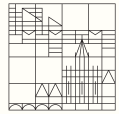
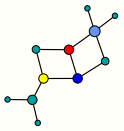


Social shifts in the Late Pre–hispanic US Southwest

Habiba, Jan C. Athenstädt & Ulrik Brandes

Department of Computer & Information Science
University of Konstanz

April 17, 2015



Agenda

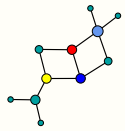
Introduction

- History
- Mills et al. (2013):Transformation of social networks in the late pre–Hispanic US Southwest
- B-R: Under the magnifying glass
- Follow–up questions

Beyond Brainerd–Robinson

- Alternative measures of similarity
- Across–Time Comparison

ViSim - A tool to explore similarities among sites



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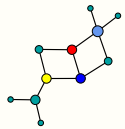
- US Southwest (A.D. 1200–1450): large-scale demographic changes
  - long-distance migration (from north to south in late 1200s)
  - population aggregation (in south in 1300s)



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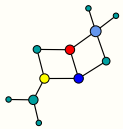

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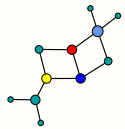

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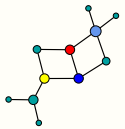
Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 200 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: exchanges movement migrations emulations = Similarity in consumption of wares



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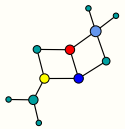

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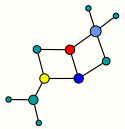

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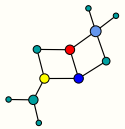

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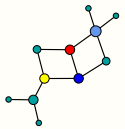

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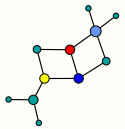

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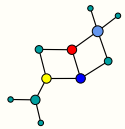
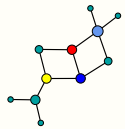


B-R: Under the magnifying glass

Sampling bias

	Site A	Site B	Site C
Type 1	80%	80%	0%
Type 2	15%	5%	75%
Type 3	5%	15%	25%

- $BR(A, B) = 180 \quad BR(A, C) = 40$
- $BR(A, C) = 100$



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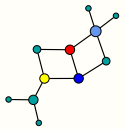

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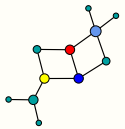

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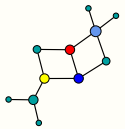

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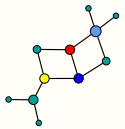

B-R: Under the magnifying glass

Symmetric similarity

	Site A	Site B	Site C
Type 1	40%	20%	20%
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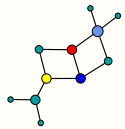
- $B, C \subset A$



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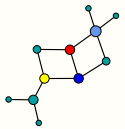

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B-R: Under the magnifying glass

Aggregation

	Site A	Site B	Site C	Site D
Type 1	80%	100%	25%	35%
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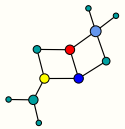
Type 3	5%	0%	30%	20%
Type 4	10%	0%	10%	5%

- $BR(A, B) = 160 \quad BR(C, D) = 160$
- C, D both contain all types and differ by atmost 10 % in quantity
- A, B, B contains only Type 1 whereas A contains all the types.



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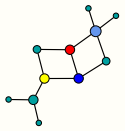

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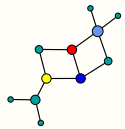

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3. How much is the evolving “identity” of settlements indicative of movement trends?

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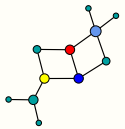

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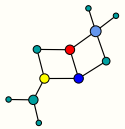

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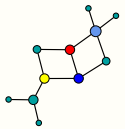
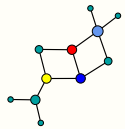


Reconstructing social shifts

Proposed Extensions

1. Asymmetric similarity - dominance relationship
2. Ranking of wares/types
3. Index of significance of wares/types
4. Across–time comparison



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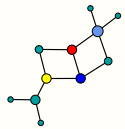

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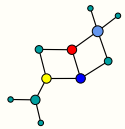

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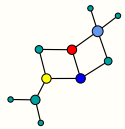

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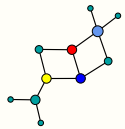

Reconstructing social shifts

Asymmetric similarity based on dominance relationship

- Integral: A site x is dominated by a site y or the site x is completely contained in the site y if and only if the set of distinct items found on site x is a proper subset of the set of distinct items found on site y.

$$S_R(x,y) = \begin{cases} 1 & \text{if } B_{x,i} \geq B_{y,i} \forall i \in [1,n] \\ 0 & \text{otherwise} \end{cases}$$

- Fractional: A site x is dominated by another site y, if each type present in x is also present in y. It is strictly dominated, if it is dominated and there is at least one type in y that is not present in x.

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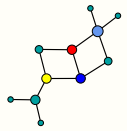

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- Fractional: A site x is dominated by another site y, if each type present in x is also present in y. It is strictly dominated, if it is dominated and there is at least one type in y that is not present in x.

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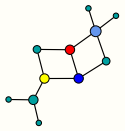

Reconstructing social shifts

Asymmetric similarity based on dominance relationship

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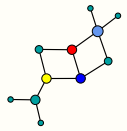


Reconstructing social shifts

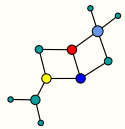
Similarity based on relative ranking of wares

- Parametrized: k-out-of-top-l
  A pair of sites are similar to each other if they have l of k top ranked wares common among them.

$$S_R(x,y) = \begin{cases} 1 & \text{if } |V_R^x[1:k] \cap V_R^y[1:k]| \geq l \\ 0 & \text{otherwise} \end{cases}$$

- Non–parametrized: Maximum Quasi–Jaccard
  A pair of sites are k similar to each other for the maximal k of p types that they can be similar in.

$$S_R(x,y) = \arg\max_k \frac{|V_R^x[1:k] \cap V_R^y[1:k]|}{|V_R^x[1:k] \cup V_R^y[1:k]|}$$



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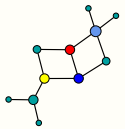

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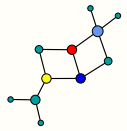

Reconstructing social shifts

Index of Significance of Wares

- *TF − IDF*: (*term frequency–inverse document frequency*), is a numerical statistic that is intended to depict the importance of a word in a document.
  - $f(i, x)$: frequency of each ware i in site x.
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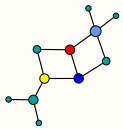

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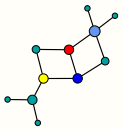

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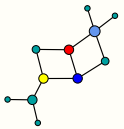

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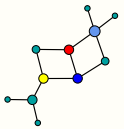

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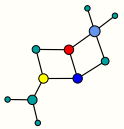

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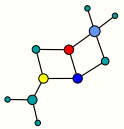

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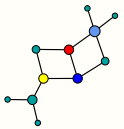

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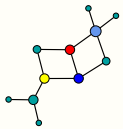
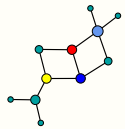


Beyond Brainerd–Robinson

Across–Time Comparison

- Long distance movement/migration/resettlement
- Shorter/longer distance movements



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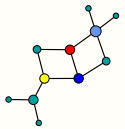

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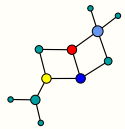

ViSim

A tool to explore similarities among settlements