Phylogenies: how and why to track them in artificial life

ALife 2024 Copenhagen, Denmark

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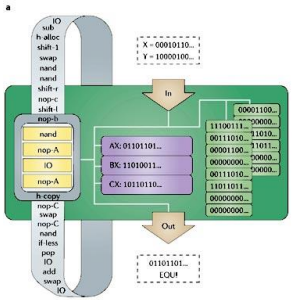
Matthew Andres Moreno
Alexander Lalejini
Jack Garbus

Agenda

1. What is a phylogeny and what can it tell you?
2. Guided phylogeny hackathon
    - Bring your own ALife system or use one of our examples!

Intro: what is a phylogeny?



vertex:
“taxonomic unit”

graphic: Adami, 2006

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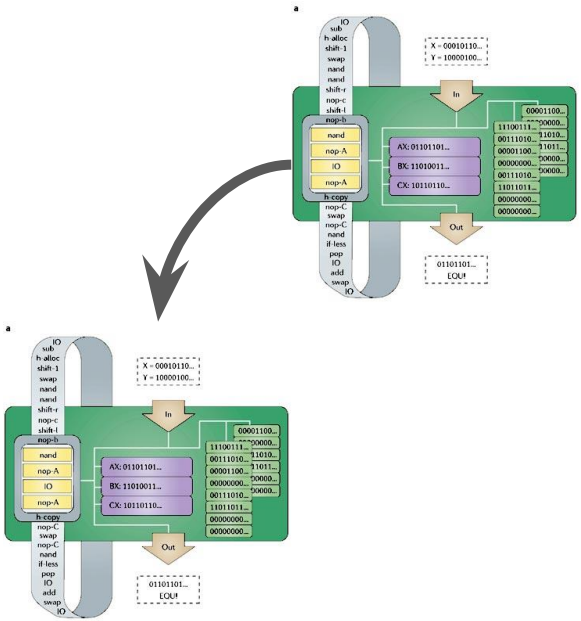

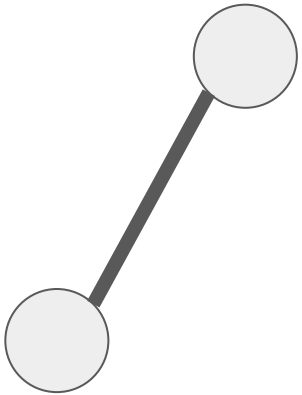

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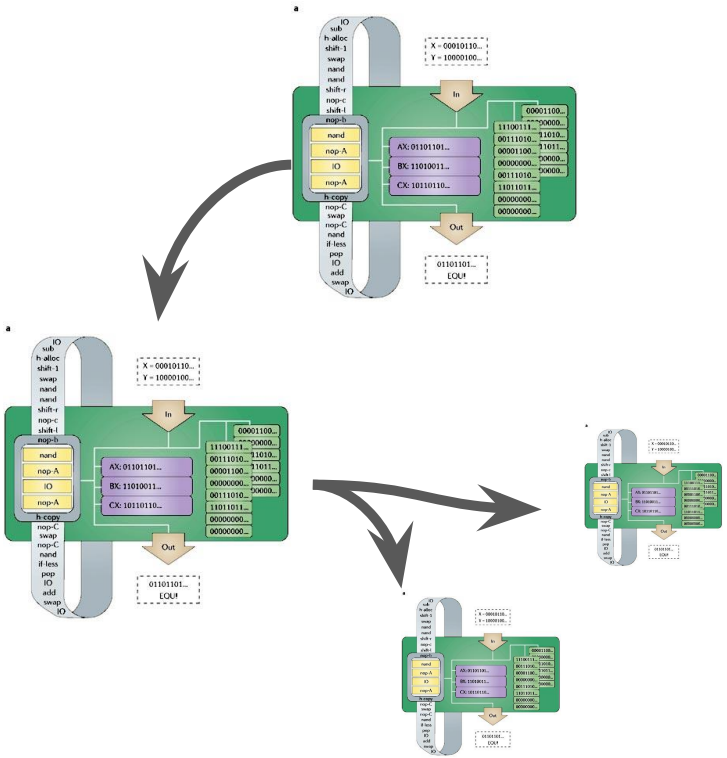

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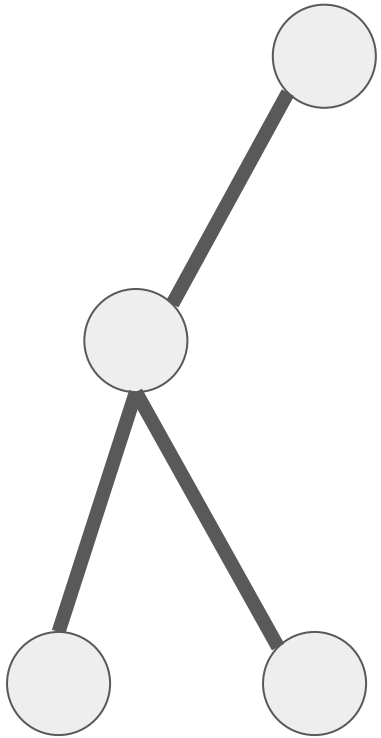

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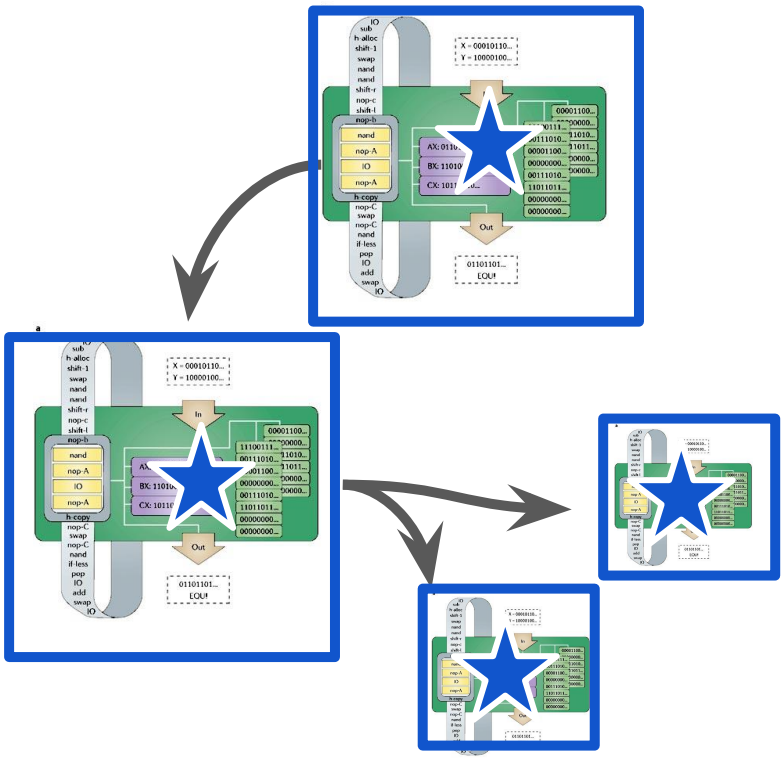

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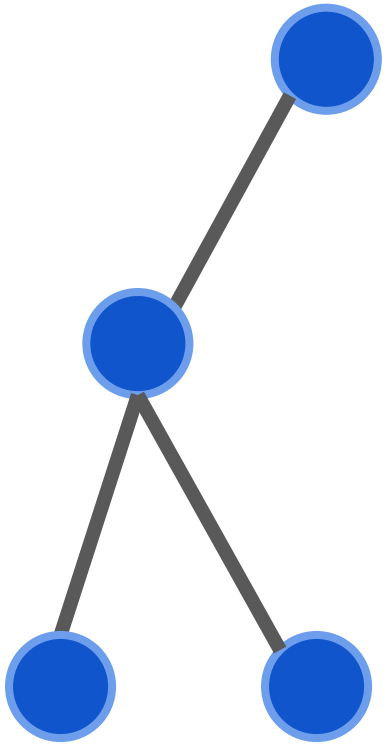

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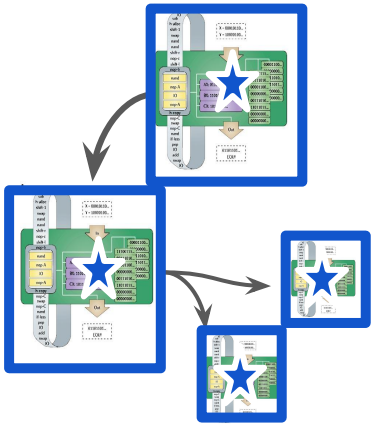

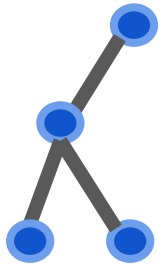

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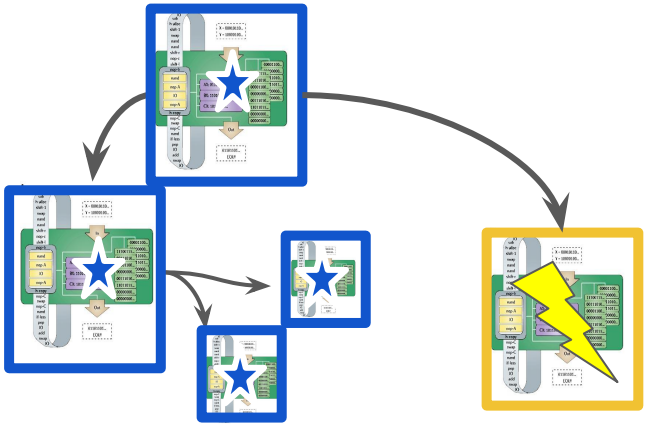

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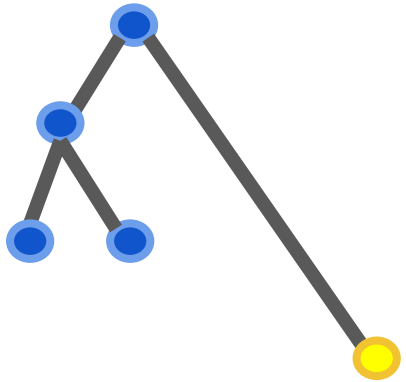

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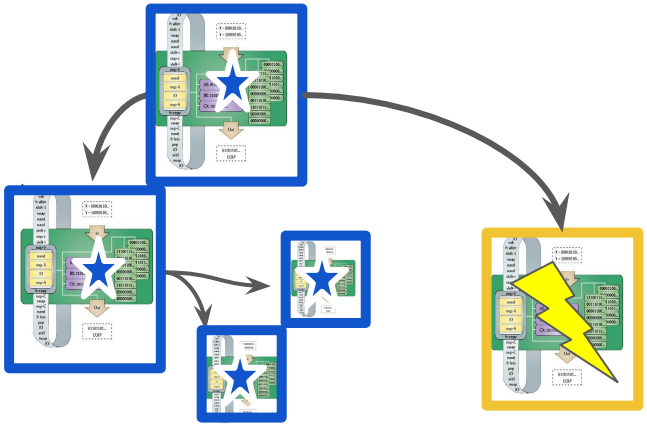

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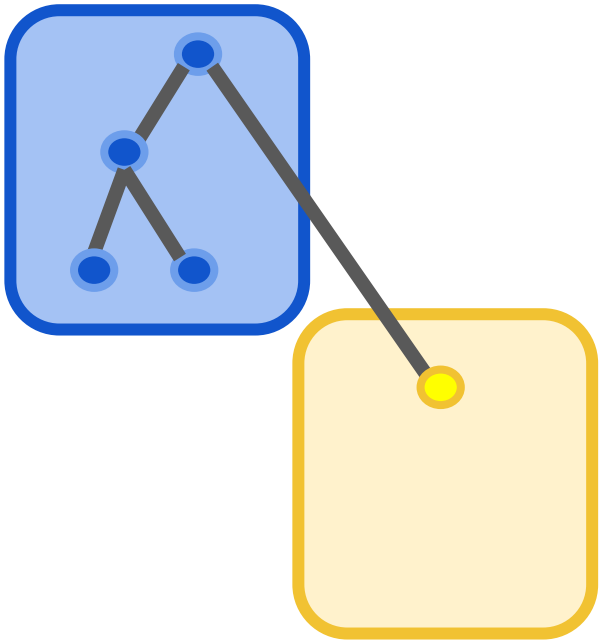

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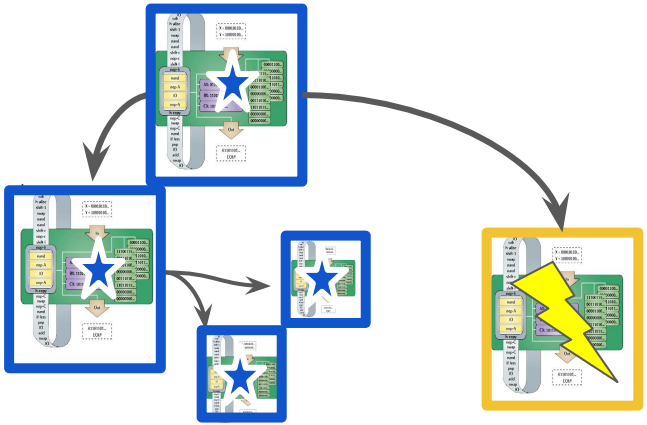

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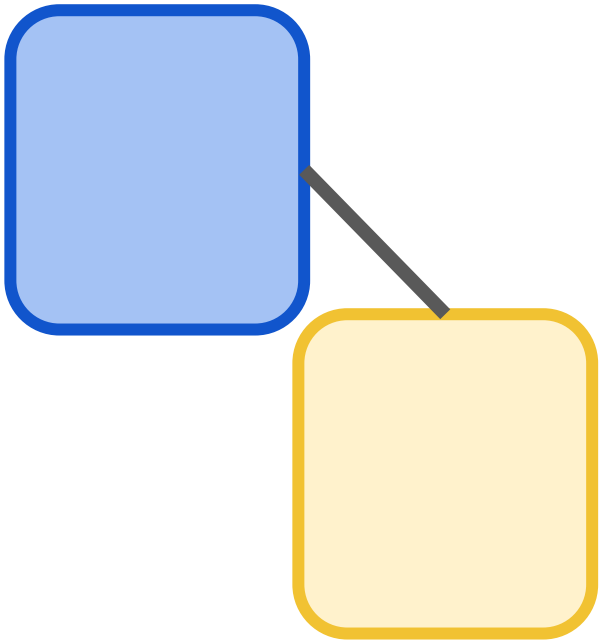

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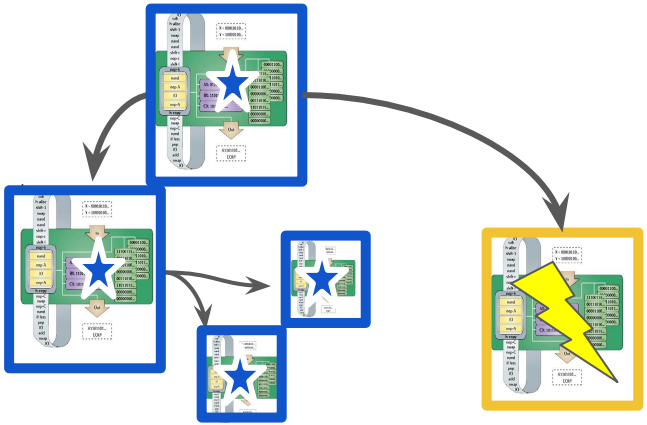

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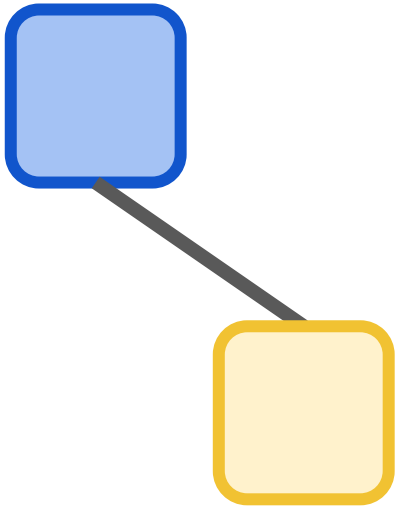

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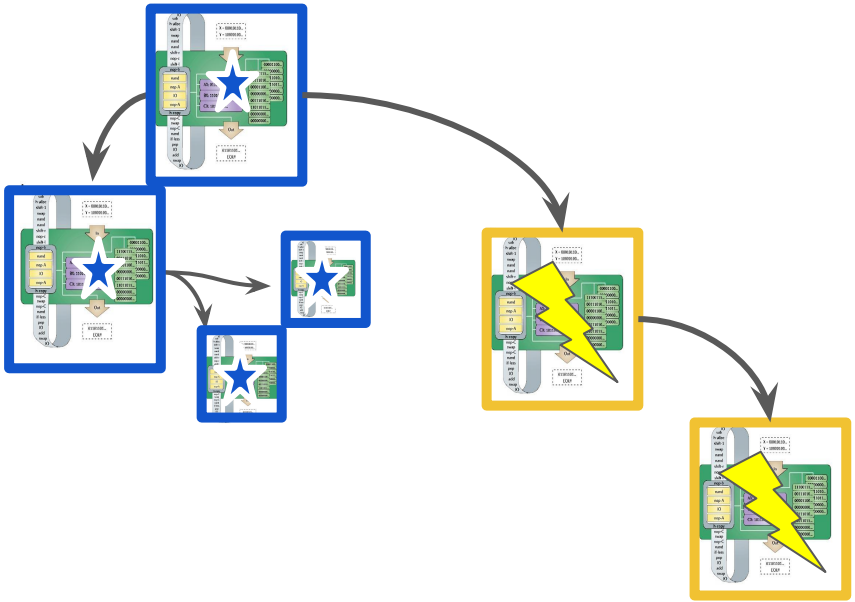

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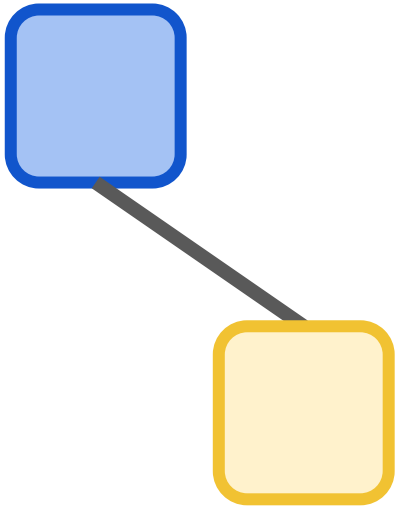

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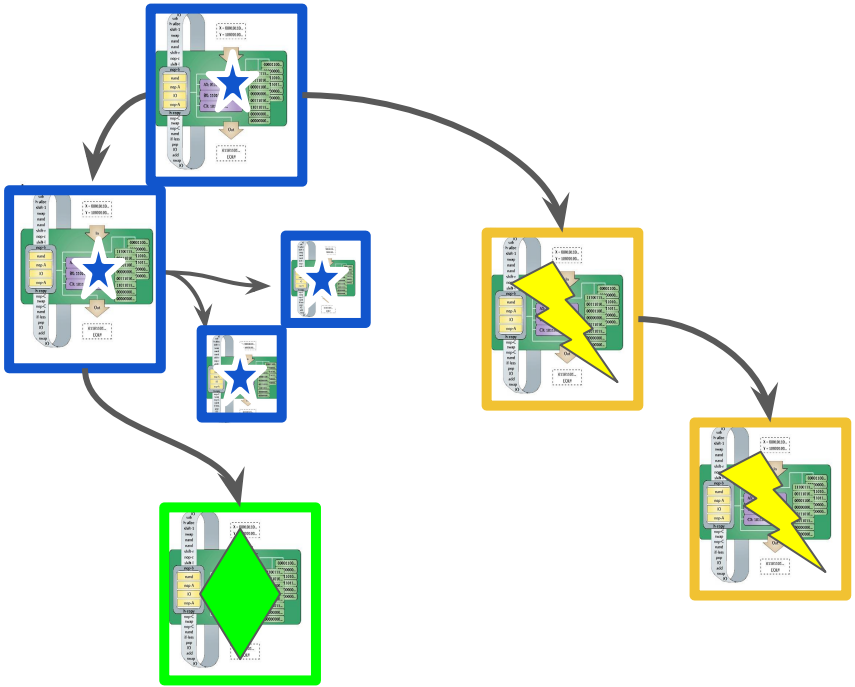

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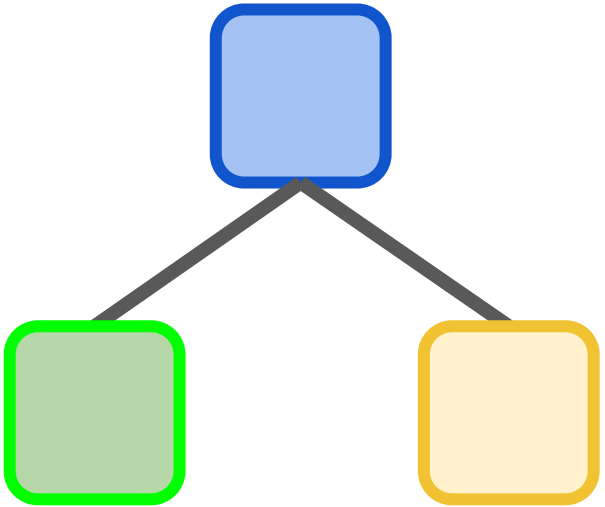
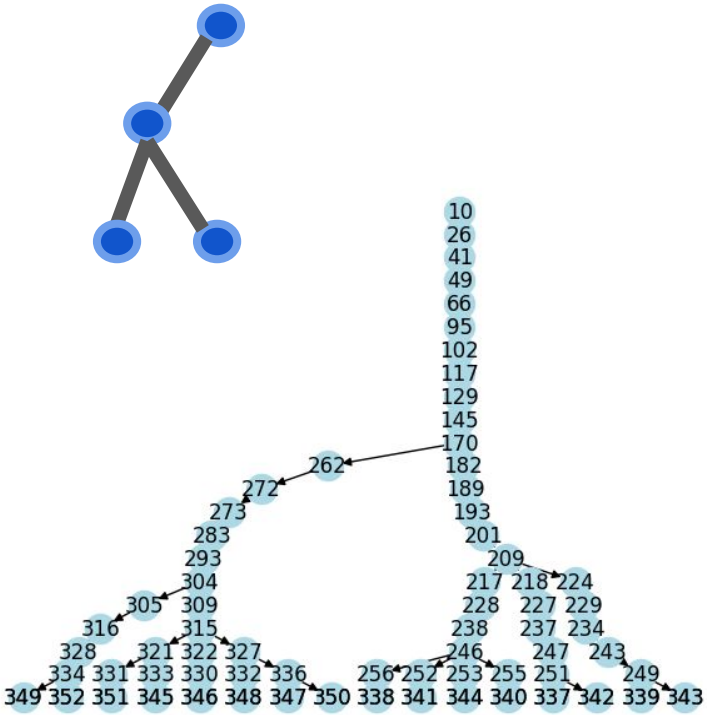


Intro: sexual vs asexual phylogenies



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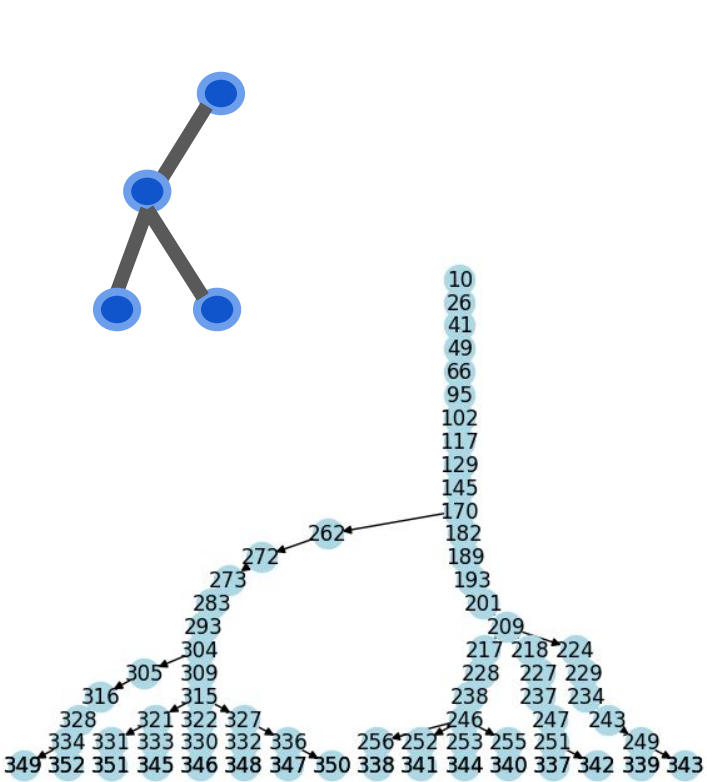

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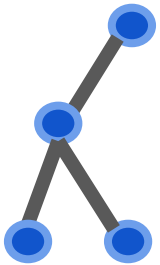

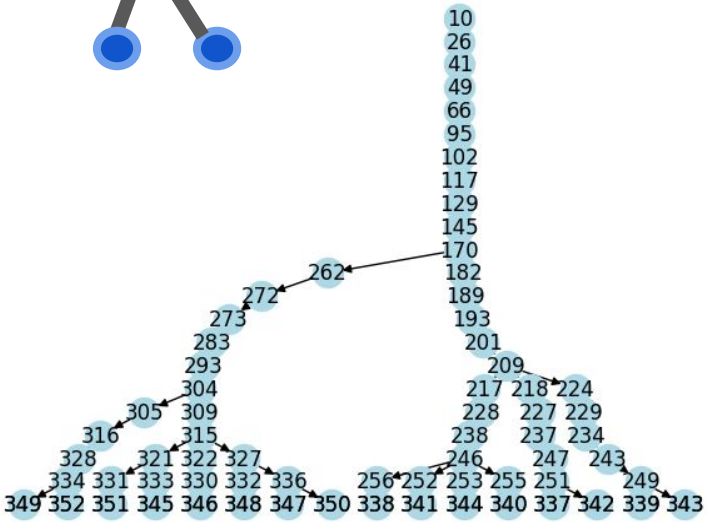

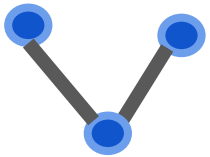

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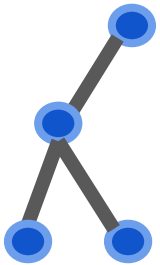

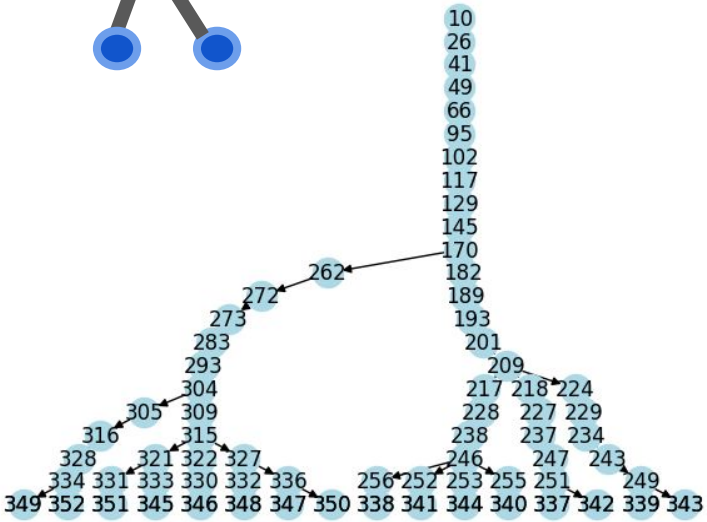

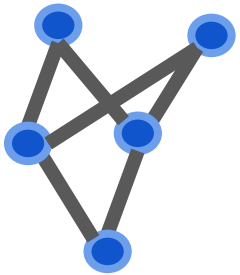

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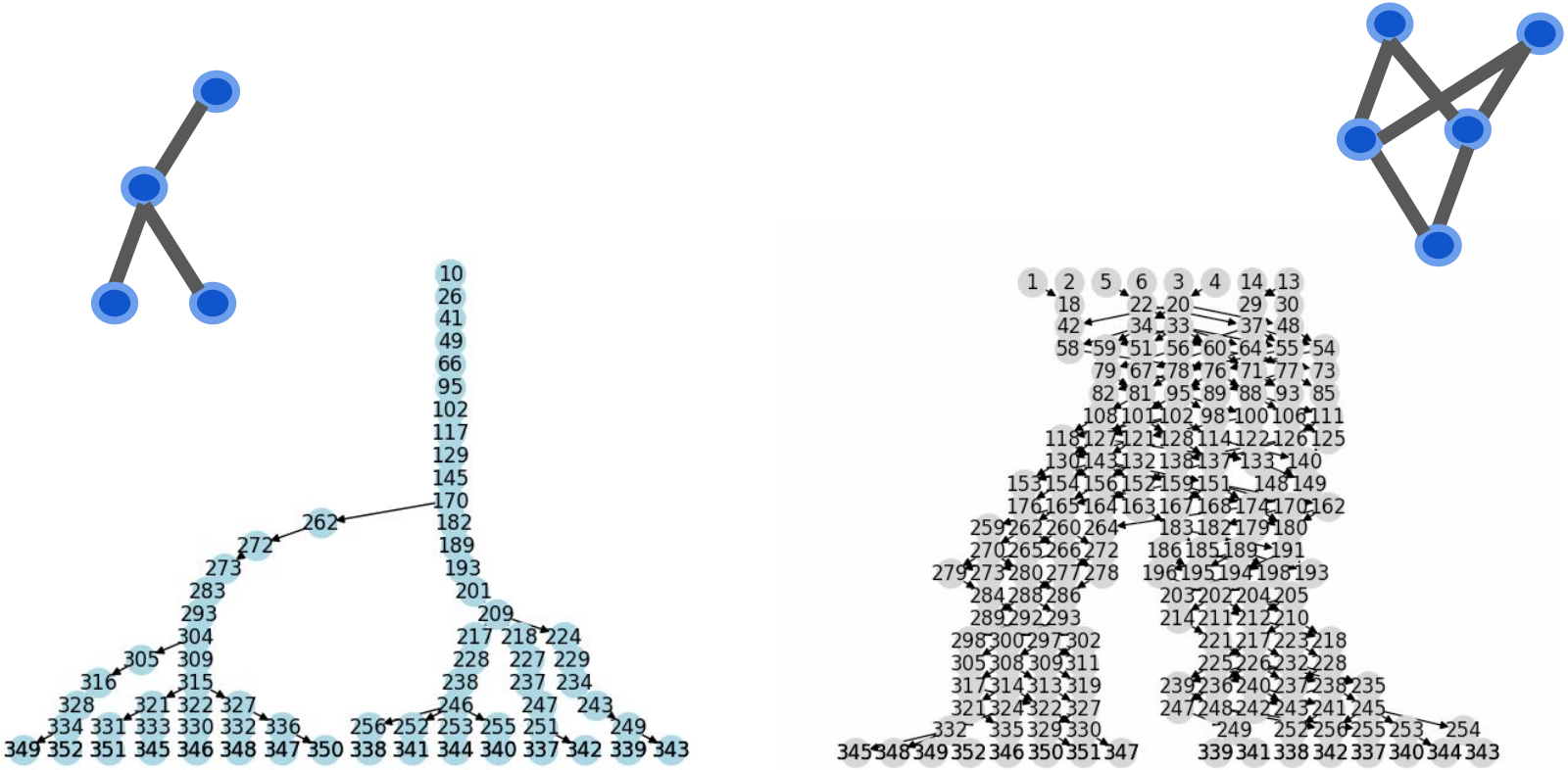

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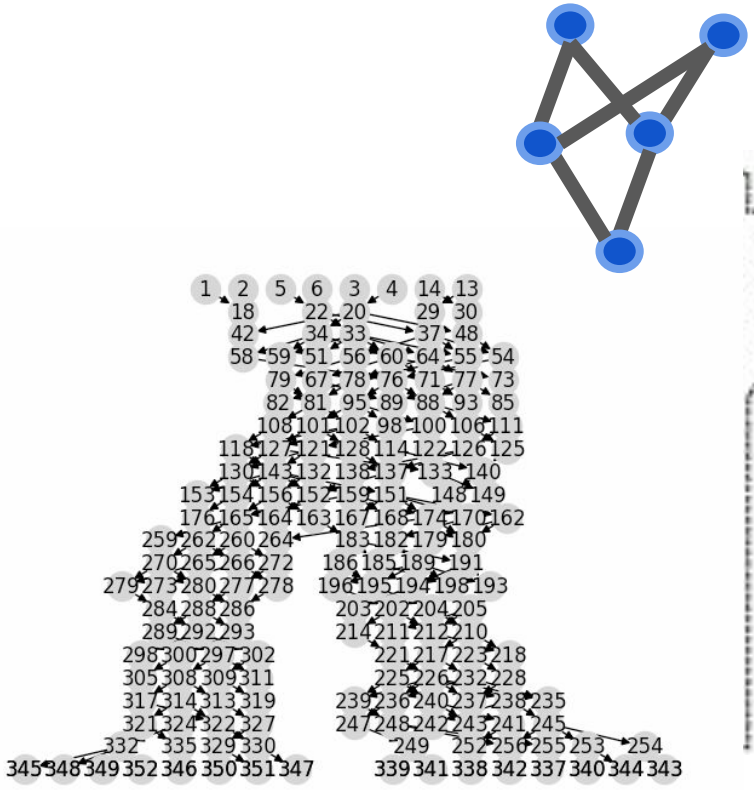
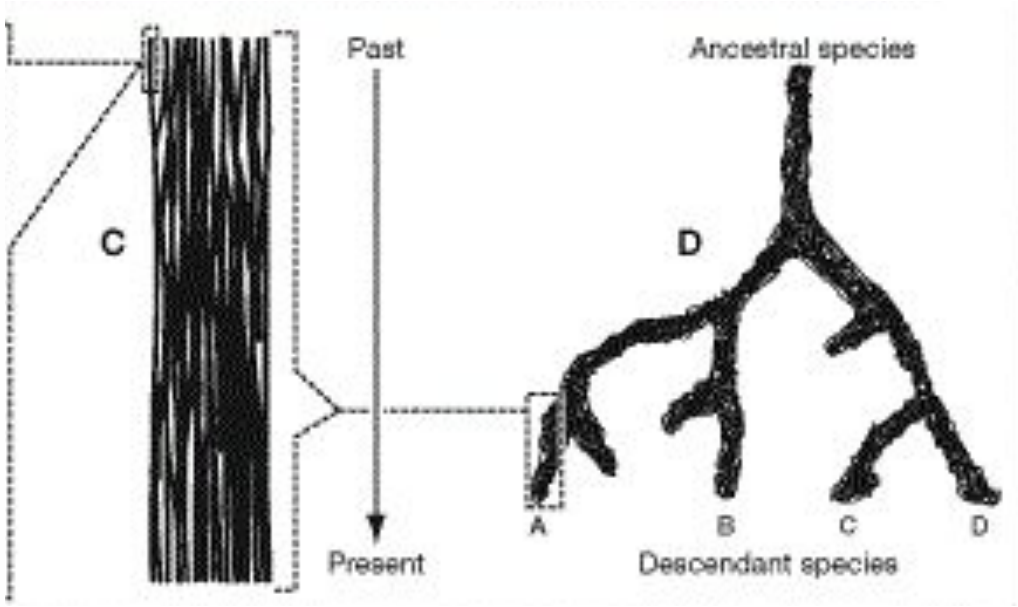


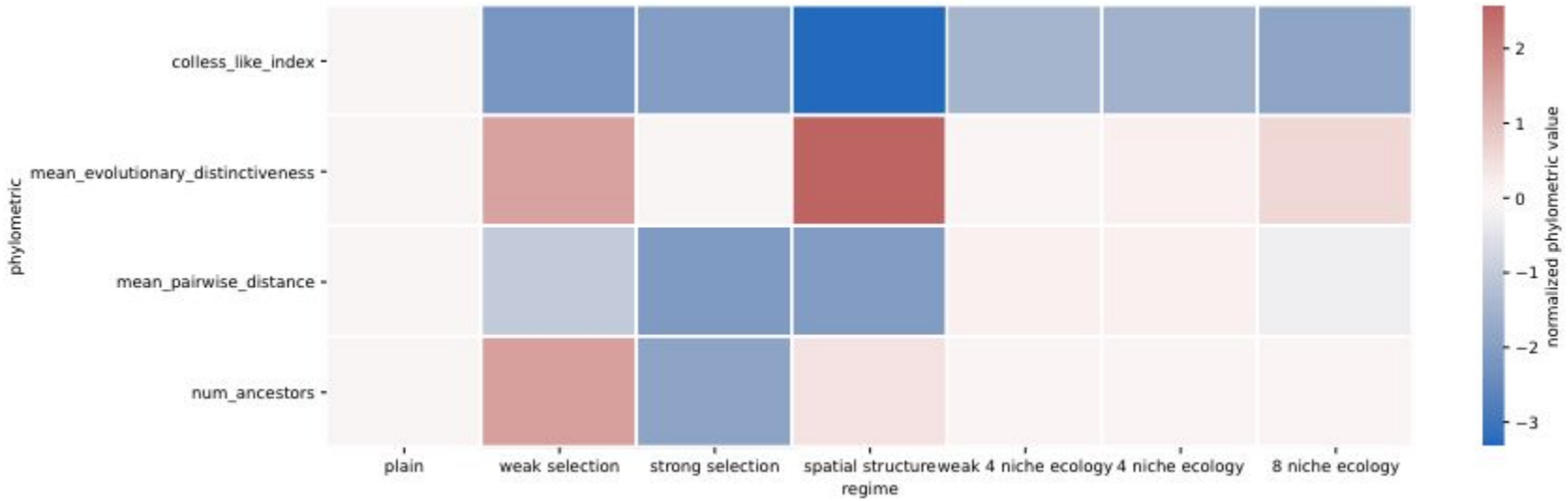


Baum and Offner, 2008

Why track phylogenies in your ALife system?

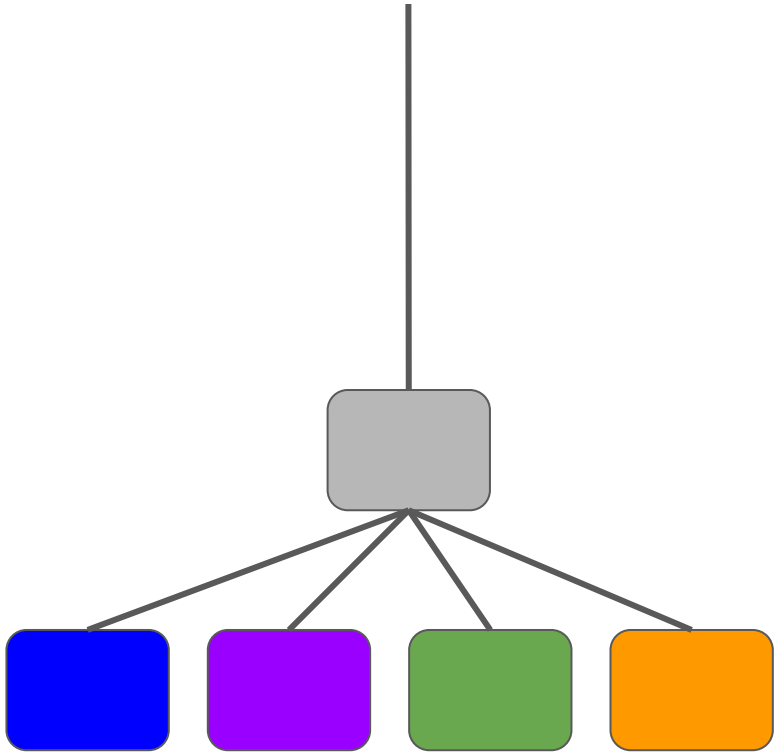
Just a few example applications...

Detecting mode & tempo of evolution



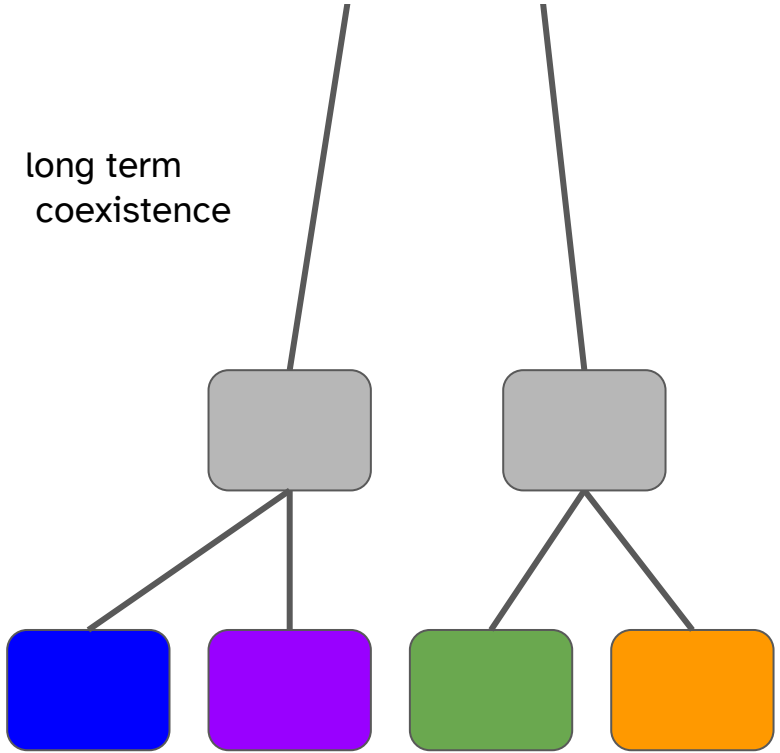
Moreno et al., 2023

Detecting ecology



Vs

long term
coexistence



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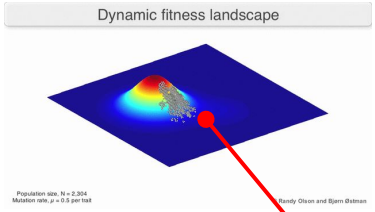

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U.S. Navy, Public domain, via Wikimedia Commons

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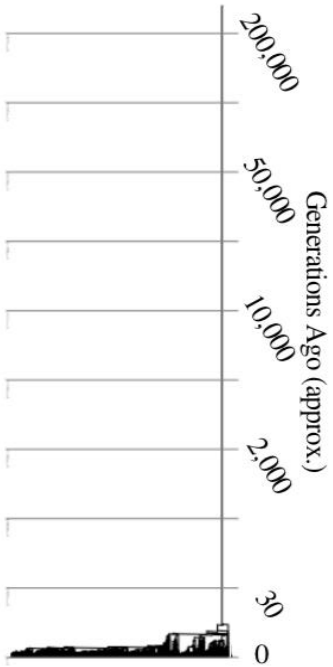

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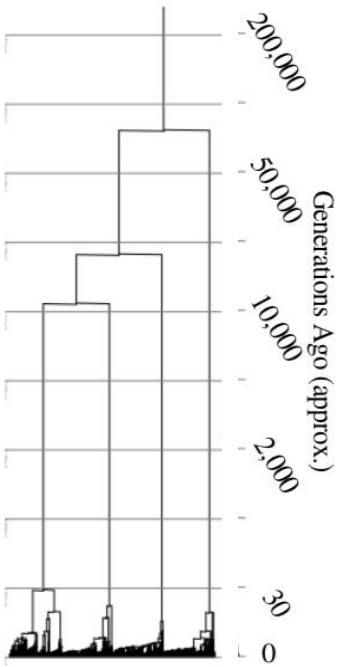
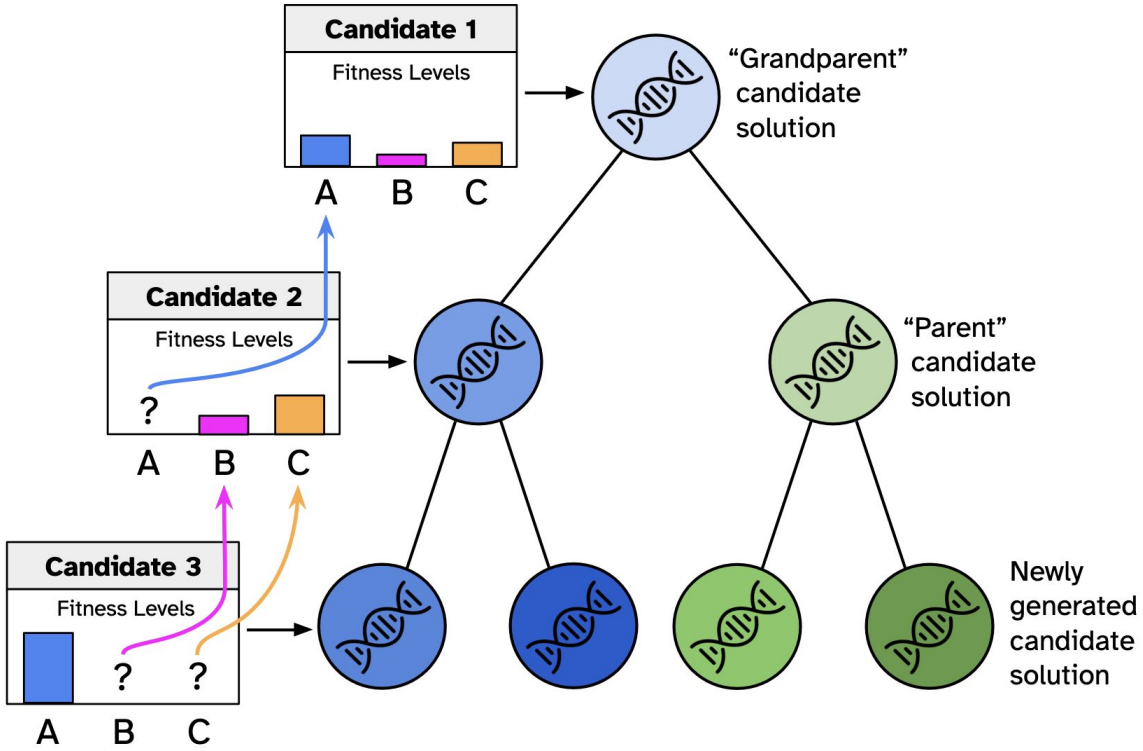


4 niche ecology

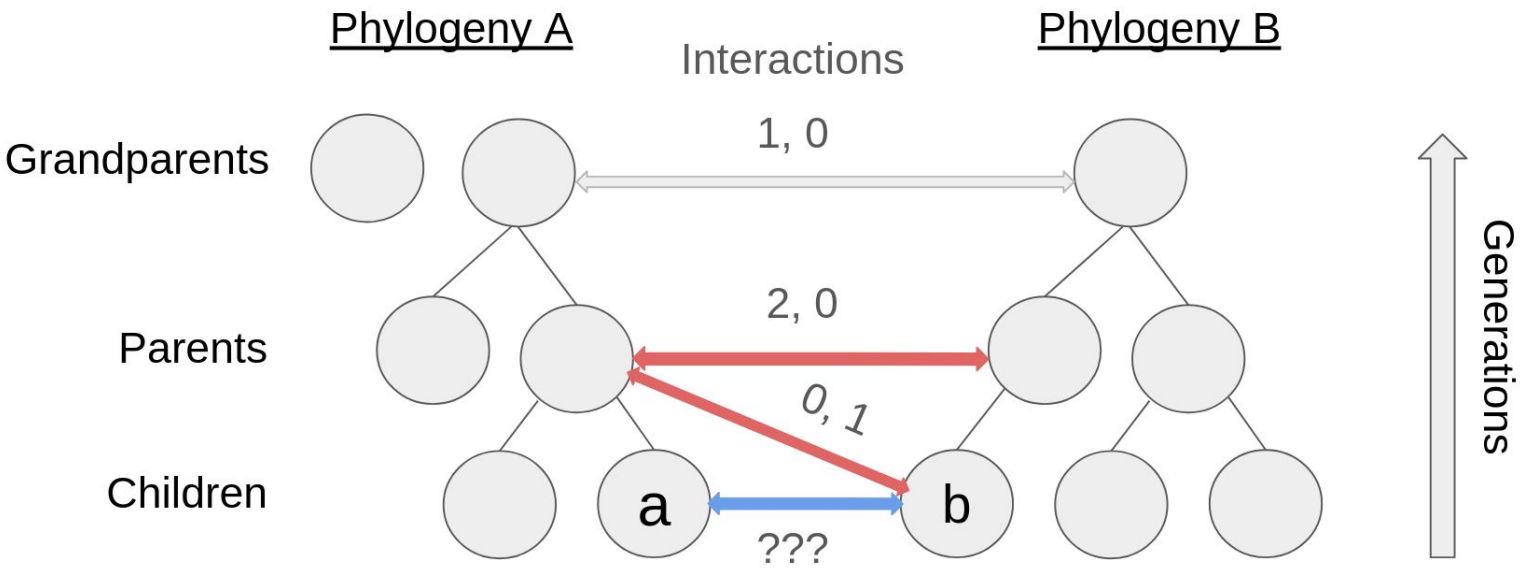
Moreno et al., 2023

Using phylogenetic information to estimate fitness



Lalejini et al. 2024
https://arxiv.org/abs/2402.01610

Fitness estimation and test selection



Coding challenges

1. Incorporate phylogeny tracking into an evolutionary system
   - We provide Julia & Python example notebooks
     - *Julia*: Use colab notebook linked in repo
   - You can also incorporate tracking into another framework!
2. Generate phylogeny
3. Visualize/Analyze phylogeny

/amlalejini/alife-2024-phylo-tutorial

Post-tutorial: Workshop report on phylogenies across (your) ALife systems? (pending interest)

Tools & Resources

ALIFE Community Data Standards

alife-data-standards.github.io/alife-data-standards/

phylotrackpy

phylotrackpy.readthedocs.io/

Visualization

emilydolson.github.io/lineage_viz_tool/phylogeny_visualizations/phylogeny.html