Inferring Influence Networks of Grapheme Innovation in Classic Maya Hieroglyphic Writing

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Problem definition

- *How to infer social ties based on shared linguistic traits?*
- *Determine whether the inferred networks map on to the known social ties.*
- Assumption:
  similarity in linguistic traits ⇒ social influence
  - social influence: unobserved
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Maya Hieroglyphic Database

- ► $\sim$ 250 known settlements/sites - ca. 200 – 1000 CE
- ► $\sim$ 3000 monuments
- ► 75, 359 glyph blocks
  - ► graphemes $\sim$ 956 (unique), 119, 109 inscriptions
  - ► social relationships $\sim$ 415 records from 79 different sites

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A sample monument
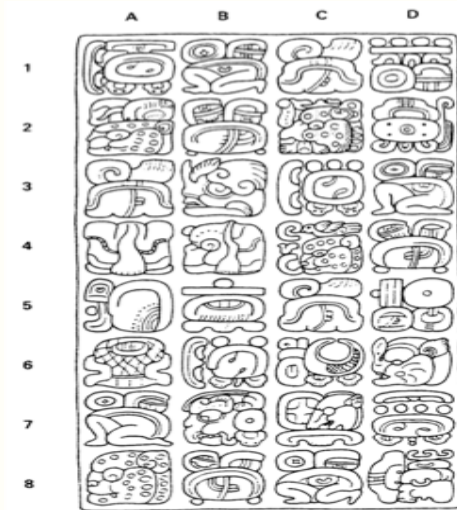
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Inferring paths of influence

Sites

Inferring paths of influence

Sites + inscription timelines of a grapheme
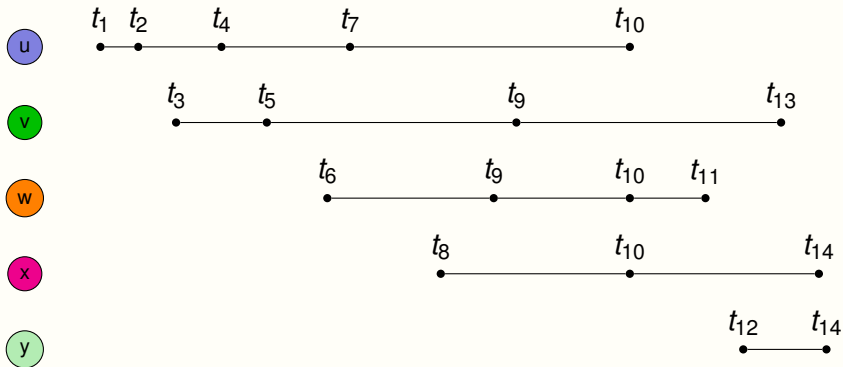
Inferring paths of influence

Step 1: All potential sources of influence
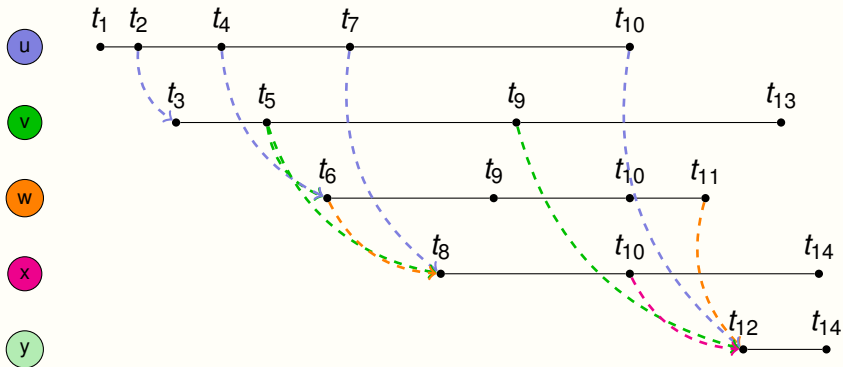
Inferring paths of influence

Step 2: Select strongest influence
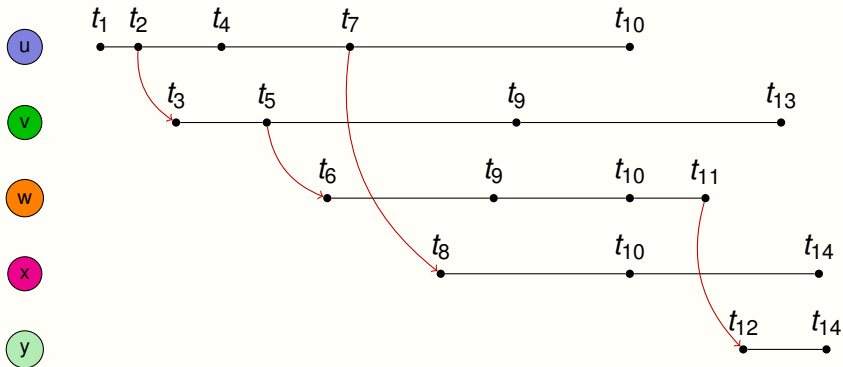
Inferring paths of influence

Step 1: *Directed Acyclic Graph* of influence
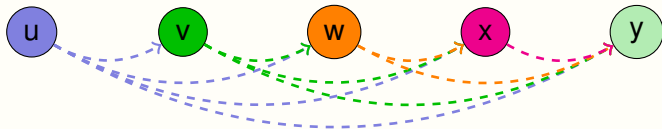
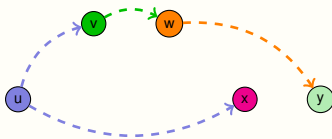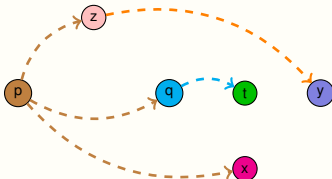# Inferring paths of influence

Step 2: Influence propagation tree
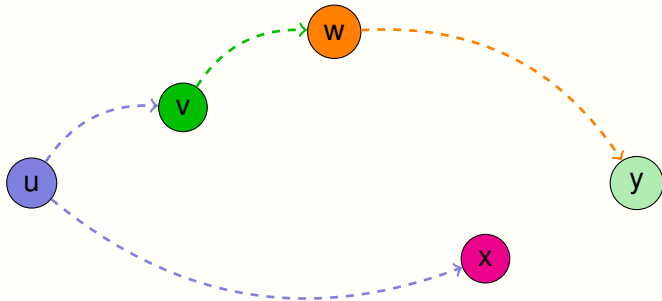
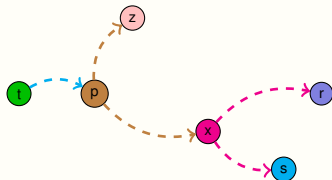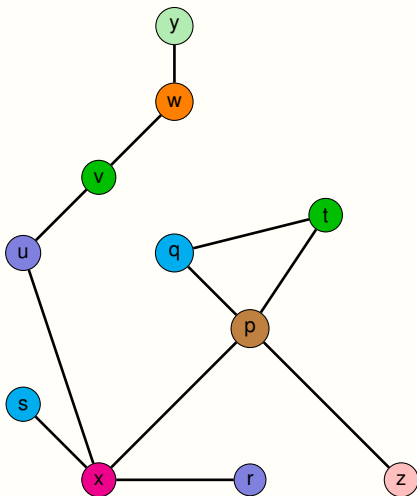# Inferring paths of influence
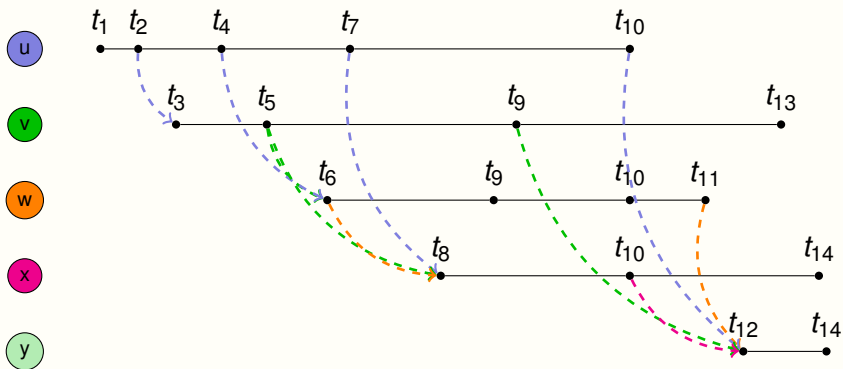
Step 3: Influence graph

Inferring paths of influence
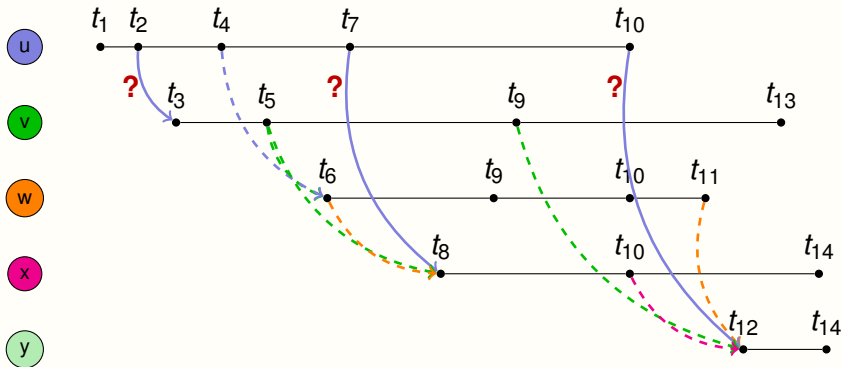
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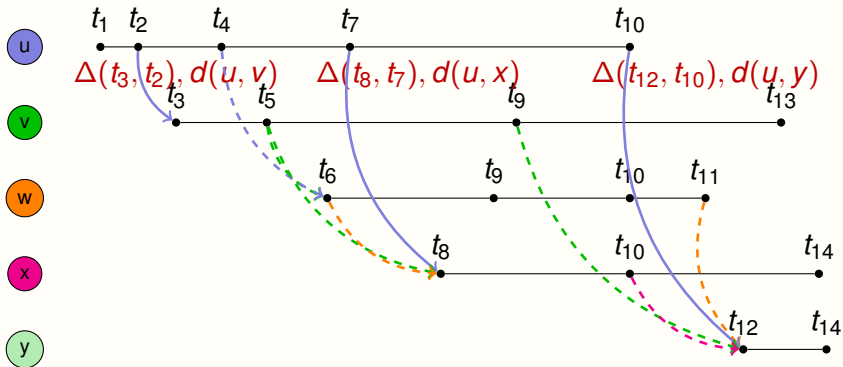
Measure of influence

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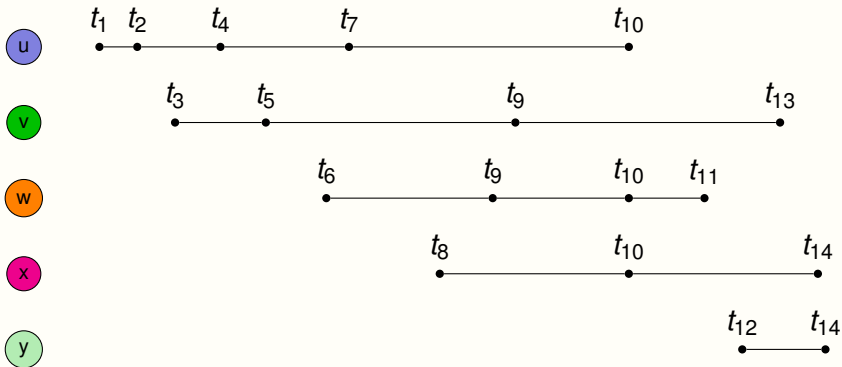Exponential waiting time distribution for influence propagation

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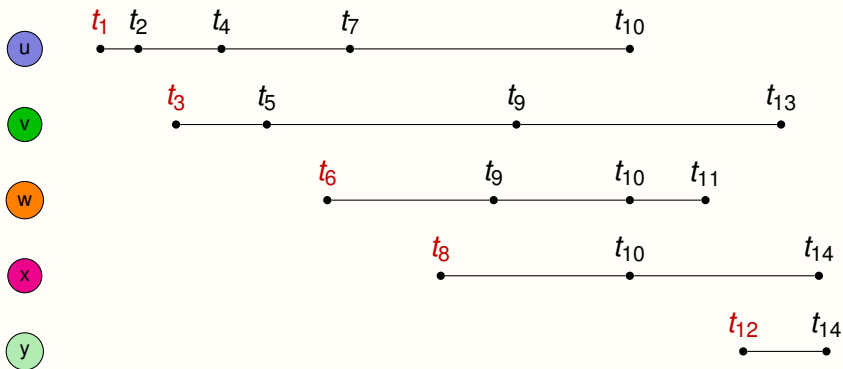Exponential waiting time distribution for influence propagation

Properties of the inference framework
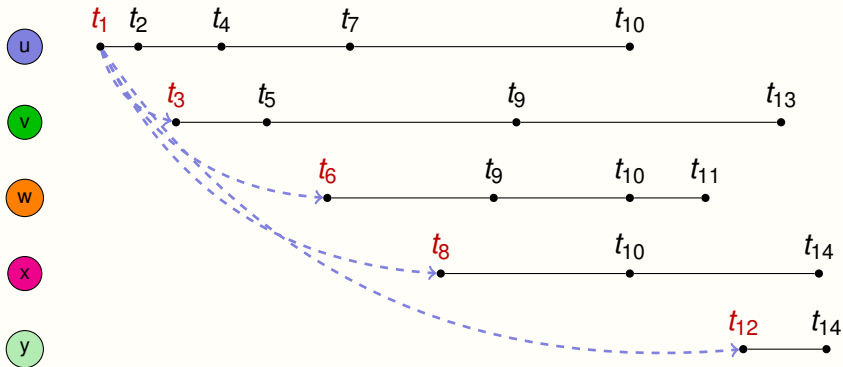
Properties of the inference framework

First recording of a grapheme: time of *"influence"*

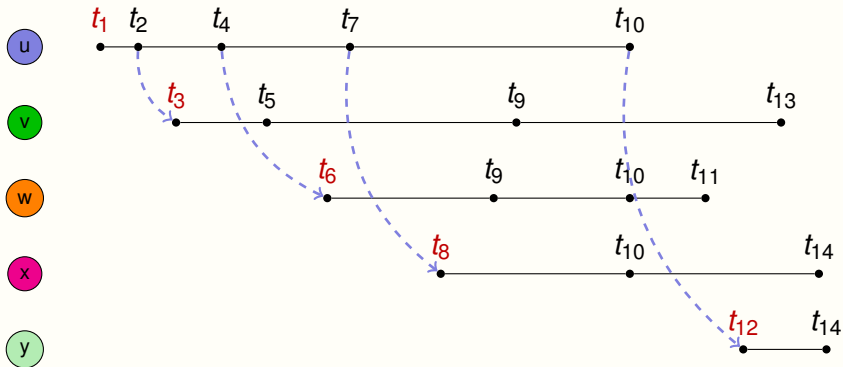# Properties of the inference framework

First time of inscription at a site determines the directionality of the influence
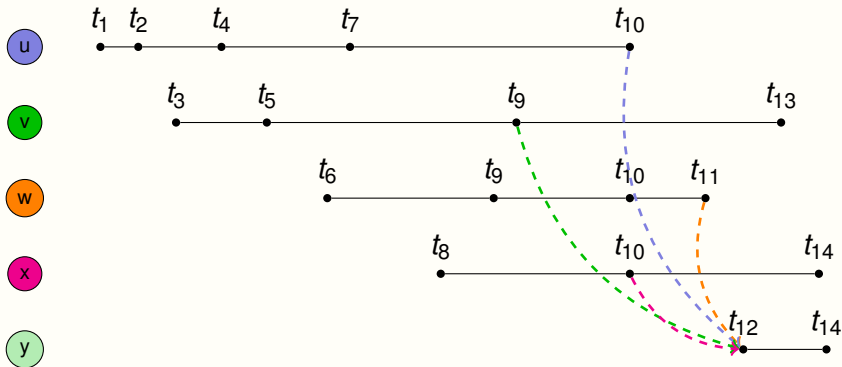
Properties of the inference framework

Strength of influence: latest inscription before adoption

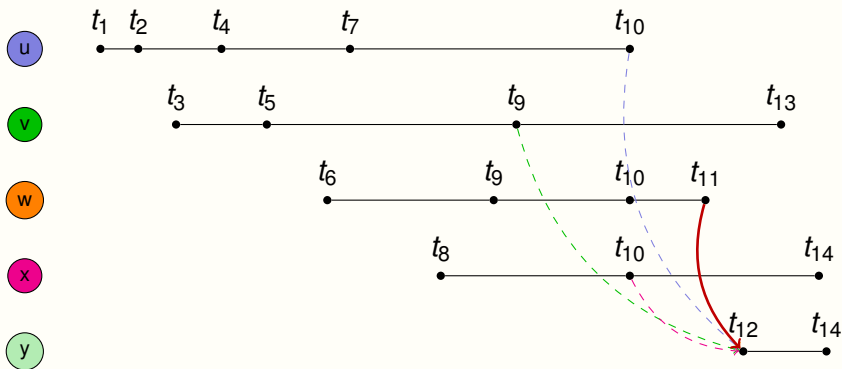# Properties of the inference framework

Source of influence: shortest time difference between latest inscription and adoption

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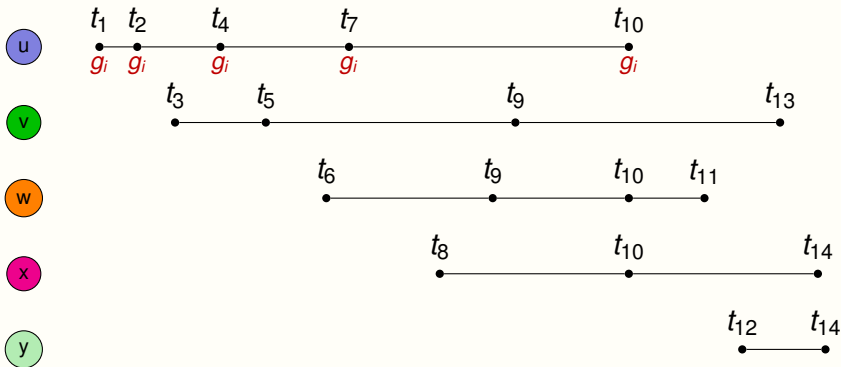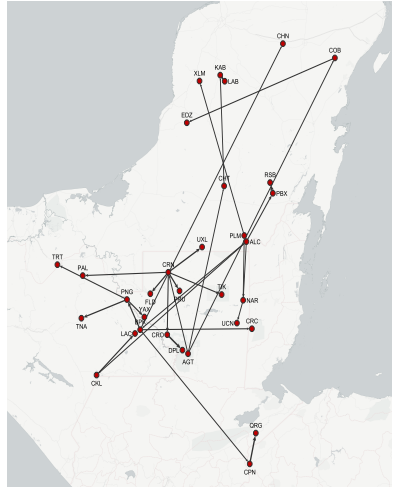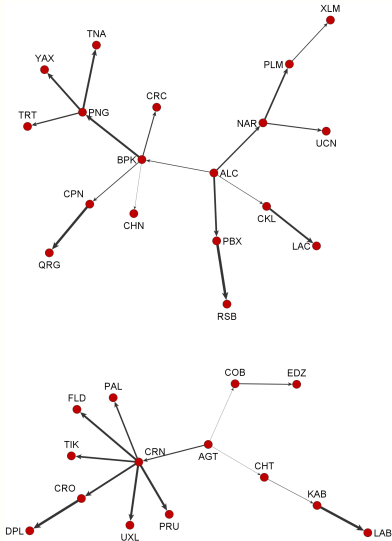# Properties of the inference framework

Grapheme is unchanging at least for the time period of observations under study
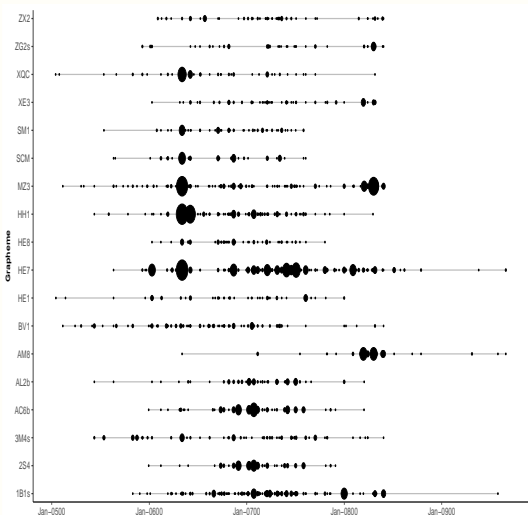
Results

Influence propagation tree of **BV1** grapheme

Results

Inscription timelines of a selected sample of graphemes

Results

Influence graph based on the 18 graphemes
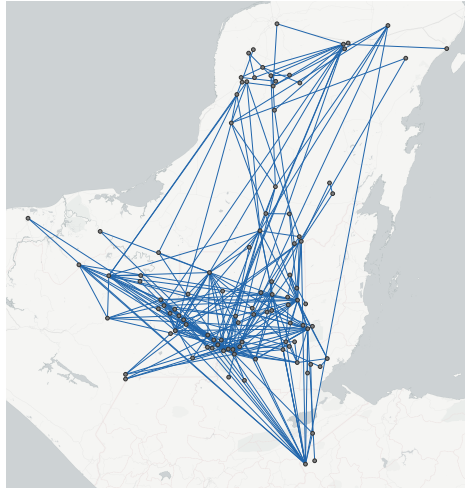
Results

Relationship graph
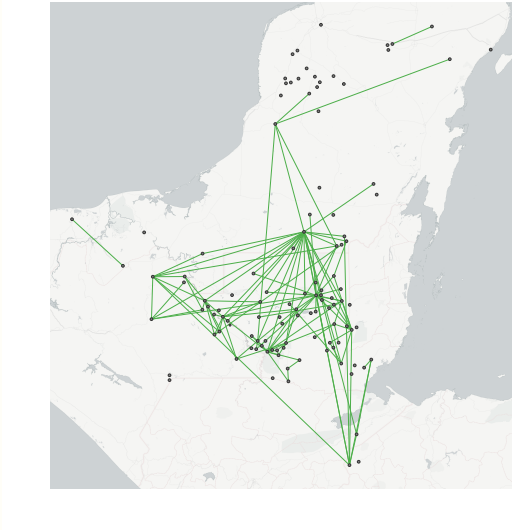
Results

Comparison of relationship graph with inferred influence paths

Future steps

- ▶ Inferring complex diffusion graphs:
  - ▶ multiple sources of influence
  - ▶ increasing the number of graphemes
- ▶ Robustness of the inference model: cross validation
- ▶ Incorporating relationship data as an explanatory variable
- ▶ No. of inscriptions of a grapheme
- ▶ "Linguistic attributes" of graphemes

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