Linking Mobility, Weighted Networks and Statistical Physics

A statistical mechanics approach to mobility data

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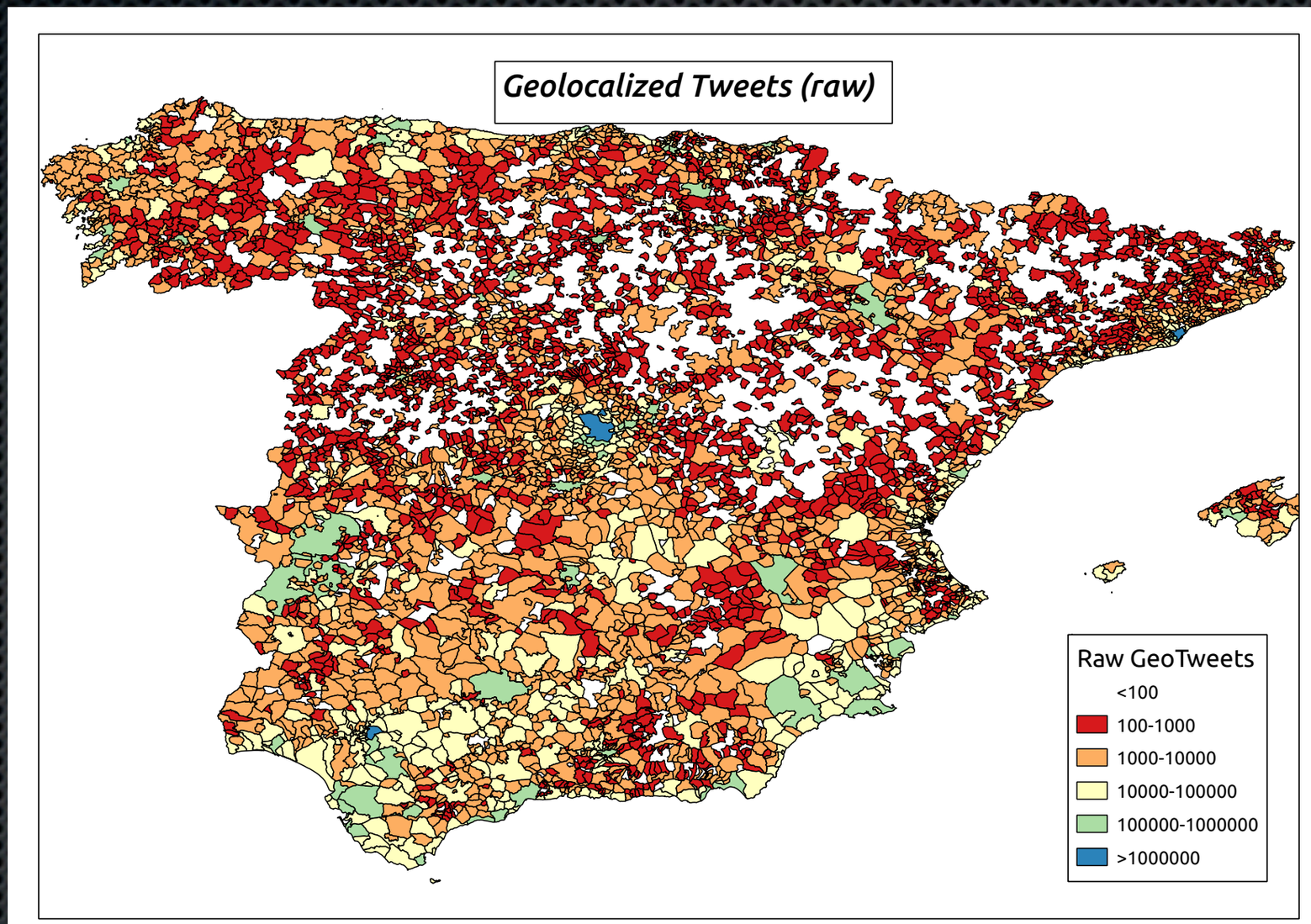
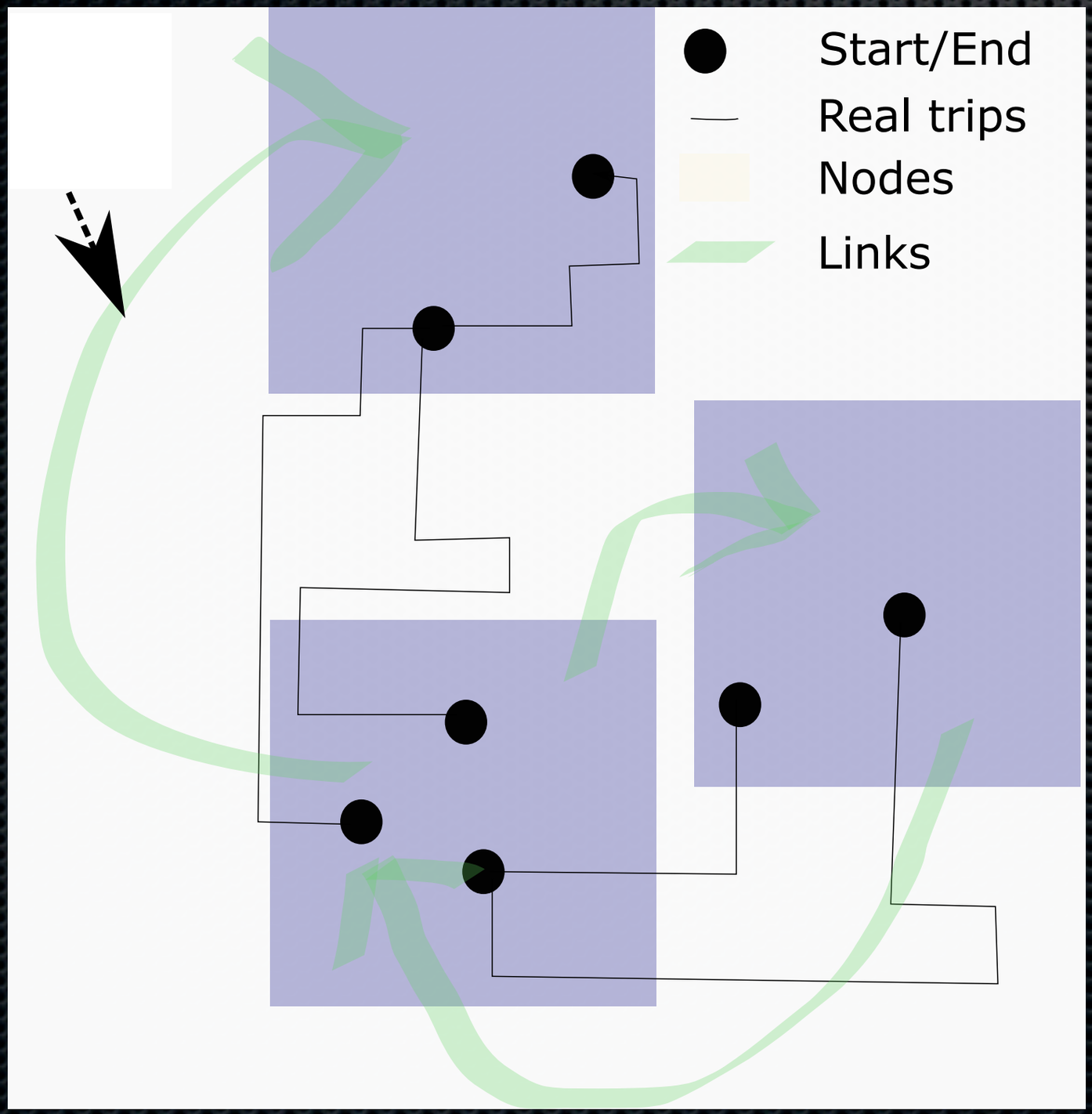
Big Data era...(for mobility too!)



yet Big Knowledge?

What do we have?
(Mobility “Weighted” Networks)



Nodes [N]

Trips [T]

Possible choices [N (N-1)]

“Let the data talk...”

Yes, ok, but...

Under “normal conditions” what would data tell us?

What do we want?

We want to **compare**: Data vs Predictions

We wanna test some hypothesis

*"What do I **expect** to see, given that I **fix** hypothesis A?"*

We need a **model**!

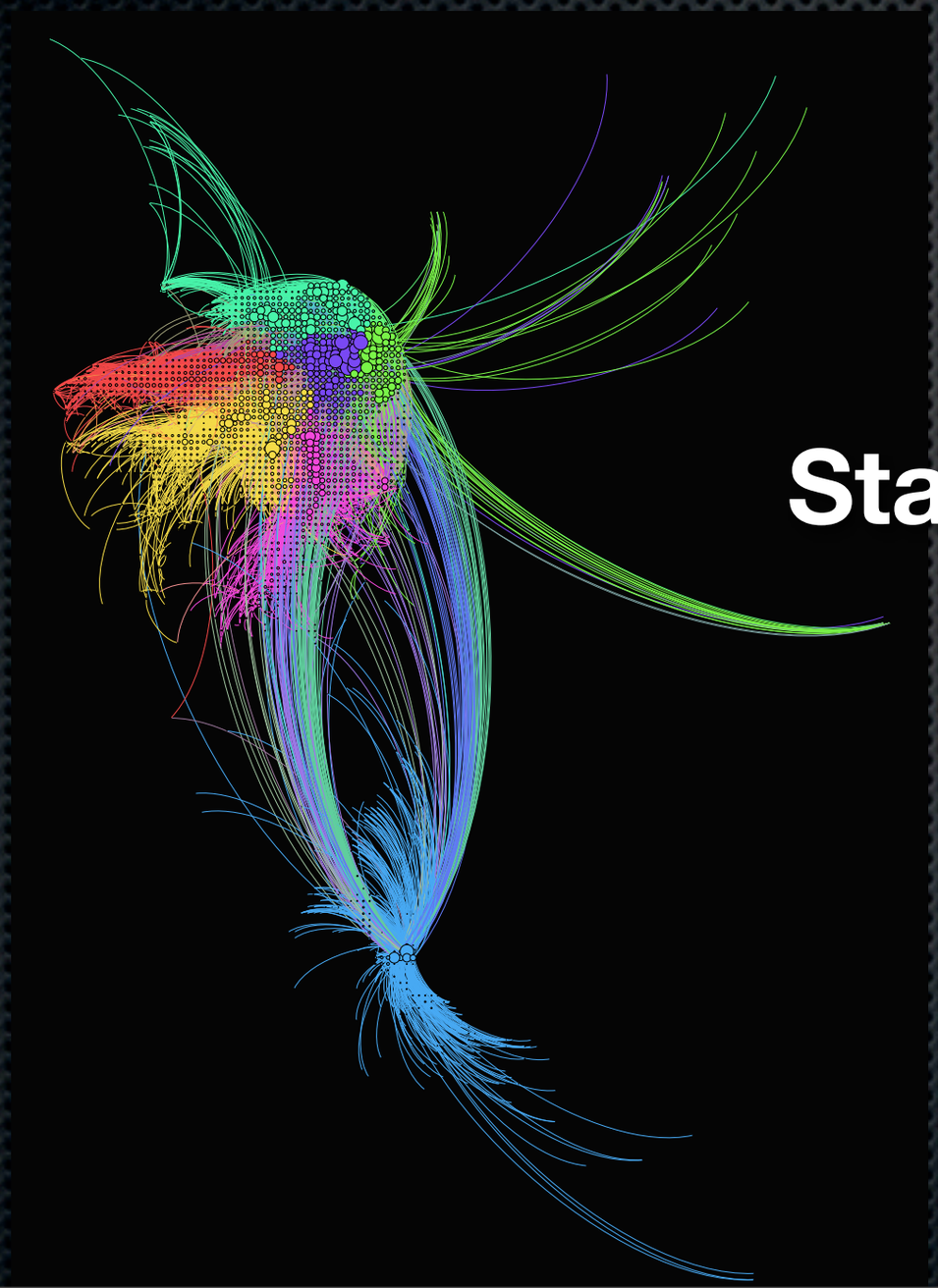
Why not **stat mech**?

Lot's of events (big data)

Distribute (countable) **trips** in **states**

This is not new for networks!

But other's models don't fit (**N fixed**)

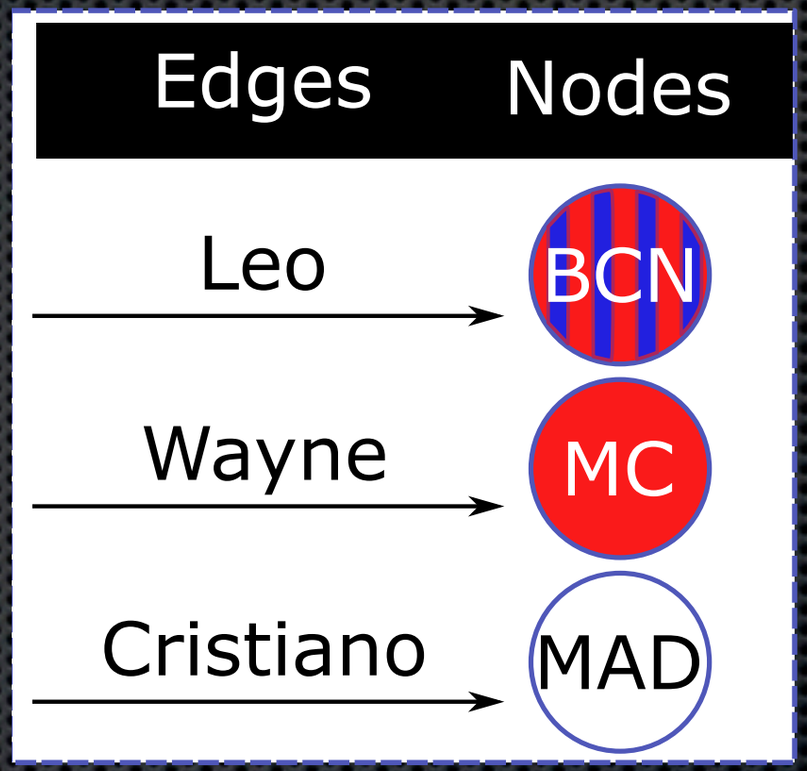


Where is the problem?

Stat mech is all about **counting configurations**...

The distinguishability problem (I)

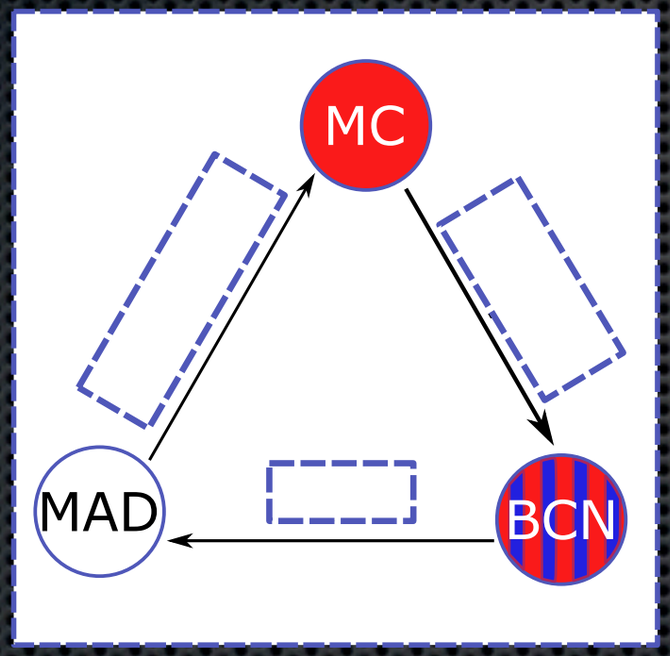
Imagine we have 3 nodes and 3 (undirected) events (with names)



ways to put 3 trips btw 3 connected nodes?

The distinguishability problem (II)

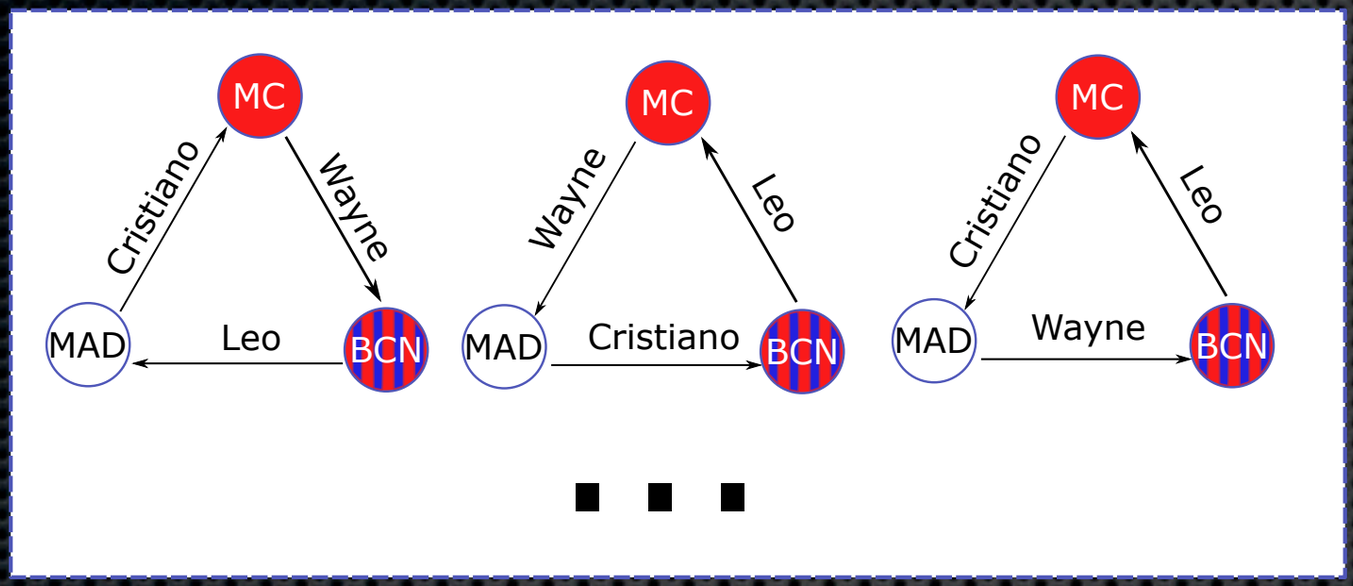
Answer in “classical” weighted complex networks: 1



“Phase Space” (degenerate)
[1,1,1]

But not in our case! The data we can see is **degenerate**

The distinguishability problem (III)



"Conf Space"
(non degenerate)
[Leo, Cristiano, Wayne]
[...]

We can't see the names, but they are there!

Our approach: Micro-Canonics

What we want: **Count the volume** of the **conf space**

What we (can) do: Maximise the volume of the **phase space**

Obtain the **statistic** of occ. numbers ("expected values")

Constraints?

Linear: “Sources, sinks”

Non-Linear: “Binary skeleton”

(A good deal of maths)

Multi-Nomial statistic:
(Strict) **Canonical Ensemble**

Zero-Inflated-Poisson statistic:
Grand-Canonical Ensemble

Tech details?

Entropy Maximisation Approach
Provides expectations for the (real) data given some hypothesis!

Points to a great (under-looked) problem:

Big data without big (general) models is useless.

Thanks for your attention…

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Want more? you'll have to read the paper!

Sagarra O. et altr. "Statistical Mechanics of Multi-Edge Networks", arXiv:1309.2453