

Next generation phylogenetic inference
@Evolution2016:
Nearest neighbors of phylogenetic time-trees

Alex Gavryushkin
(joint work with Chris Whidden and Erick Matsen)

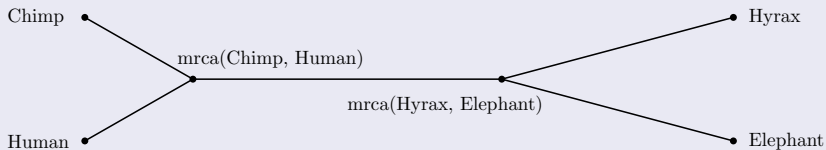
June 20, 2016



THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

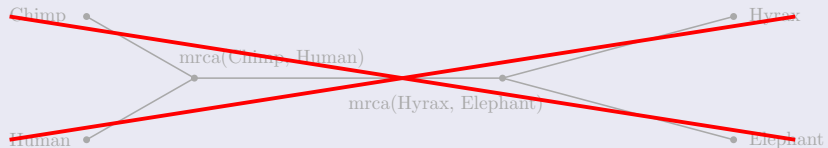
Introduction

Phylogenetic tree

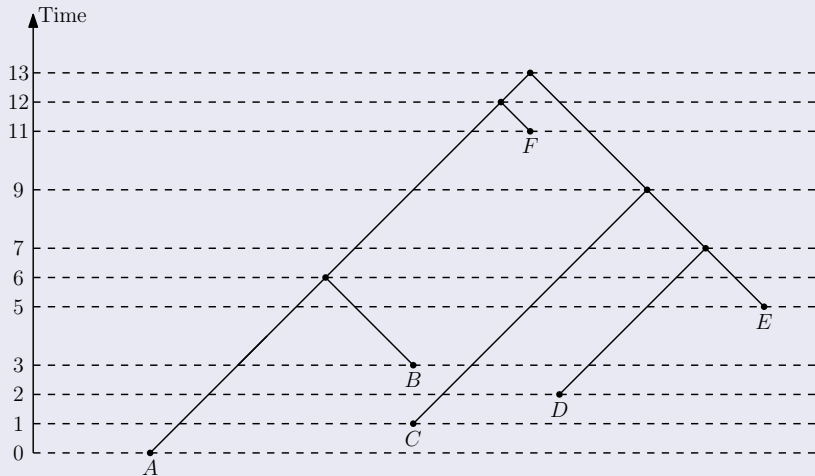


Introduction

Not in this talk

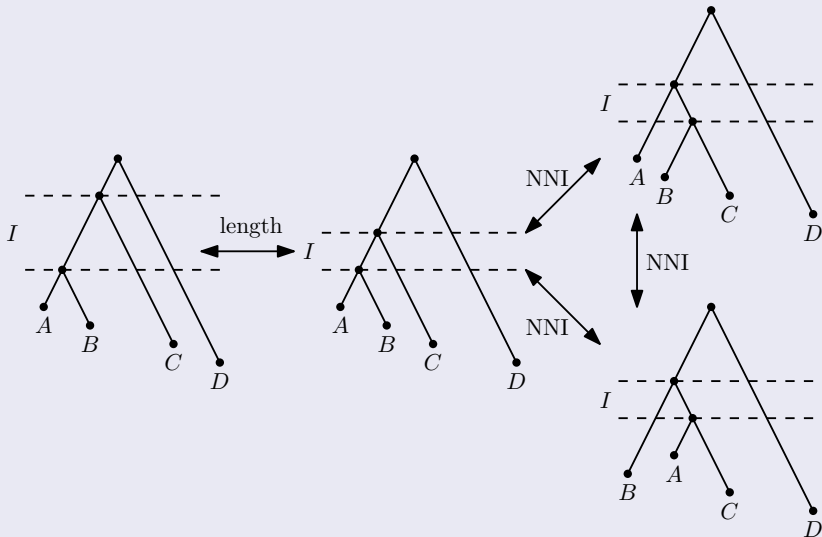


(Discrete) Time-tree



Main definition

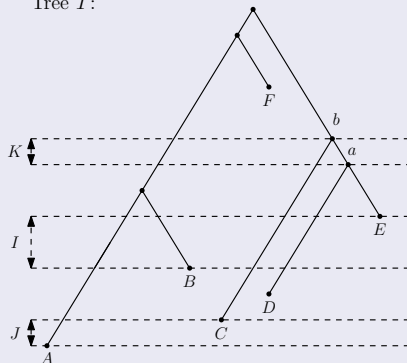
Discrete time-tree space



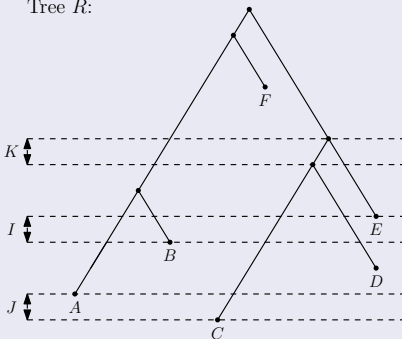
Main example

Trees at distance 3

Tree T :

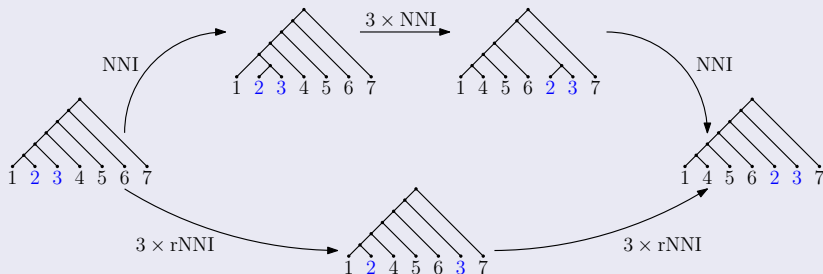


Tree R :



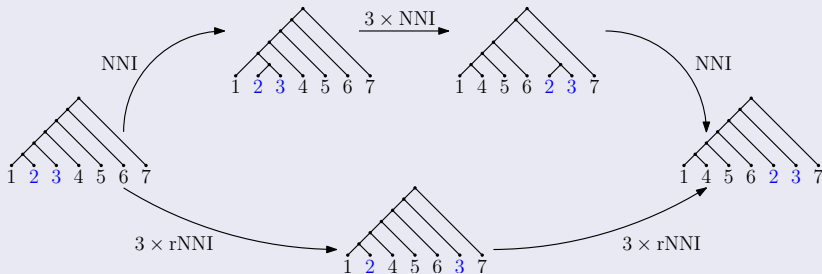
Looks promising

G, Whidden, and Matsen. *arXiv*, to appear in July 2016



Looks promising

G, Whidden, and Matsen. *arXiv*, to appear in July 2016



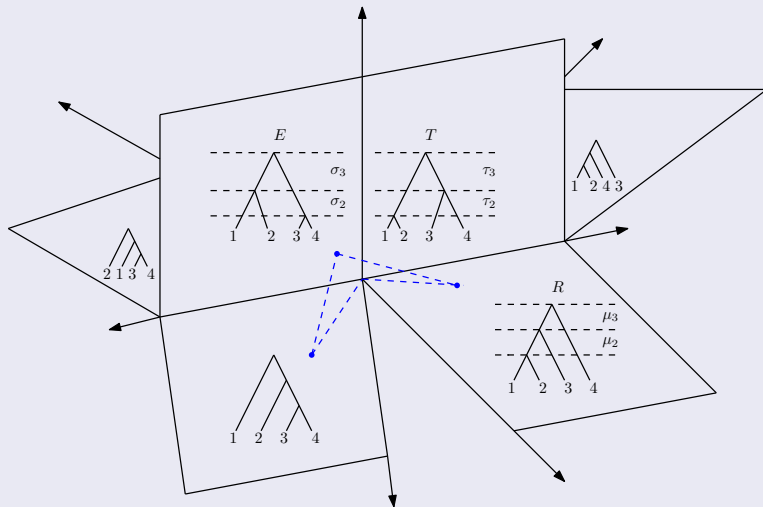
And challenging!

What is the complexity of this graph?

- Over 25 years to solve for NNI
- Over 7 erroneous papers published

Promising indeed

G and Drummond. *JTB*, 2016



Mathematical insight

- Geometry of discrete time-trees
 - Diameter
 - Micro- and macro-geometry
- Random walking
 - Bottle necks
 - Curvature

Mathematical insight

- Geometry of discrete time-trees
 - Diameter
 - Micro- and macro-geometry
- Random walking
 - Bottle necks
 - Curvature

Surprise!

A better bound for the size of r -neighborhoods in NNI.

Take home message

- Time-trees and classical phylogenetic trees have different geometric and algorithmic properties.
- Often, geometric and algorithmic results for classical trees do not scale to time-trees.

Take home message

- Time-trees and classical phylogenetic trees have different geometric and algorithmic properties.
 - Often, geometric and algorithmic results for classical trees do not scale to time-trees.
-
- Math/algorithms:
 - Challenging problems that matter
 - Connections to other areas of math
 - Computing:
 - Amenable to various tree search techniques
 - Natural and efficient data structures

Thank you for your attention!



Alex Gavryushkin and Alexei Drummond

The space of ultrametric phylogenetic trees

Journal of Theoretical Biology, Vol. 402, 197–208, 2016



Alex Gavryushkin, Chris Whidden, and Frederick A. Matsen IV

Combinatorics of discrete time-trees: algorithmic insights and open problems

To appear on the *arXiv*, July 2016



<https://github.com/gavruskin/tauGeodesic>



<https://github.com/gavruskin/tTauCurvature>