

Population Genetics

Peerteaching KW24

Samuel Hehn
Swastik Kashyap

Universität Tübingen

10. Juni 2024

Inhalt

The coalescent process

The standard coalescent model

The coalescent process

Population
Genetics

Samuel Hehn
Swastik Kashyap

“*to coalesce*”: grow together, to join, to fuse

The coalescent
process

The standard
coalescent model

The coalescent process

Population
Genetics

Samuel Hehn
Swastik Kashyap

“to coalesce”: grow together, to join, to fuse

Definition (coalescent event)

If traversing the sequence-transmission paths backward in time, two sequence transmission paths intersect at some sequence, the paths coalesce at that intersection point. This is called a coalescent event.

The coalescent
process

The standard
coalescent model

The coalescent process

Population
Genetics

Samuel Hehn
Swastik Kashyap

“to coalesce”: grow together, to join, to fuse

Definition (coalescent event)

If traversing the sequence-transmission paths backward in time, two sequence transmission paths intersect at some sequence, the paths coalesce at that intersection point. This is called a coalescent event.

Basic idea

The coalescent
process

The standard
coalescent model

The coalescent process

Population
Genetics

Samuel Hehn
Swastik Kashyap

“to coalesce”: grow together, to join, to fuse

Definition (coalescent event)

If traversing the sequence-transmission paths backward in time, two sequence transmission paths intersect at some sequence, the paths coalesce at that intersection point. This is called a coalescent event.

Basic idea

- ▶ Start with present-day generation

The coalescent
process

The standard
coalescent model

The coalescent process

“to coalesce”: grow together, to join, to fuse

Definition (coalescent event)

If traversing the sequence-transmission paths backward in time, two sequence transmission paths intersect at some sequence, the paths coalesce at that intersection point. This is called a coalescent event.

Basic idea

- ▶ Start with present-day generation
- ▶ Construct previous generations

The coalescent process

“to coalesce”: grow together, to join, to fuse

Definition (coalescent event)

If traversing the sequence-transmission paths backward in time, two sequence transmission paths intersect at some sequence, the paths coalesce at that intersection point. This is called a coalescent event.

Basic idea

- ▶ Start with present-day generation
- ▶ Construct previous generations
- ▶ By randomly choosing parents in the previous generation

The coalescent process

Example

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

The coalescent process

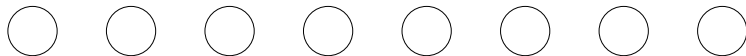
Example

Population
Genetics

Samuel Hehn
Swastik Kashyap

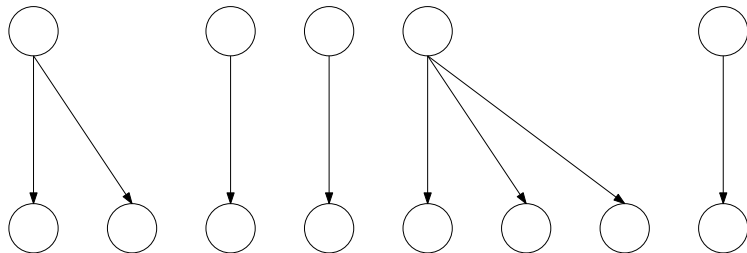
The coalescent
process

The standard
coalescent model



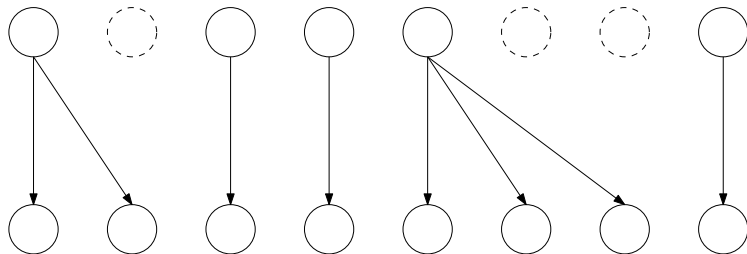
The coalescent process

Example



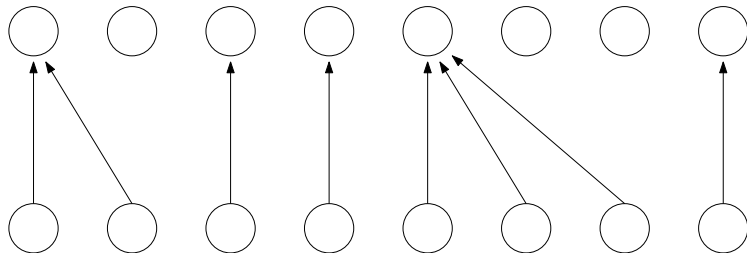
The coalescent process

Example



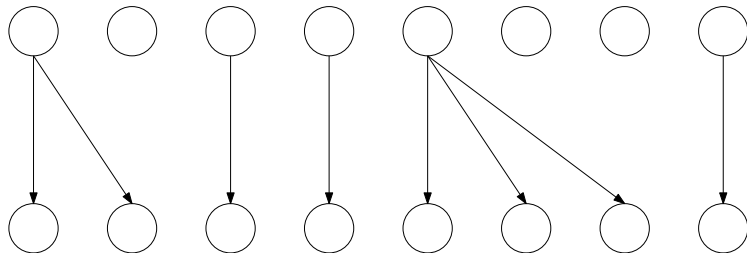
The coalescent process

Example



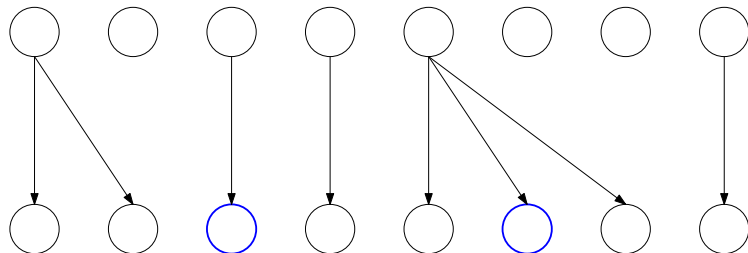
The coalescent process

Example



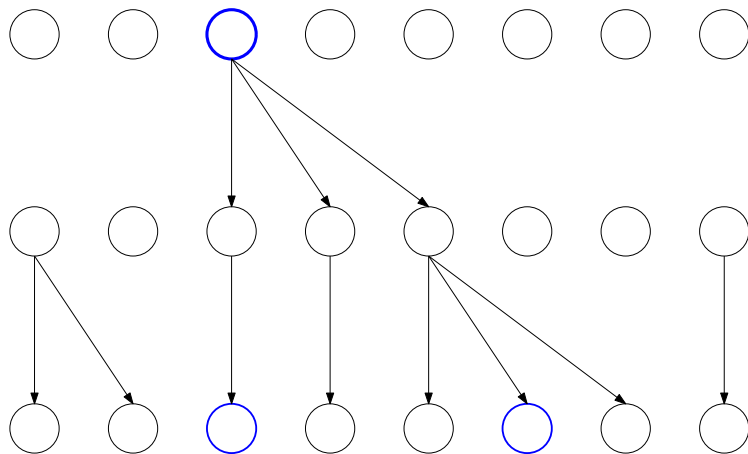
The coalescent process

Example



The coalescent process

Example



The standard coalescent model

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Construct a tree based on estimated coalescent events.
Needs more content

Coalescence of 2 genes

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

Coalescence of 2 genes

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

We want to know two things:

Coalescence of 2 genes

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

We want to know two things:

1. When did the two genes coalesce?

Coalescence of 2 genes

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

We want to know two things:

1. When did the two genes coalesce?
→ Who is their common ancestor

Coalescence of 2 genes

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

We want to know two things:

1. When did the two genes coalesce?
→ Who is their common ancestor
2. How long is the waiting time until the two genes coalesced?

Coalescence of 2 genes

Considering a haploid model with n genes.

For two present day genes i and j , when did they coalesce?

We want to know two things:

1. When did the two genes coalesce?
→ Who is their common ancestor
2. How long is the waiting time until the two genes coalesced?
→ How many generations back is their common ancestor?

Coalescence of 2 genes

When did the two genes coalesce?

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Coalescence of 2 genes

When did the two genes coalesce?

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

We select a random ancestor for each individual:

Coalescence of 2 genes

When did the two genes coalesce?

We select a random ancestor for each individual:
Probability to select the right ancestor of i is 1, since there are no requirements.

Coalescence of 2 genes

When did the two genes coalesce?

We select a random ancestor for each individual:

Probability to select the right ancestor of i is 1, since there are no requirements.

Probability to select the right ancestor of j is

Coalescence of 2 genes

When did the two genes coalesce?

We select a random ancestor for each individual:

Probability to select the right ancestor of i is 1, since there are no requirements.

Probability to select the right ancestor of j is

$$\frac{1}{n}$$

since we need to "hit" the ancestor we've chosen for i .

Coalescence of 2 genes

How long is the waiting time until the two genes coalesced?

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Coalescence of 2 genes

How long is the waiting time until the two genes coalesced?

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

What is the Probability that the common ancestor is in
Generation n ?

Coalescence of 2 genes

How long is the waiting time until the two genes coalesced?

What is the Probability that the common ancestor is in
Generation n ?
($n - 1$ failures following one success)

Coalescence of 2 genes

How long is the waiting time until the two genes coalesced?

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

What is the Probability that the common ancestor is in
Generation n ?

($n - 1$ failures following one success)

$$\left(1 - \frac{1}{n}\right)^{n-1}$$

Coalescence of 2 genes

How long is the waiting time until the two genes coalesced?

What is the Probability that the common ancestor is in
Generation n ?

($n - 1$ failures following one success)

$$\left(1 - \frac{1}{n}\right)^{n-1} \cdot \left(\frac{1}{n}\right)$$

Coalescence of k genes

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model

Continuous time coalescent model

Population
Genetics

Samuel Hehn
Swastik Kashyap

The coalescent
process

The standard
coalescent model