

# Understanding complexity barriers in evolving systems

By Emily Dolson, Anya Vostinar, Michael  
Wiser, and Charles Ofria



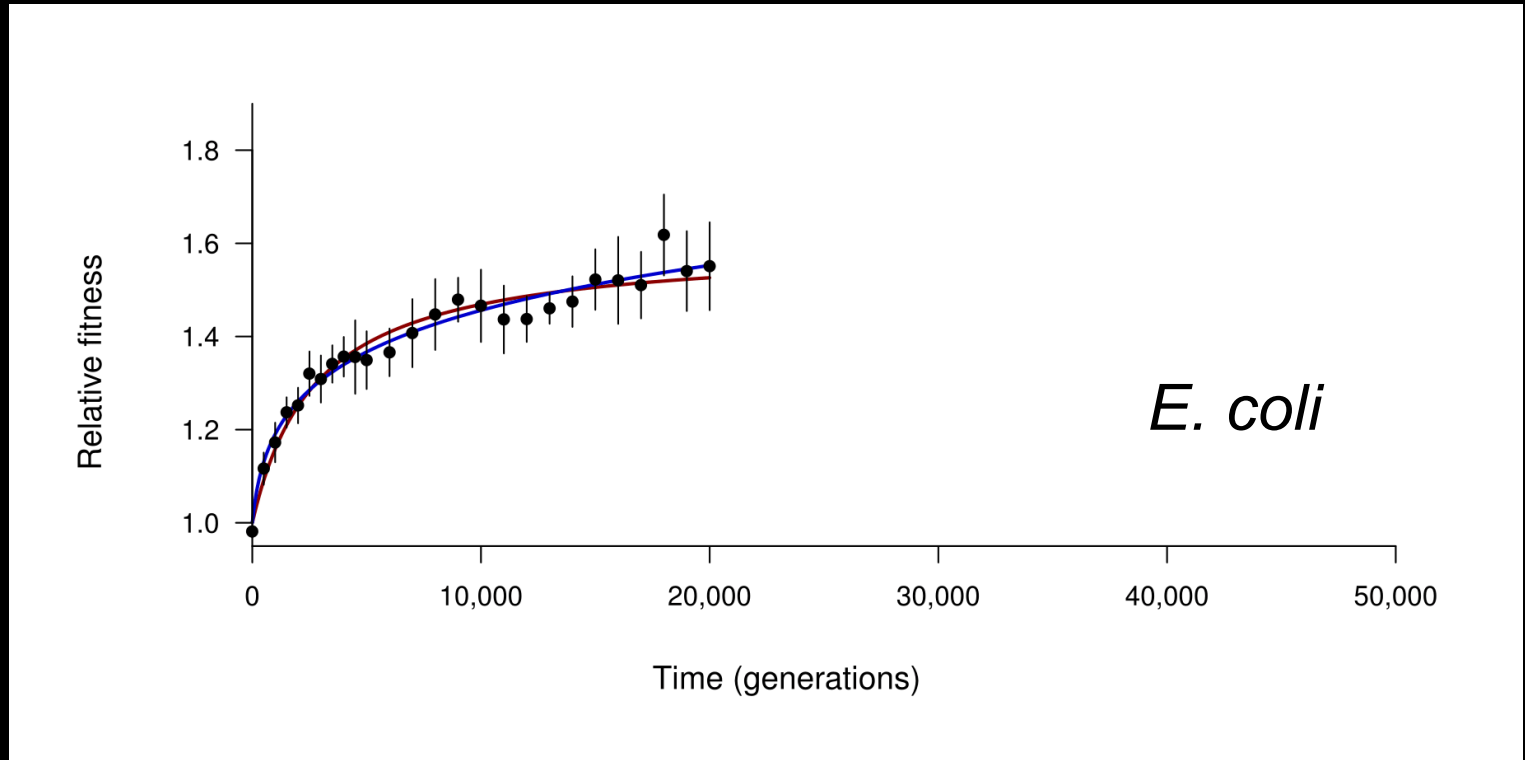
# Introduction

- Informally open-endedness =  
“keep doing interesting things”

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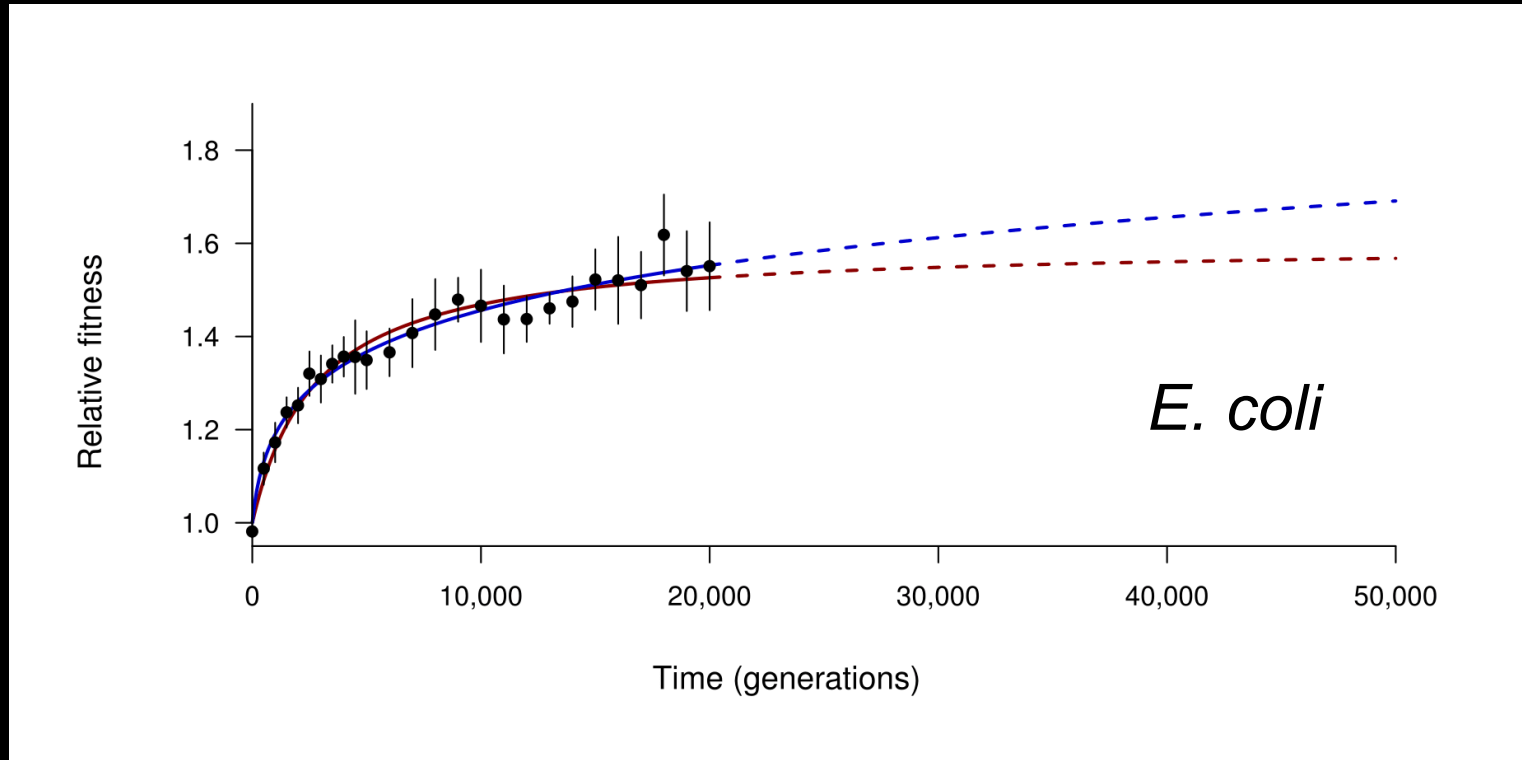
- Informally open-endedness = “keep doing interesting things”
  - Define “keep doing”

# How do we define *keep doing*?



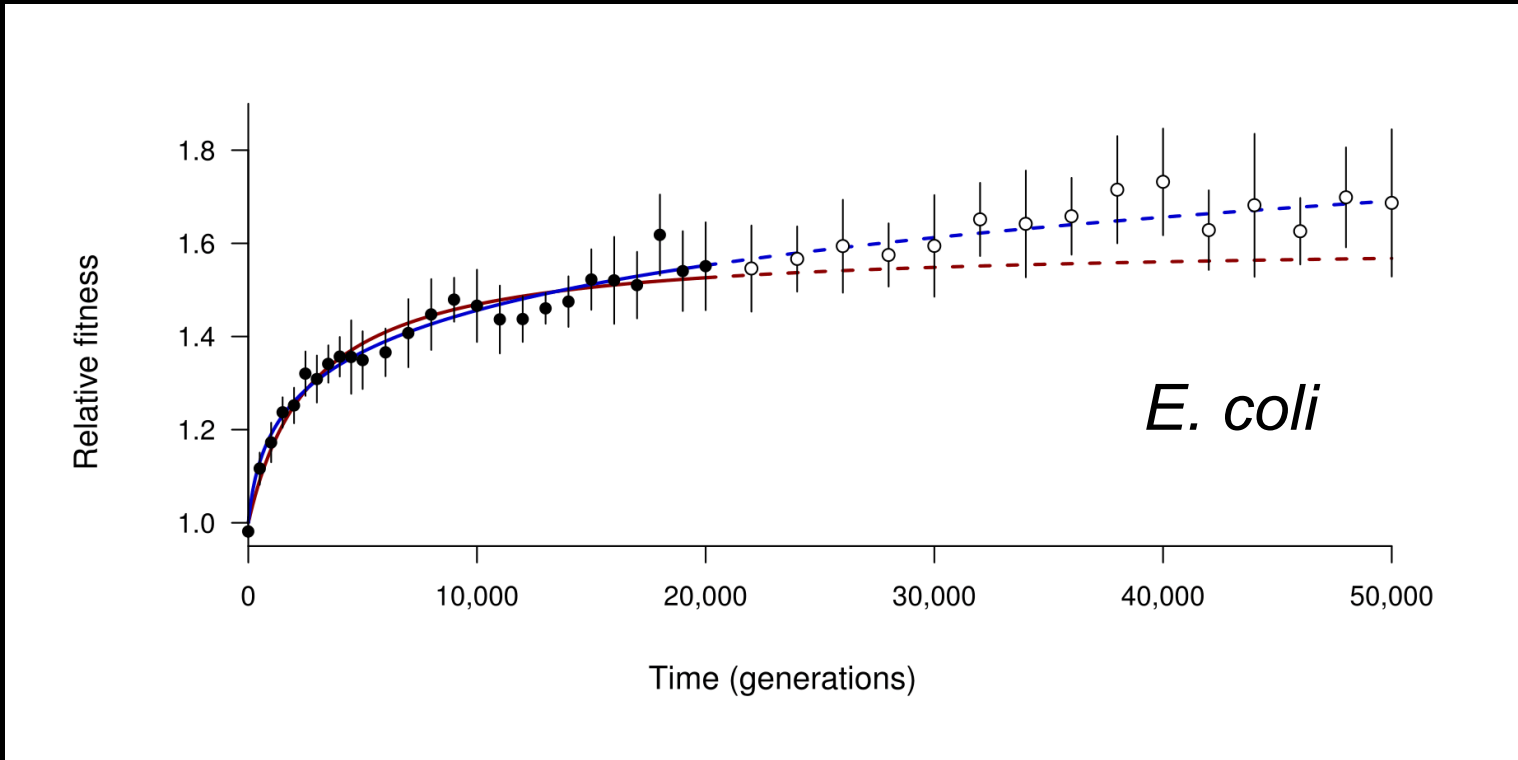
(Wiser, Ribbeck, Lenski 2013)

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(Wiser, Ribeck, Lenski 2013)

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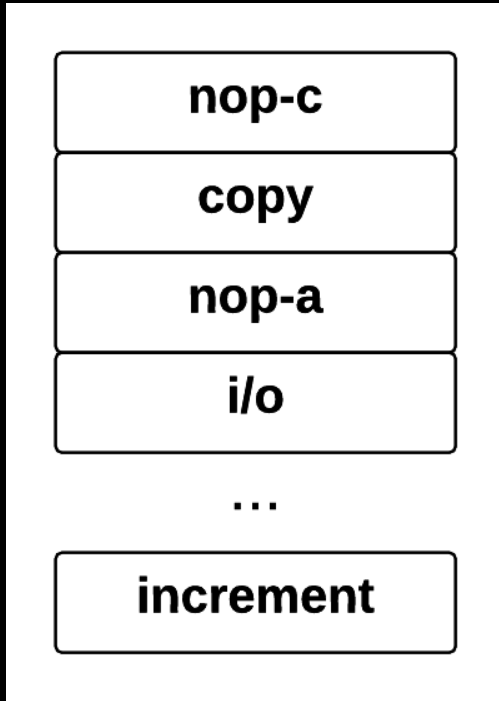


(Wiser, Ribbeck, Lenski 2013)

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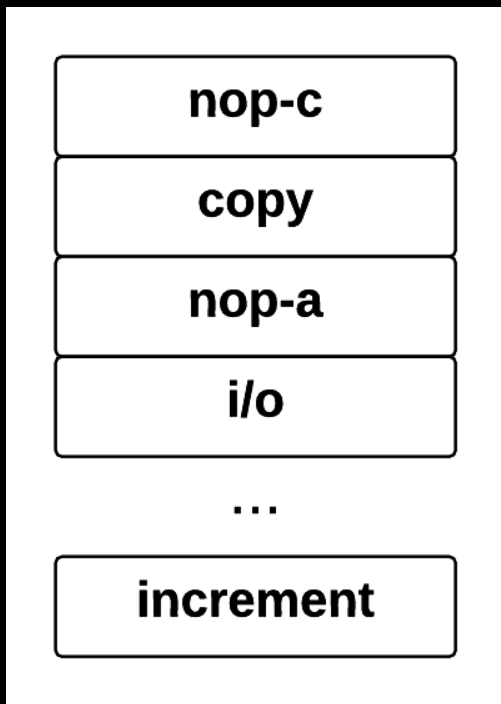
- Informally open-endedness = “keep doing interesting things”
  - Define “keep doing”
  - Define “interesting things”

# Genomic Skeletons



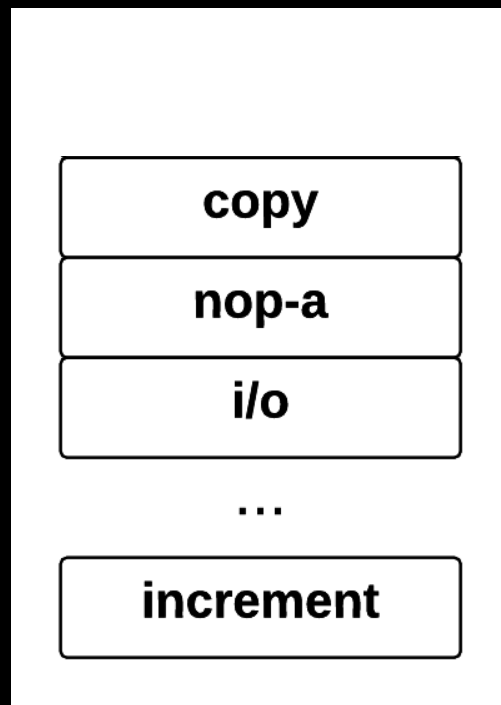
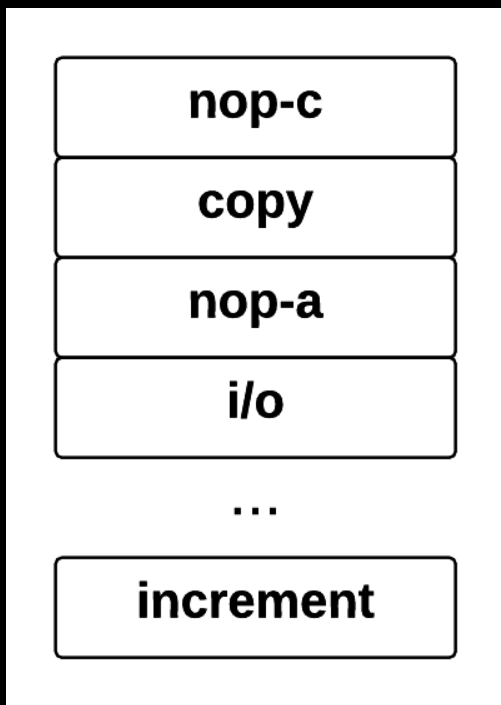


# Genomic Skeletons



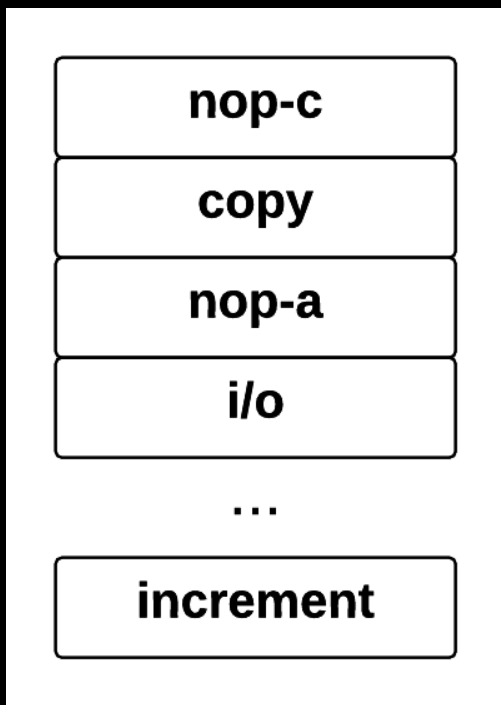
Fitness: 3

# Genomic Skeletons

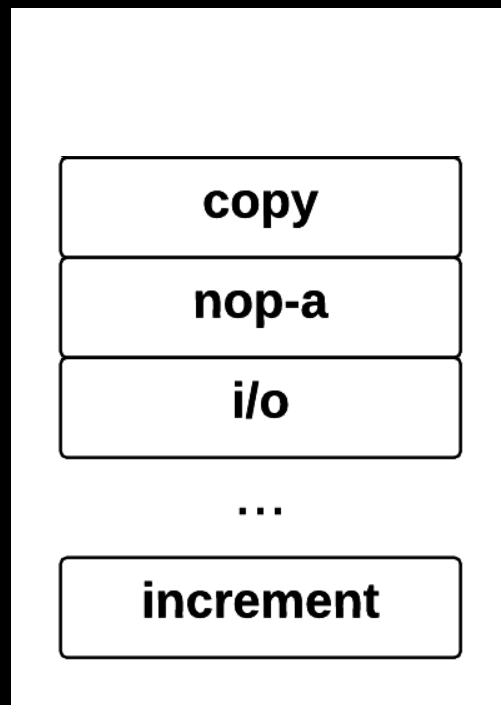


Fitness: 3

# Genomic Skeletons

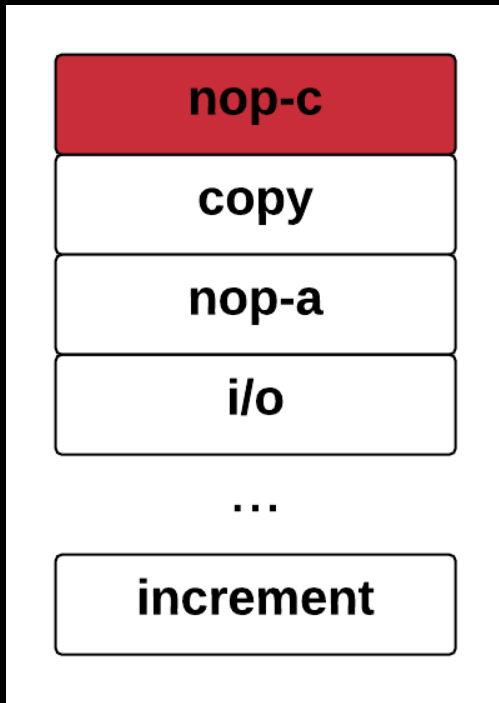


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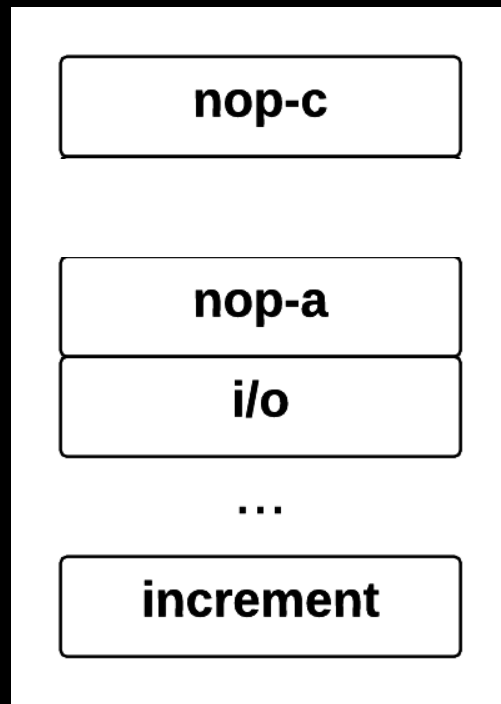
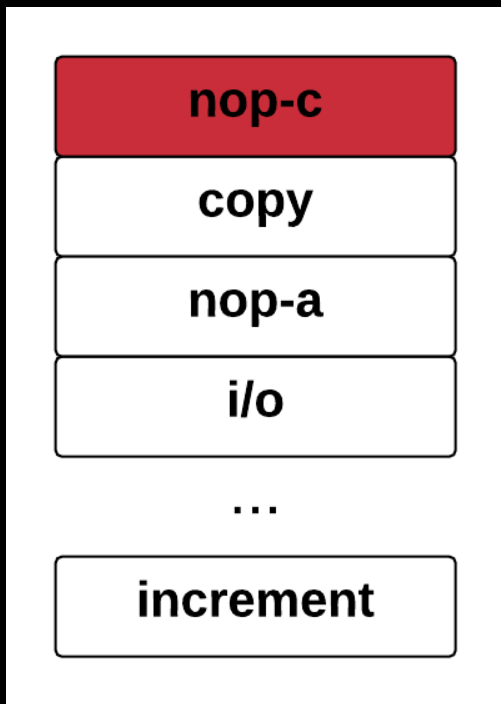
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# Genomic Skeletons



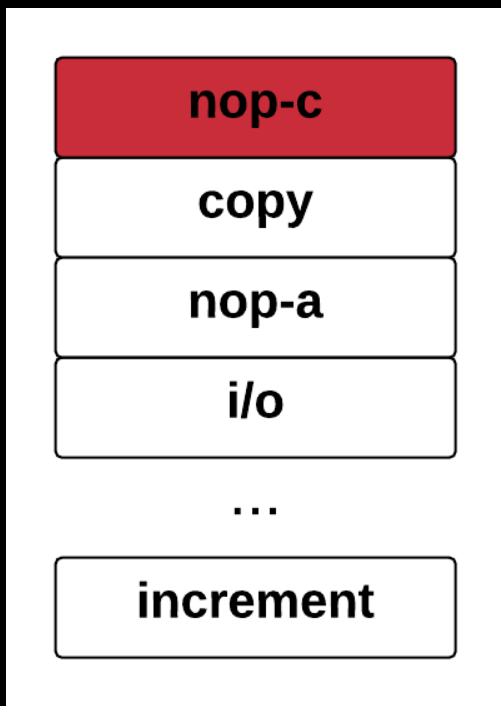
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# Genomic Skeletons

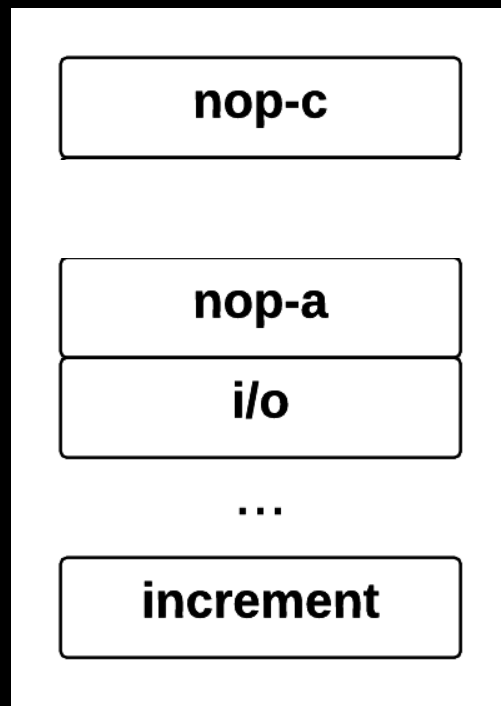


Fitness: 3

# Genomic Skeletons

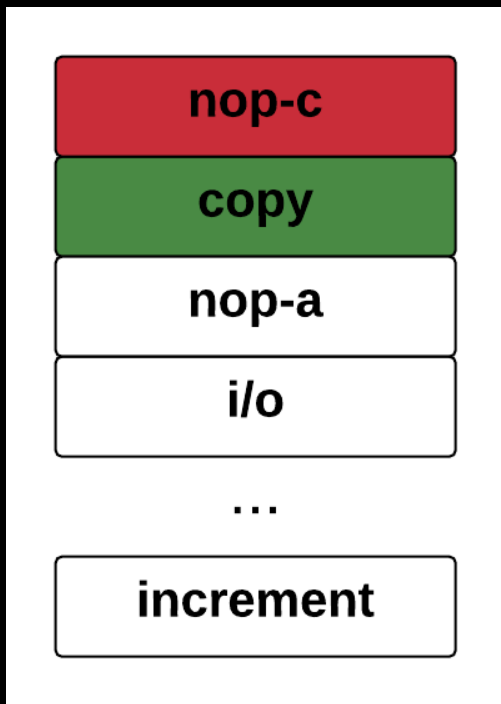


Fitness: 3



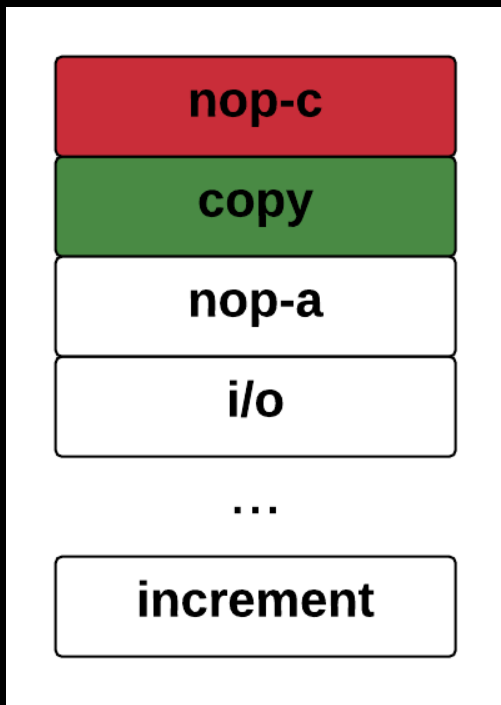
Fitness: 0

# Genomic Skeletons

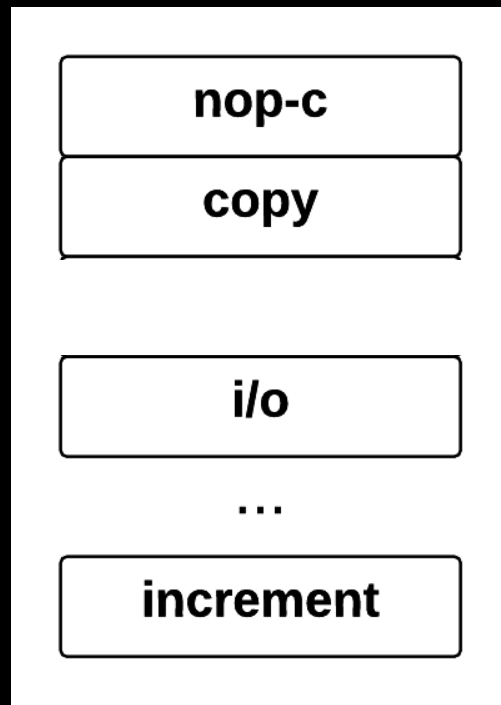


Fitness: 3

# Genomic Skeletons



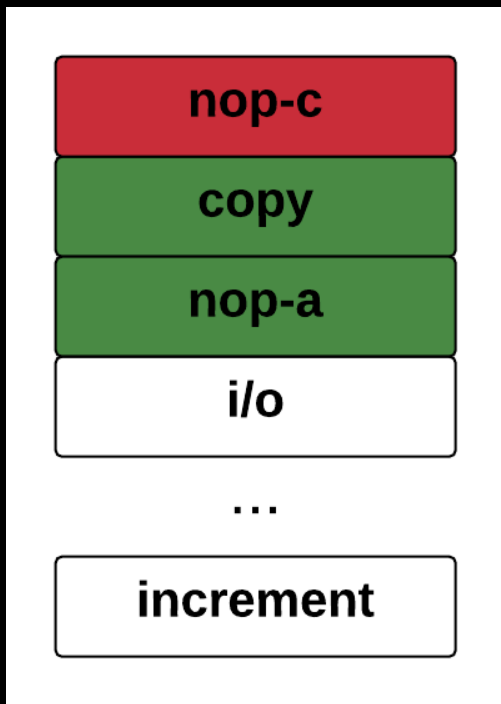
Fitness: 3



Fitness: 2

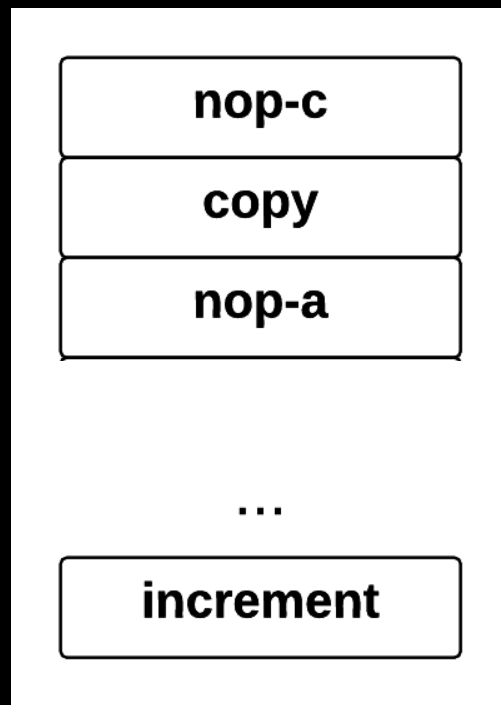
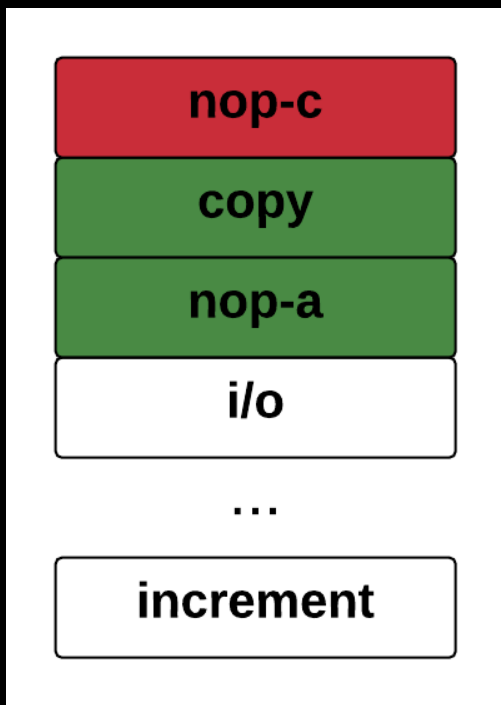


# Genomic Skeletons



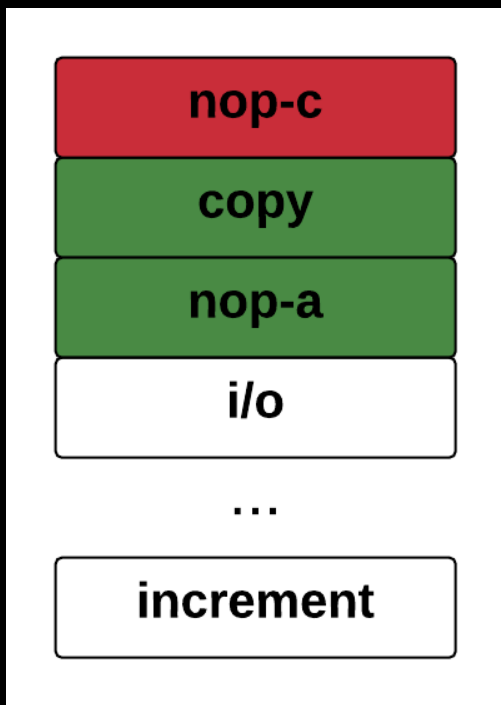
Fitness: 3

# Genomic Skeletons

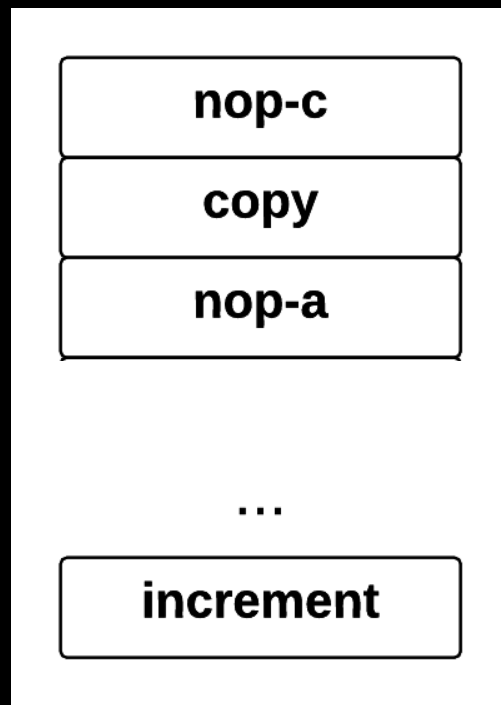


Fitness: 3

# Genomic Skeletons

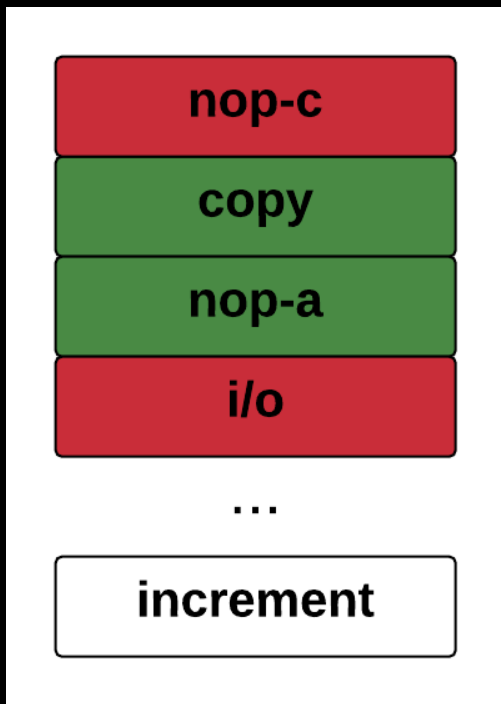


Fitness: 3



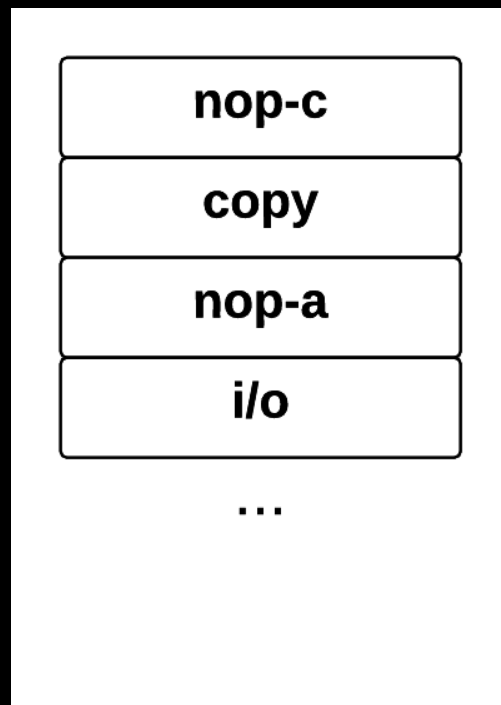
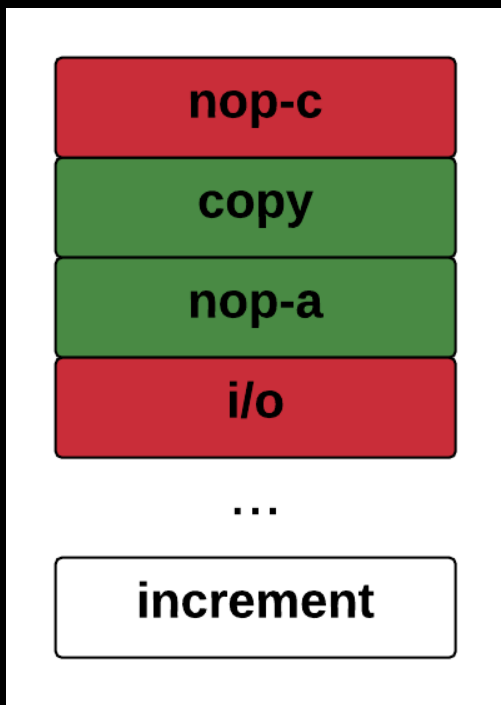
Fitness: 3.2

# Genomic Skeletons



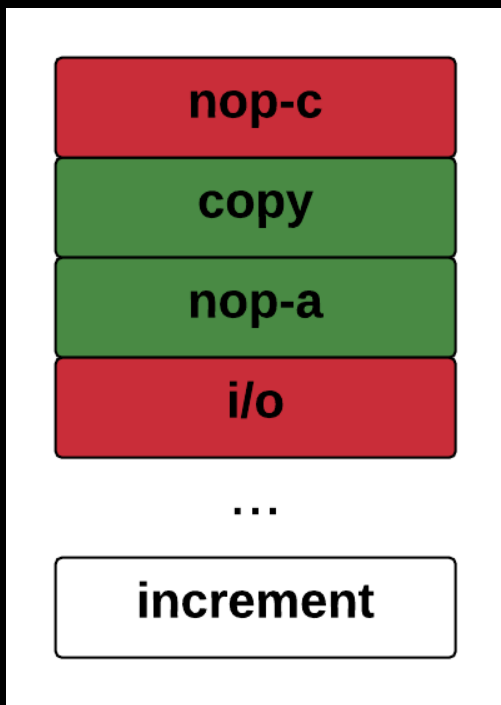
Fitness: 3

# Genomic Skeletons

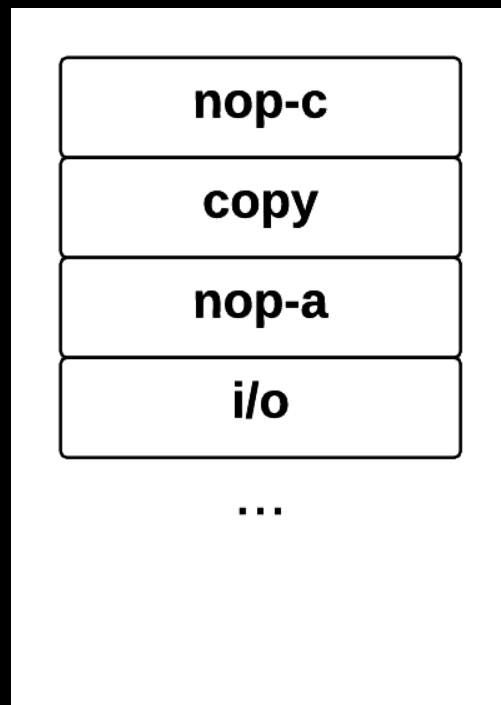


Fitness: 3

# Genomic Skeletons

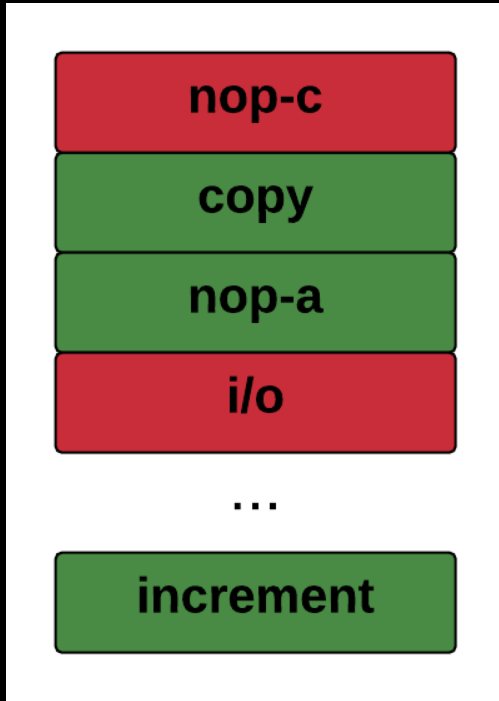


Fitness: 3



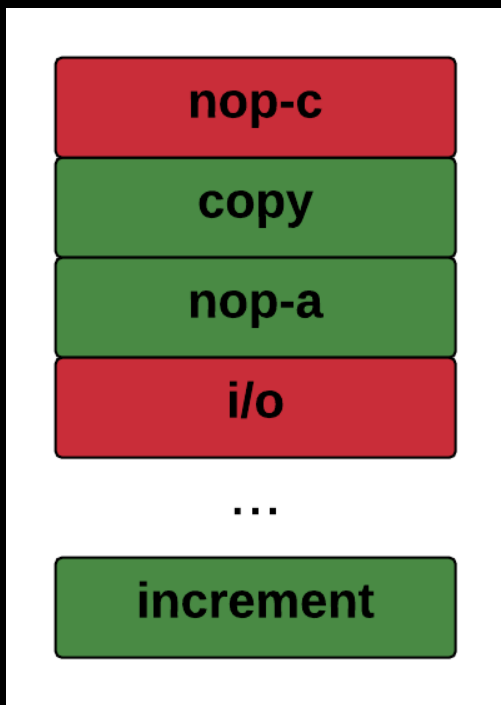
Fitness: 2.5

# Genomic Skeletons

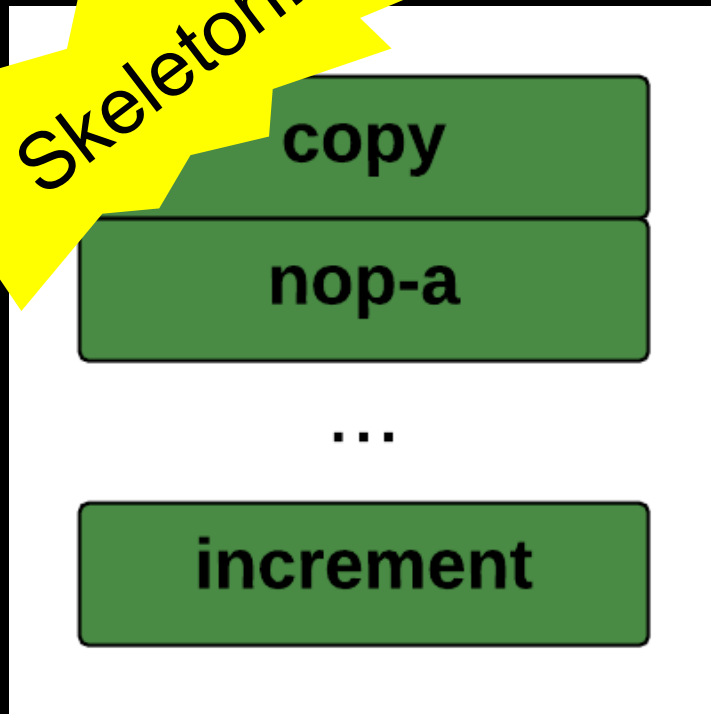
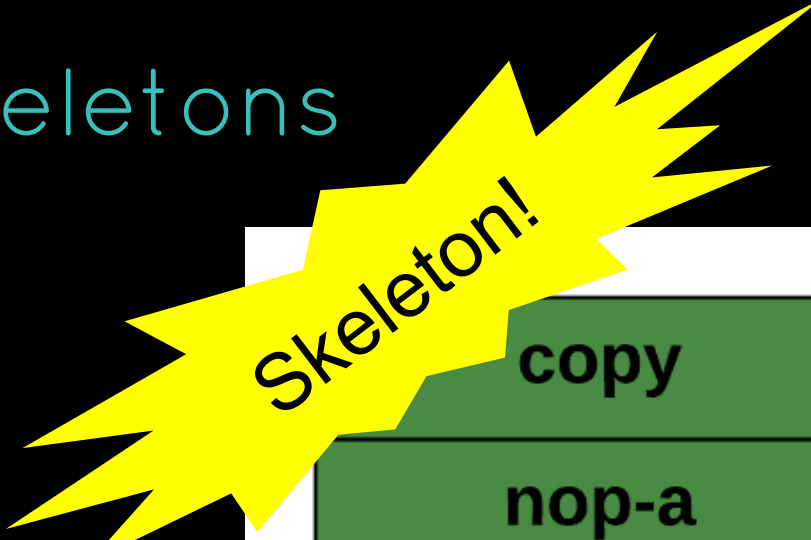


Fitness: 3

# Genomic Skeletons



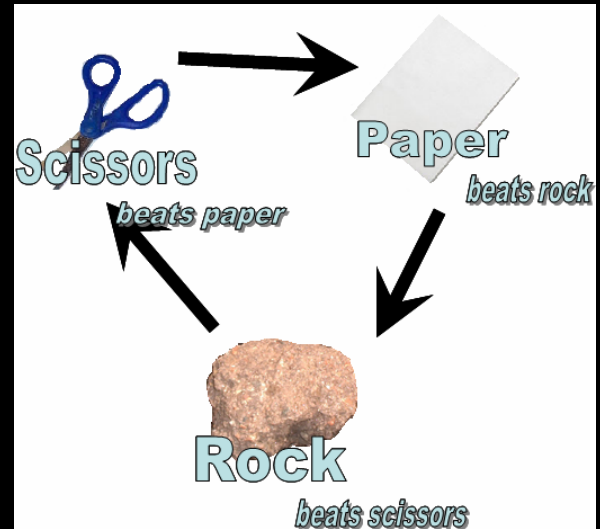
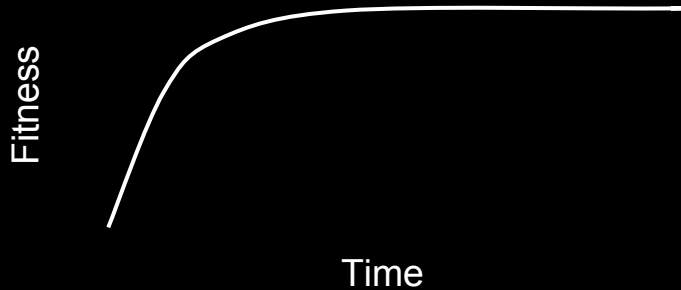
Fitness: 3





# Change Potential

How much do we expect the population composition to change during an interval?



# Novelty Potential

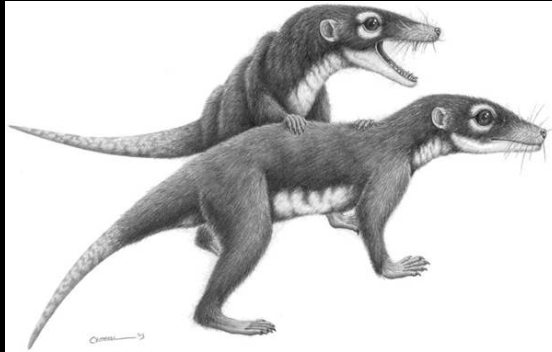
How many entirely new strategies do we expect to arise during an interval?



Novelty Search (Lehman  
and Stanley, 2011)

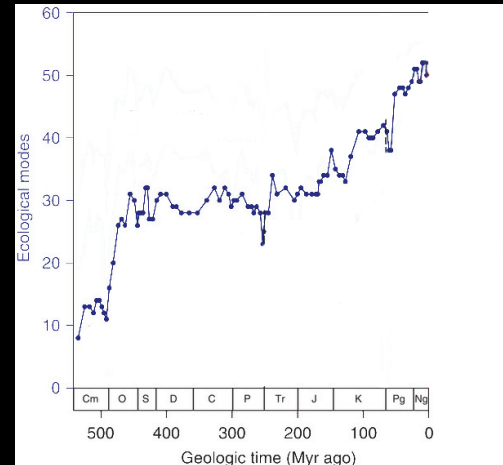
# Complexity Potential

How much do we expect the greatest individual complexity to increase during an interval?



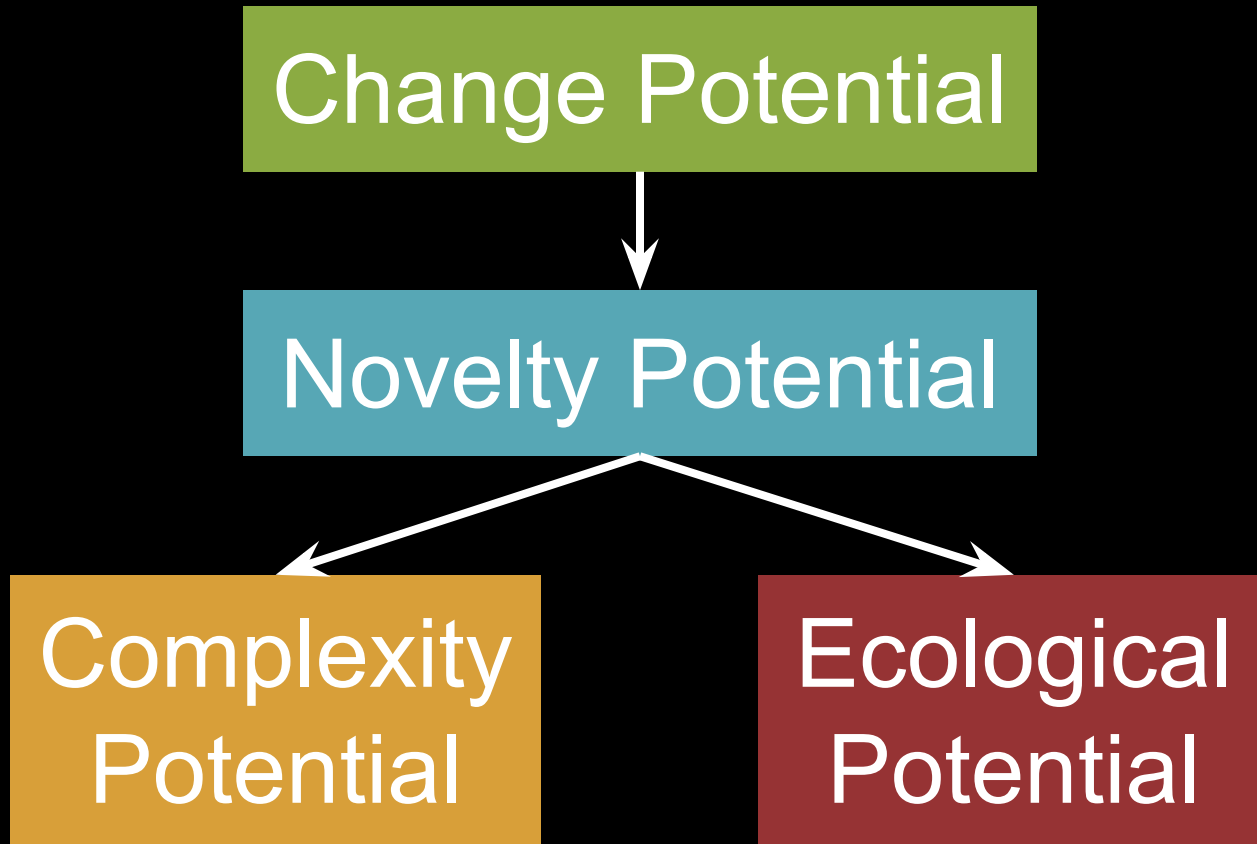
# Ecological Potential

How much do we expect “meaningful” diversity to increase during an interval?

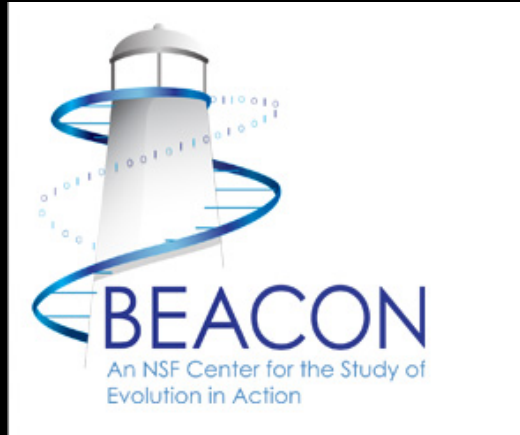
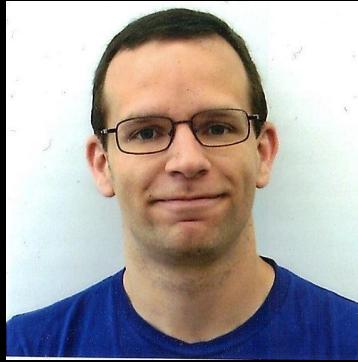


(Knape et al, 2015)

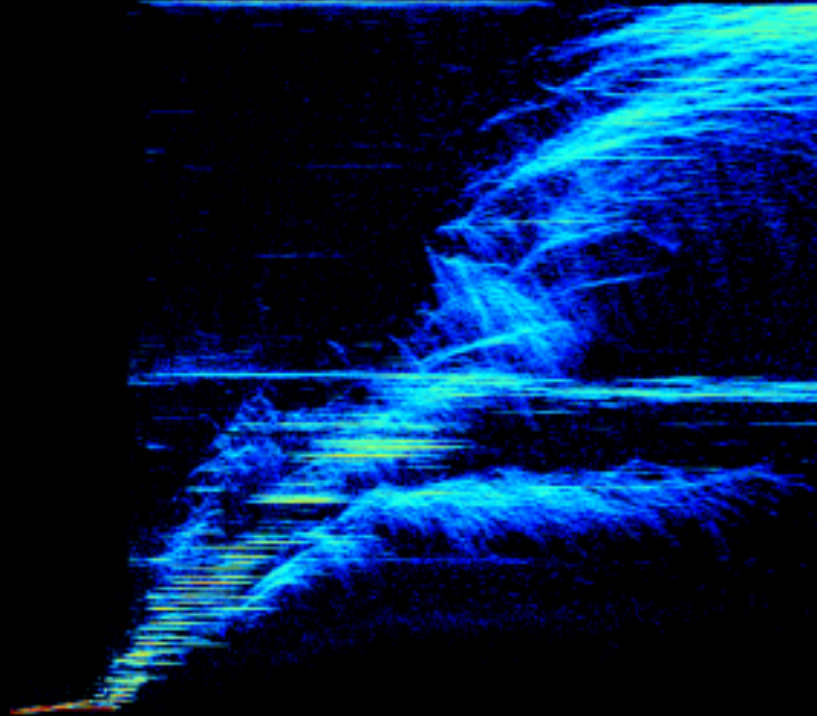
# Conclusions



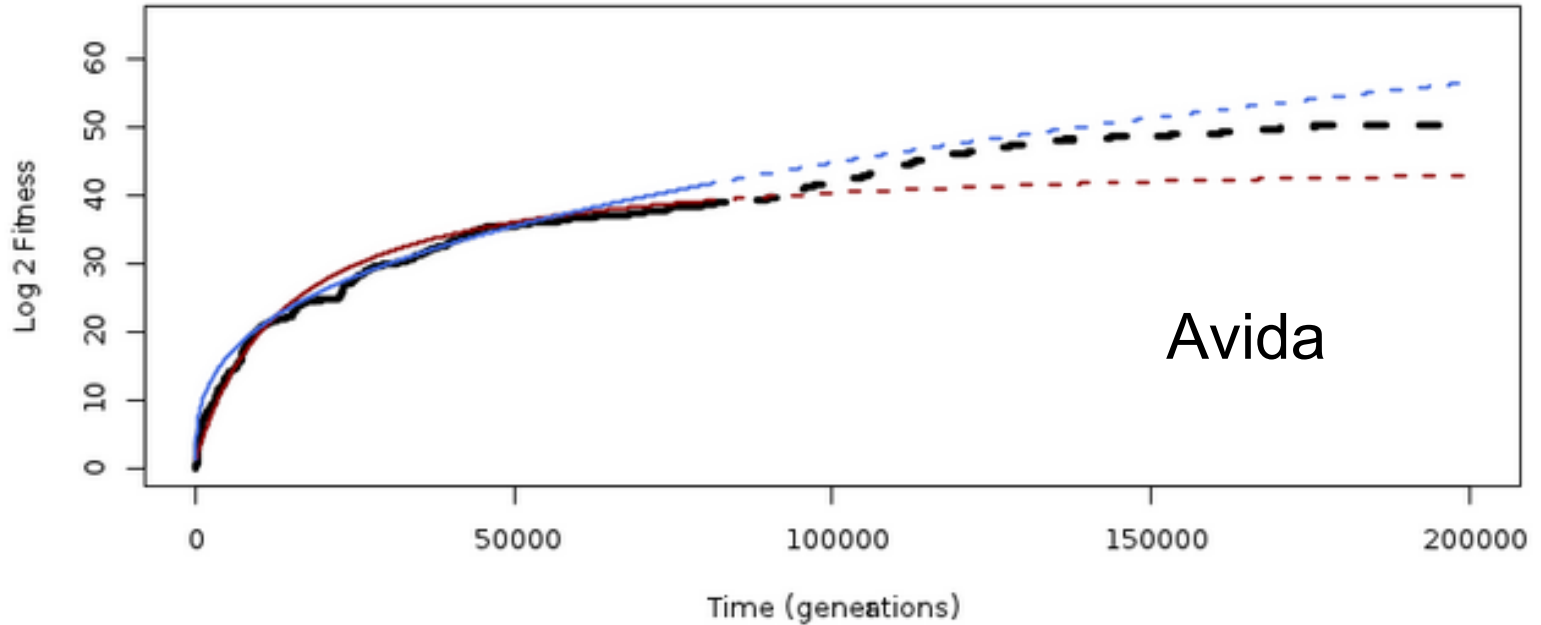
# Acknowledgements



Questions?



# Fitness growth in Avida



Avida

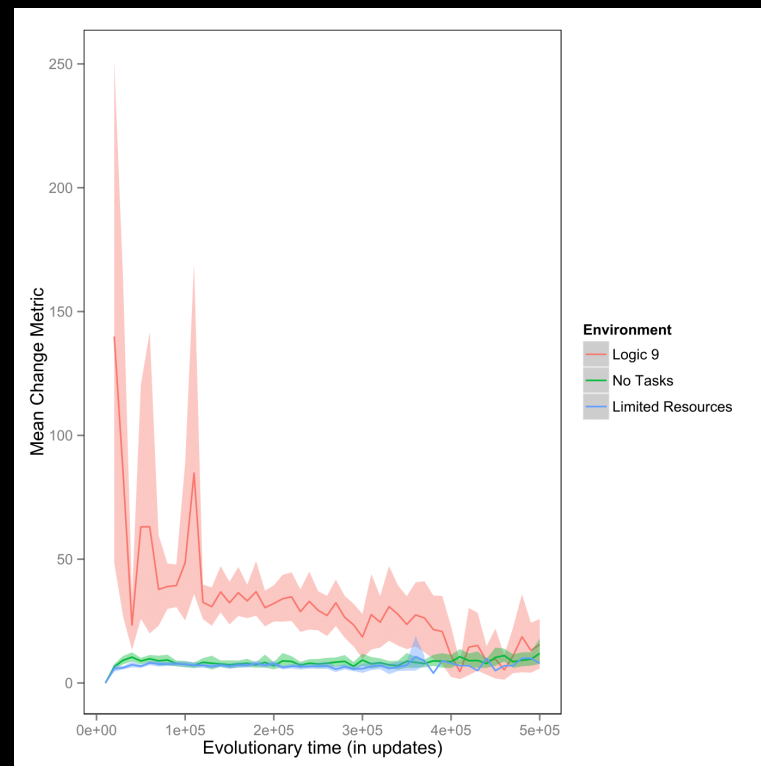
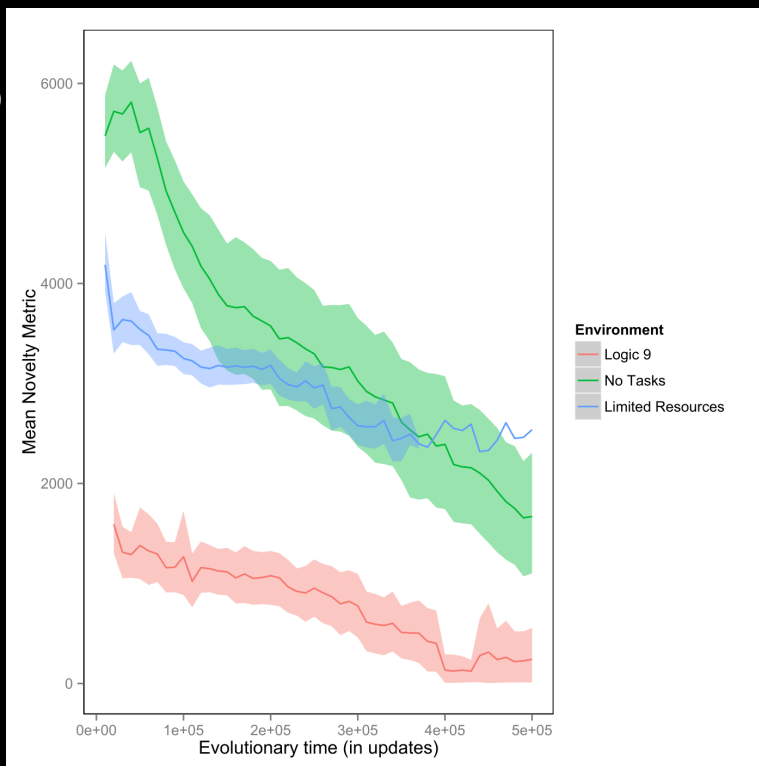


# Filtering for adaptive evolution

## Coalescence time



# Preliminary data



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