# Genealogical Processes including Fossils


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joint work with
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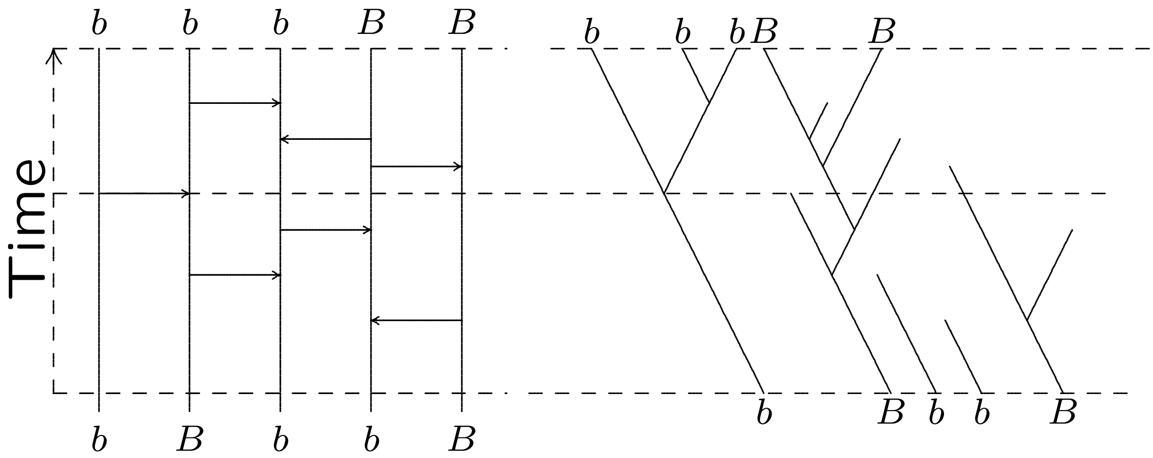
## Genealogies in the Moran model



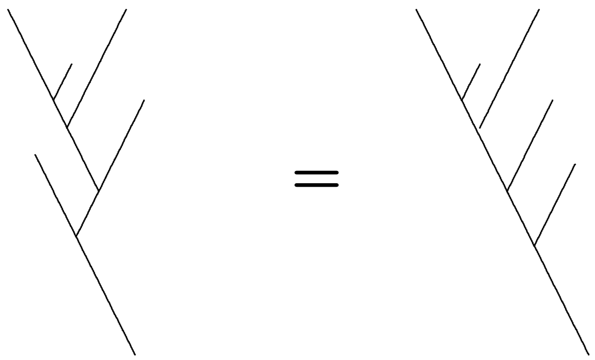

- Fraction of $B$s: $p^N$, Random trees: $T^N$
- $p^N \overset{N\to\infty}{\Longrightarrow} p^\infty$ exists.
  Is there also $T^N \overset{N\to\infty}{\Longrightarrow} T^\infty$?
- What properties does $T^\infty$ have?

## $\mathbb{R}$-trees

- Andreas Dress introduced $\mathbb{R}$-trees.

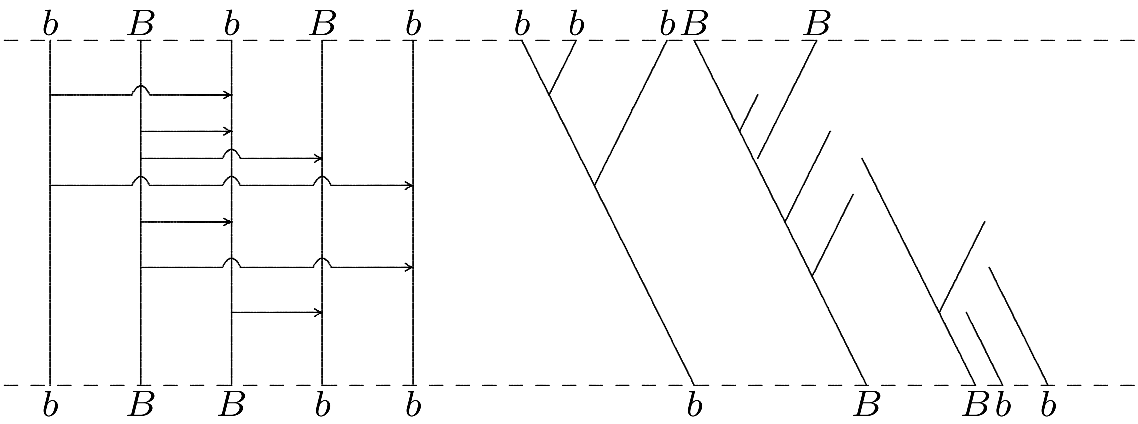
  An $\mathbb{R}$-tree is a complete metric space $(X, d)$ with
  - $\forall x, y \in X \; \exists! \Phi_{x,y} : [0, d(x, y)] \to X :$ $\Phi_{x,y}$ isometry, $\Big(\Phi_{x,y}(0) = x\Big) \wedge \Big(\Phi_{x,y}(d(x, y)) = y\Big)$
  - $\forall \psi : [0, 1] \to X$ injective: $\psi([0, 1]) = \Phi_{\psi(0),\psi(1)}(0, d(\psi(0), \psi(1)))$

- Consequence: These trees are the same



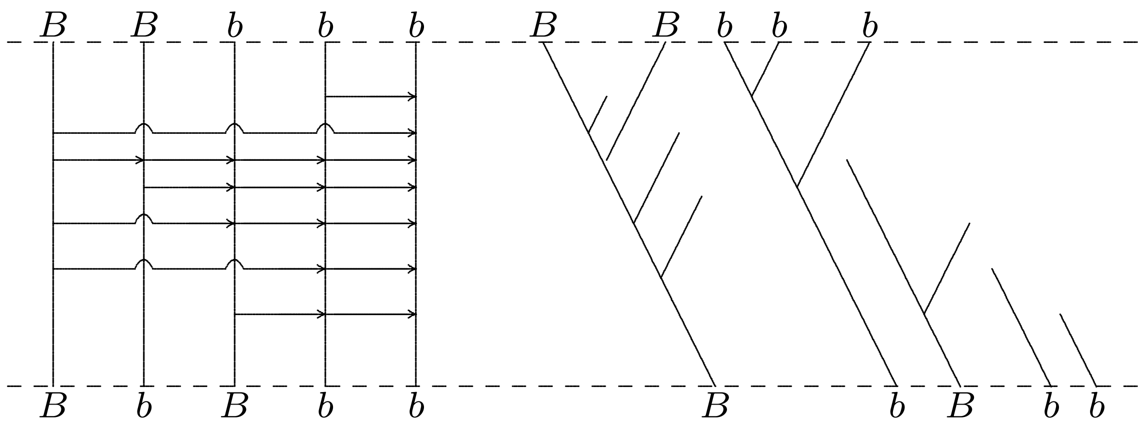
- The space of compact $\mathbb{R}$-trees equipped with the Gromov-Hausdorff-metric gives a complete separable metric space.

## The Lookdown I Process




- Donnelly and Kurtz: $p^N \sim p^{N,LDI}$.
  Also $T^N \sim T^{N,LDI}$ is true.
- $T^{N,LDI} \overset{N\to\infty}{\Longrightarrow} T^\infty$ is constructed by adding single individuals.

## The Lookdown II Process




- Donnelly and Kurtz: $p^N \sim p^{N,LDII}$. Also $T^N \sim T^{N,LDII}$ is true.

- One can remove individuals from $T^\infty$ and obtain $T^N$.

- All $T^N$ can be constructed from $T^\infty$.

## Outlook

- Define dynamics for trees via Martingale problem
- Find a set of functions that separates $\mathbb{R}$-trees
- Include Mutations
- Include substructures in the model. There are corresponding Lookdown Processes constructed by Greven, Limic, Winter
- Quantify the change of trees when selection is present