

# CAA2016

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

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Univ. Pompeu Fabra  
Complex System Lab.

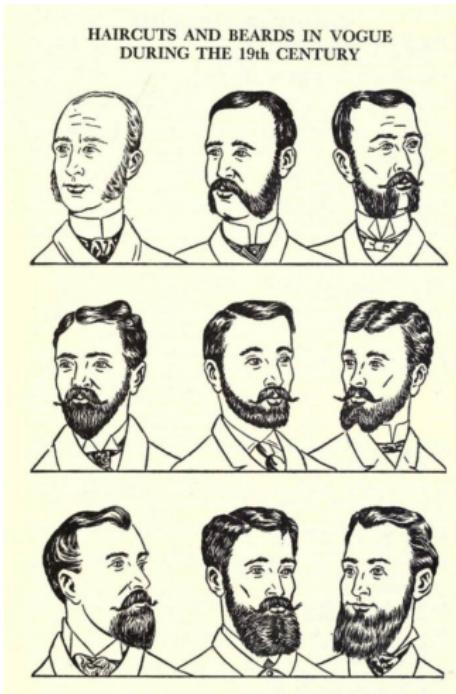


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# Plan of the presentation

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

# Cultural Evolution



How Social Traits Evolve?

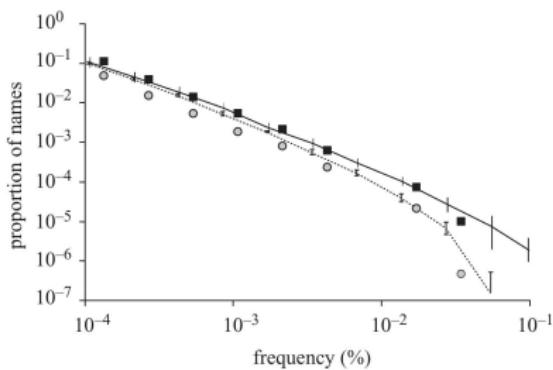
# Cultural Evolution



# 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

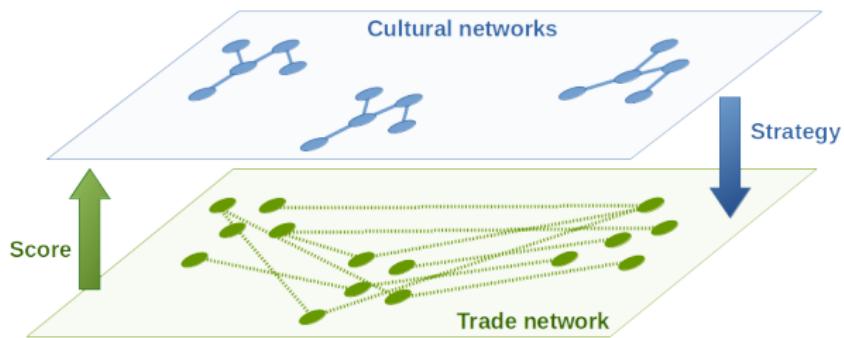
- ▶  $N$  goods
- ▶  $M$  Agent  $\begin{cases} \text{a quantity of each Goods} \\ N \text{ values attributed to each goods} \end{cases}$
- ▶ Agents *produce* one good and *exchange* it to obtain the other goods.
- ▶ After the exchange, the agents *consume* all goods

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

# The Model

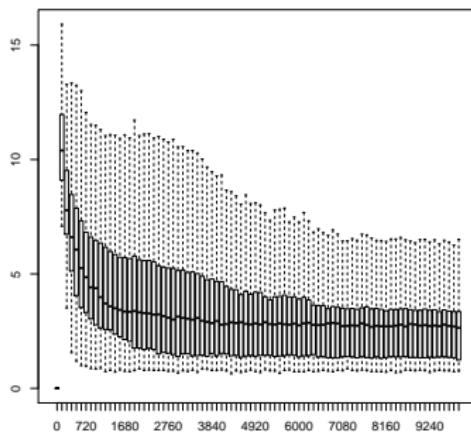
## 2. Cultural Mechanisms

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



# The Model

Figure: Example for 3 goods and 600 agents

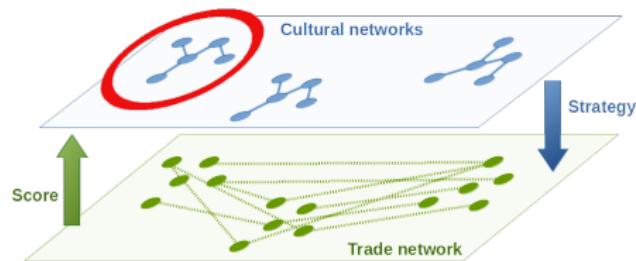


@ Equilibrium: mean of score  $\rightarrow$  score max.

# Experiments

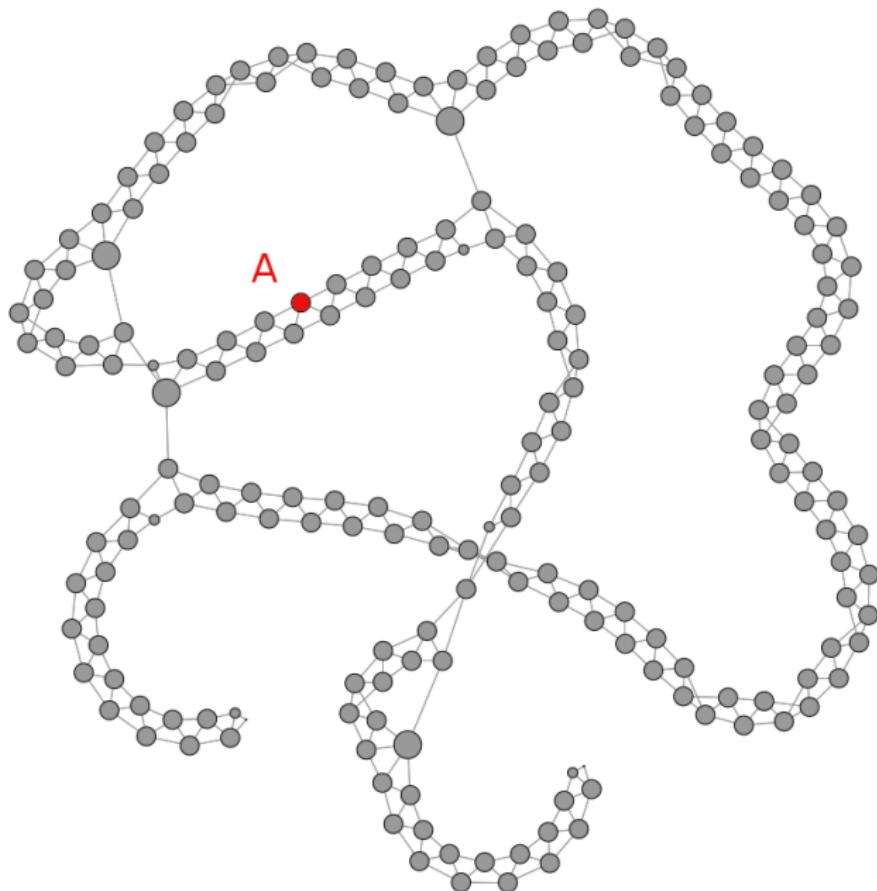
## Impact of the topology of the cultural network

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

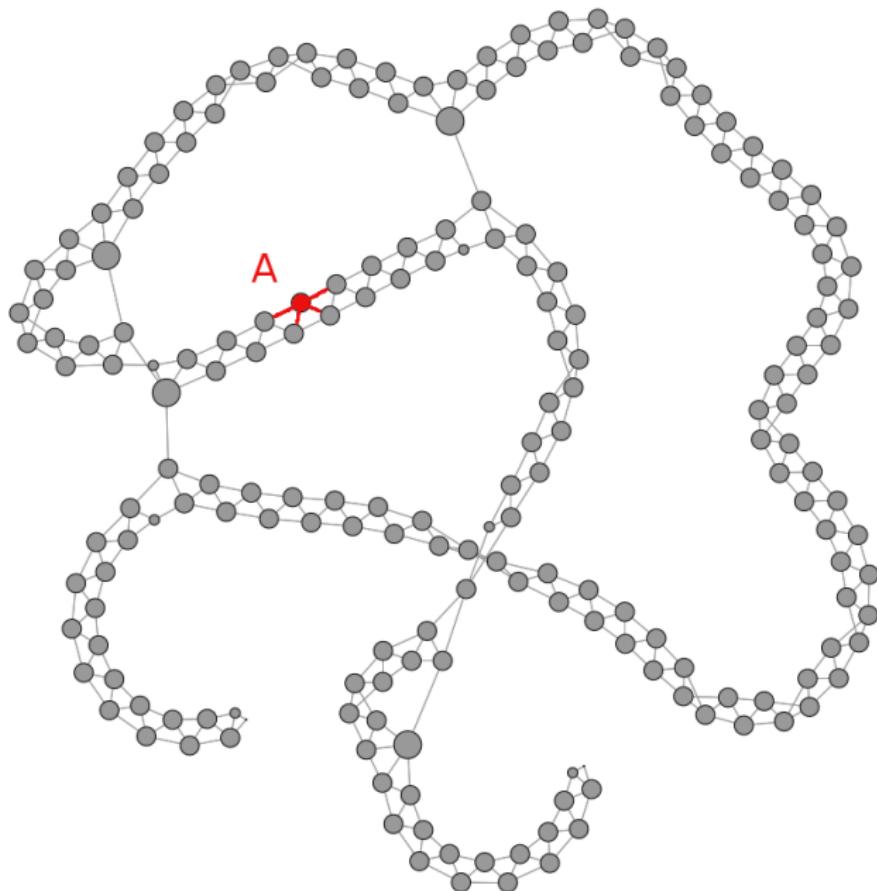


→ Average Distance vs Average Degree

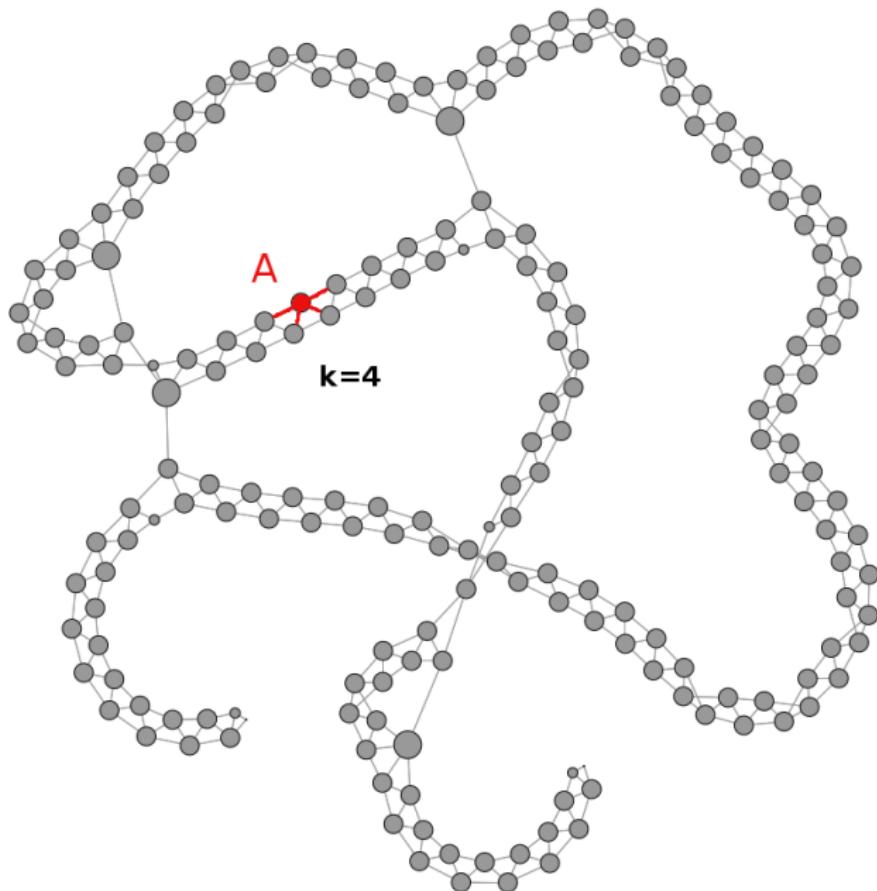
# Degree



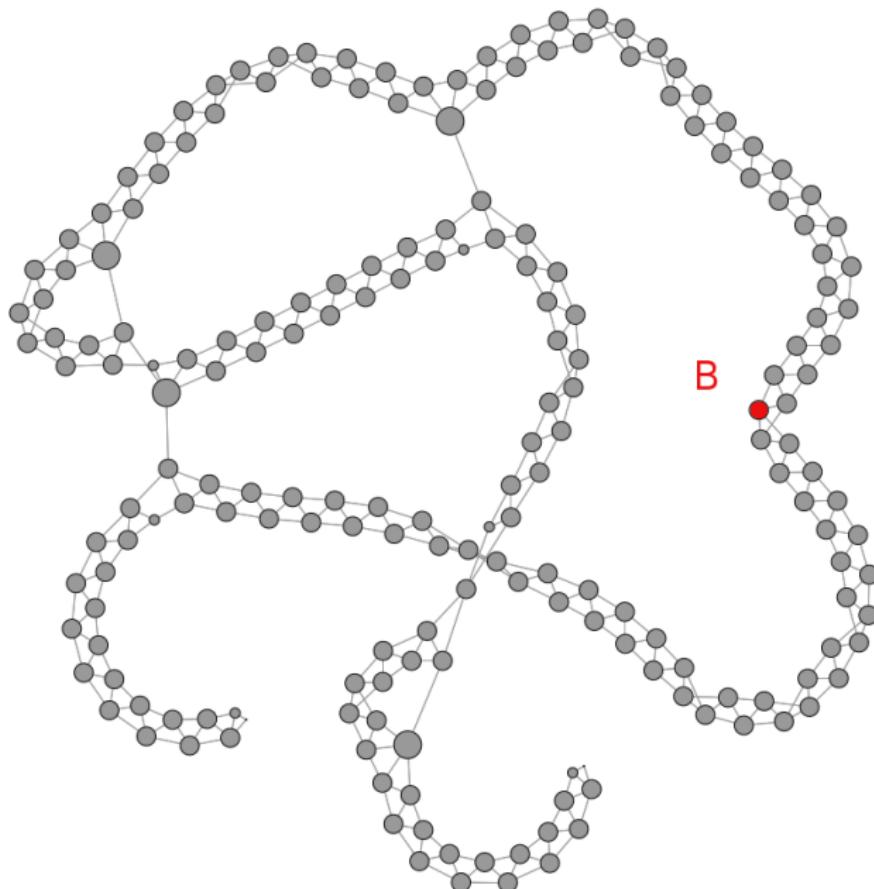
# Degree



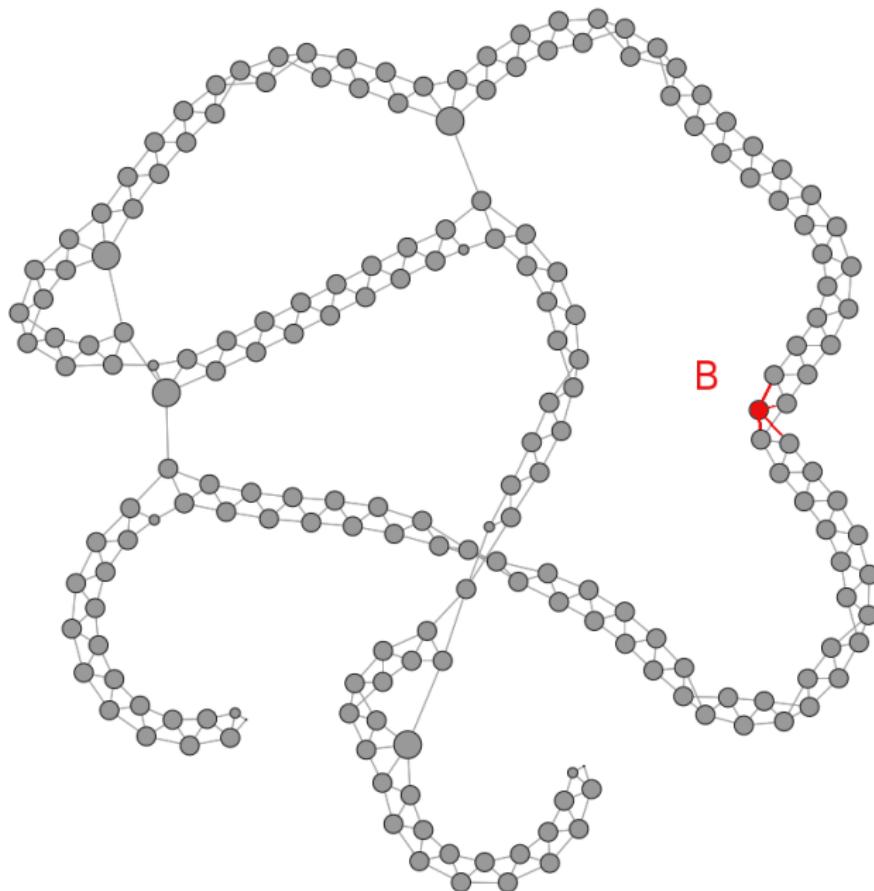
# Degree



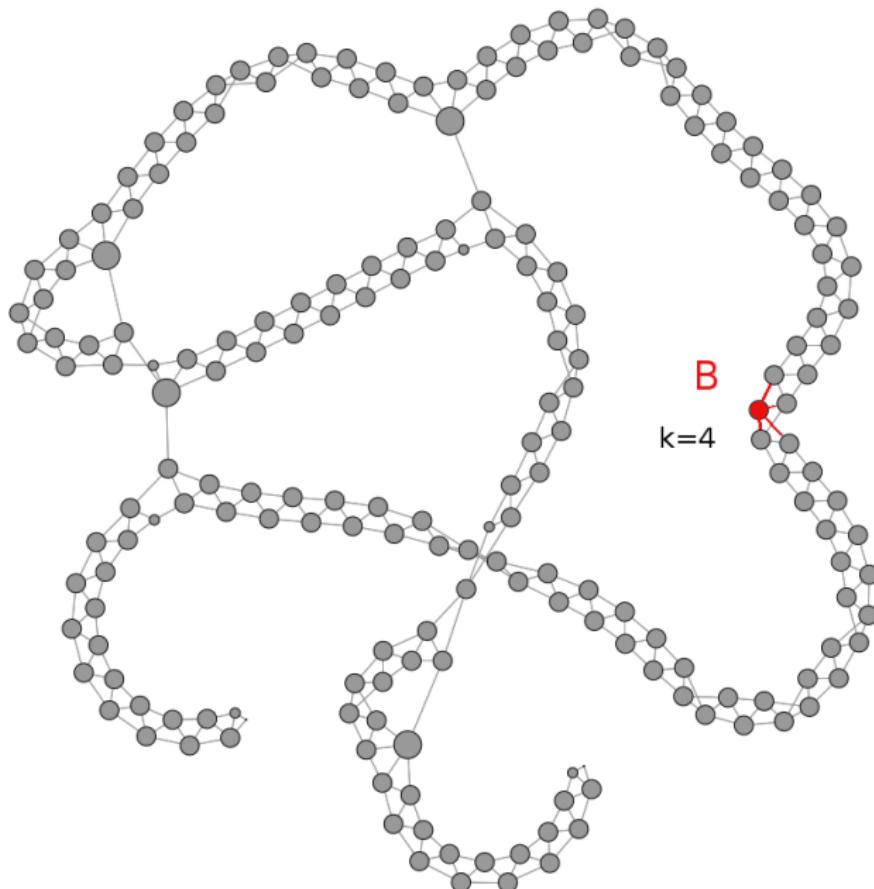
# Degree



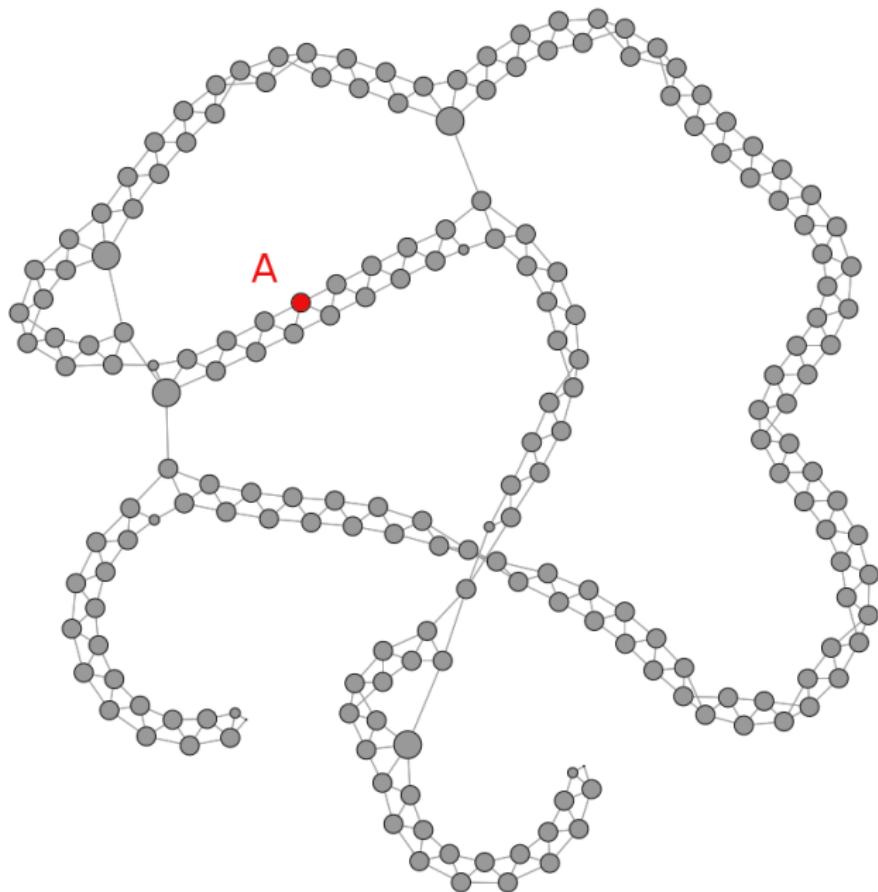
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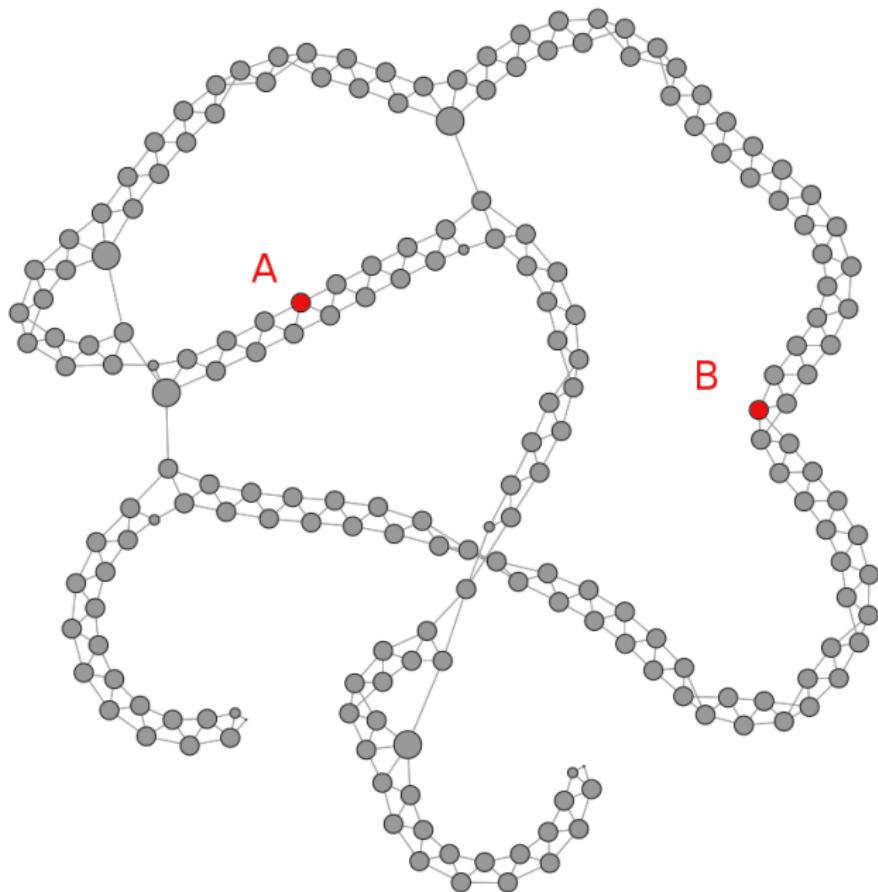
# Degree



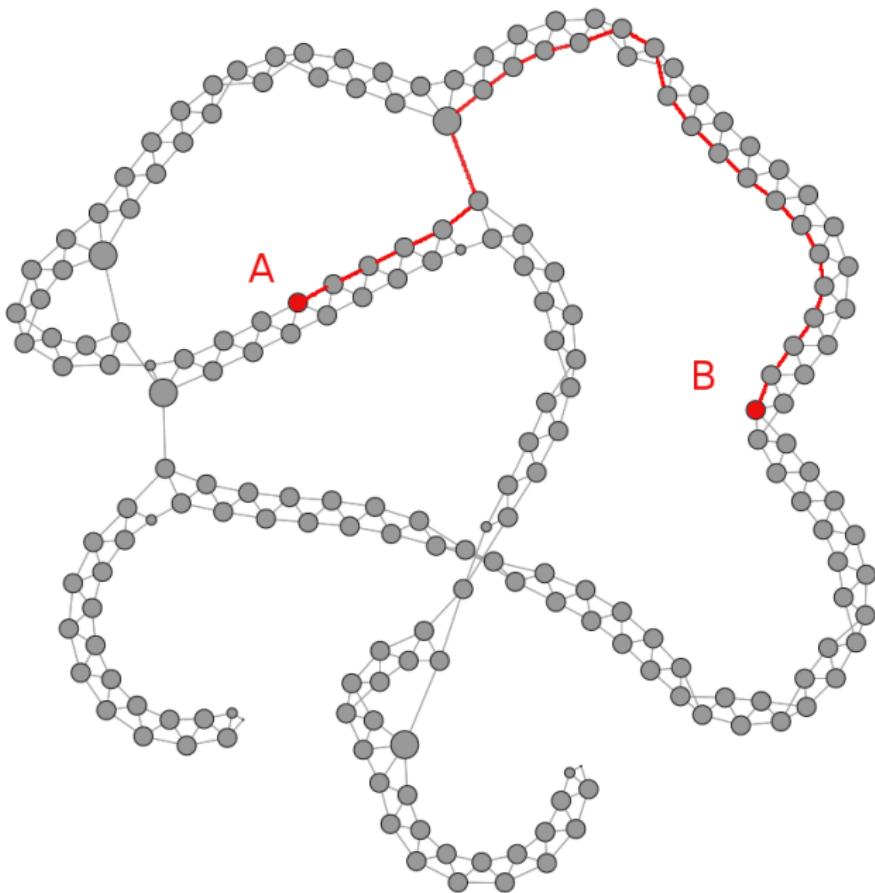
# Shortest Path Length



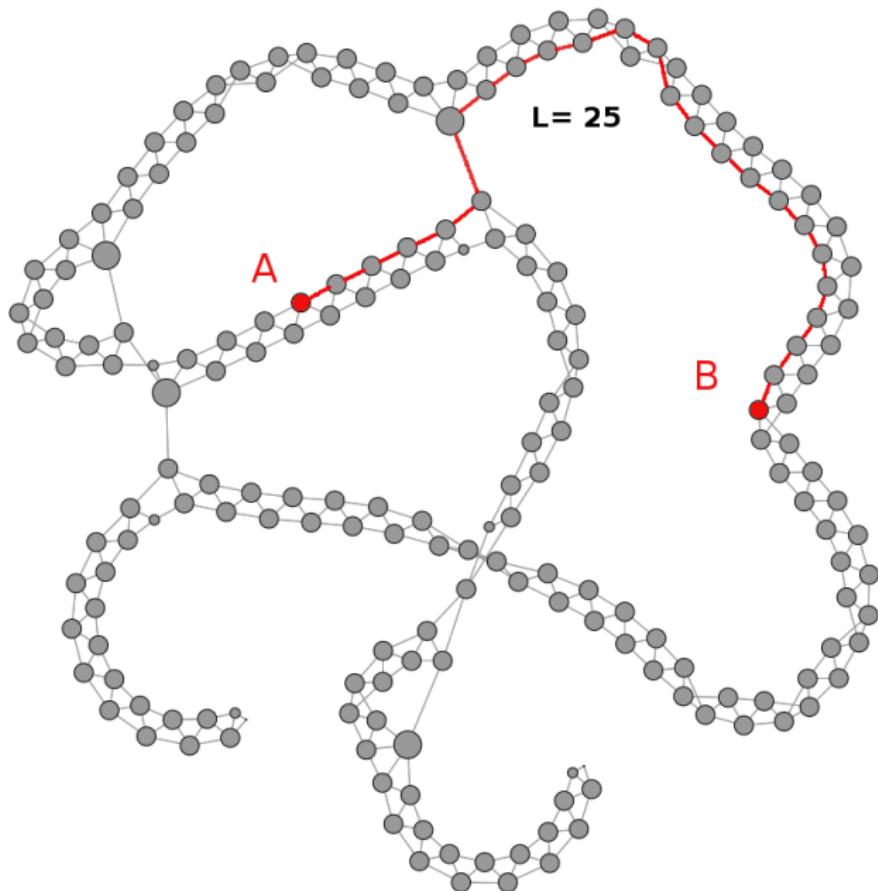
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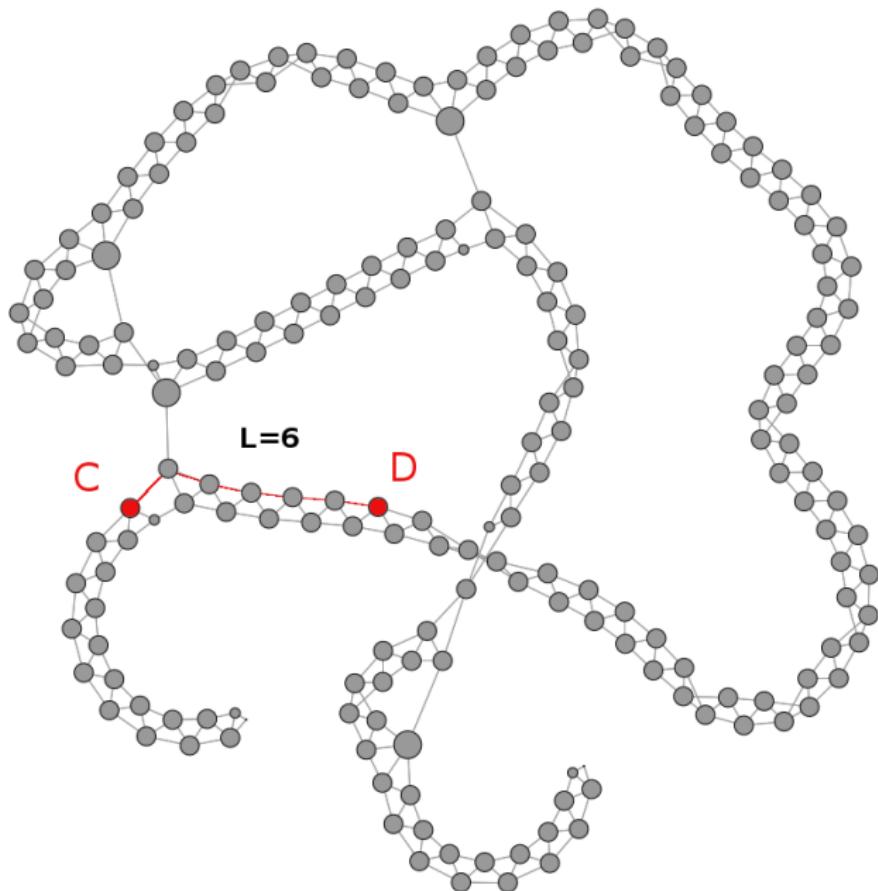
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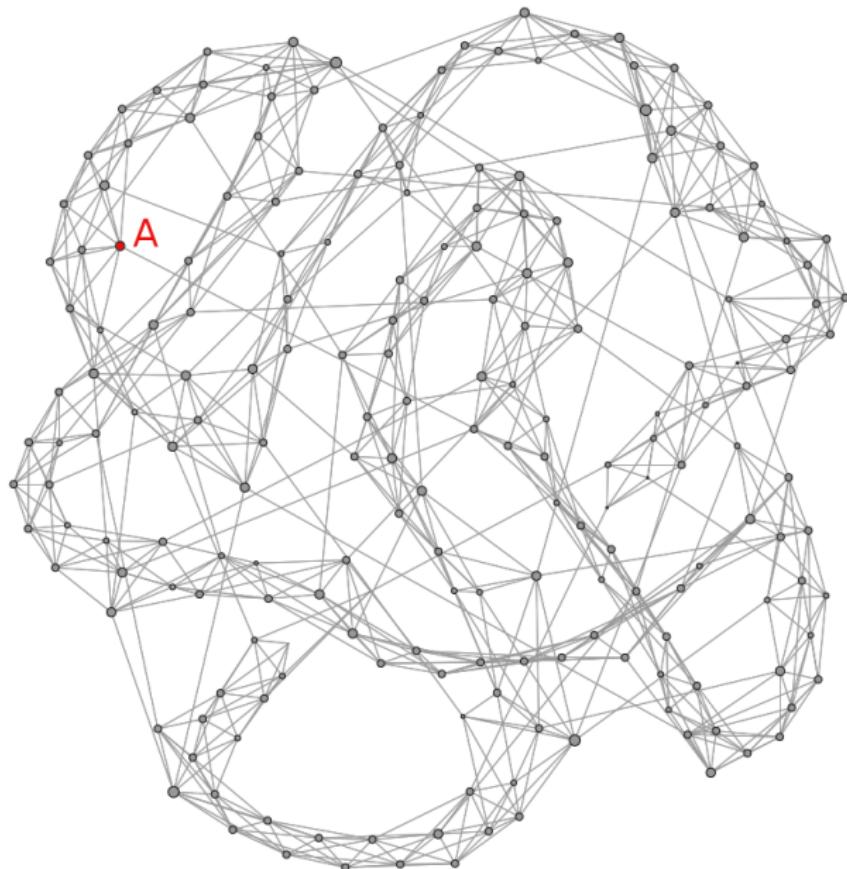
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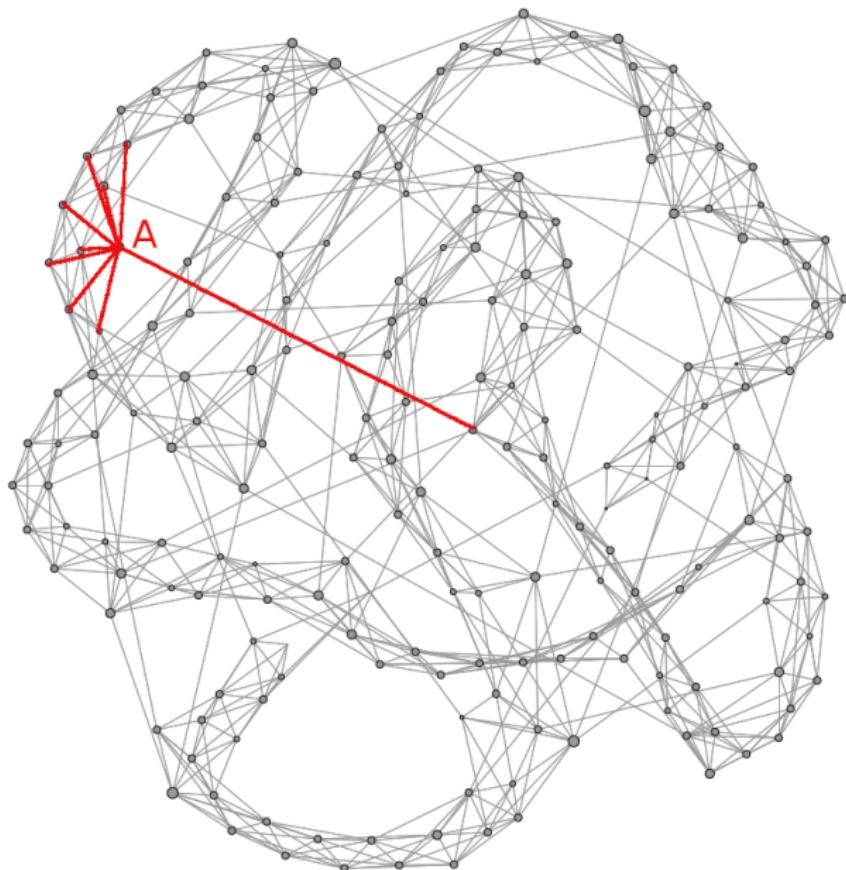
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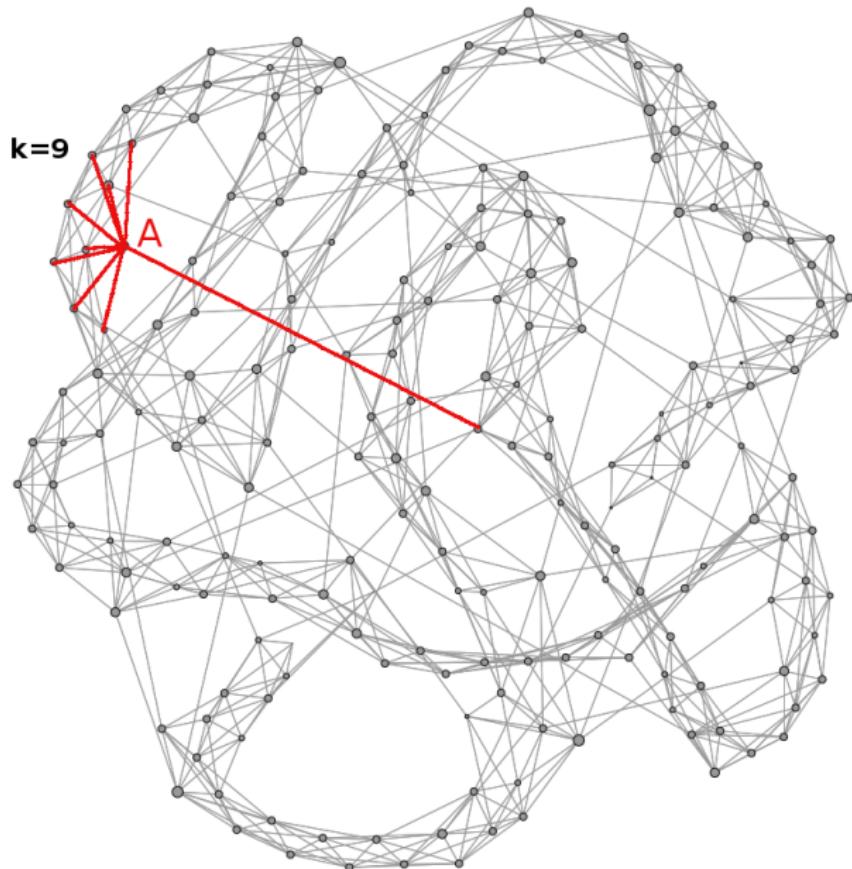
# Degree



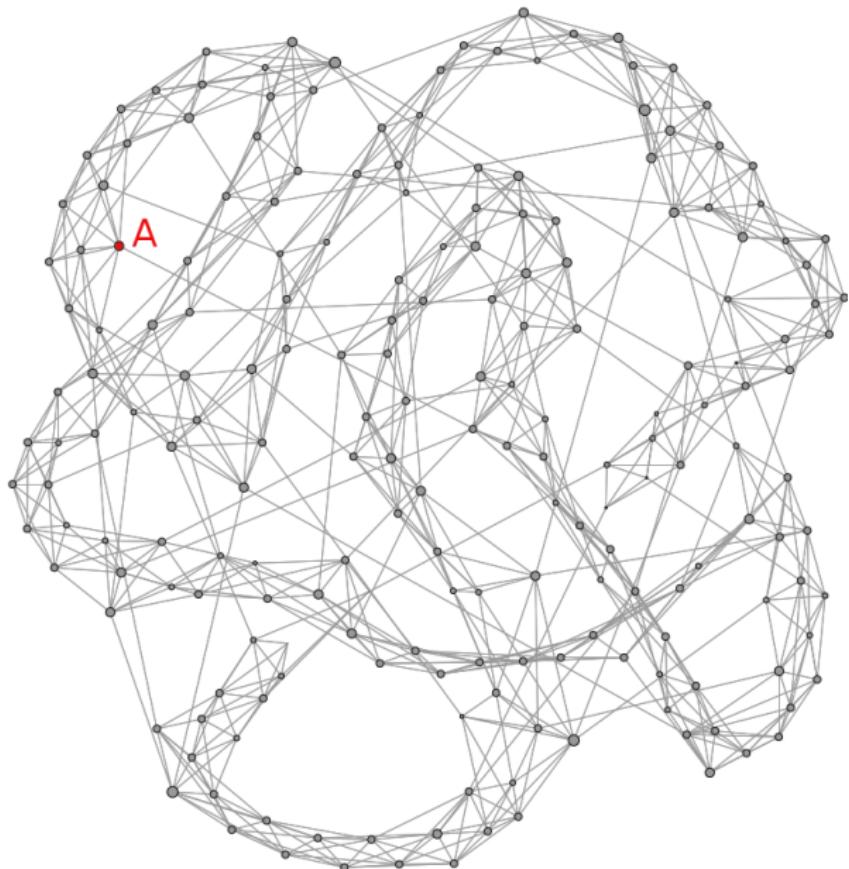
# Degree



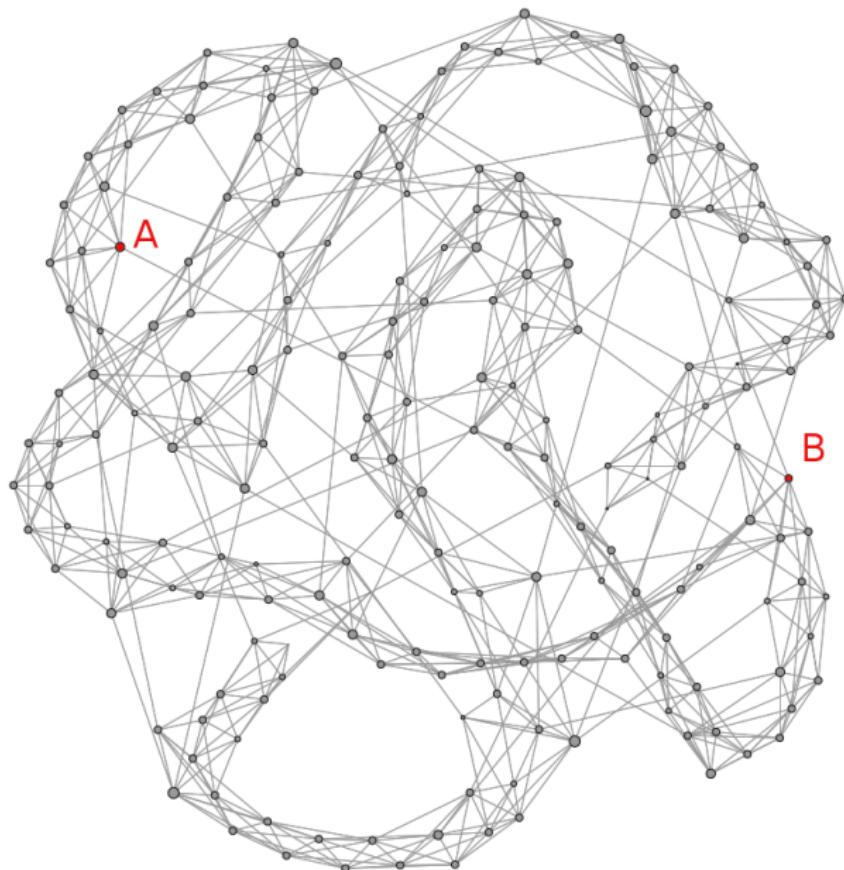
# Degree



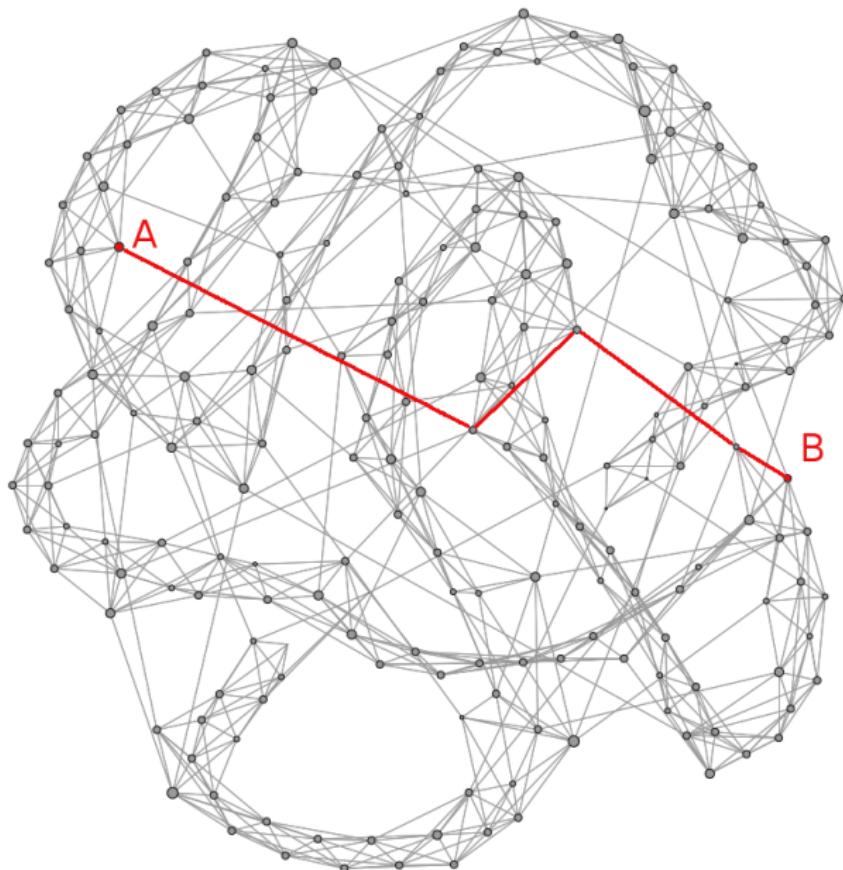
# Shortest Path Length



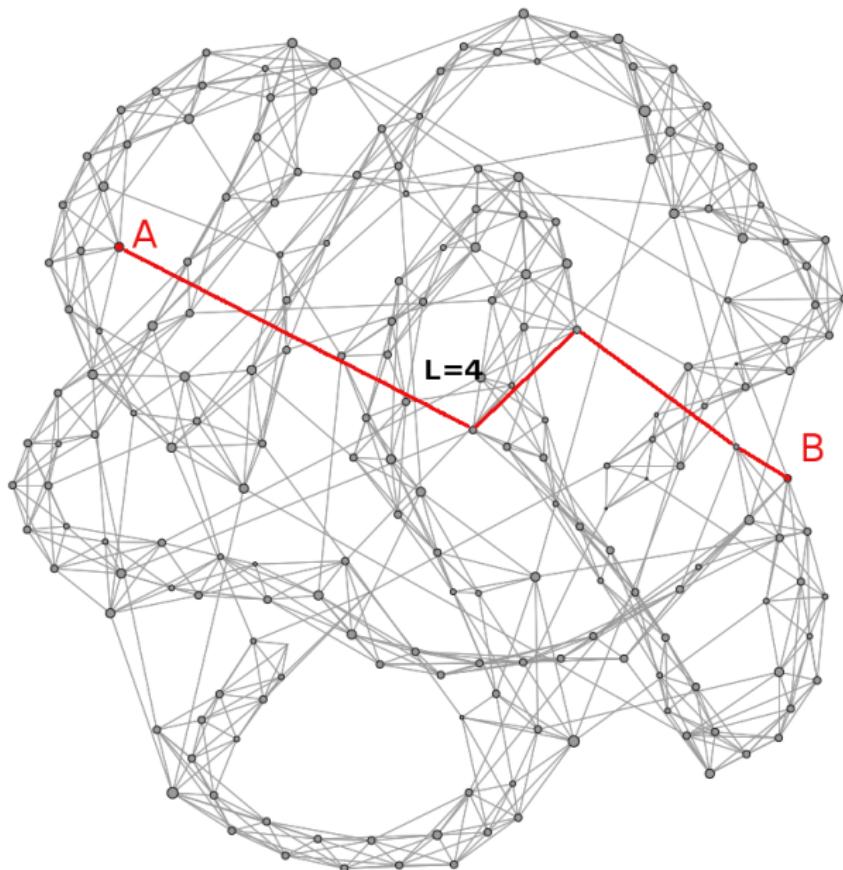
# Shortest Path Length



# 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

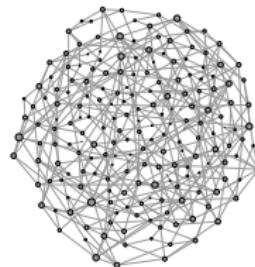
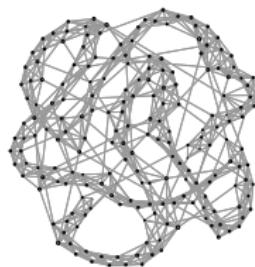
$$\langle k \rangle = 8$$

$$\langle k \rangle = 4$$

$$L \approx 17$$

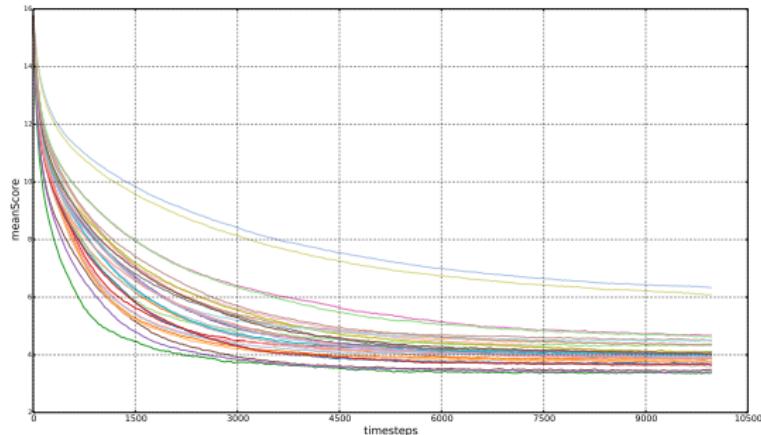


$$L \approx 4$$



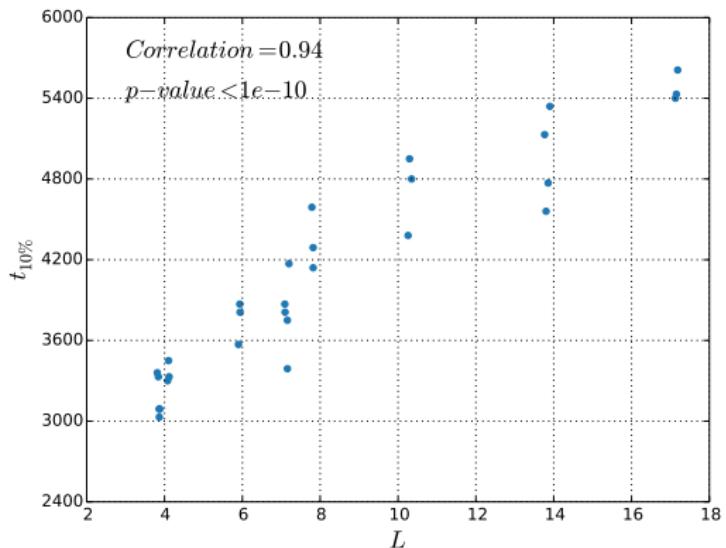
# Results:

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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