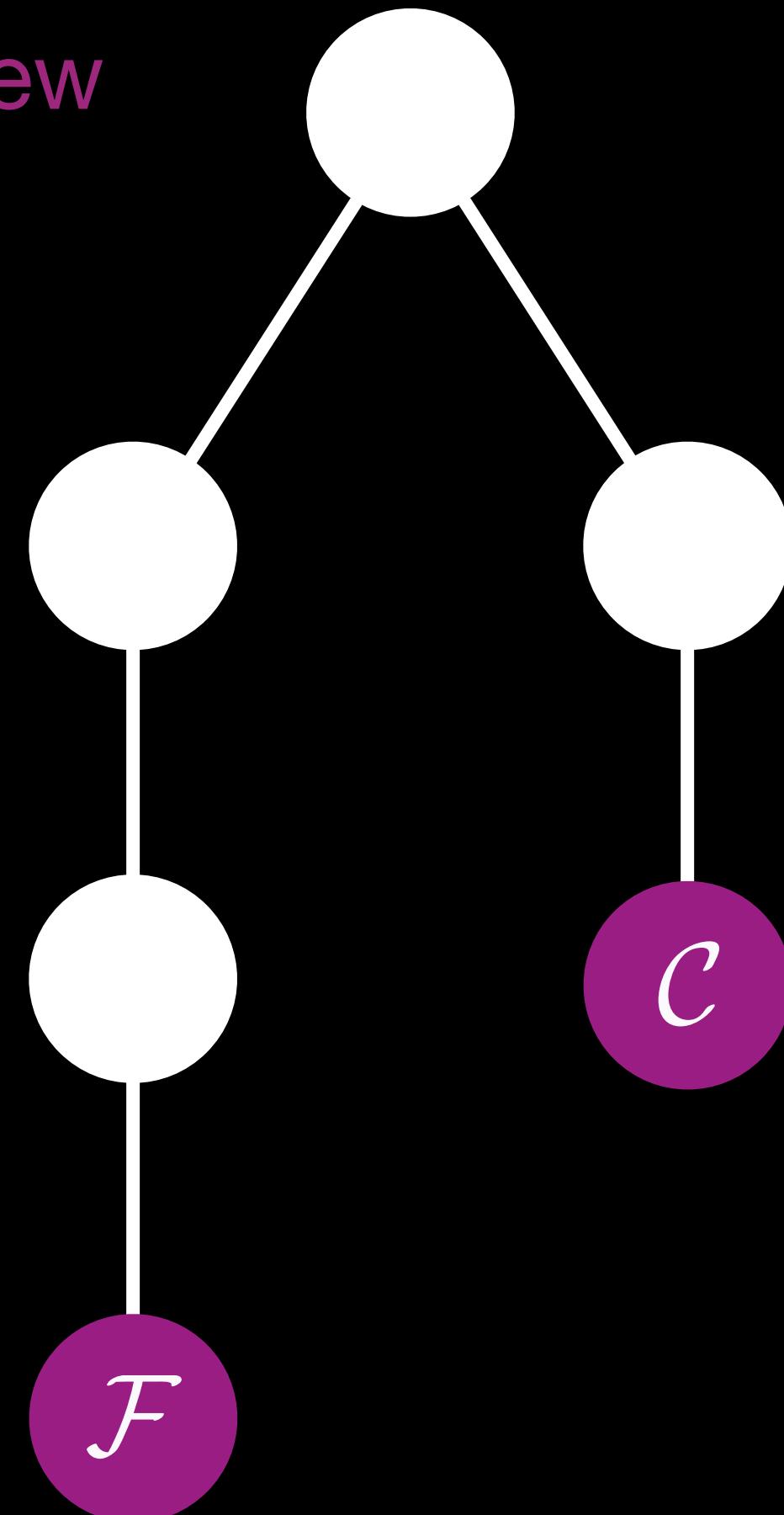
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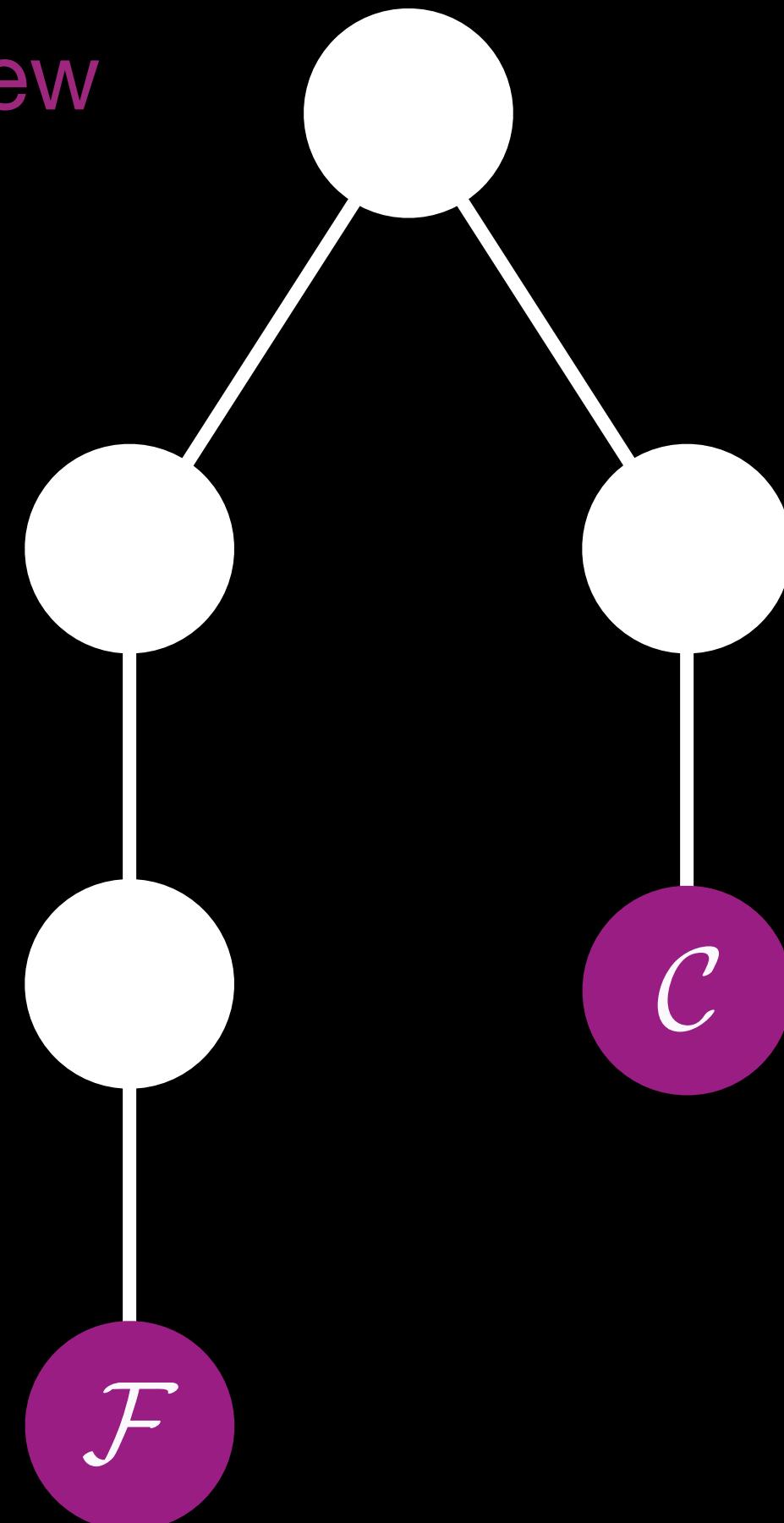
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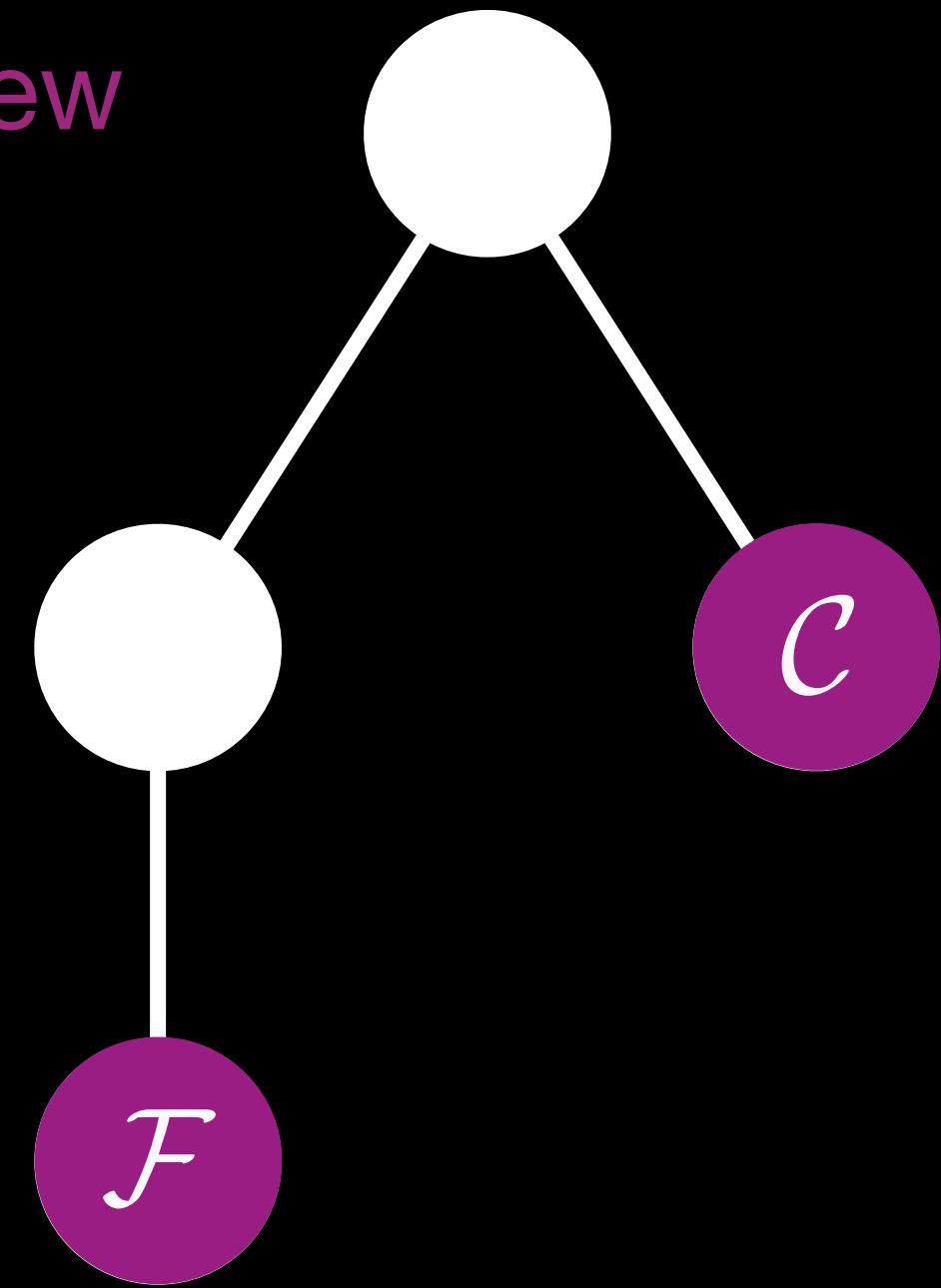
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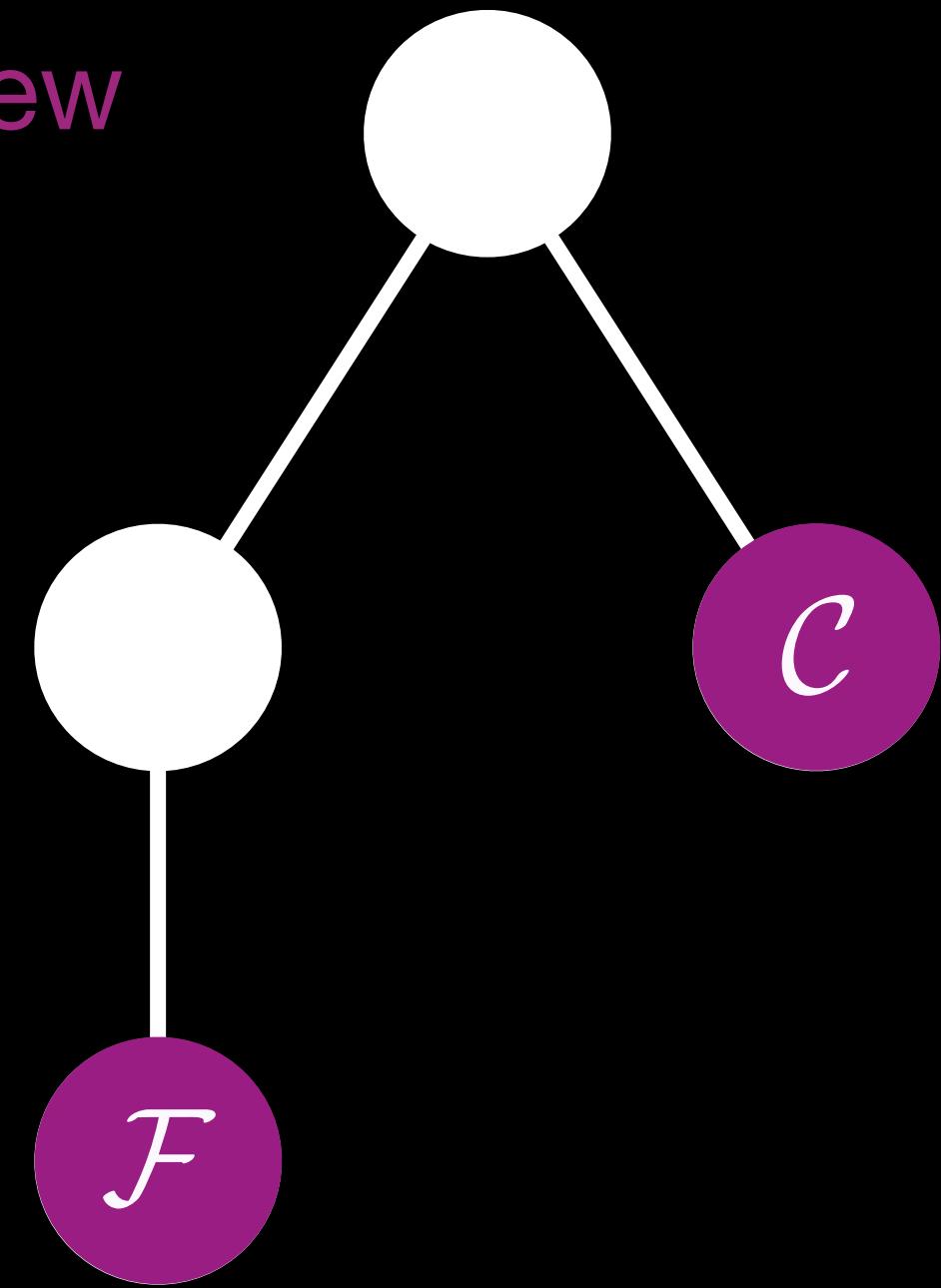
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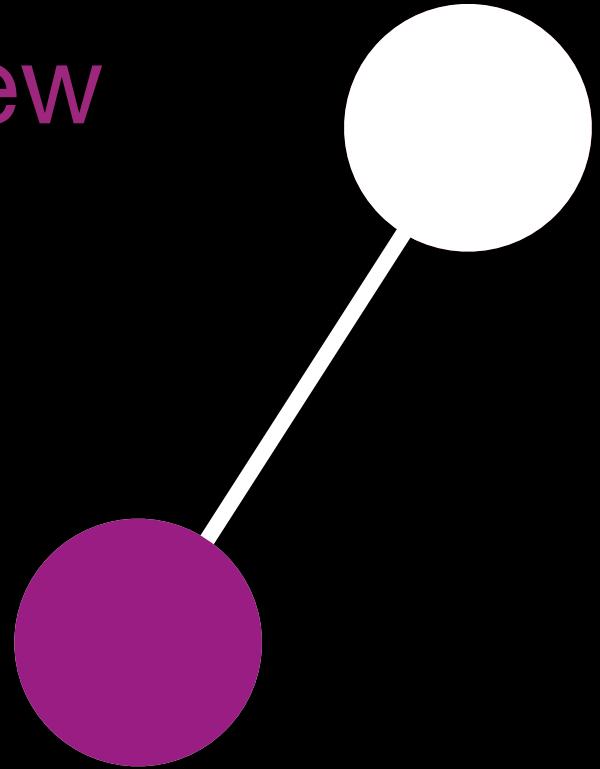
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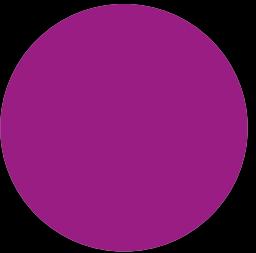
I3 return to the initial state

Current View



Interactions I - General

Current View



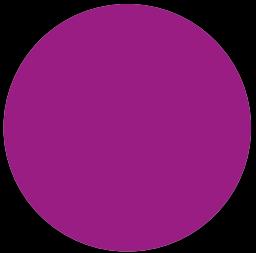
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Interactions II – F+C

Current View



I4 define an area of interest (focus)

I5a change the focus to a subset of the current focus

I5b change the focus to a different set of points

I6 request more detail for the focus

I7 request less detail for the focus

Interactions II – F+C

I4 define an area of interest (focus)

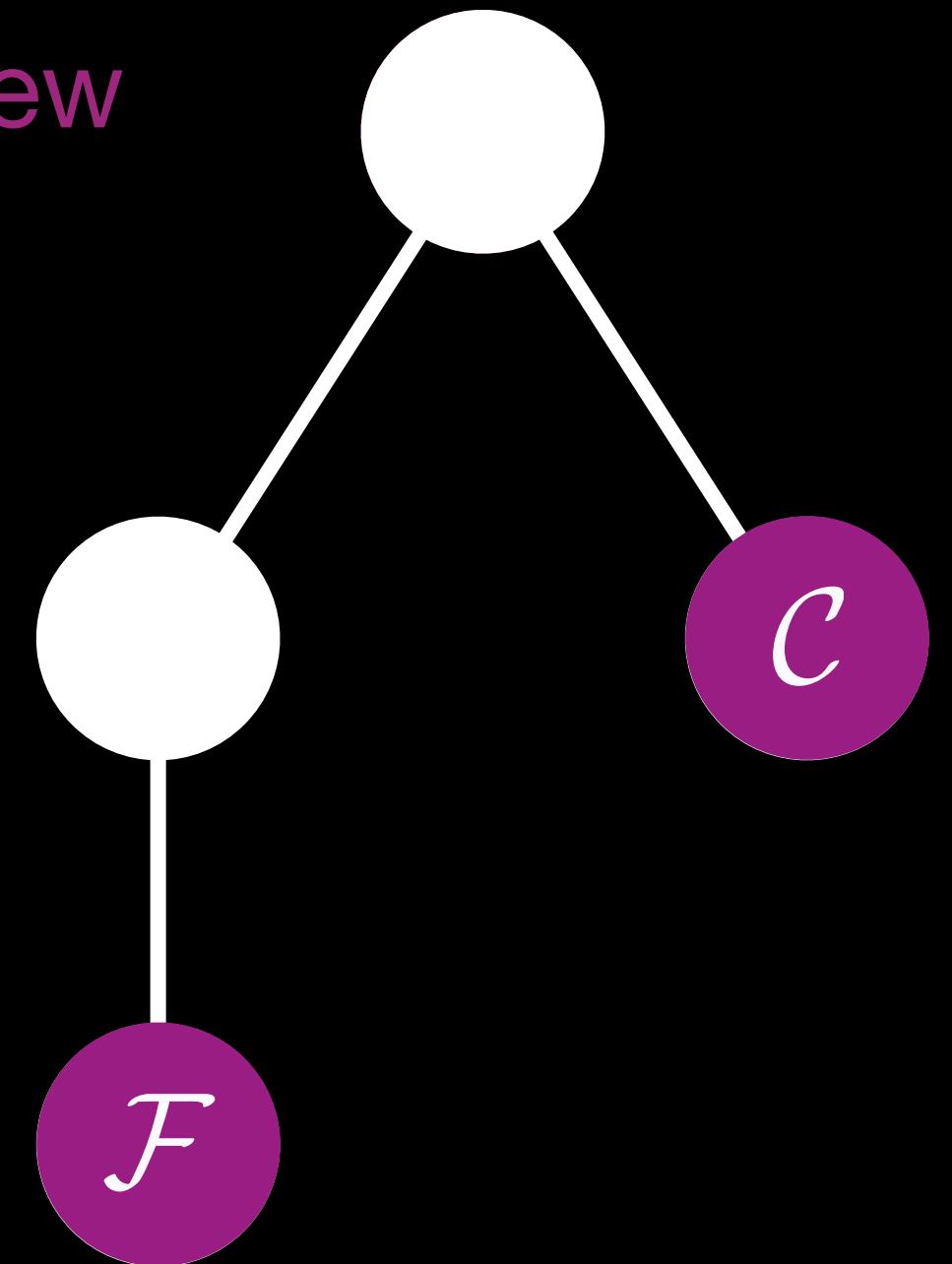
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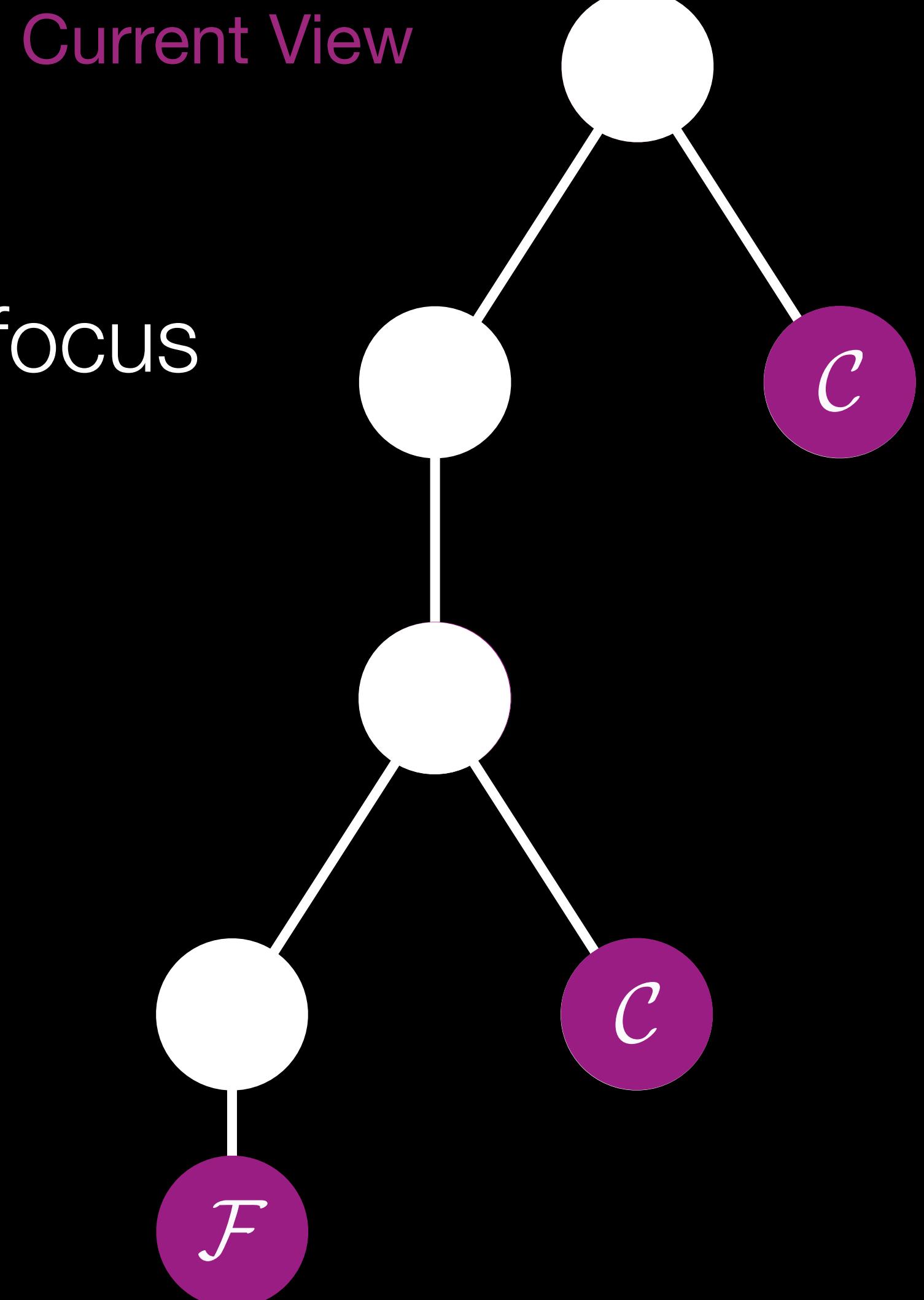
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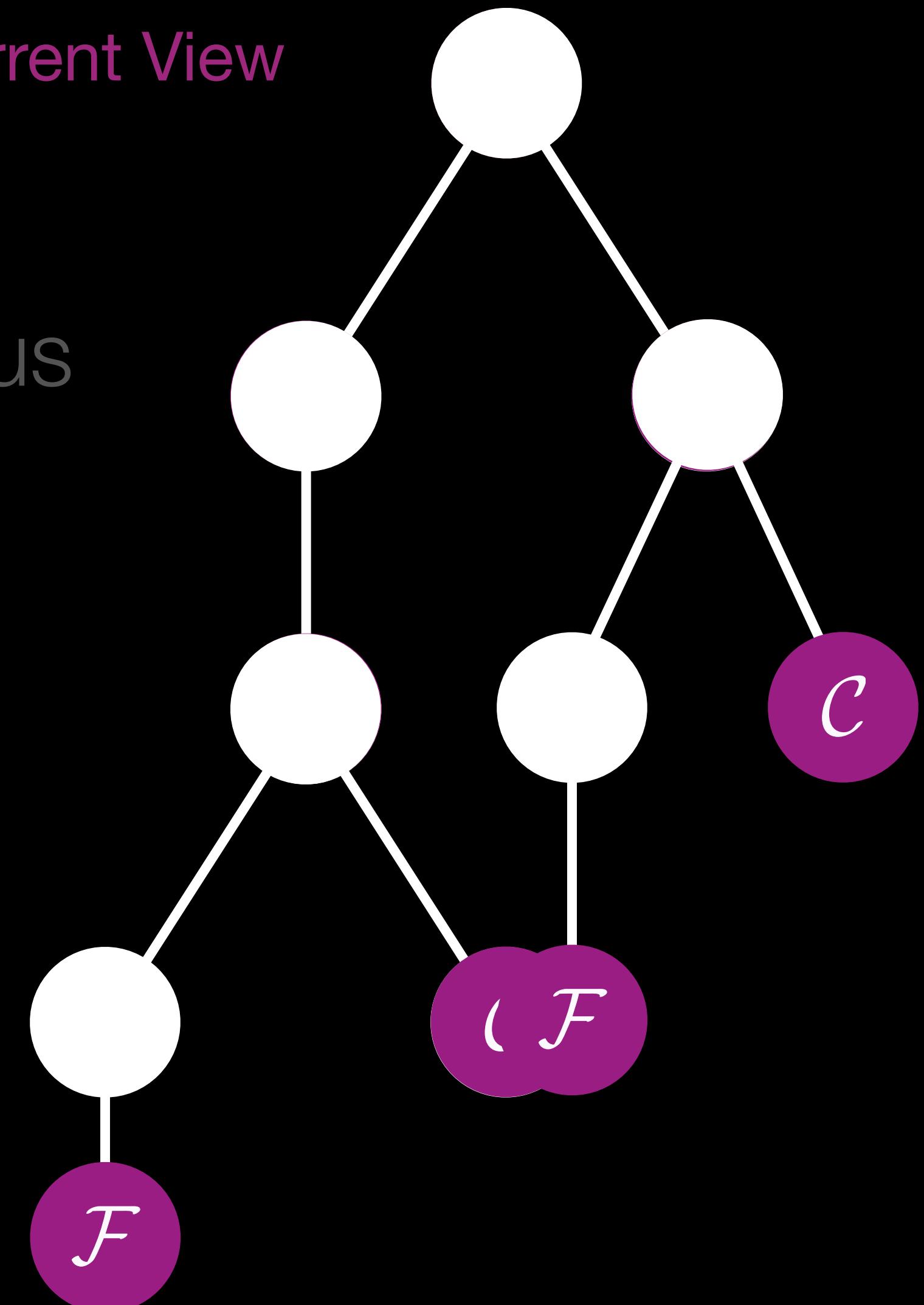
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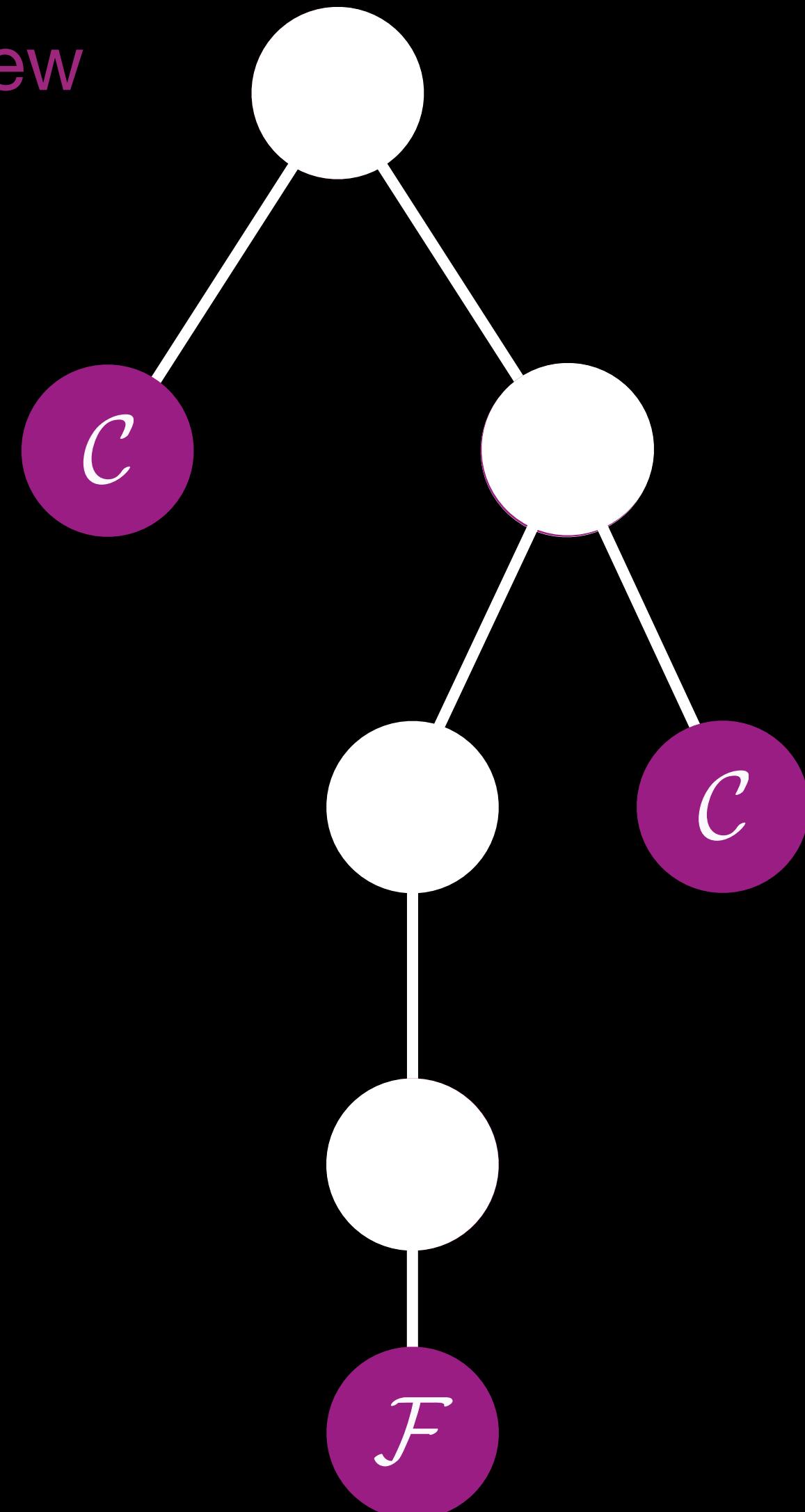
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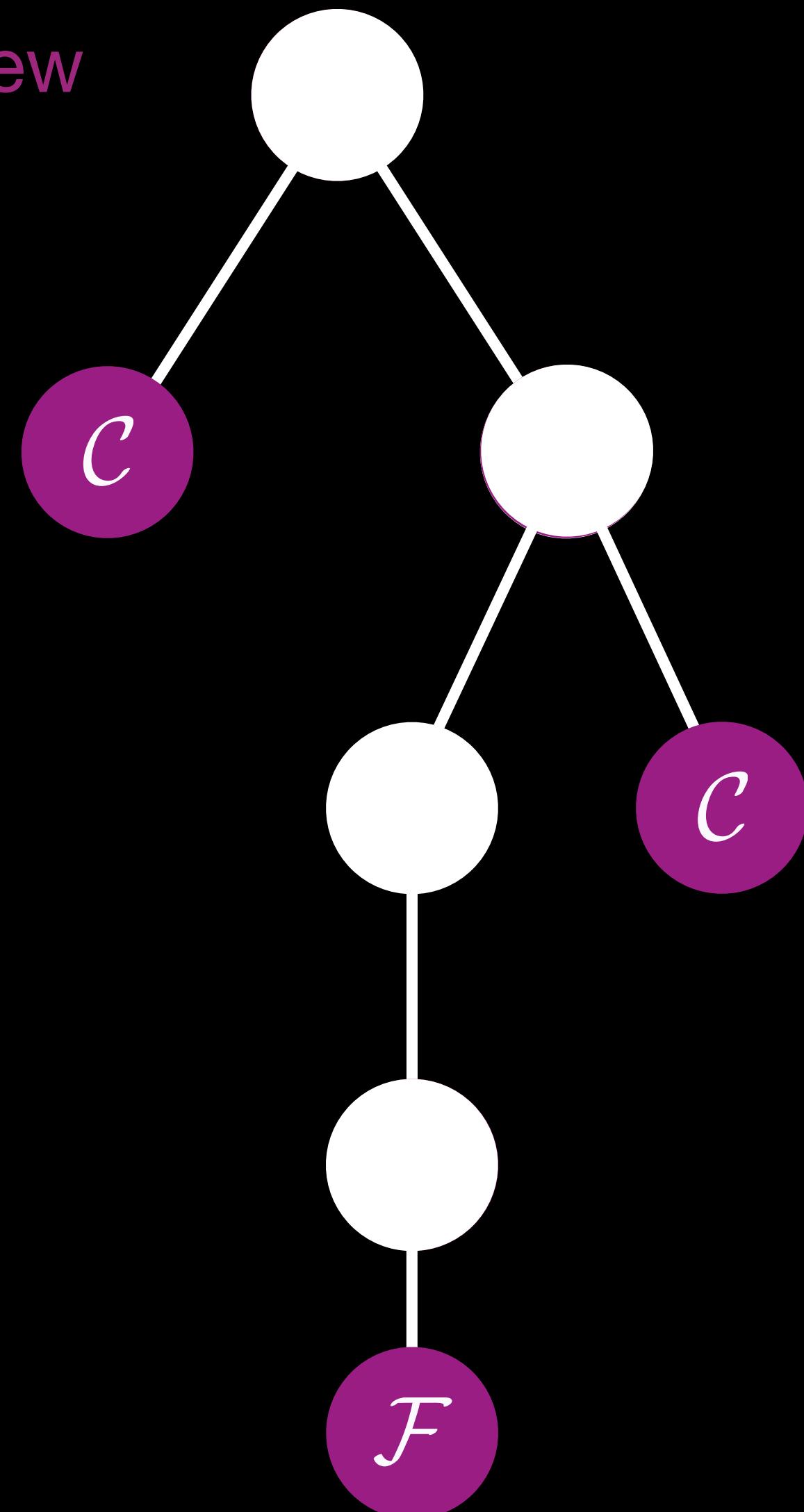
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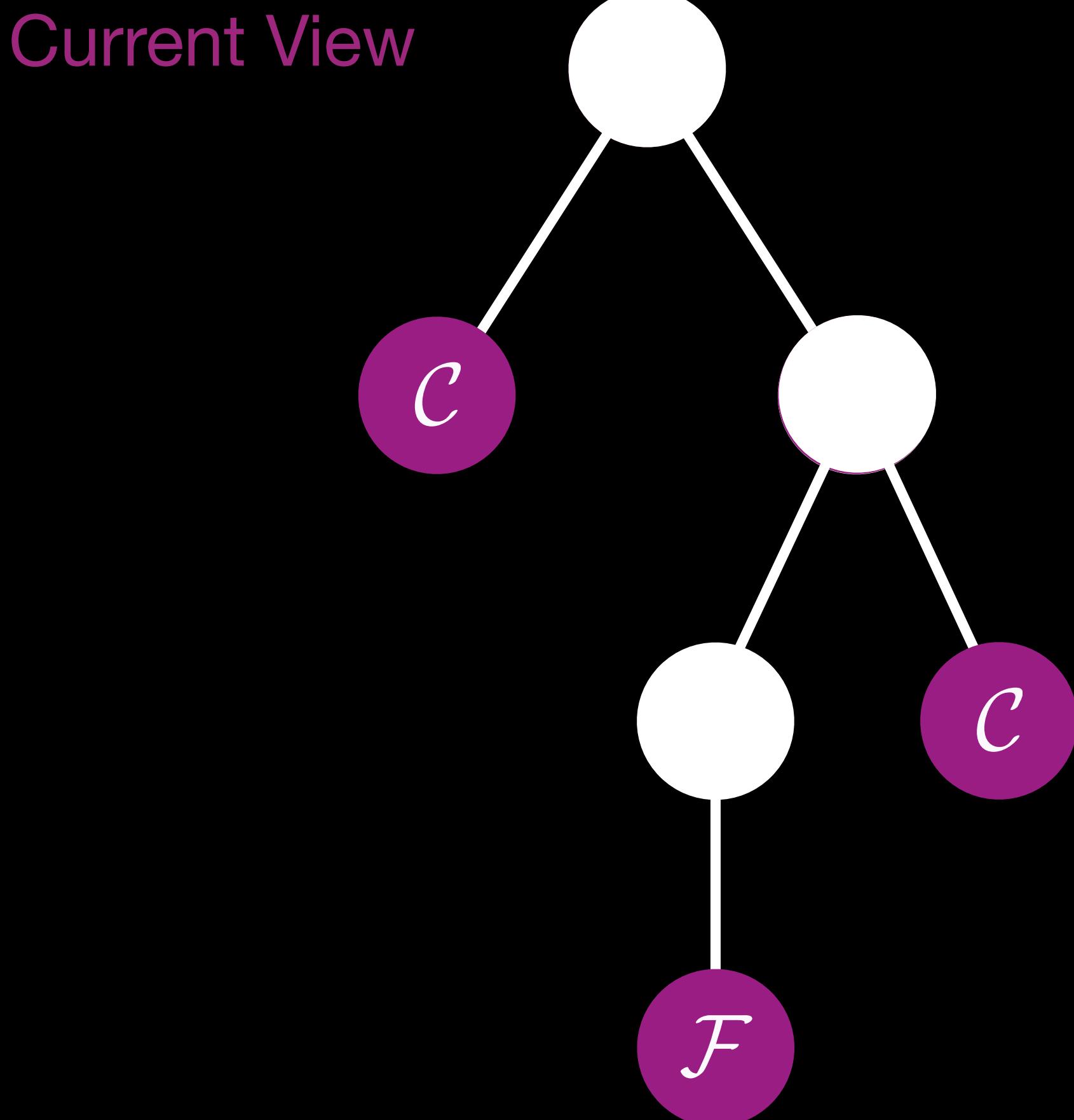
Current View



Interactions III – Comparative

I8 create a second focus for comparison

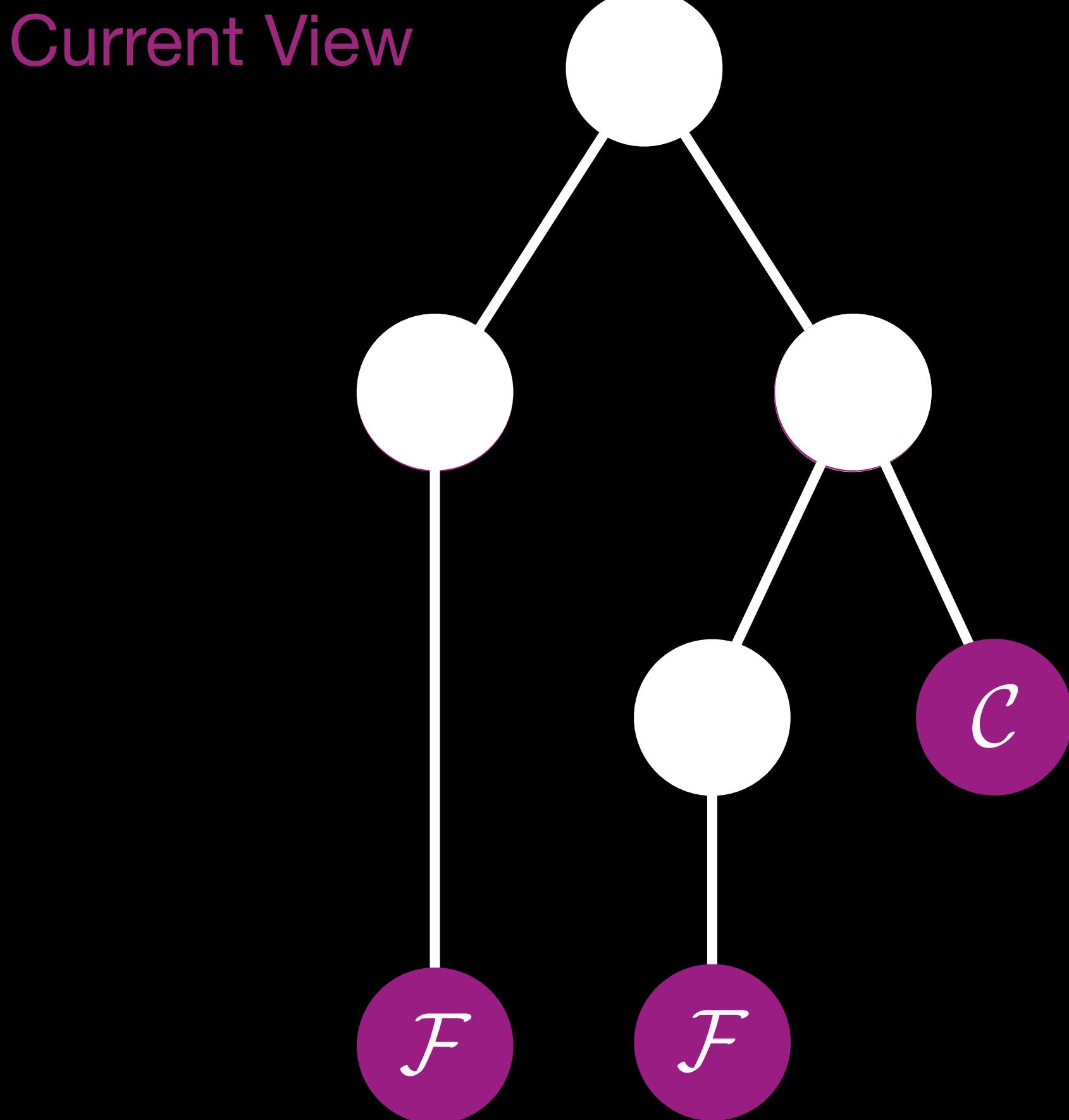
I9 resolve the second focus



Interactions III – Comparative

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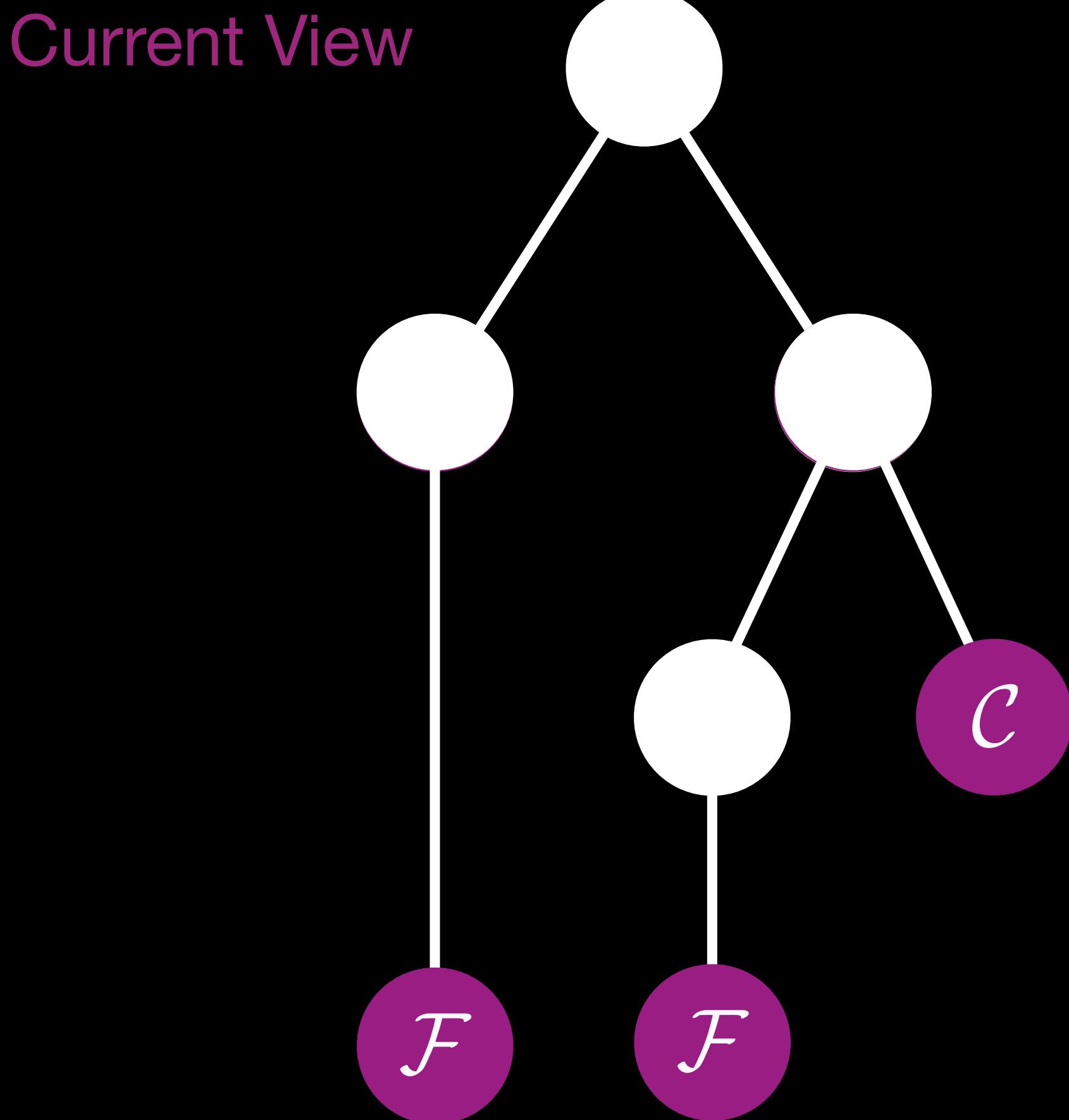
I9 resolve the second focus



Interactions III – Comparative

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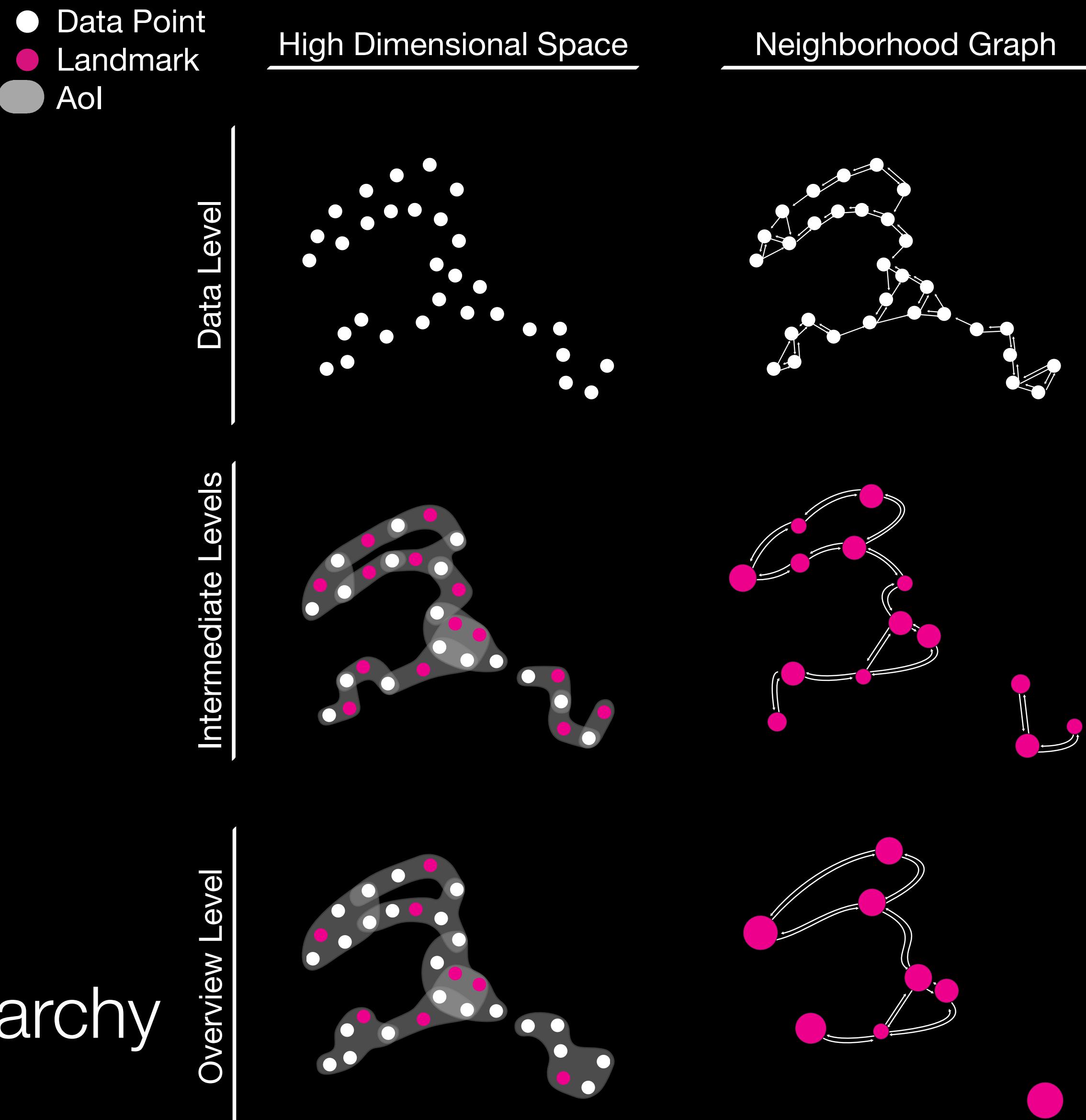
I9 resolve the second focus



Multi-Level Similarity Matrices

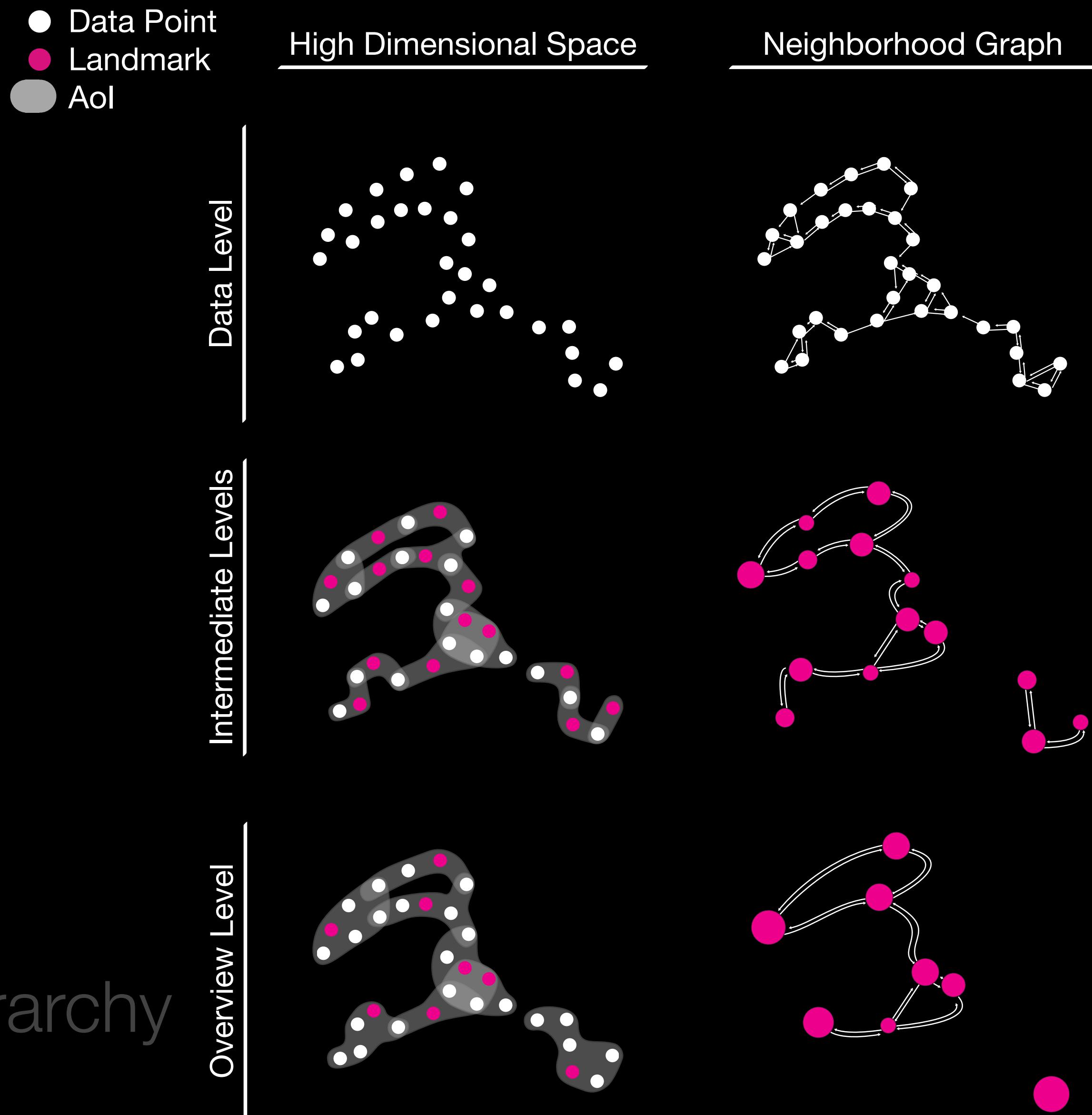
Background: HSNE-Hierarchy

- Landmarks represent data points
- Landmarks selected based on local connectivity in neighborhood graph
- Data points represented by Landmark define Area of Influence (Aol)
- Similarity (above data level) defined by degree of overlap Aol
- Retains non-linearity throughout the hierarchy



Background: HSNE-Hierarchy

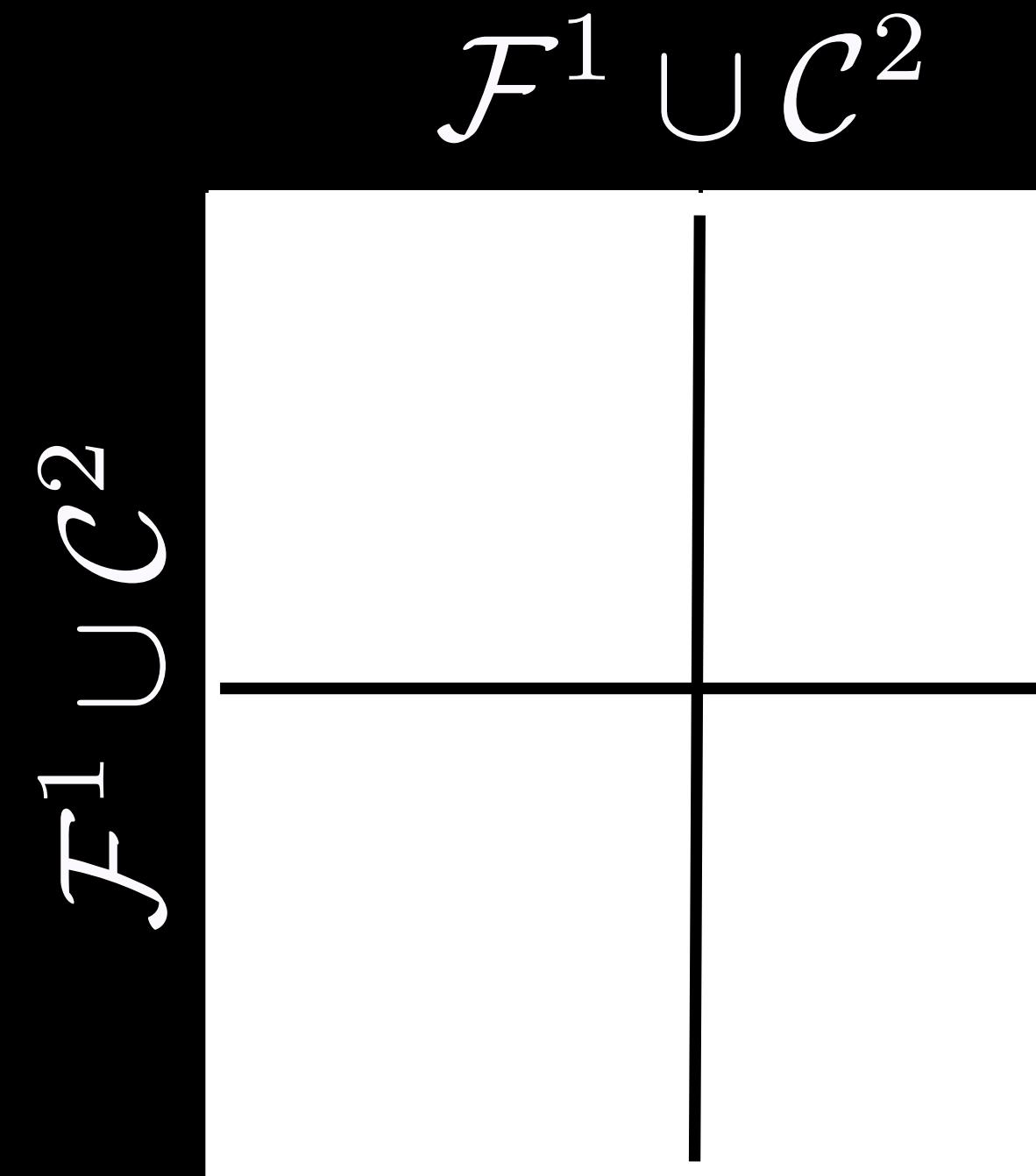
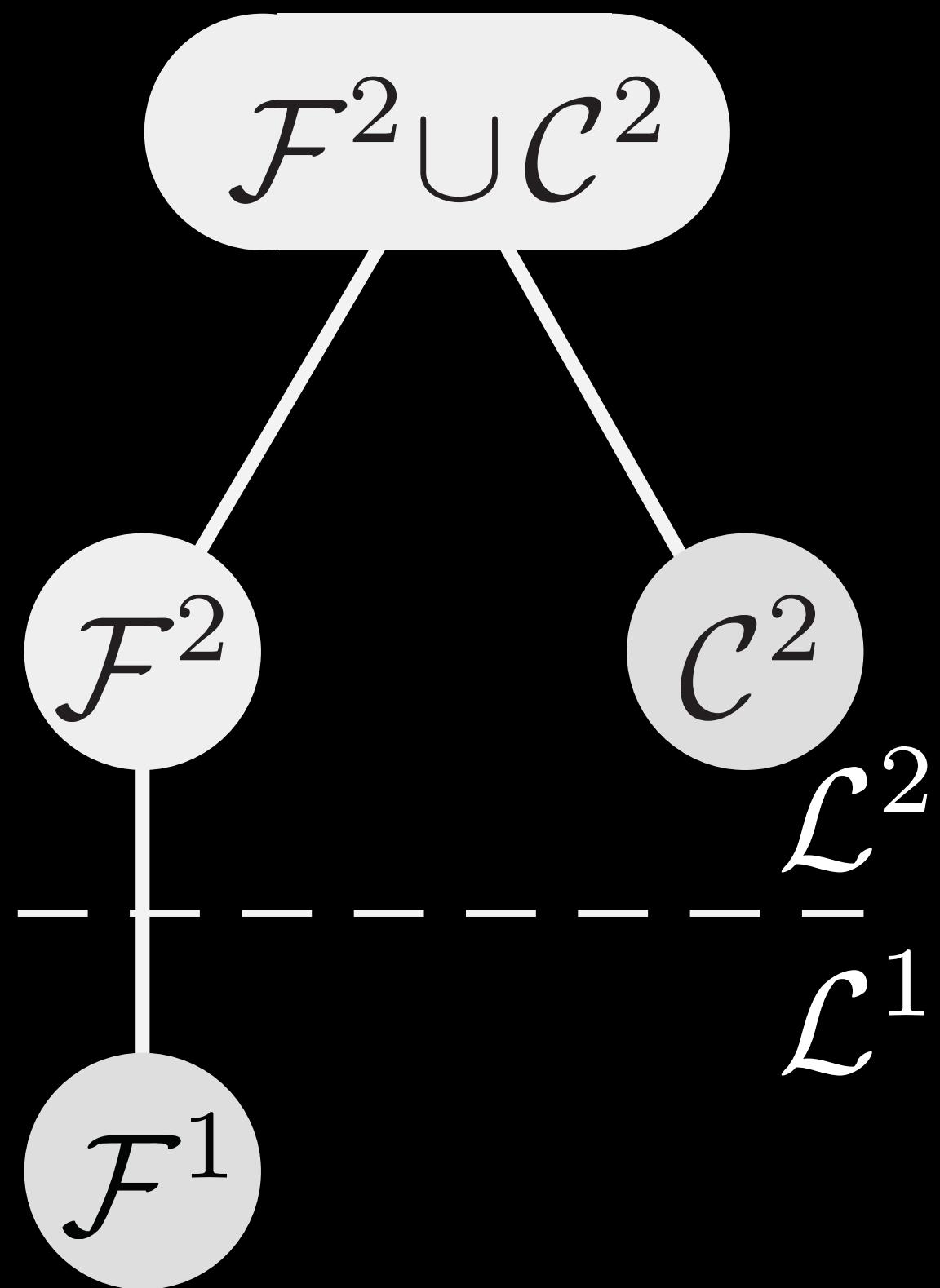
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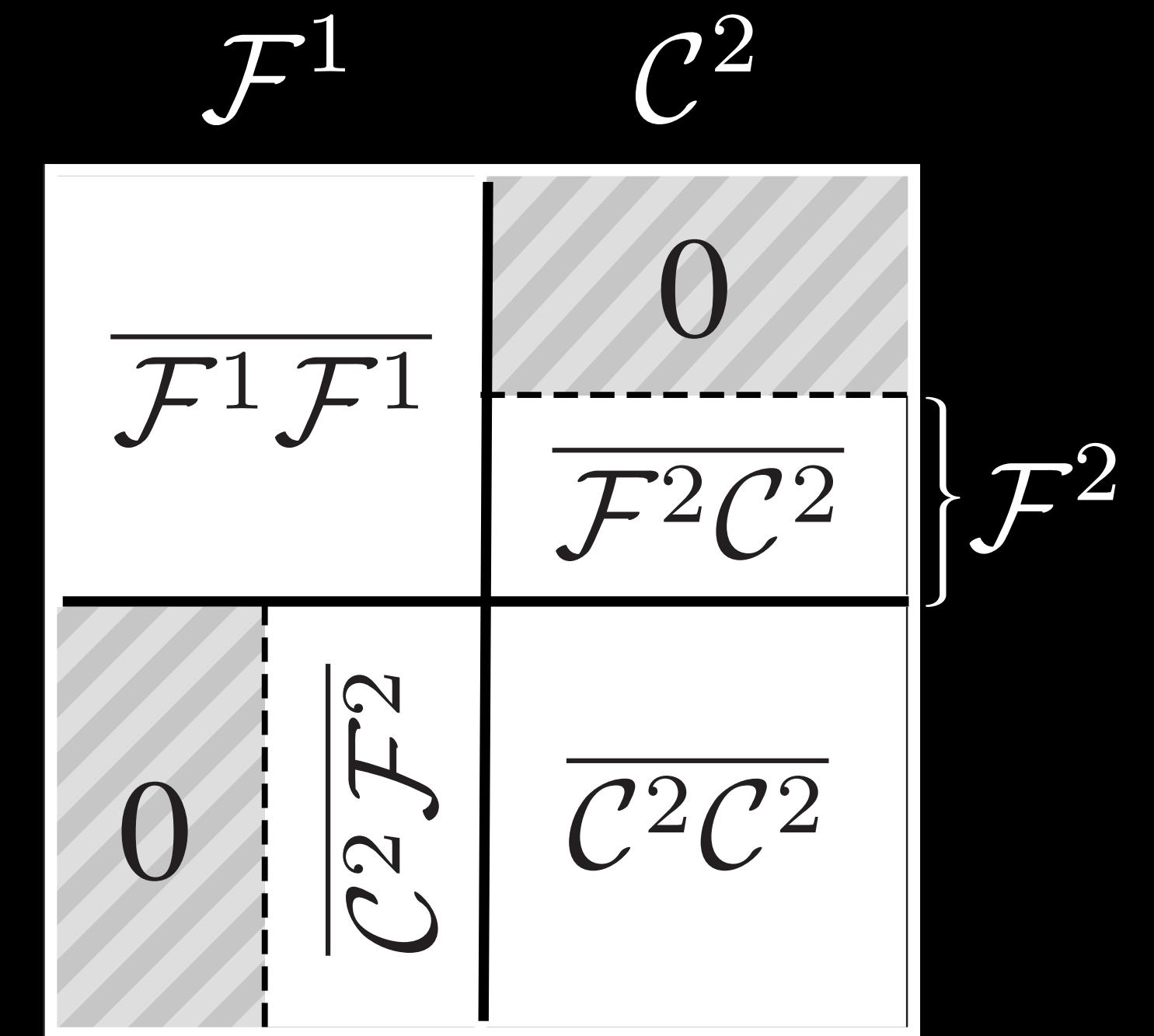
Multi-Level Similarity Matrices

- Similarities in HSNE are based on previous levels
 - No distances between points from different levels
 - One similarity matrix per-level
- Combine distance matrices from multiple levels

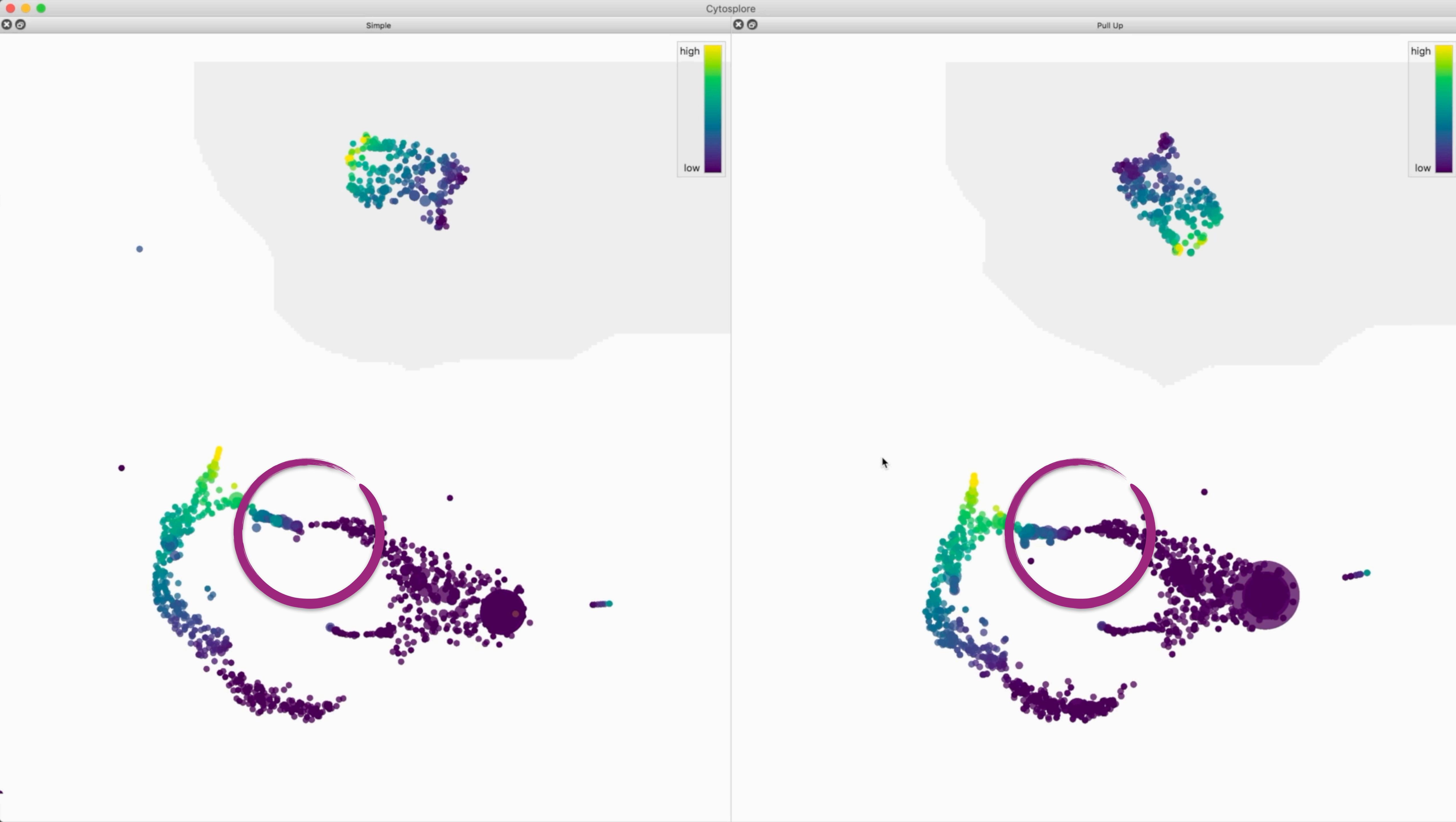
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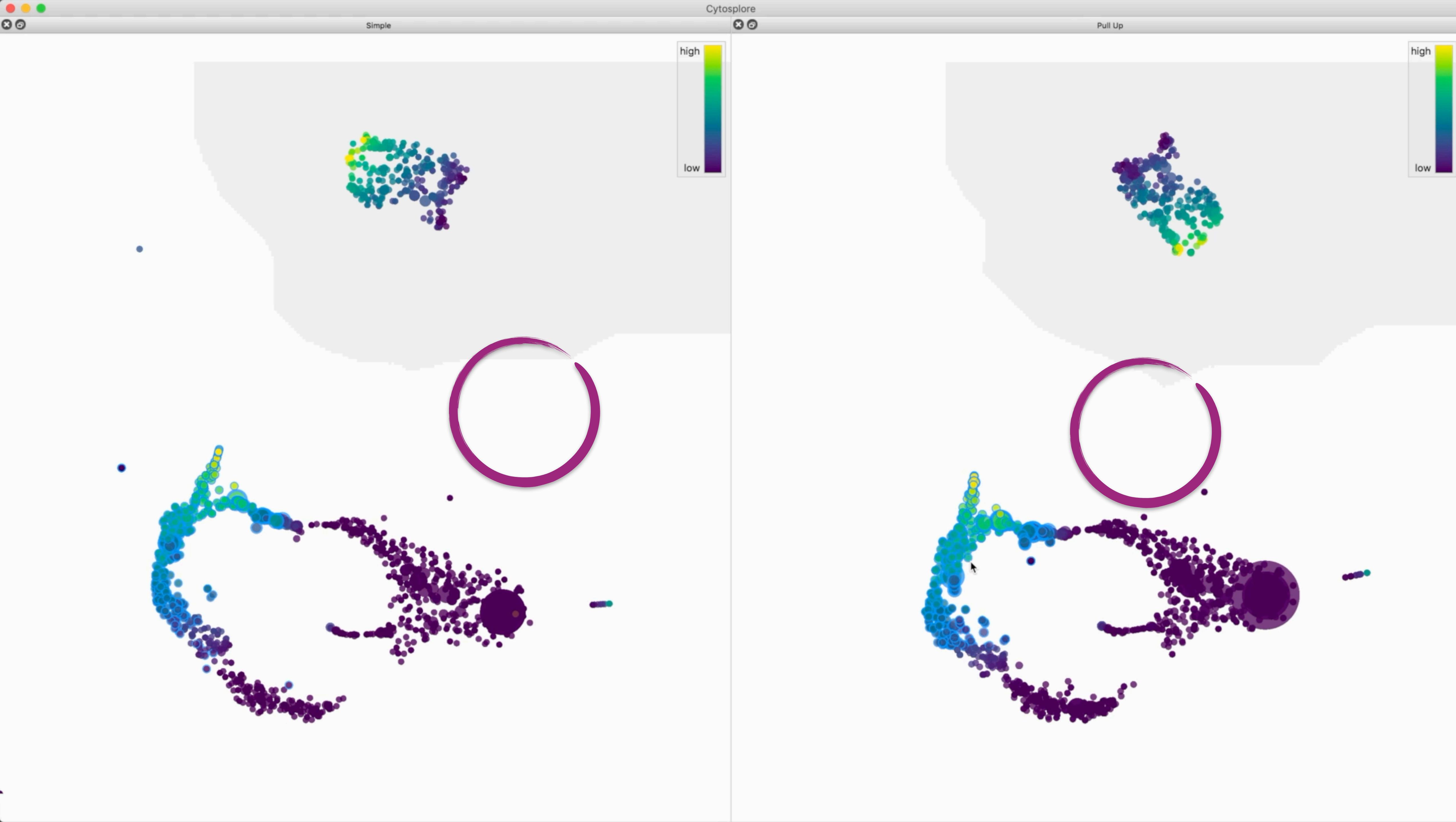


Simple



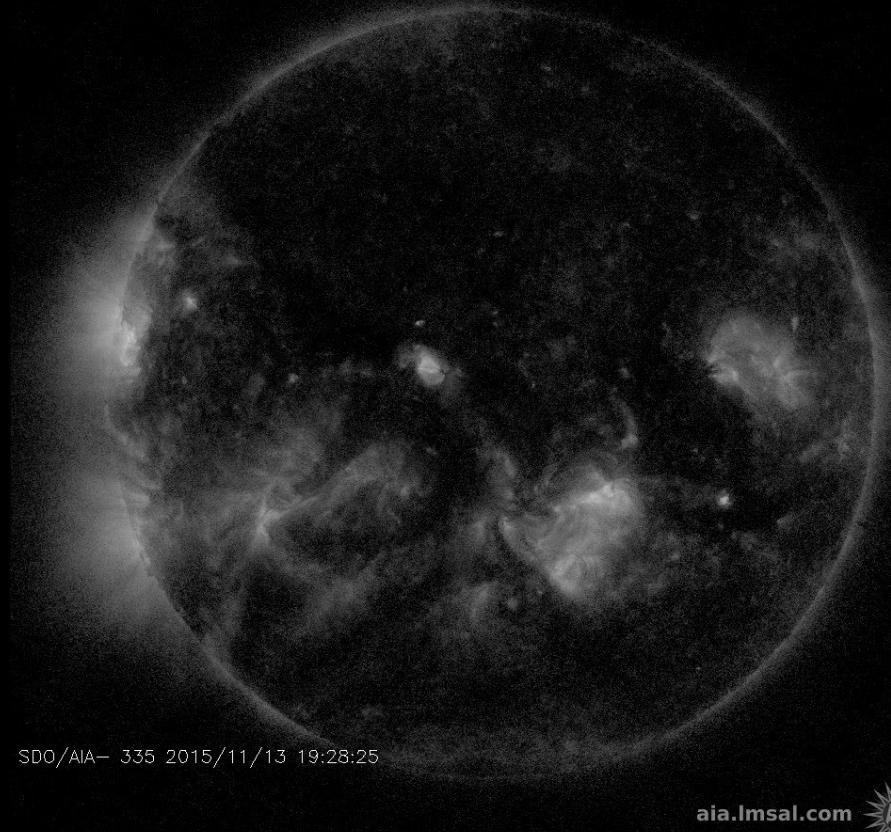
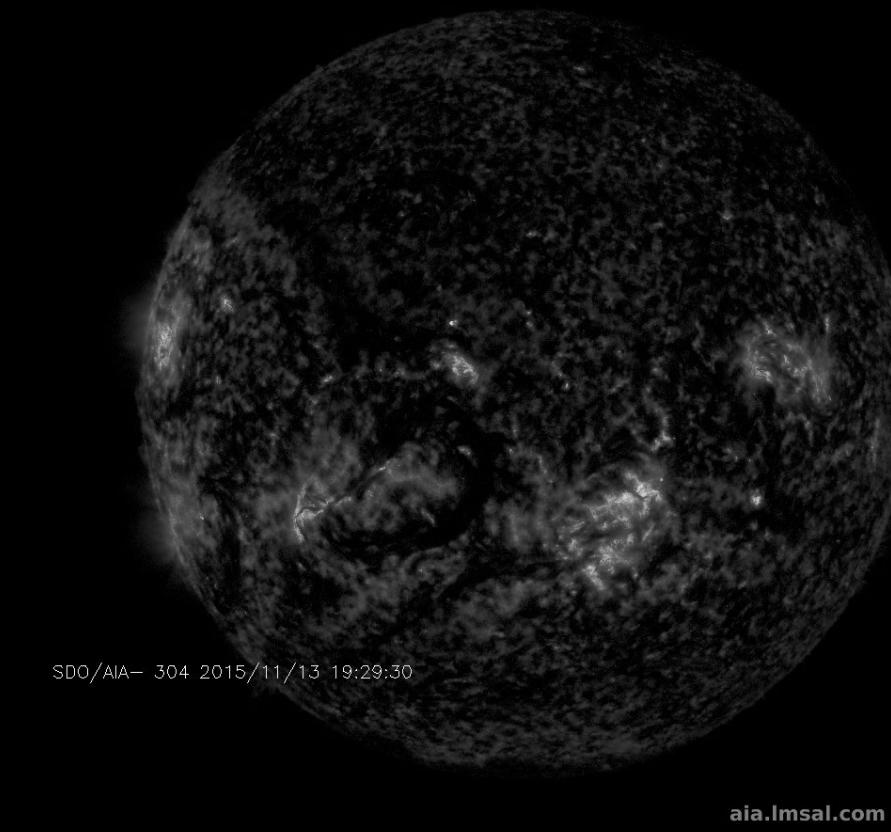
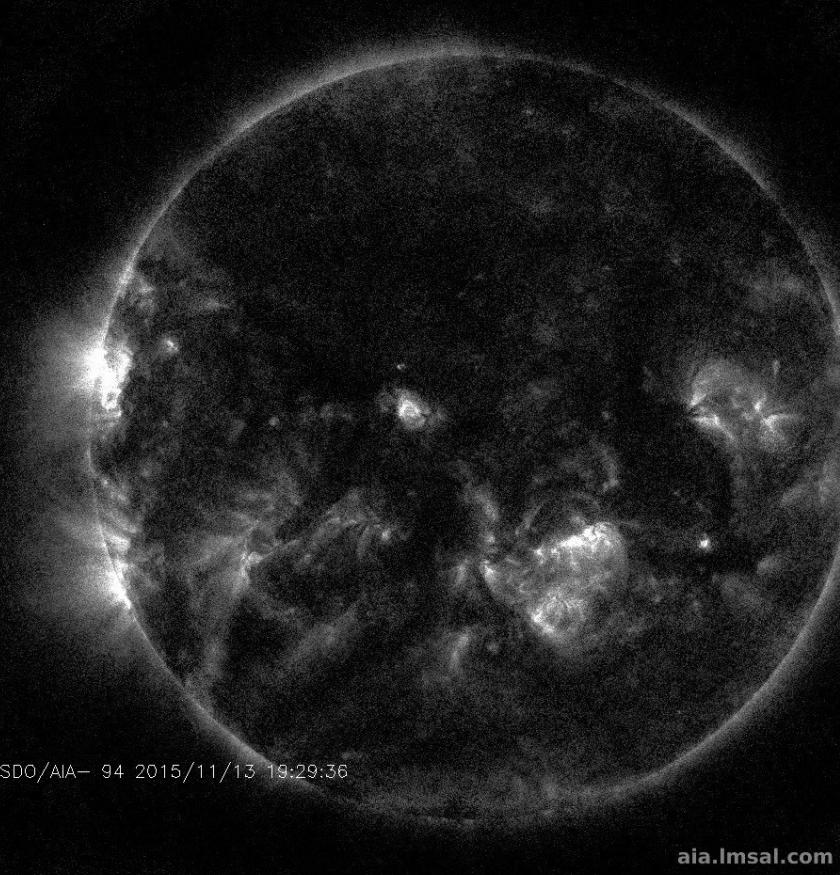
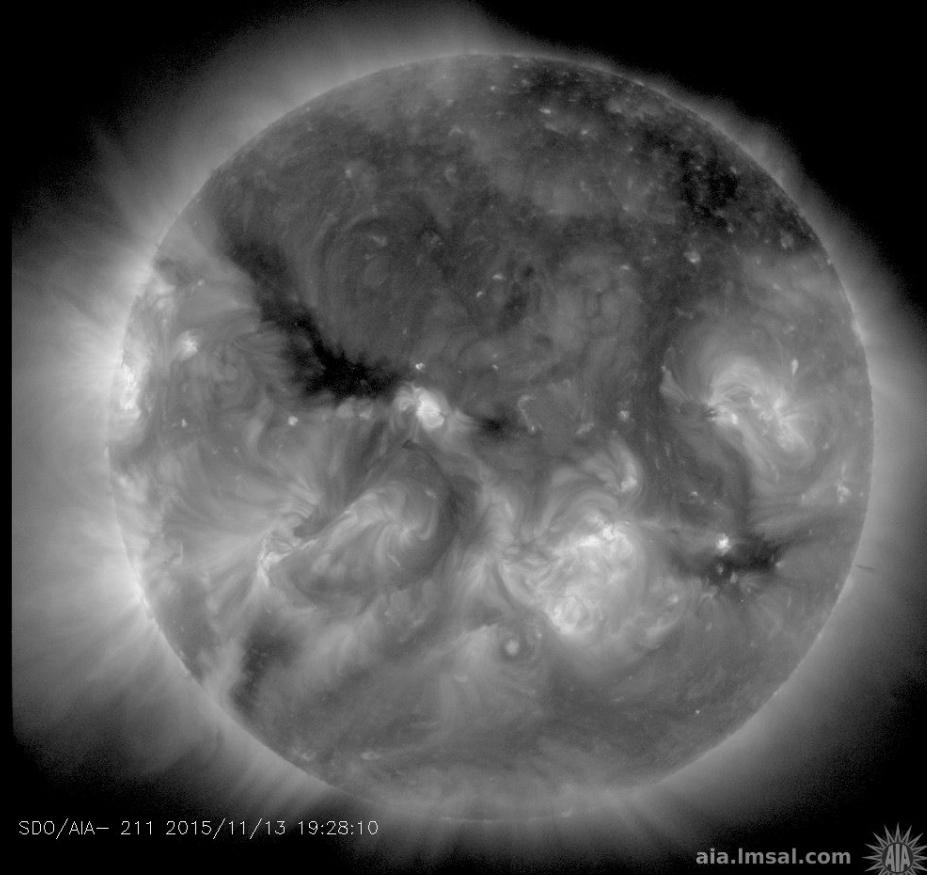
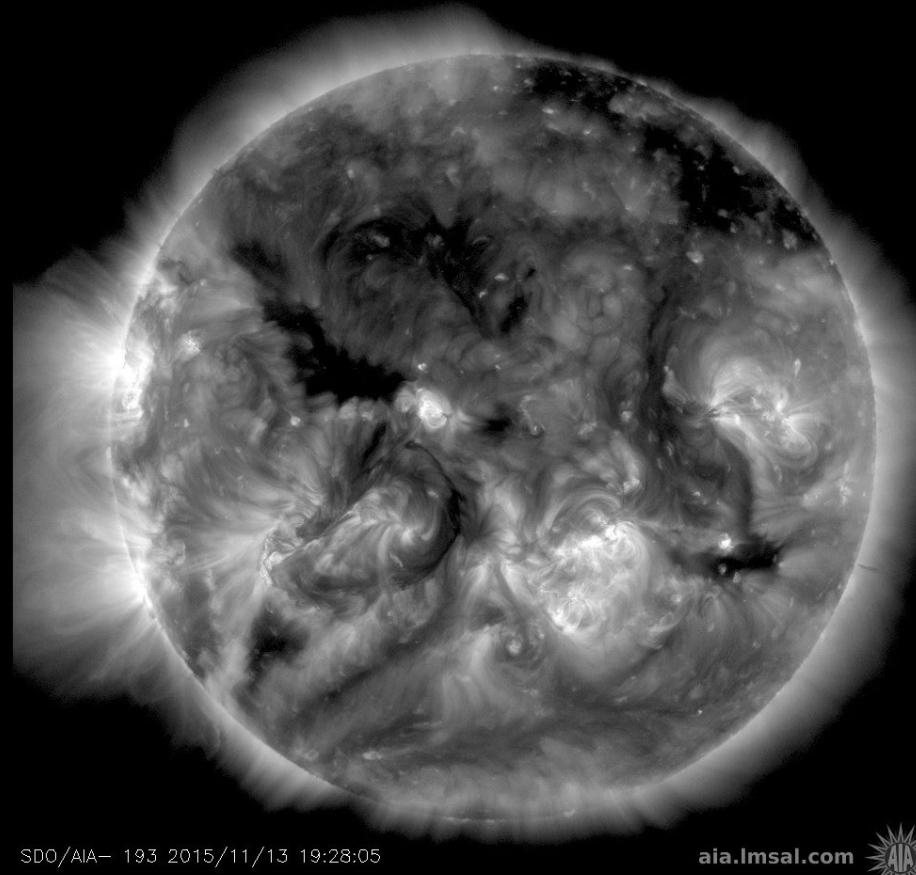
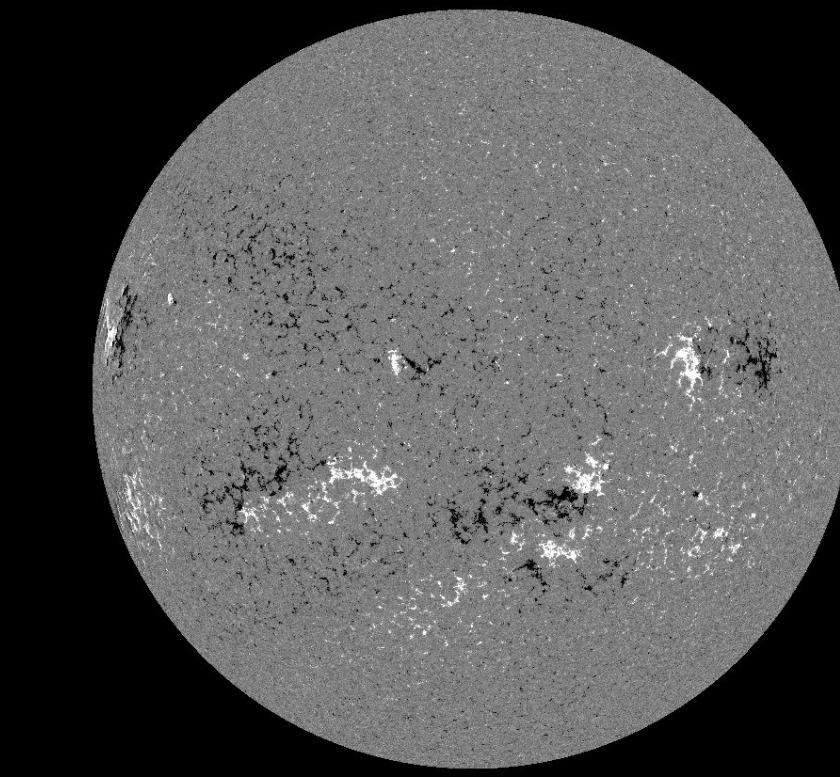
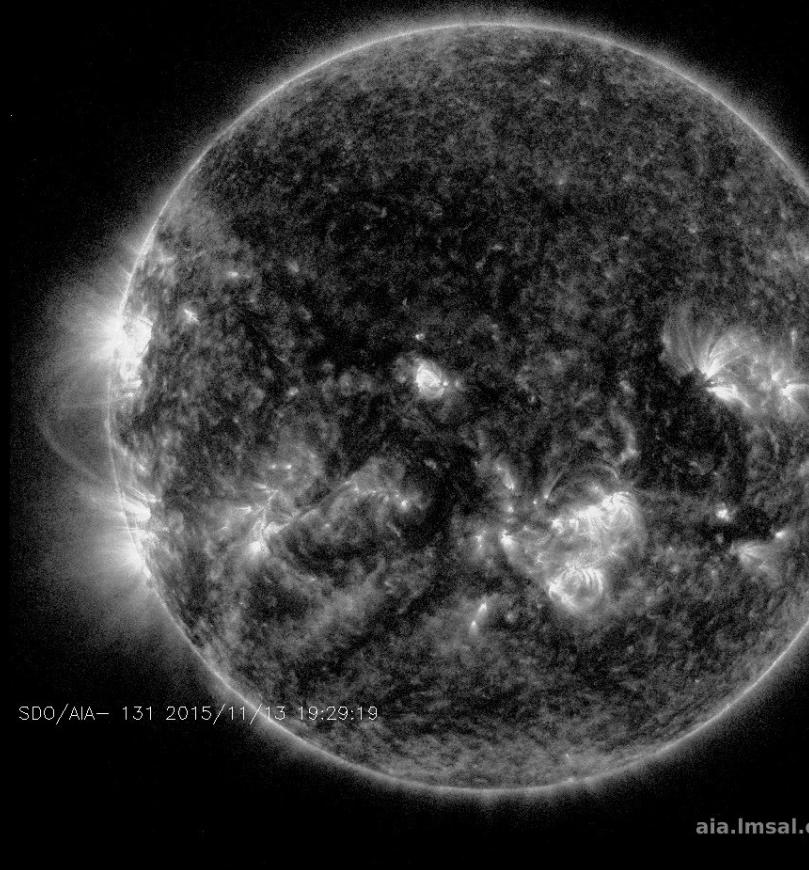
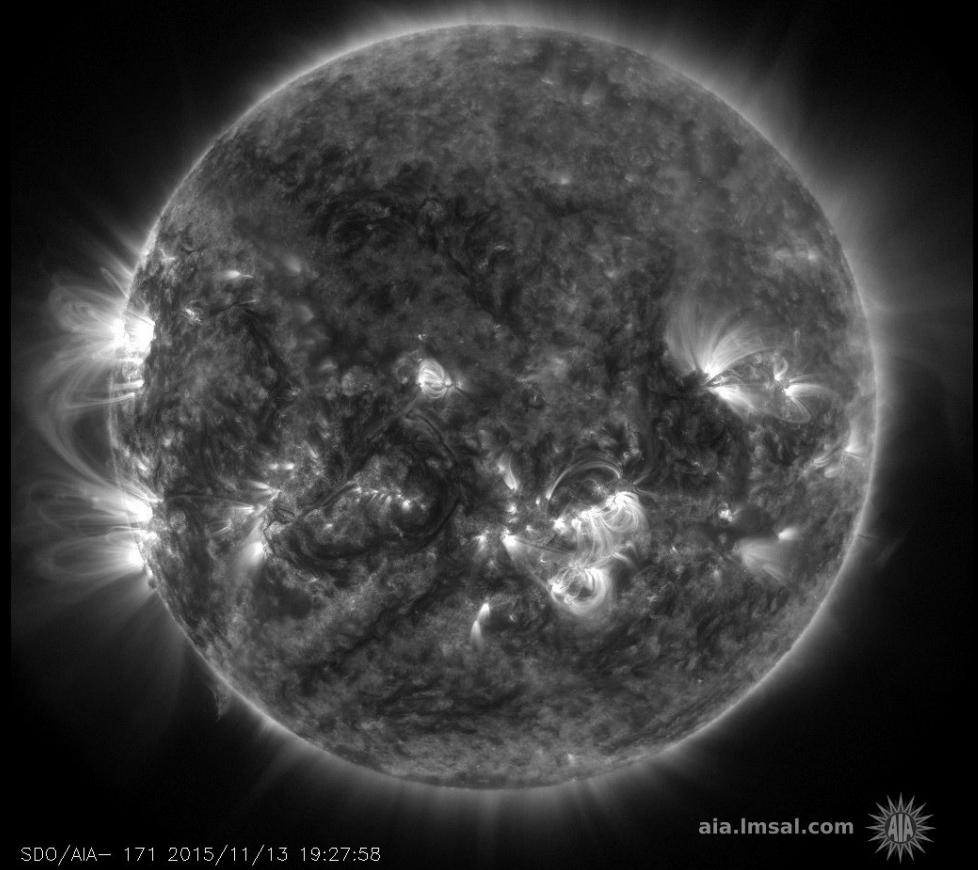
Pull-Up

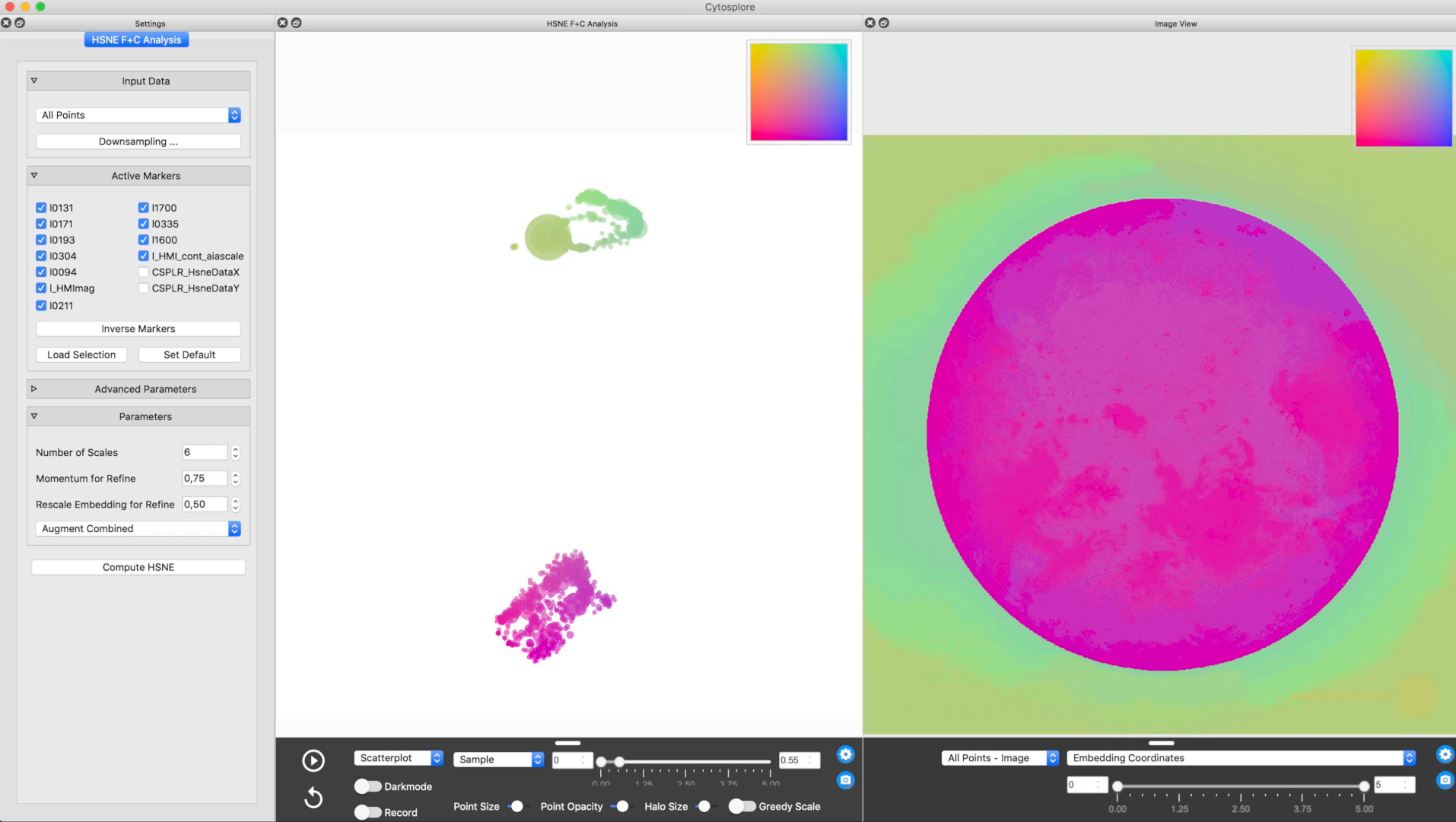


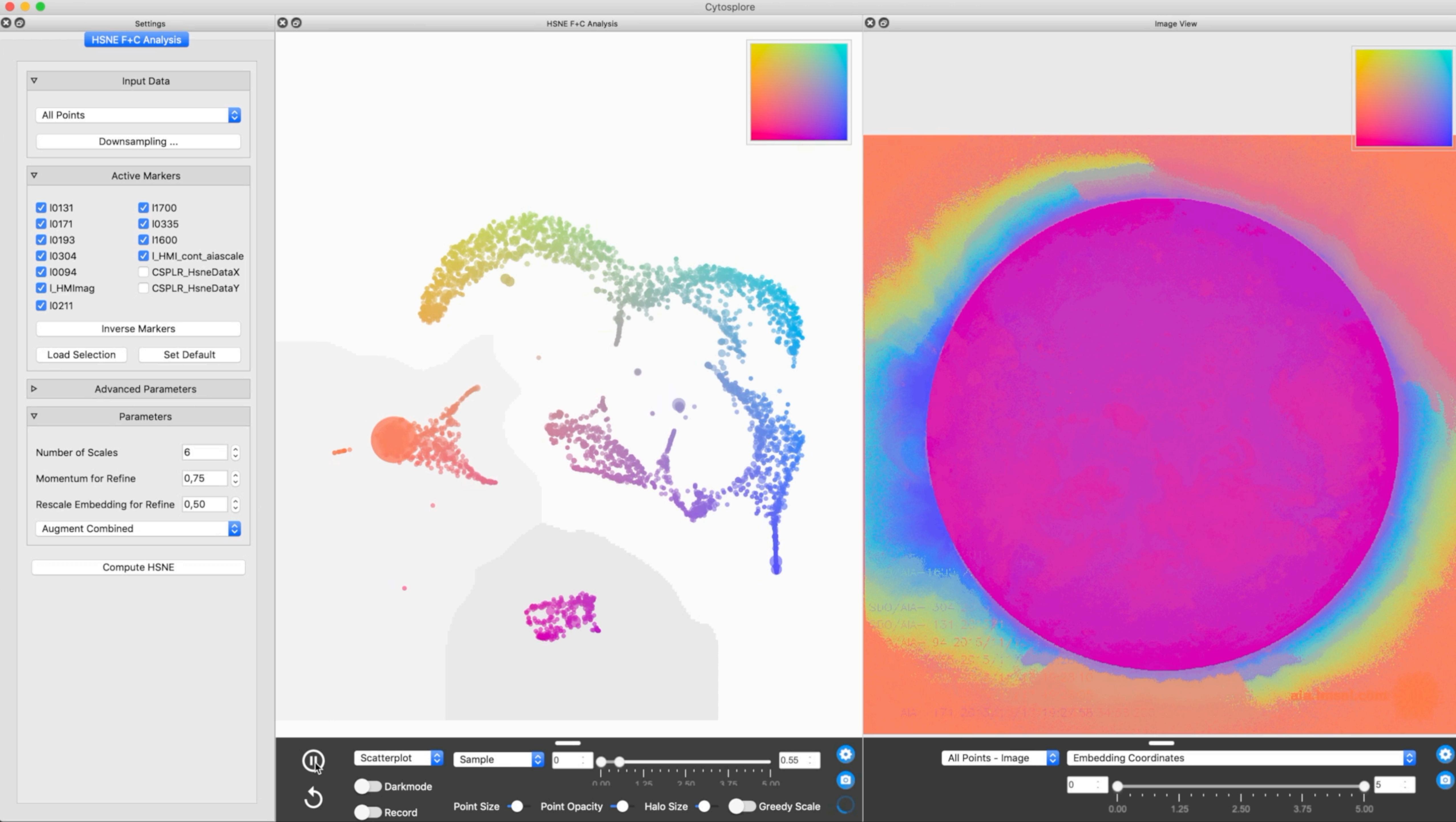


Results

Hyperspectral Imaging



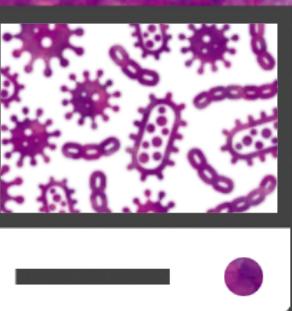




**Contact me for an open PhD
position in this project**

t.hoellt@lumc.nl

<https://www.lcbc.nl>



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Computational Biology Center

