

CAA2016

Co-evolution of trade and culture Impact of cultural network topology on economic dynamics.

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31 March 2016

Barcelona Supercomputing
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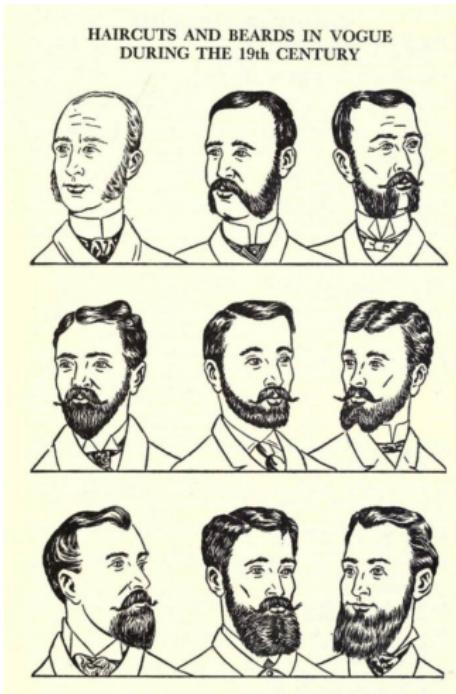


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Plan of the presentation

1. Co-evolution of trade and culture
2. The Model
3. Cultural Network Topologies

Cultural Evolution



How Social Traits Evolve?

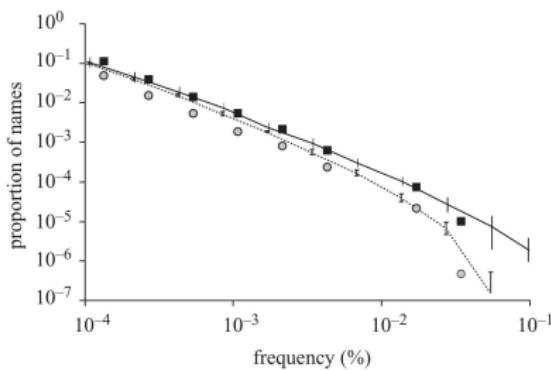
Cultural Evolution



What Generate Those Cultural Changes?

Simple mechanisms (Bentley et al, 2004):

- ▶ Random Copy
- ▶ Frequency biased (conformist/anti-conformist...)
- ▶ ...



Square: male names
Circle: female names
Dotted and plain lines: model result with different copy probabilities.
From Bentley et al, 2004.

Trade and Cultural Network

What happens when such mechanisms act on social traits impacting trade?



Traits + artefacts with
“economic” value (ie Context or
Content Biased).

- ▶ “Usefulness”
- ▶ popularity
- ▶ availability
- ▶ ...

Co-evolution of Trade and Culture

Interaction between Culture and Trade

Social Interactions transform Trade Mechanisms



Trade mechanisms change Social Interactions

A General Agent Based Framework

Two main components:

1. Trade side: Bartering Economy (Gintis 2009),
2. Cultural side: “copy the most successful” (Bentley 2006).

The Model

1. The Economy & the Barter Mechanism

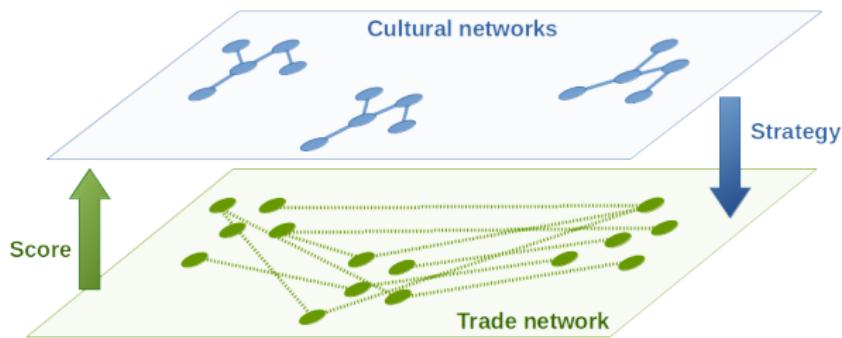
- ▶ N goods
- ▶ M Agent $\begin{cases} \text{a quantity of each Goods} \\ N \text{ values attributed to each goods} \end{cases}$
- ▶ Agents *produce* one good and *exchange* it to obtain the other goods.
- ▶ After the exchange, the agents *consume* all goods

Agent perform this 10 times and a scores is given to each of them.

The Model

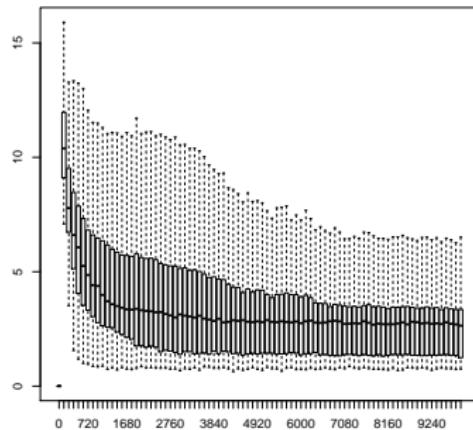
2. Cultural Mechanisms

- ▶ Less successful agents *copy* the most successful (Biased-Copy).
- ▶ Given a probability μ the value attributed to some goods is modified (Innovation/Mutation)



The Model

Figure: Example for 3 goods and 600 agents

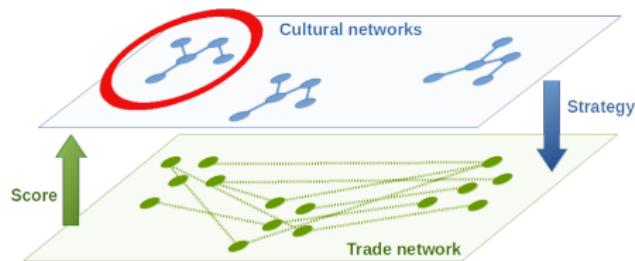


@ Equilibrium: mean of score \rightarrow score max.

Experiments

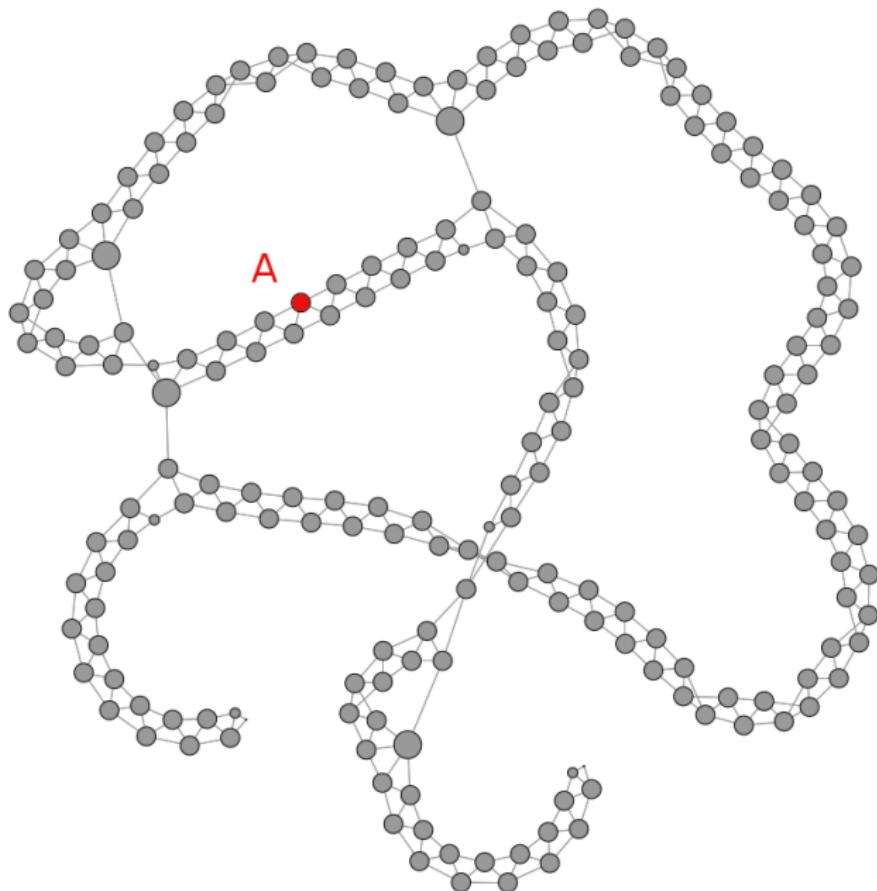
Impact of the topology of the cultural network

"What properties of the cultural network influence the economic dynamics? "

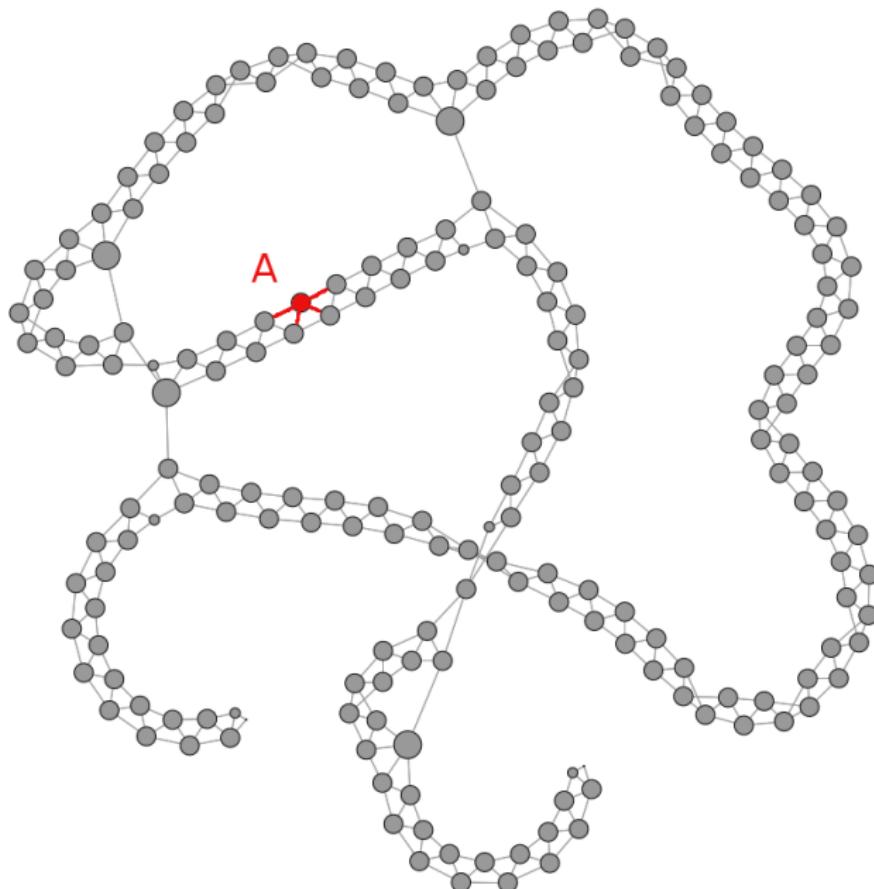


→ Average Distance vs Average Degree

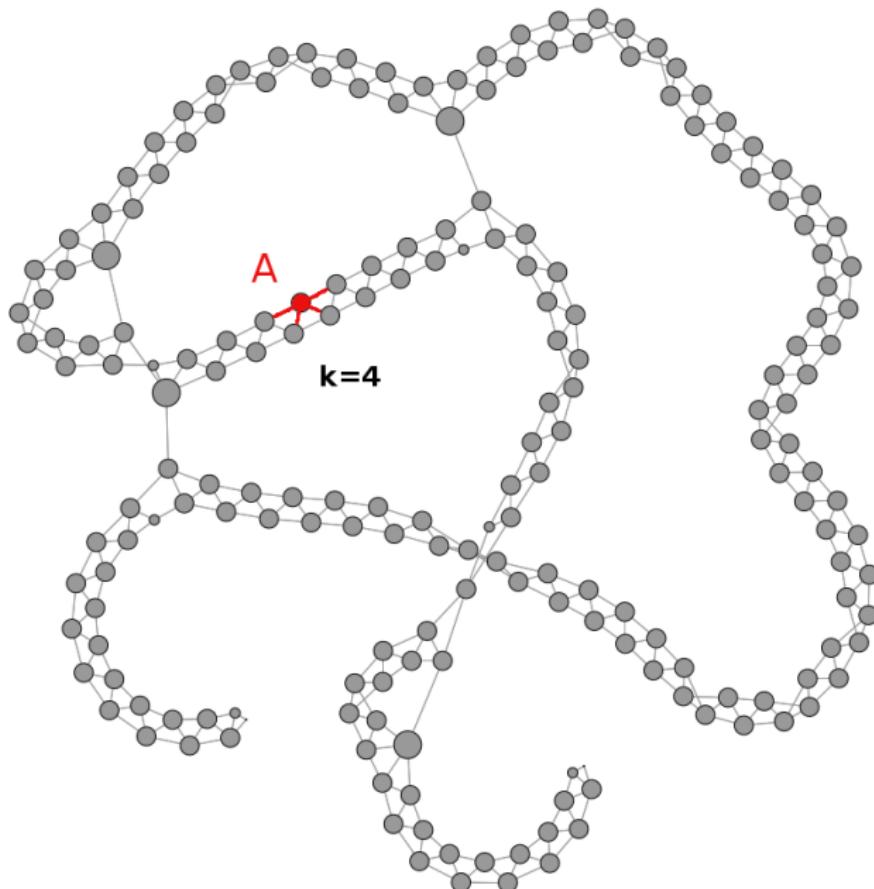
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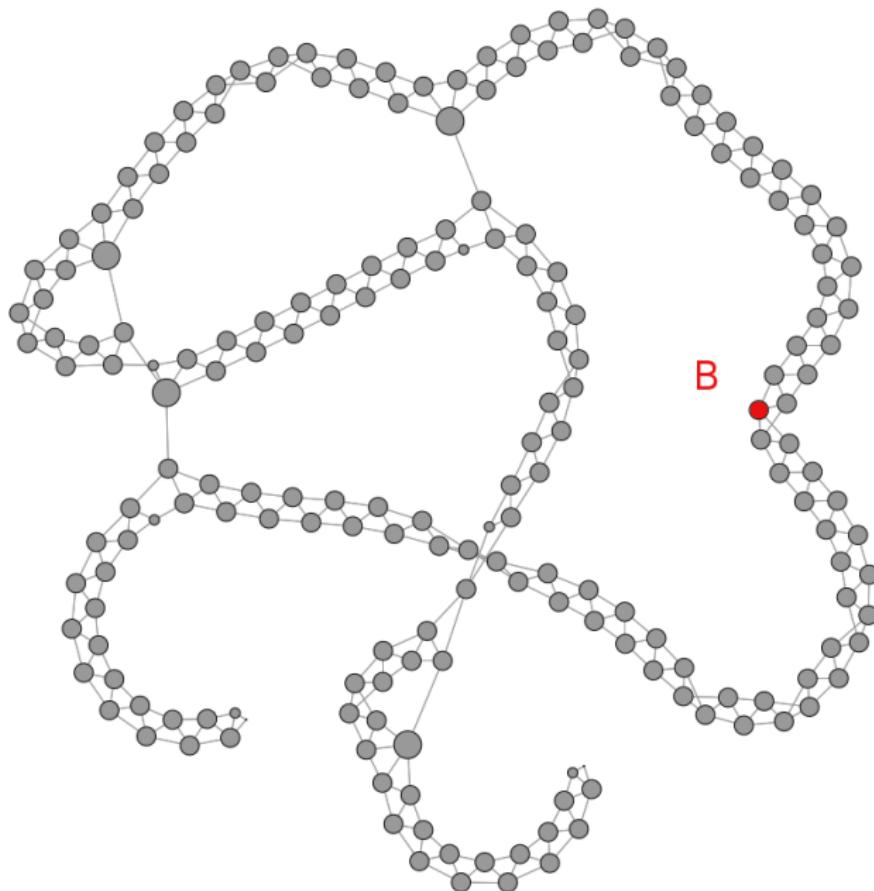
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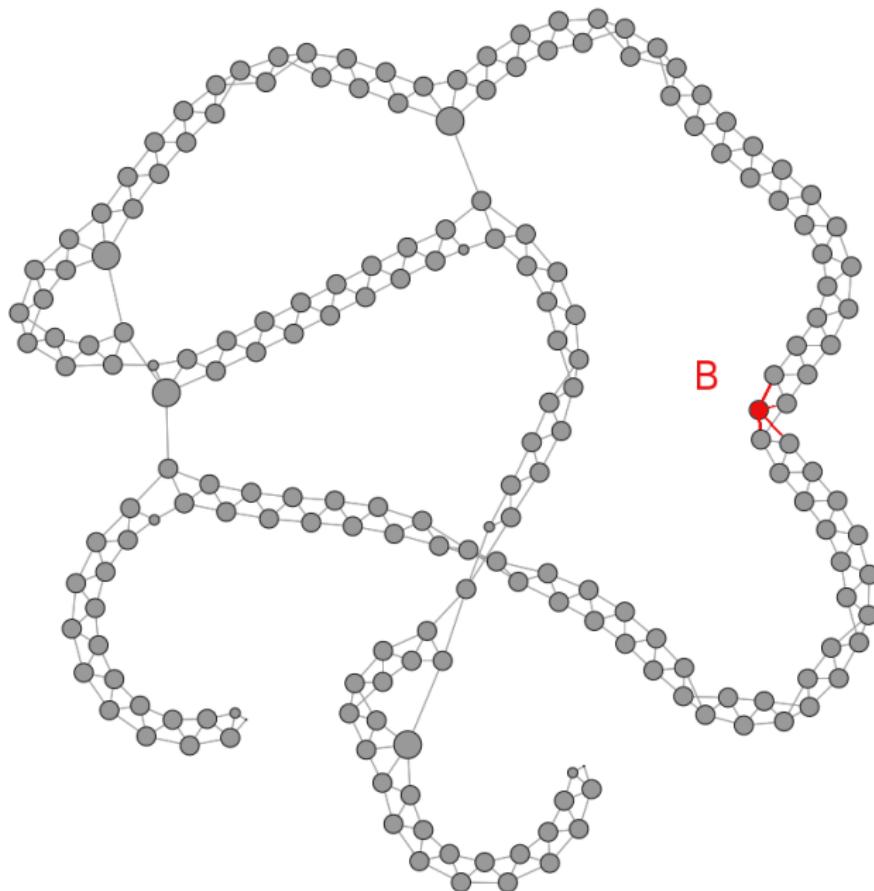
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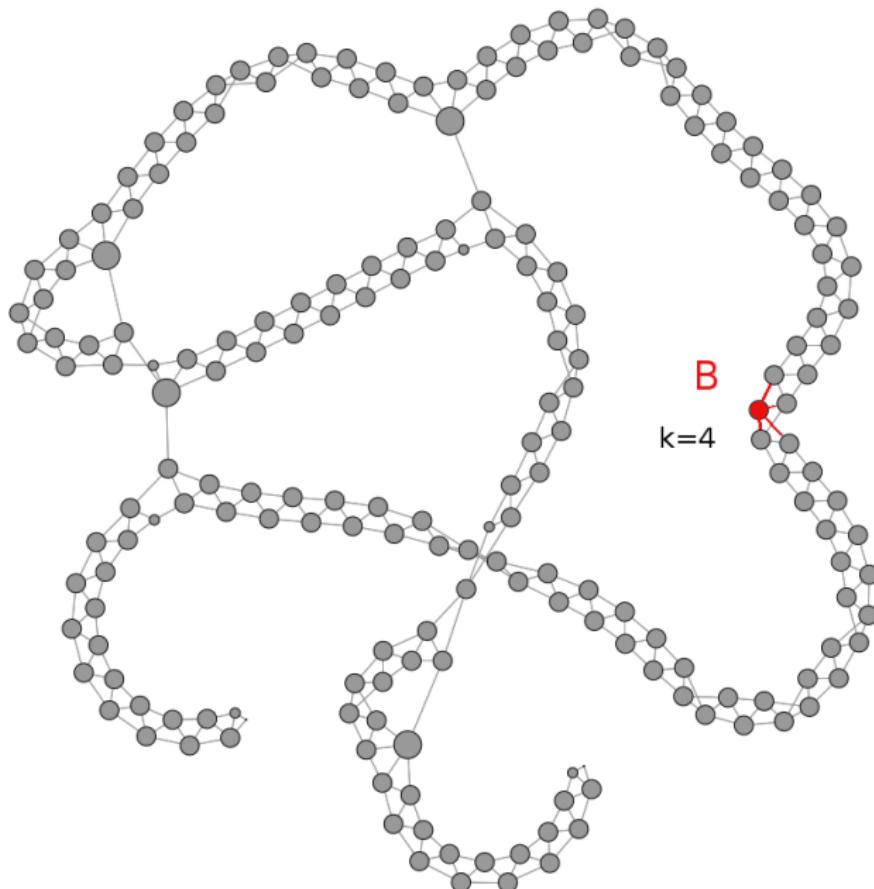
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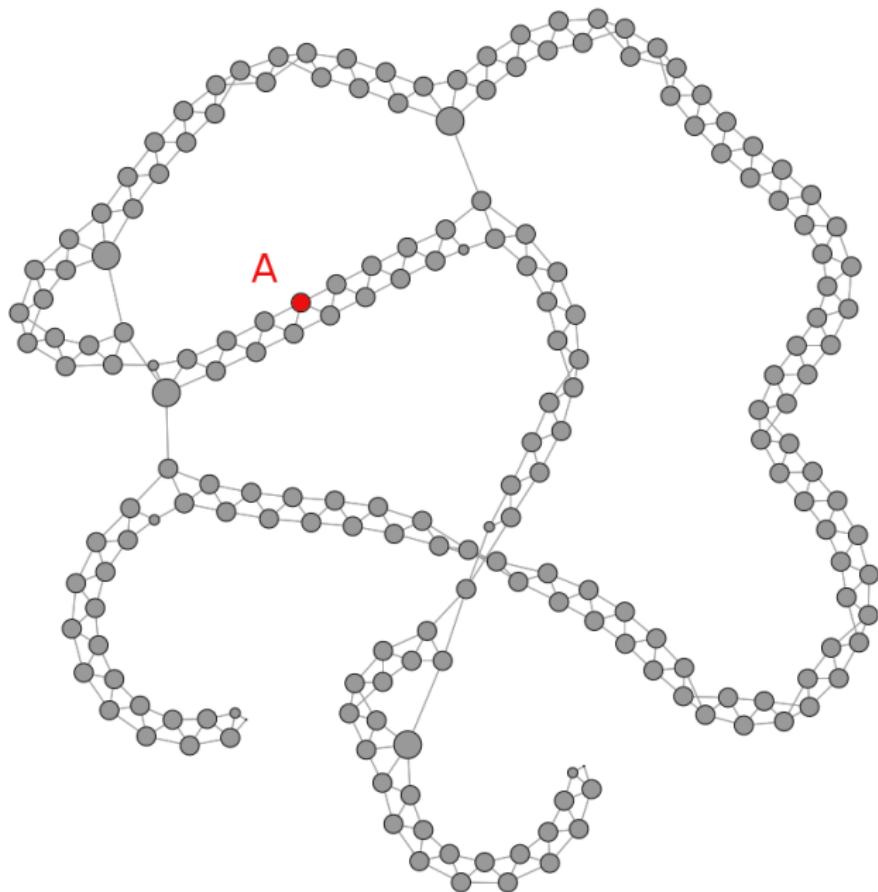
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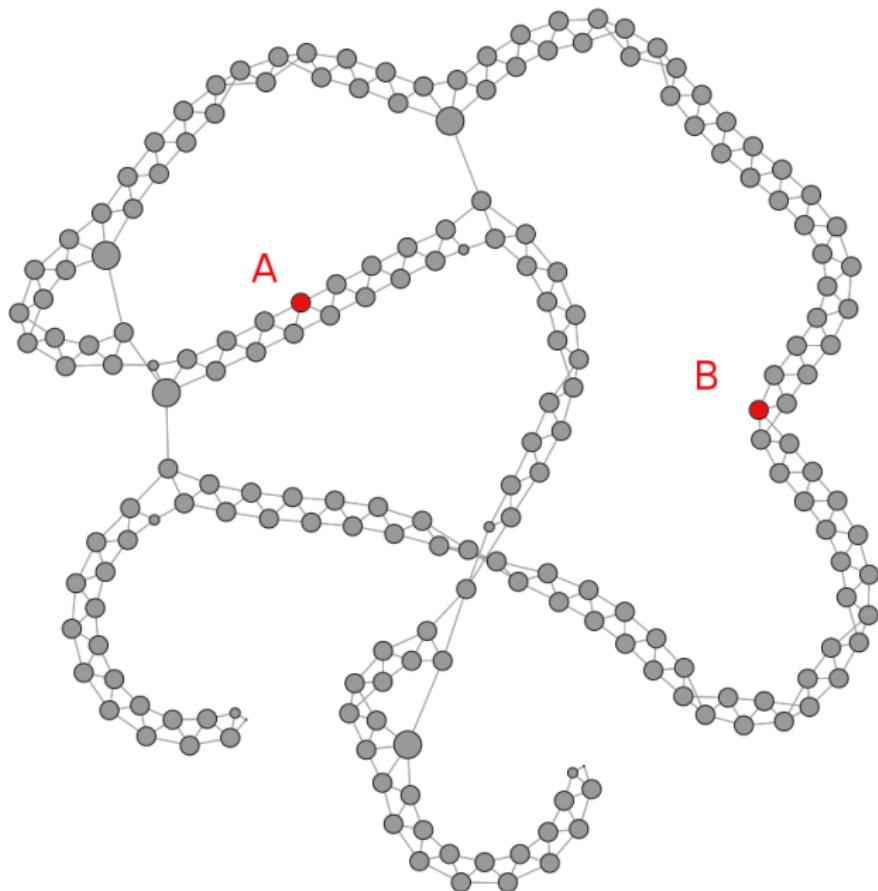
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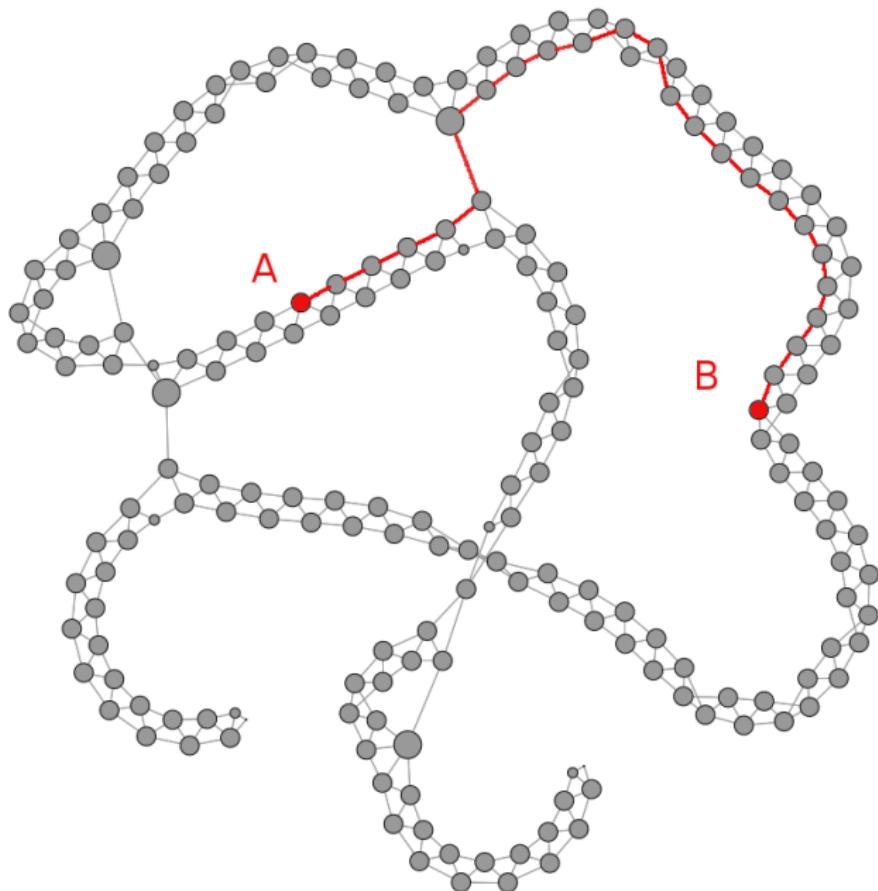
Shortest Path Length



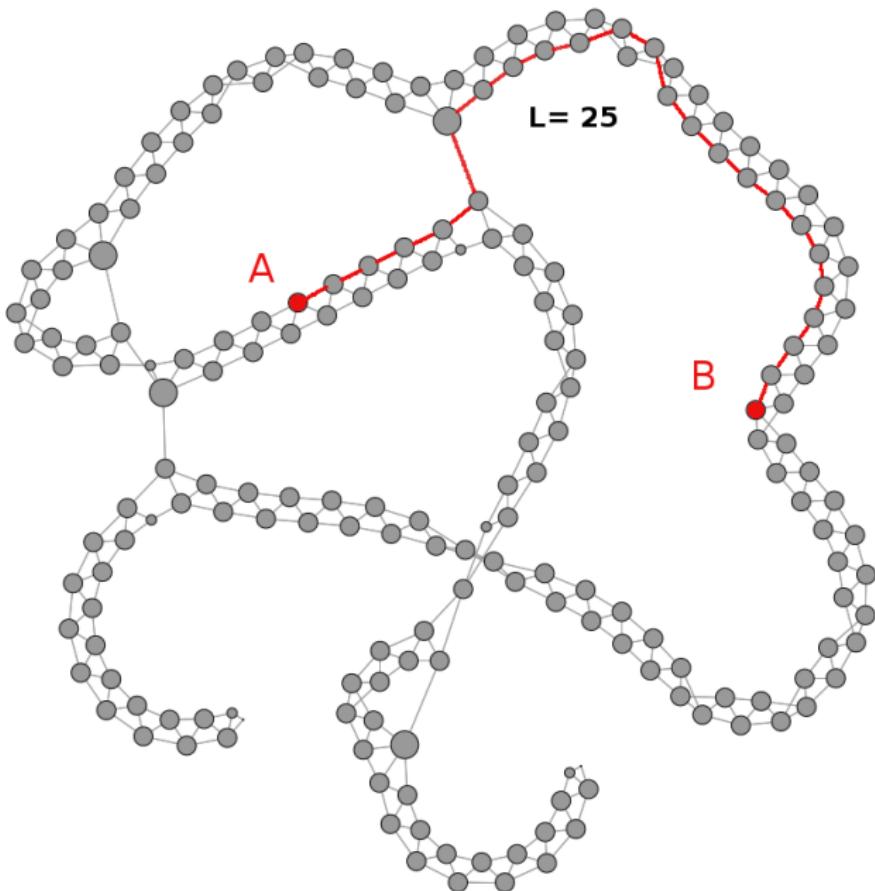
Shortest Path Length



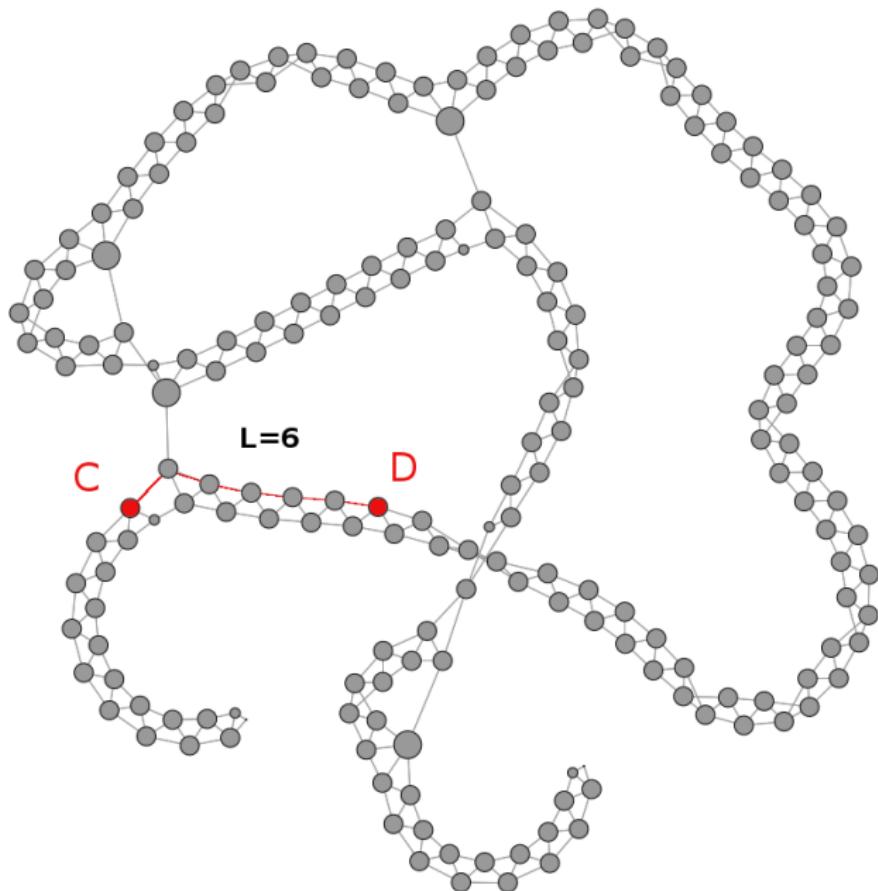
Shortest Path Length



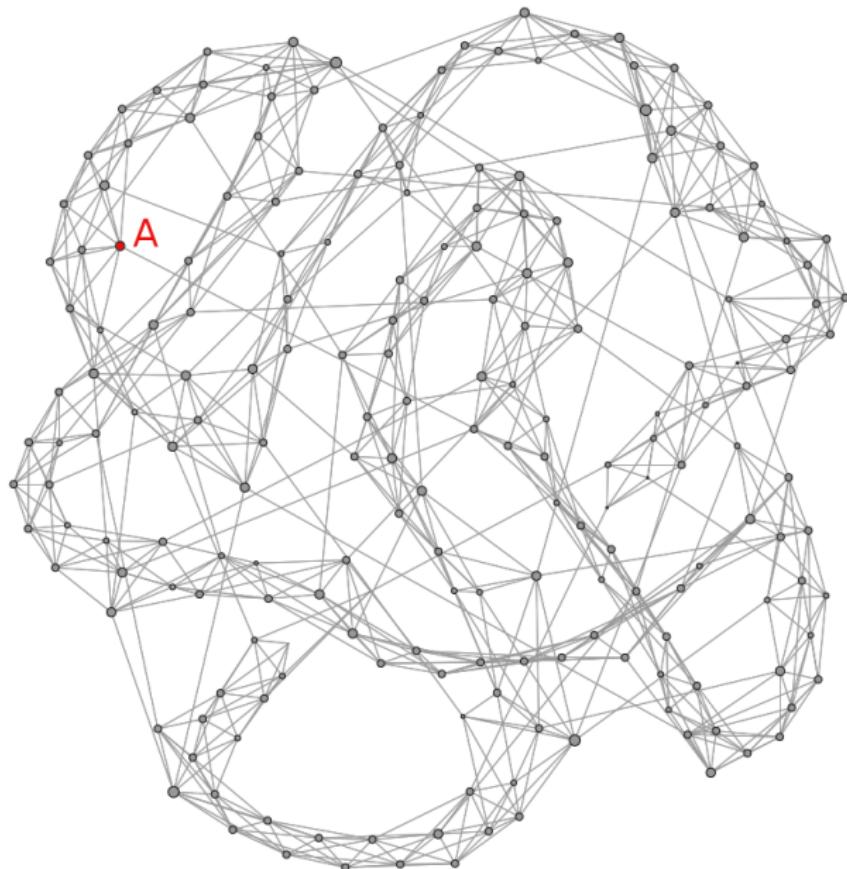
Shortest Path Length



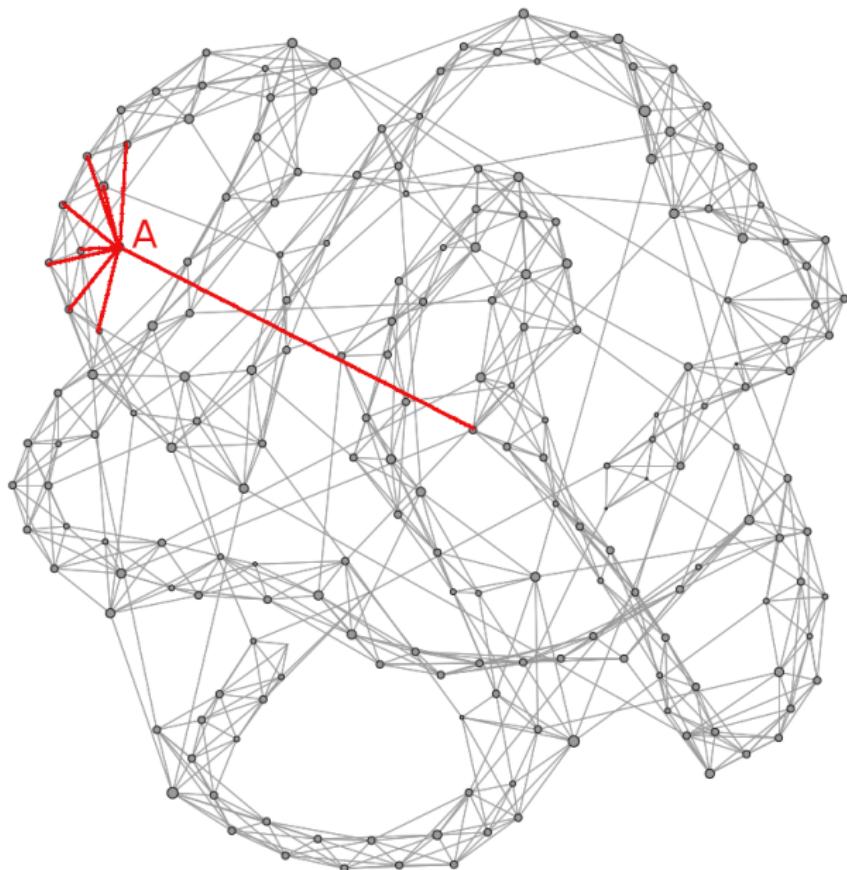
Shortest Path Length



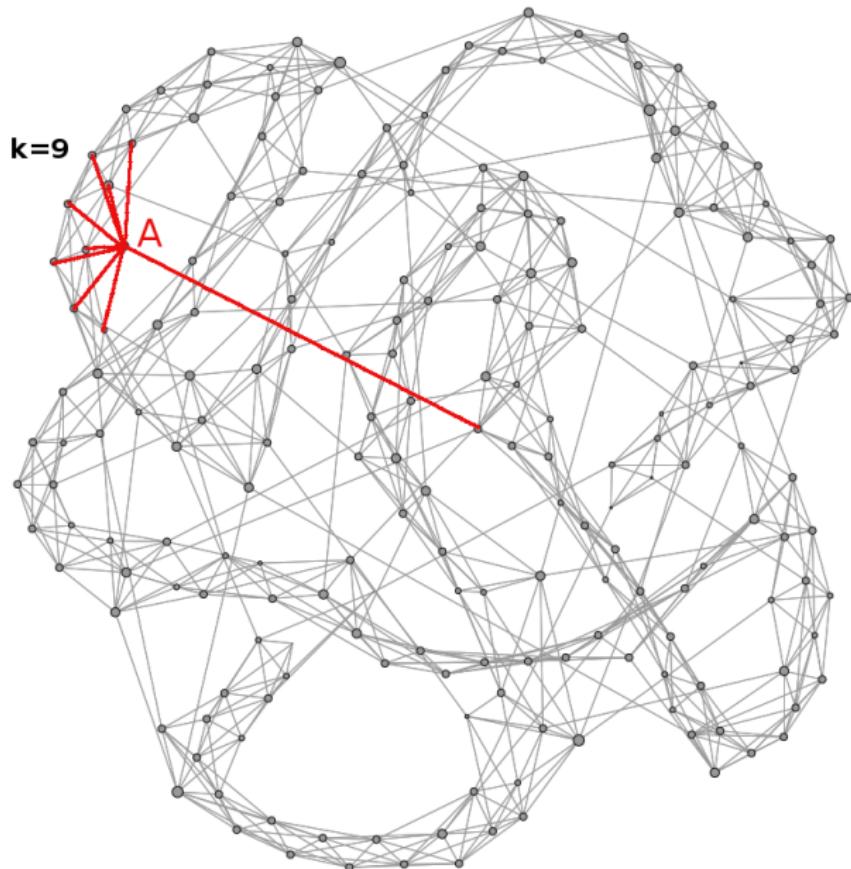
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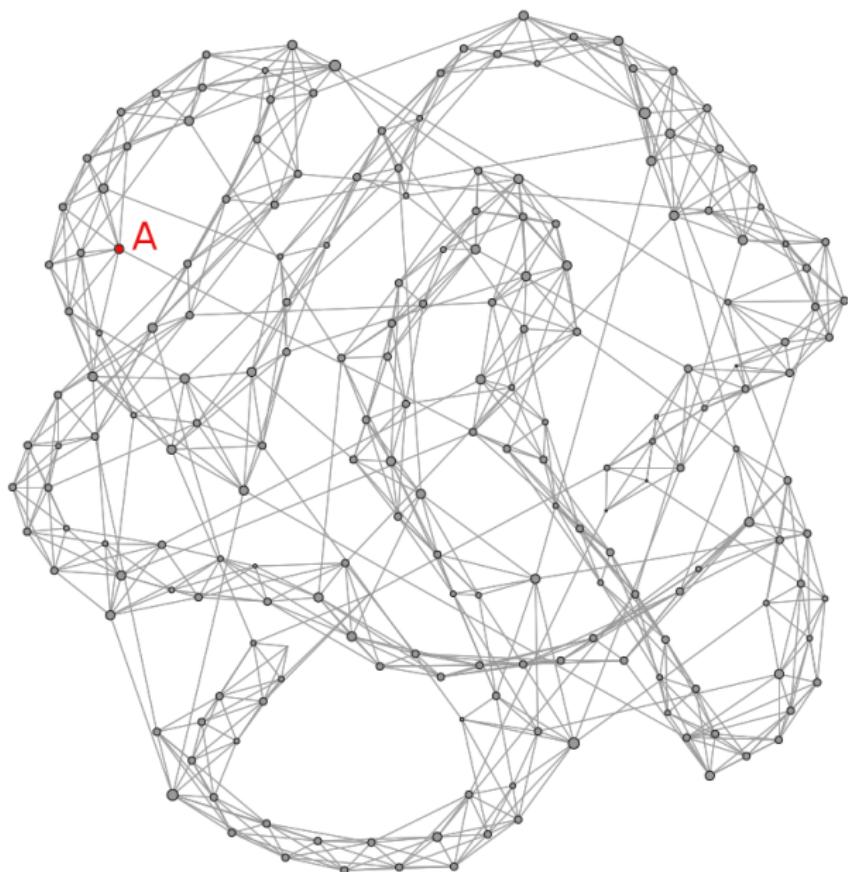
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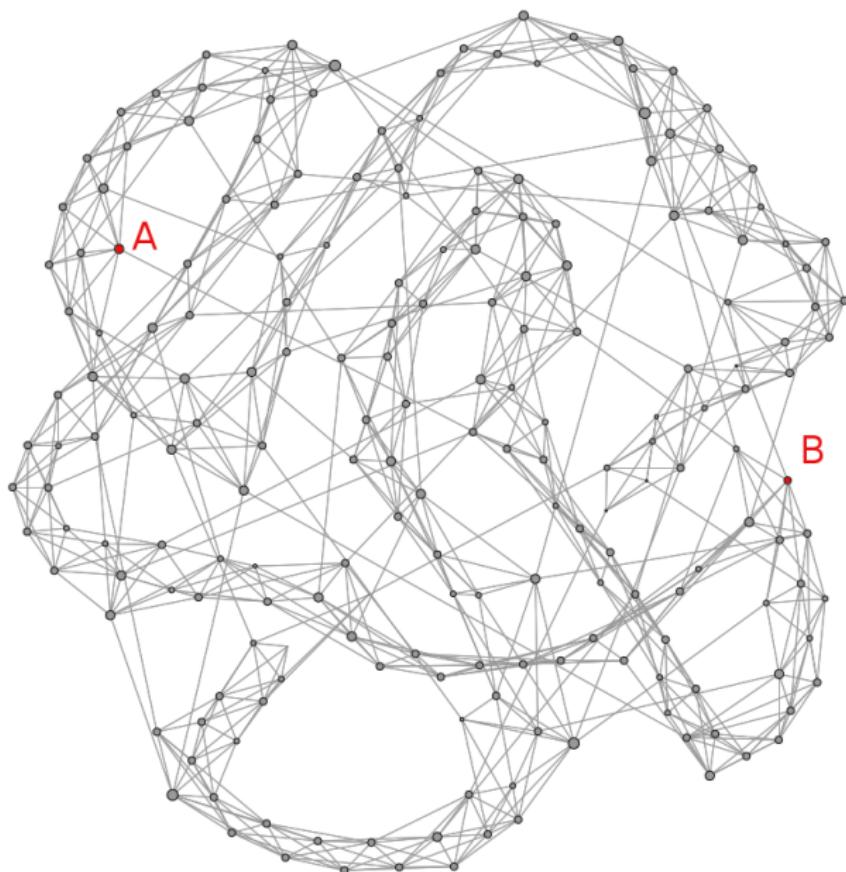
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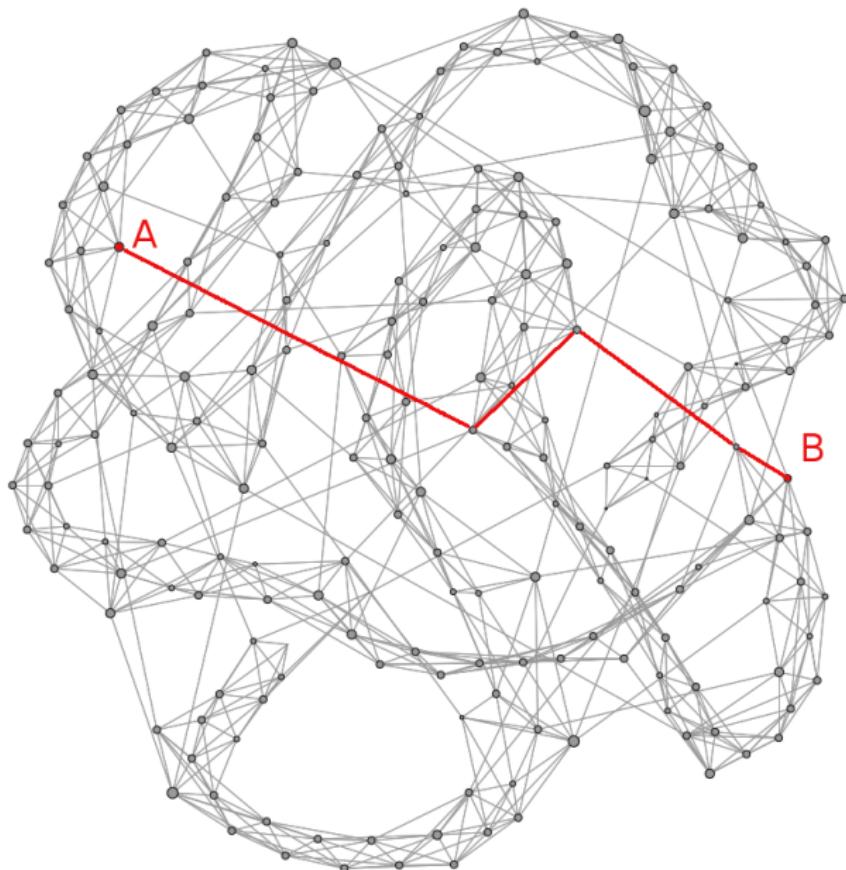
Shortest Path Length



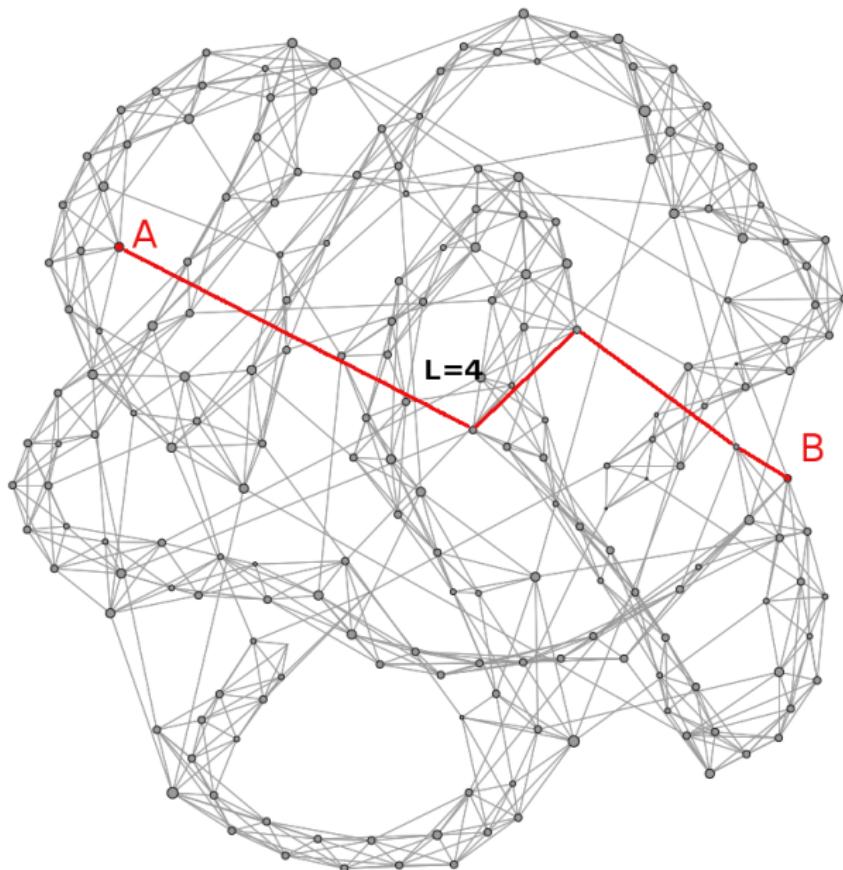
Shortest Path Length



Shortest Path Length



Shortest Path Length



Experimental Setup

Set of networks with combination of properties:

- ▶ Average Degree (D)
- ▶ Average Distance (A)

	$\langle k \rangle_1$...	$\langle k \rangle_n$
L_1	G_{11}		G_{1n}
...		...	
L_m	G_{m1}	...	G_{mn}

Experimental Setup

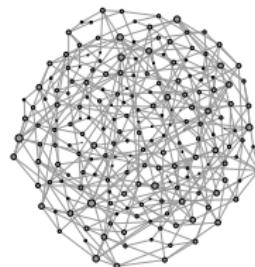
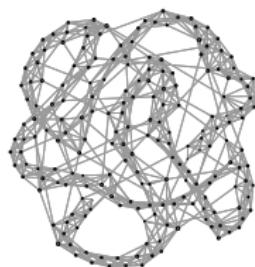
$$\langle k \rangle = 8$$

$$\langle k \rangle = 4$$

$$L \approx 17$$

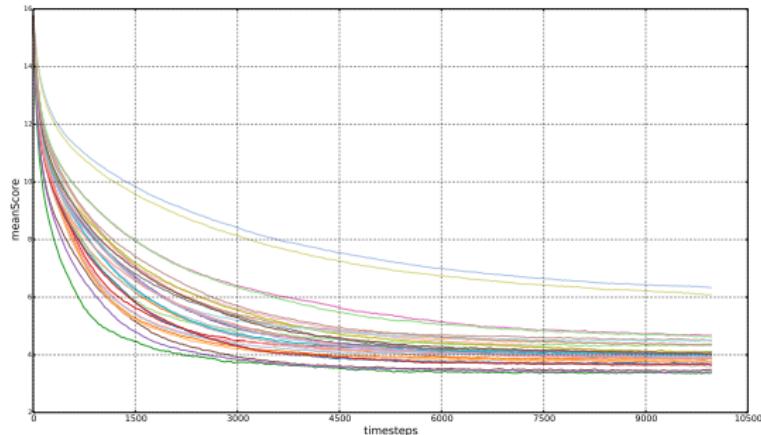


$$L \approx 4$$



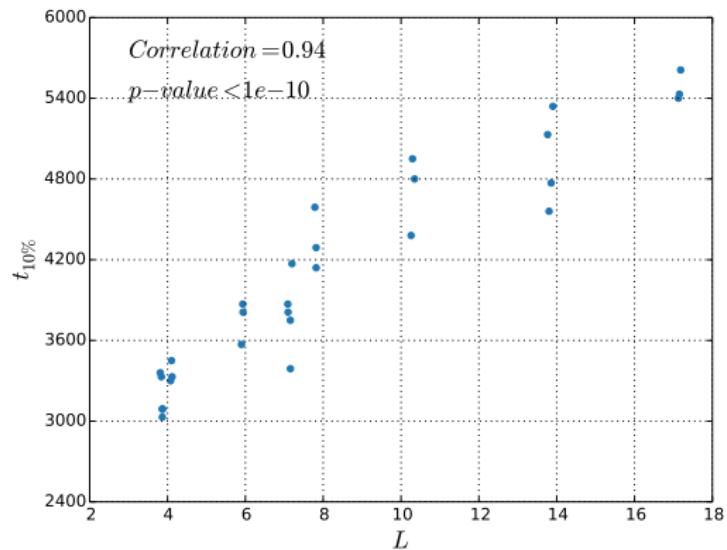
Results:

General Behaviour of the simulations with different topologies.



Results:

Time of convergence as a function of L .



Results:

- ▶ Average Degree doesn't seem to have much impact
- ▶ Average Distance speed up the convergence

Summary

- ▶ Simple cultural mechanism and simple trade can lead to efficient economic dynamics:
→ Both aspect should be studied together.

- ▶ Properties of the cultural network impact those dynamics.
→ Different network support different economy

Future Works

1. *Non-equilibrium* conditions,
2. Comparaison with “real-world” data,
3. ...

Thank for you attention!



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