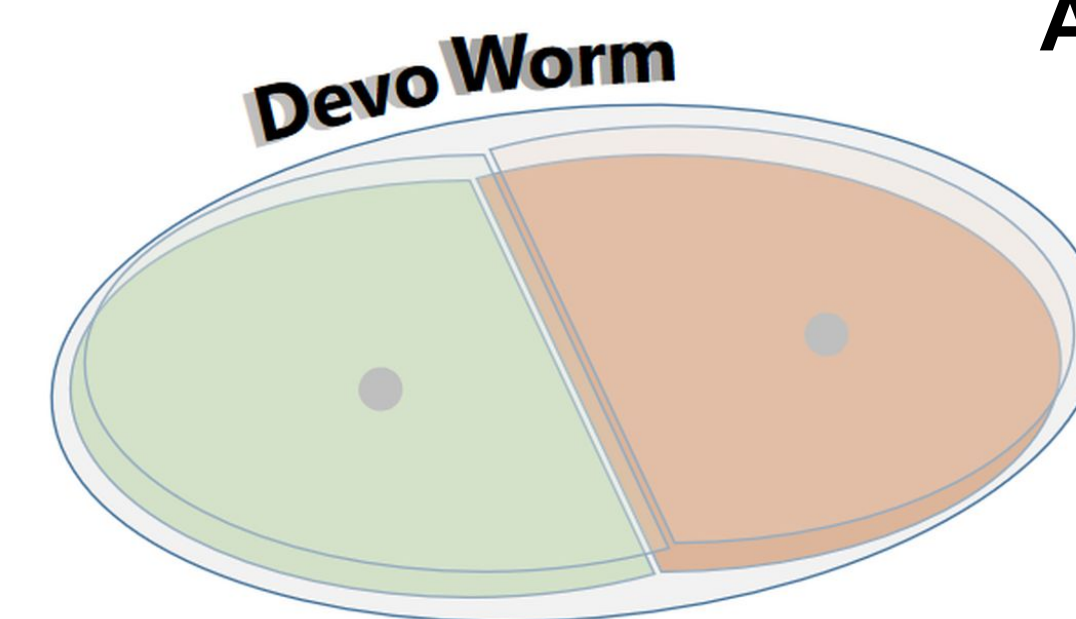


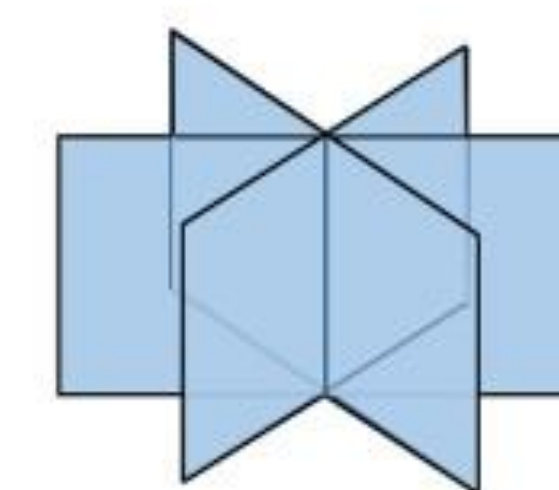
Mathematics of DevoWorm

Bradly Alicea and the DevoWorm Group

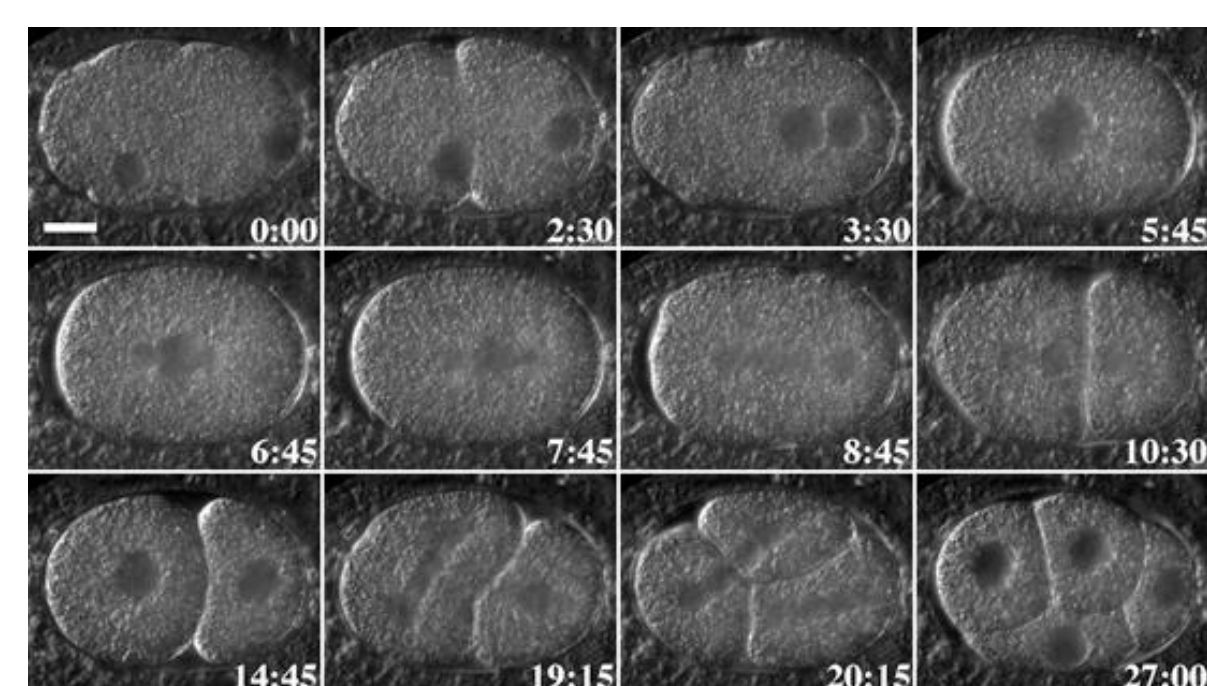
Participatory, Open Source Computational Developmental Biology



Affiliated with

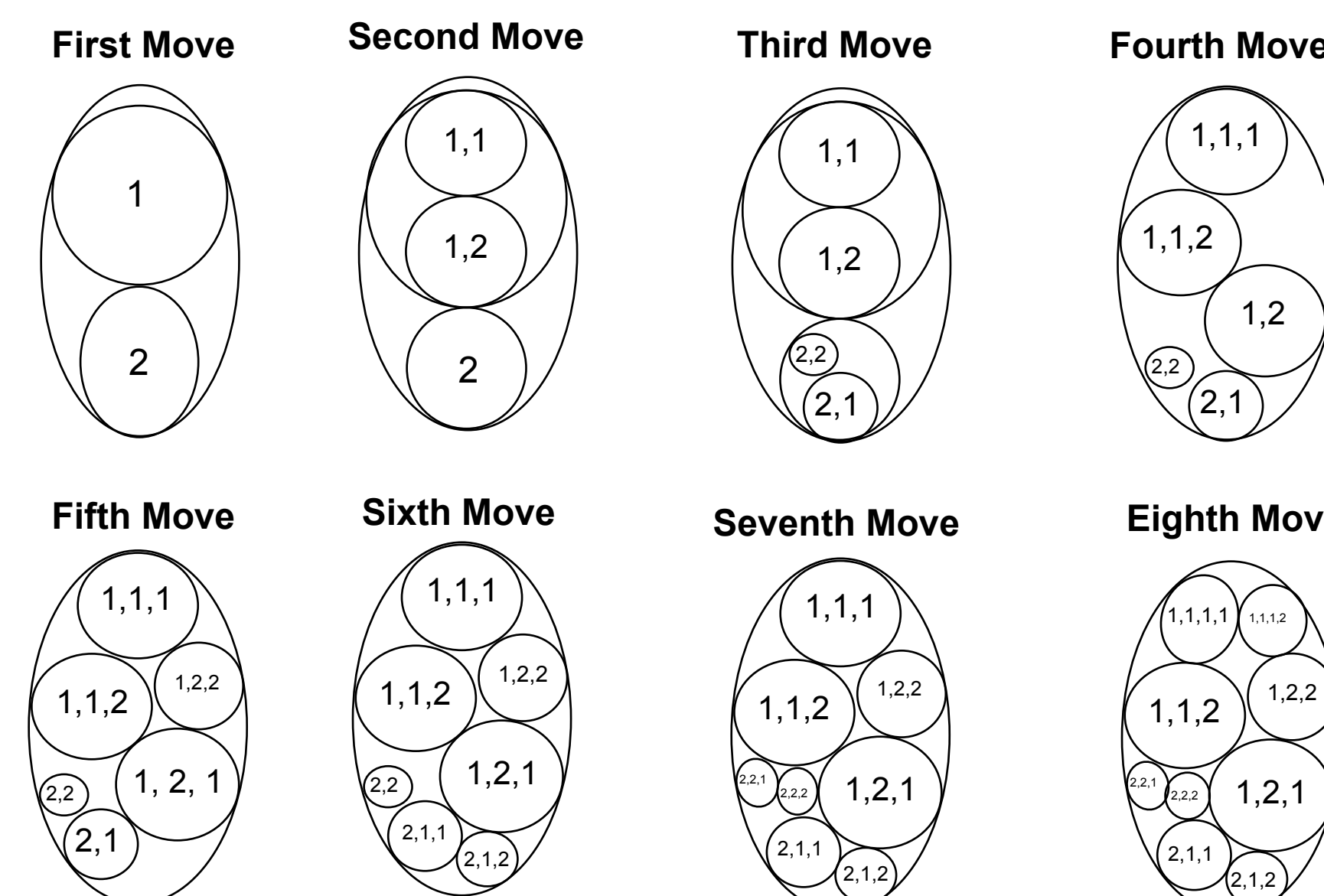


<https://devoworm.weebly.com/publications.html>



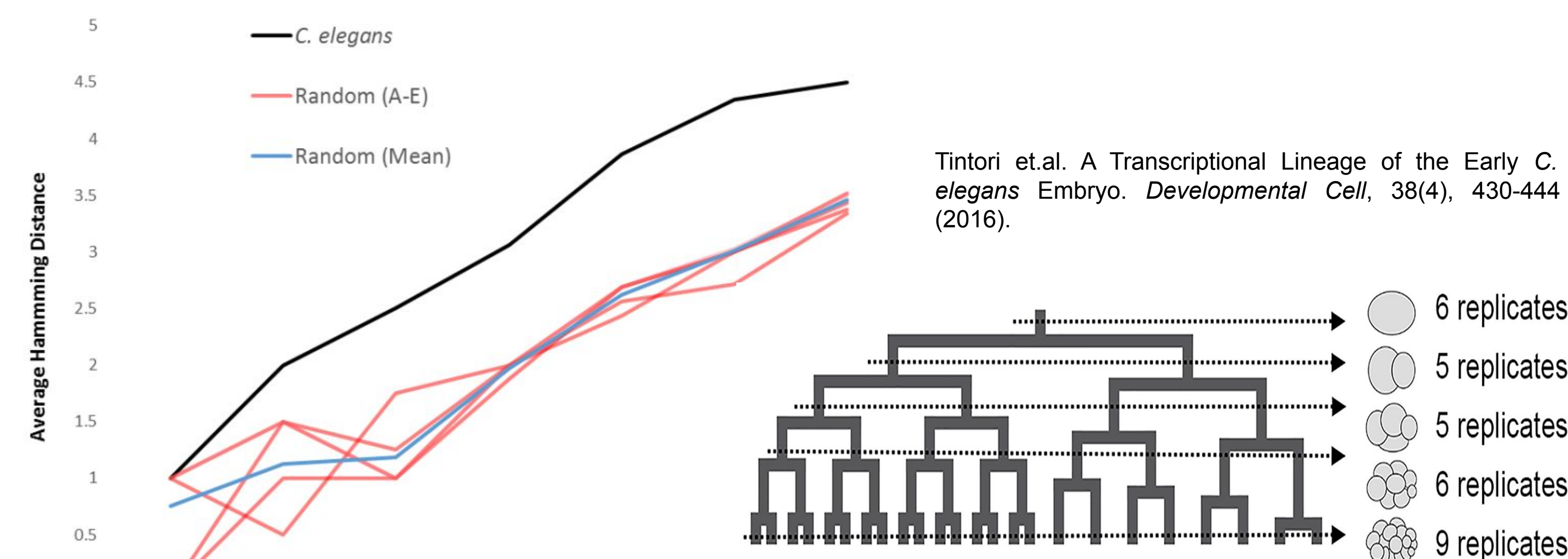
Verbrugghe and Chan, Imaging *C. elegans* Embryos using an Epifluorescent Microscope and Open Source Software. *JoVE*, doi:10.3791/2625 (2011).

How do we capture the multitude of interactions and state changes (cell identity) that occur across embryogenesis?
Discrete Dynamical and Categorical Models

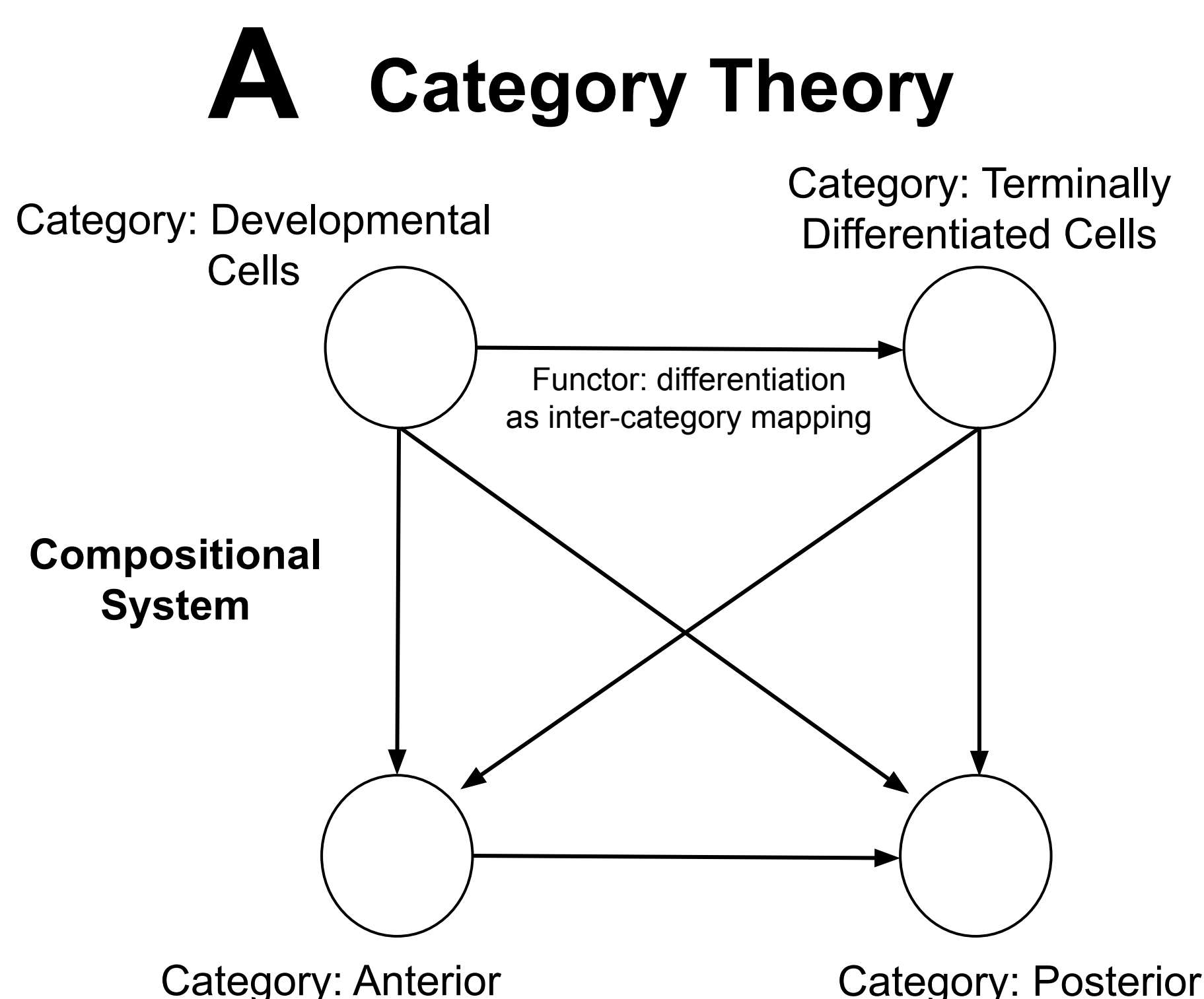
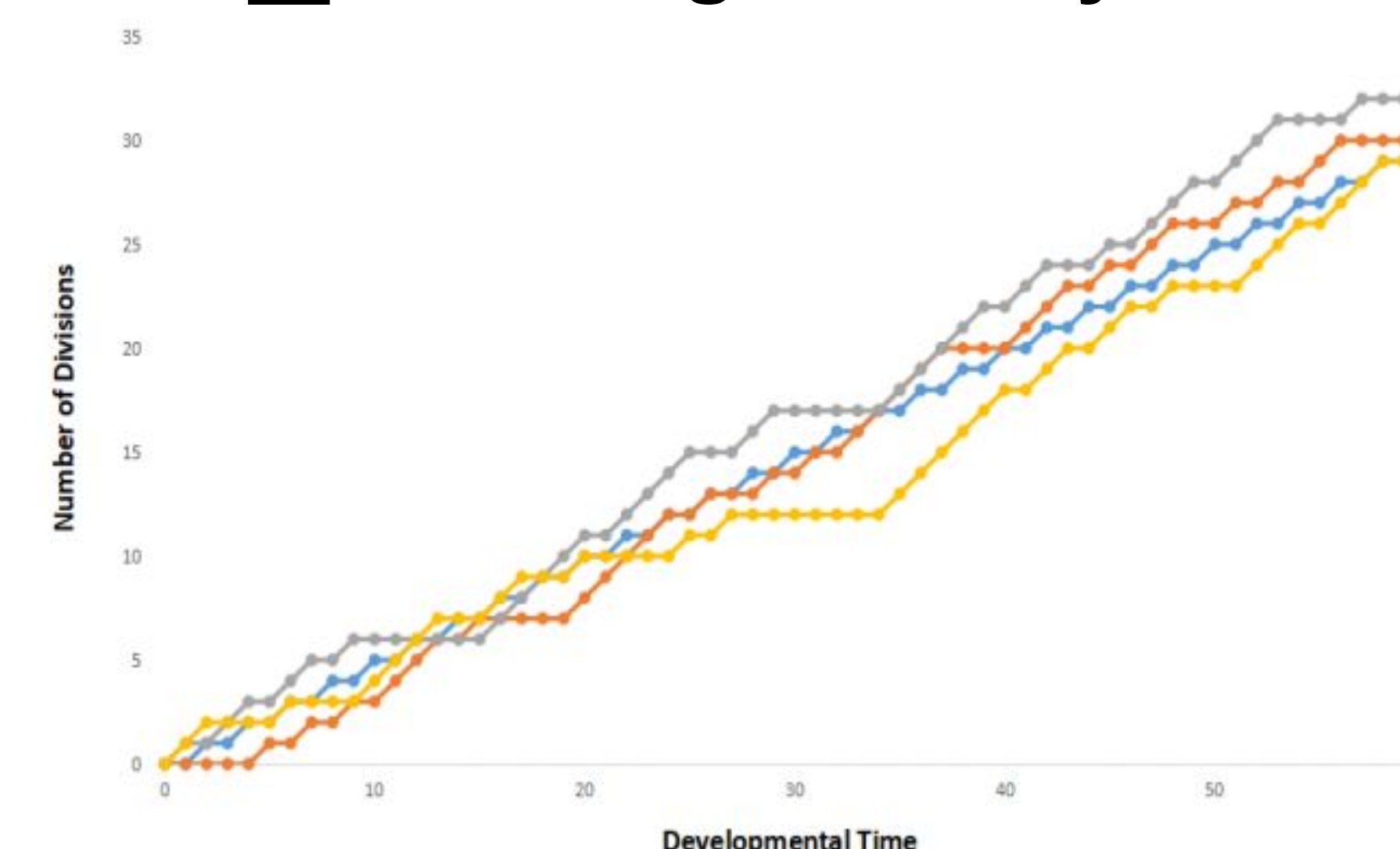


B Developmental Game Theory

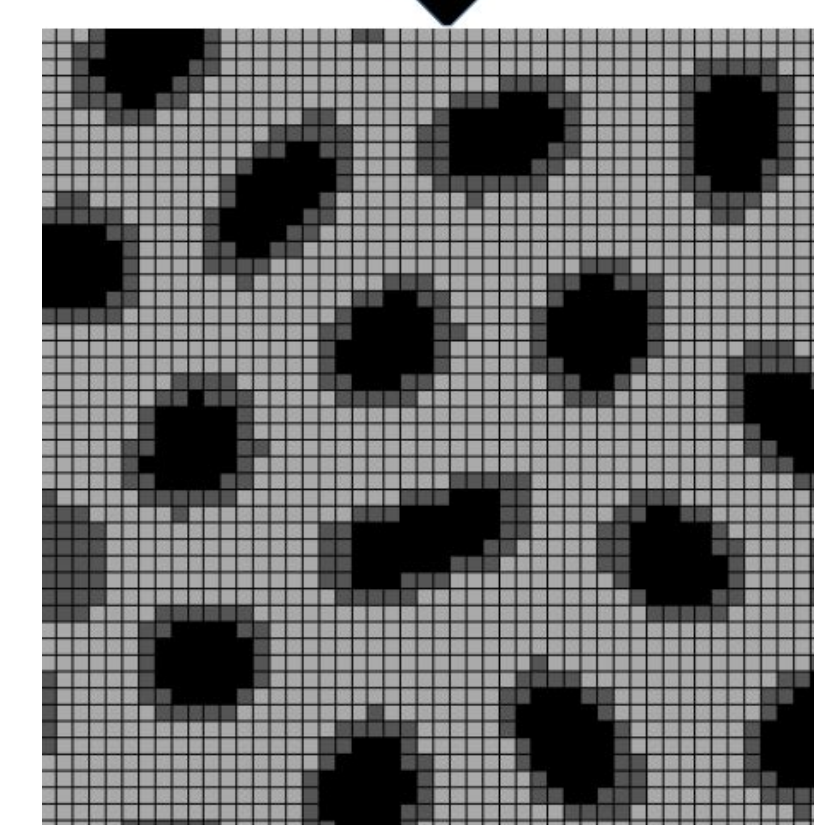
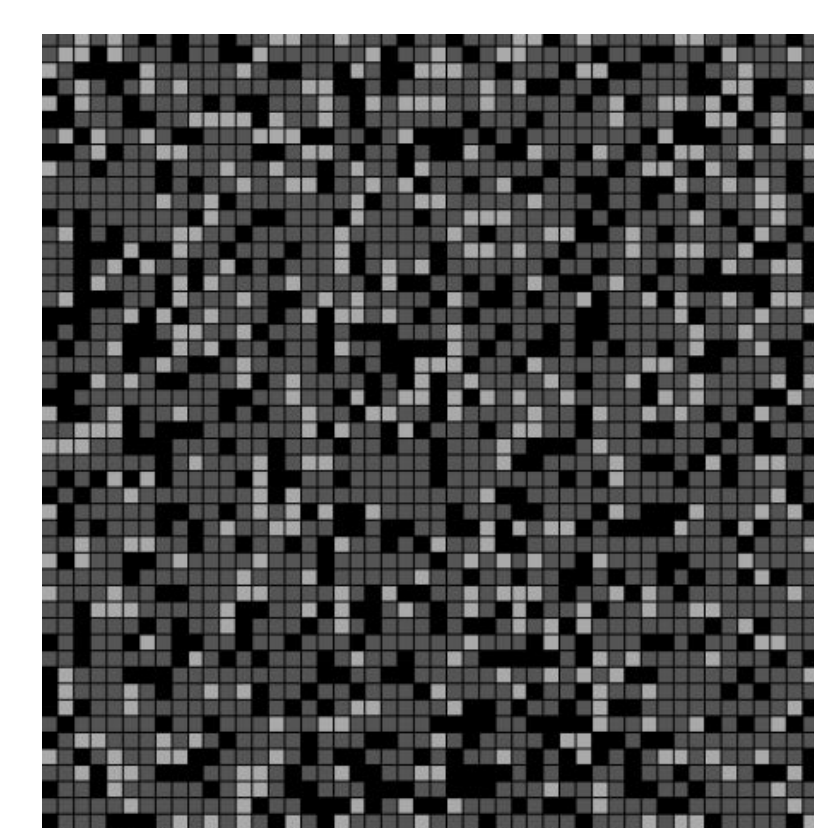
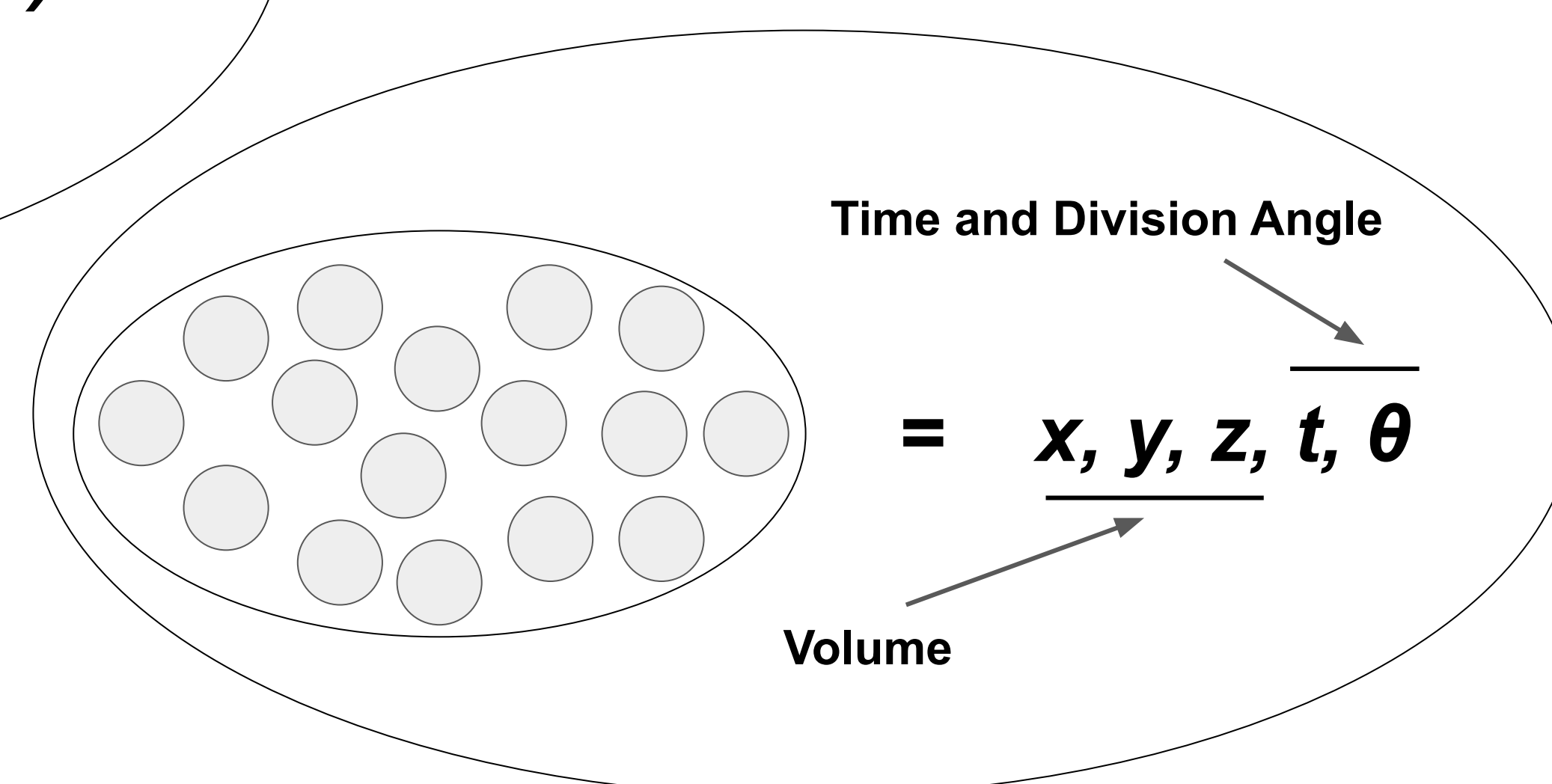
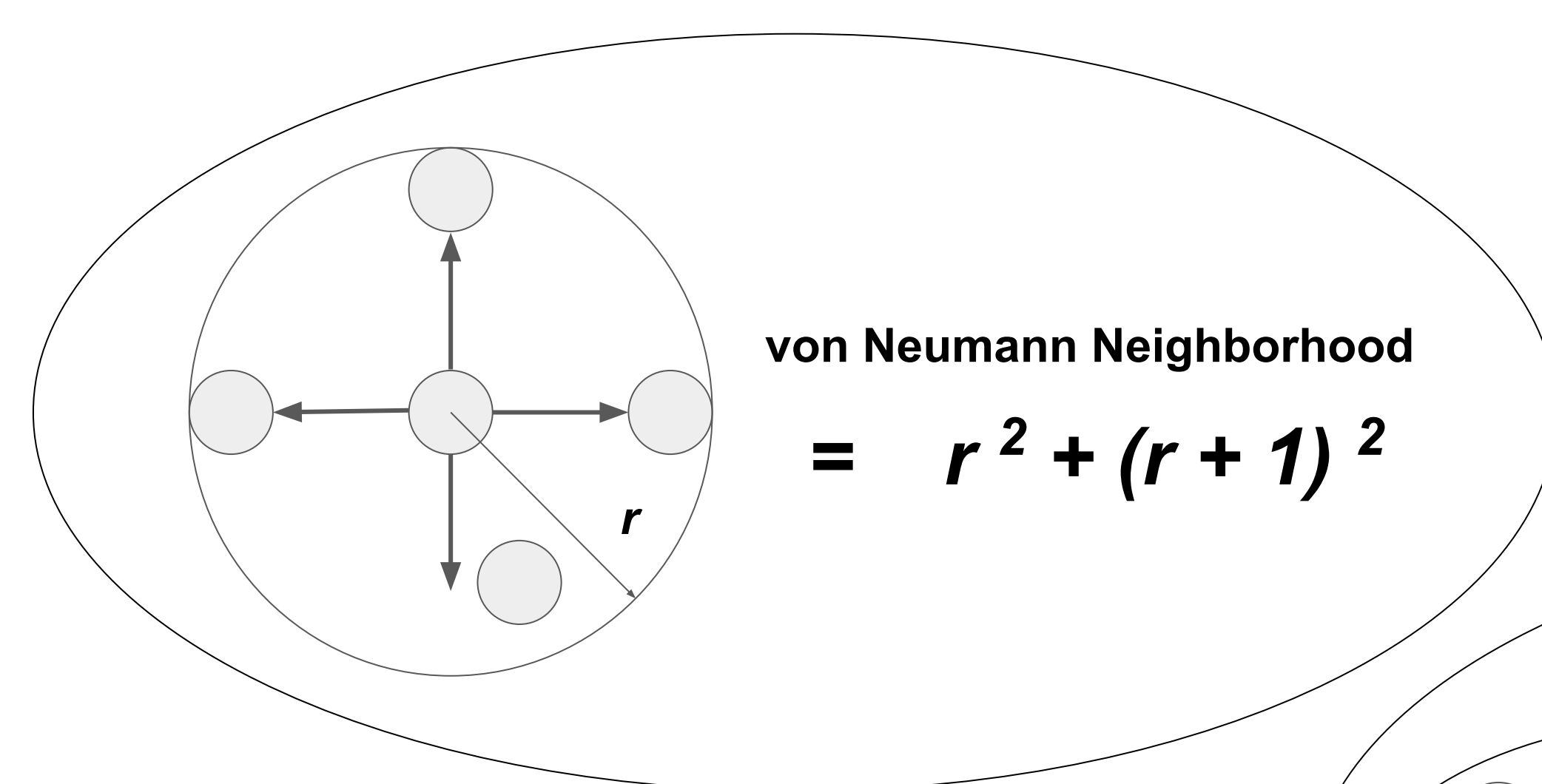
How do we capture pattern formation and cell migration dynamics as a computational process?
Cellular Automata and Spatial Data Structures



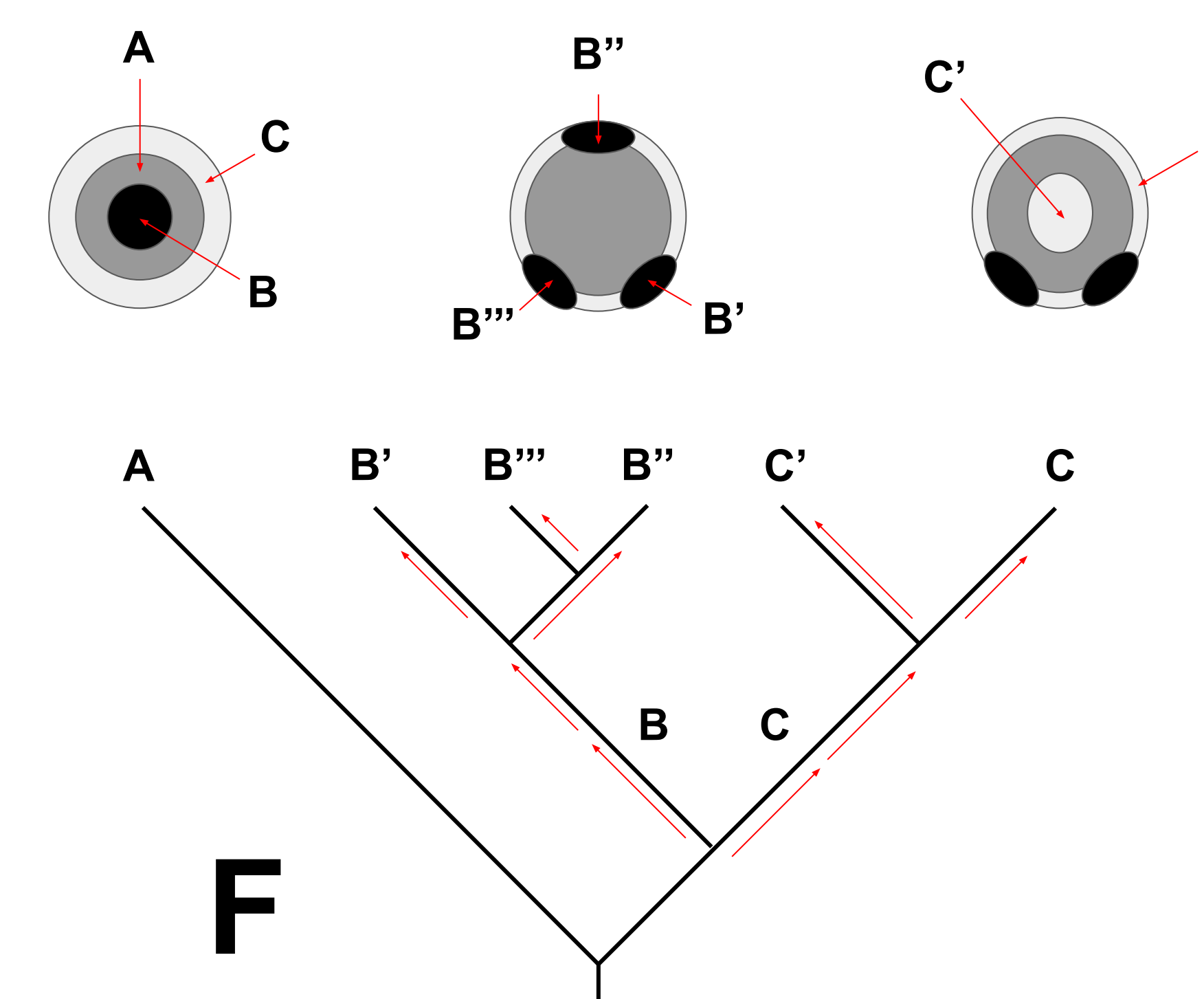
E Lineage Tree Dynamics



C Spatial Complexity and Self-Organization

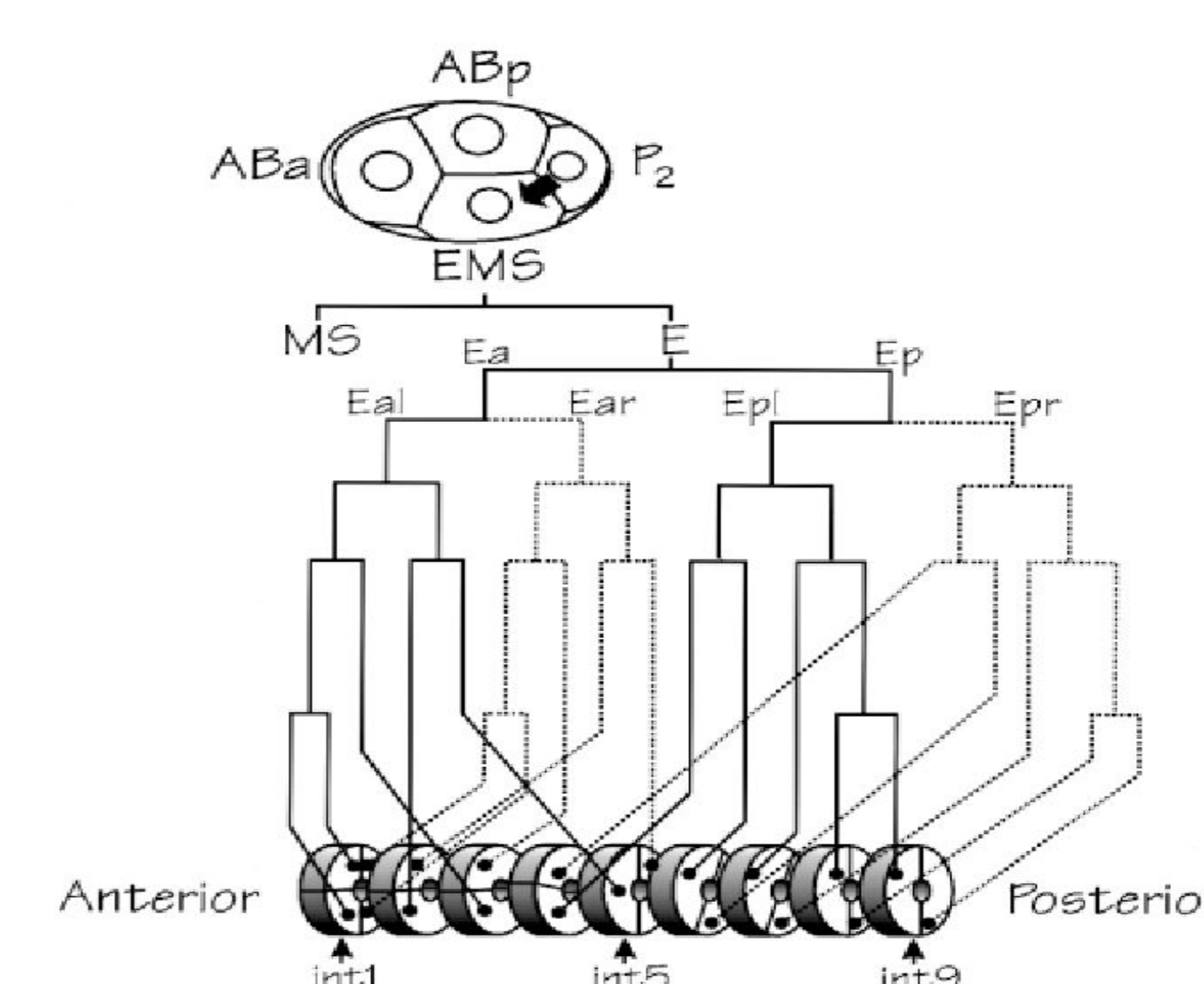


How do we characterize the rate, recombination, and conservation of growth and form?
Lineage and Differentiation Tree Modeling



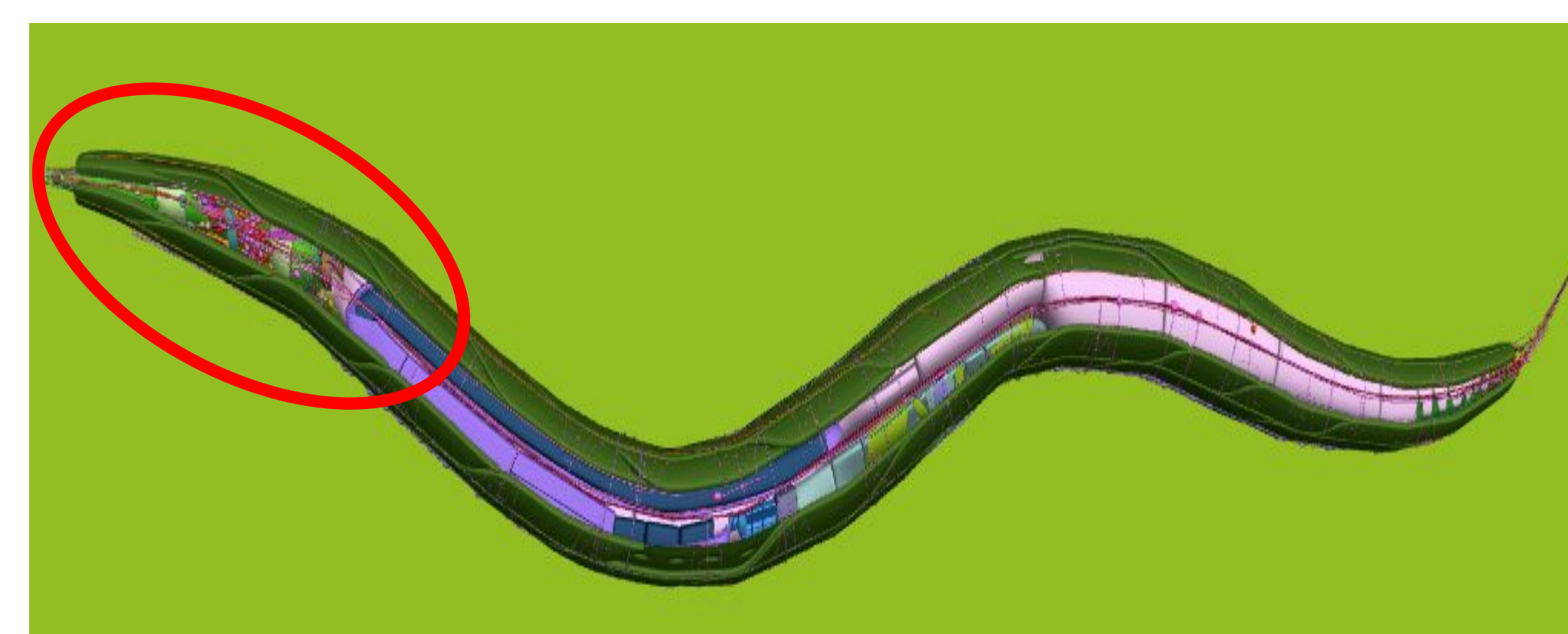
D Differentiation Tree and Computational Development

Schroeder and McGhee. Anterior-posterior patterning within the *Caenorhabditis elegans* endoderm. *Development*, 125(24), 4877-4887 (1999).



D Developmental Function

How do we characterize the organization of developmental cells, expanding morphological structures, and emerging connectomes?
Neural Networks, Complex Networks, and Trees



A Alicea, B., Gordon, R., and Portegys, T.E. (2021). Data- theoretical Synthesis of the Early Developmental Process. *Neuroinformatics*, doi:10.1007/s12021-020-09508-1.

B Stone, R., Portegys, T., Mikhailovsky, G., and Alicea, B. (2018). Origins of the Embryo: self-organization through cybernetic regulation. *BioSystems*, 173, 73-82.

C Portegys, T., Pascualy, G., Gordon, R., McGrew, S., and Alicea, B. (2016). Morphozoic: cellular automata with nested neighborhoods as a metamorphic representation of morphogenesis. Chapter 3 in "Multi-Agent Based Simulations Applied to Biological and Environmental Systems".

D Alicea, B. (2017). The Emergent Connectome in *Caenorhabditis elegans* Embryogenesis. *BioSystems*, 173, 247-255.

E Alicea, B., Portegys, T.E., and Gordon, R. (2016). Information Isometry Technique Reveals Organizational Features in Developmental Cell Lineages. *bioRxiv*, doi:10.1101/062539