

Data, Modelling and the Science of Cities

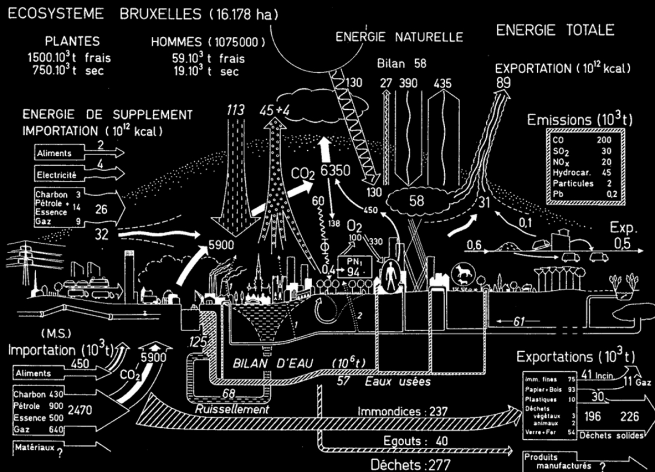


Cities are Important

- ▶ Cities are expanding:
 - ▶ Over 50% people living in cities,
 - ▶ by 2050: 60%–80%

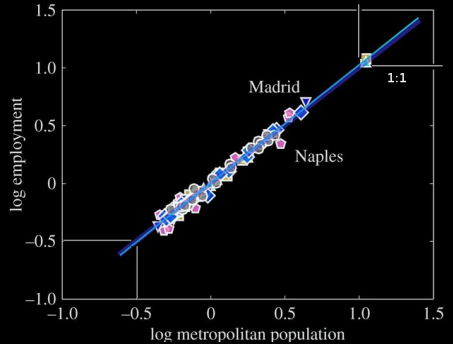
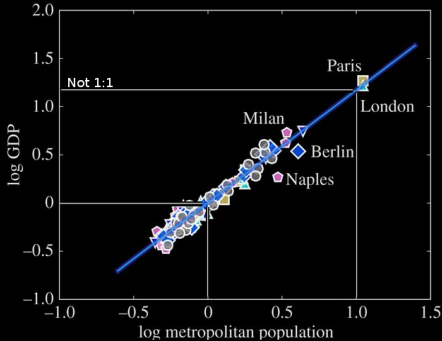
- ▶ Buildings consume 20%–40% of total energy.
- ▶ Commuting alone accounts for 5%–10%. . .
- ▶ Total transport \approx 50%

Cities are Complex Systems

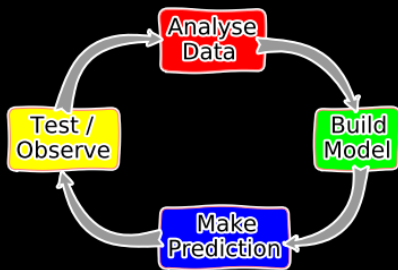


Duvigneaud, P., Denayeyer-De Smet, S., 1977. L'Ecosystème Urbain, in L'Ecosystème Urbain Bruxellois, in Productivité en Belgique. In: Duvigneaud, P., Kestemont, P. (Eds.), Travaux de la Section Belge du Programme Biologique International, Bruxelles, pp. 581-597.

Is there a Science of Cities?



Developing a Scientific Theory



BATH: HACKED

We open local data and make useful things

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Annual Report 2016



Its now been just over a year since we turned Bath: Hacked from a community

<https://data.bathhacked.org>

Strava Metro: interacting with the data



Strava Metro: animating the data



Yesterday we looked at some maps of the Strava Metro data for Bath. Different

Welcome to the Bath: Hacked data store

It's where we liberate data, and make useful things



Economy



Education



Environment



Government



Health



Heritage



Population



Transport



Live Air Quality Data

Air quality data taken from sensors sited around Bath



House Prices

House price data from 1995 until the present day



Street Level Crime

Crime reports in the BANES area from police.gov.uk



Live Parking Spaces

Latest occupancy in Bath city car parks and Park n Rides



Unsaved View

Save As...

Revert



Find in this Dataset



Based on Heat map of Median consumption Postcode level electricity estimates

This dataset contain the number of electricity meters and consumption levels in BANES at postcode level.

Manage

More Views

Filter

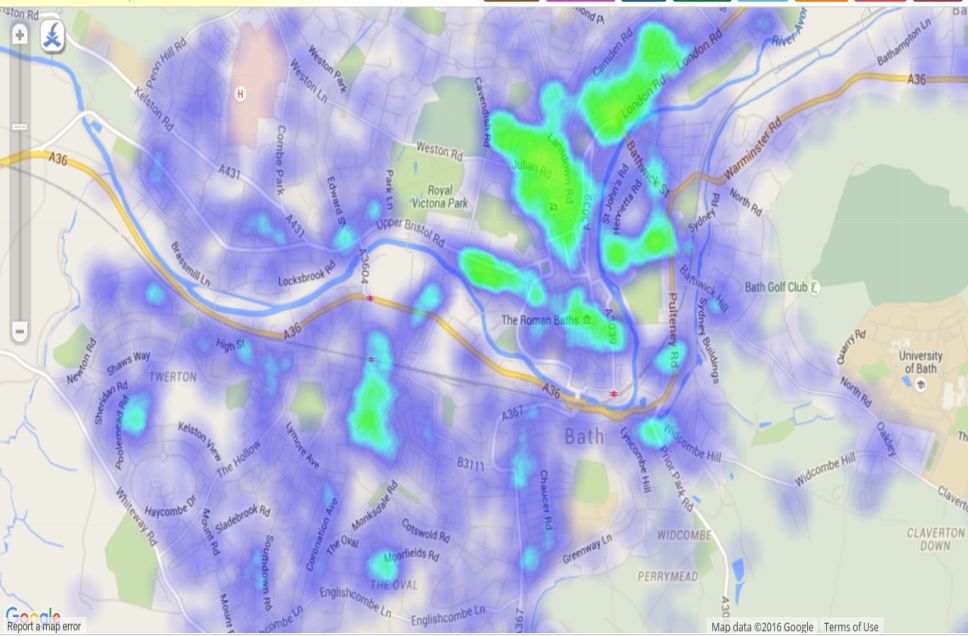
Visualize

Export

Discuss

Embed

About





Unsaved View

Save As...

Revert



Find in this Dataset



Based on Heatmap of BANES Estimated Annual average daily flows (AADFs) - major roads

AADF figures are produced for each junction to junction link on the

Manage

More Views

Filter

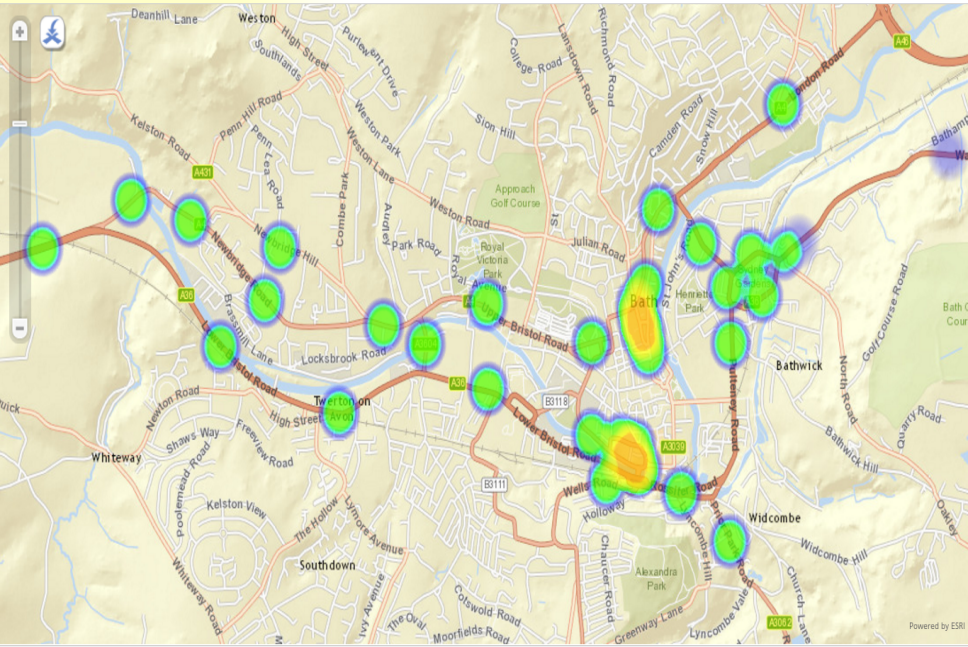
Visualize

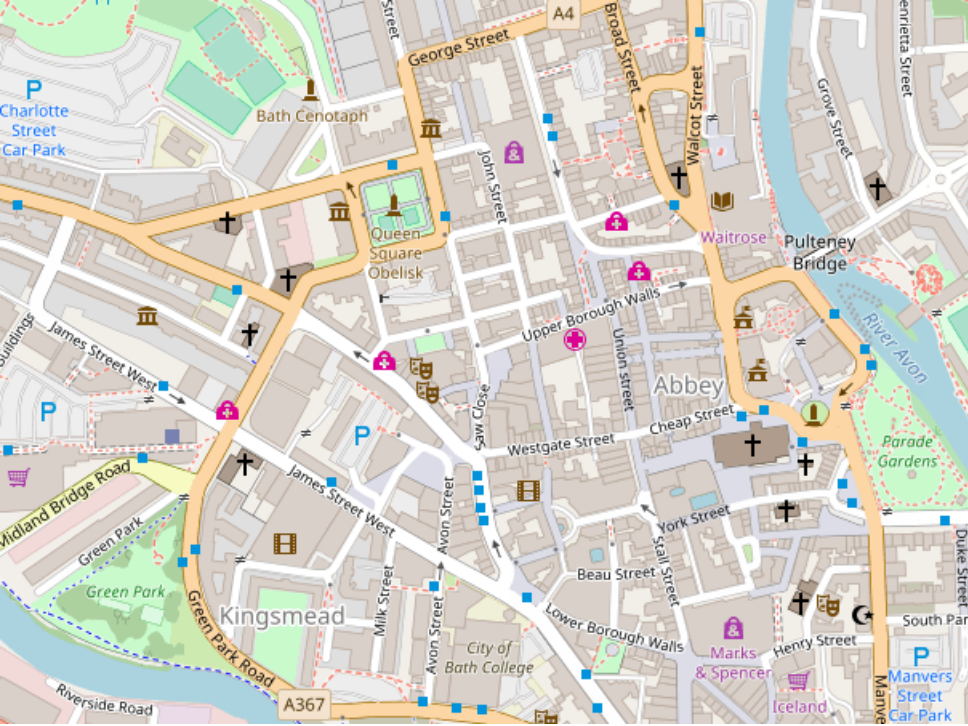
Export

Discuss

Embed

About





P
Charlotte
Street
Car Park

Bath Cenotaph

Queen
Square
Obelisk

George Street
A4

Broad Street

Waitrose

Pulteney
Bridge

River Avon

Parade
Gardens

Abbey

Midland Bridge Road
Green Park
Green Park

Kingsmead

City of
Bath College

Marks
& Spencer

Henry Street

Iceland

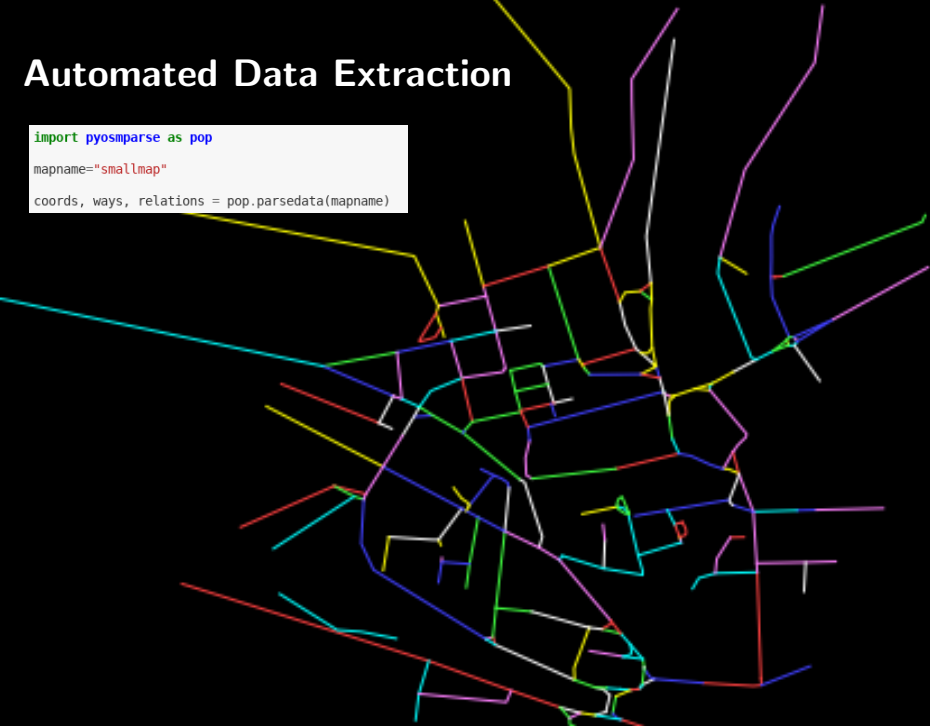
Manvers
Street
Car Park

Riverside Road

A367

Automated Data Extraction

```
import pyosmparse as pop
mapname="smallmap"
coords, ways, relations = pop.parsedata(mapname)
```



Automated Data Extraction

```
import myfunctions as my
```

```
##this function just gets the centroids of things and puts them in a list:  
publist=my.findall(ways, coords, "amenity", "pub")
```

King's Arms

New Inn

The Griffin

Molloy's

Garricks Head

Flan O'Briens

The West Gate

The Grapes

Bath Brew House

The Trinity

The Cork

Hobgoblin The Lamb and Lion

The Pig & Fiddle

Saracen's Head

The Rising Sun

The Salamander The Old Green Tree

The Raven

The Volunteer Rifleman's Arms

Sam Wellers

The Boar

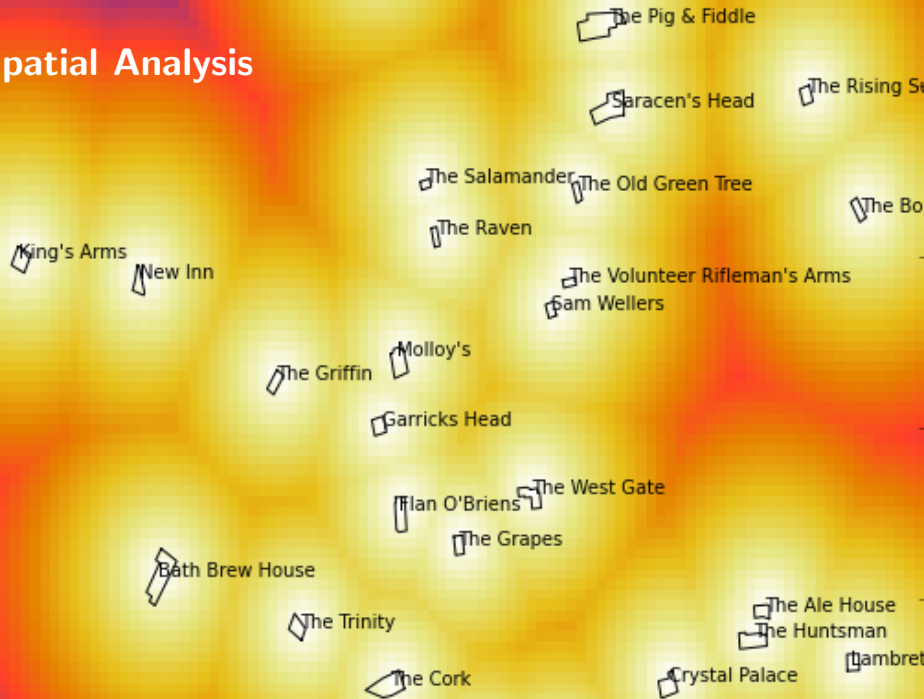
The Ale House

The Huntsman

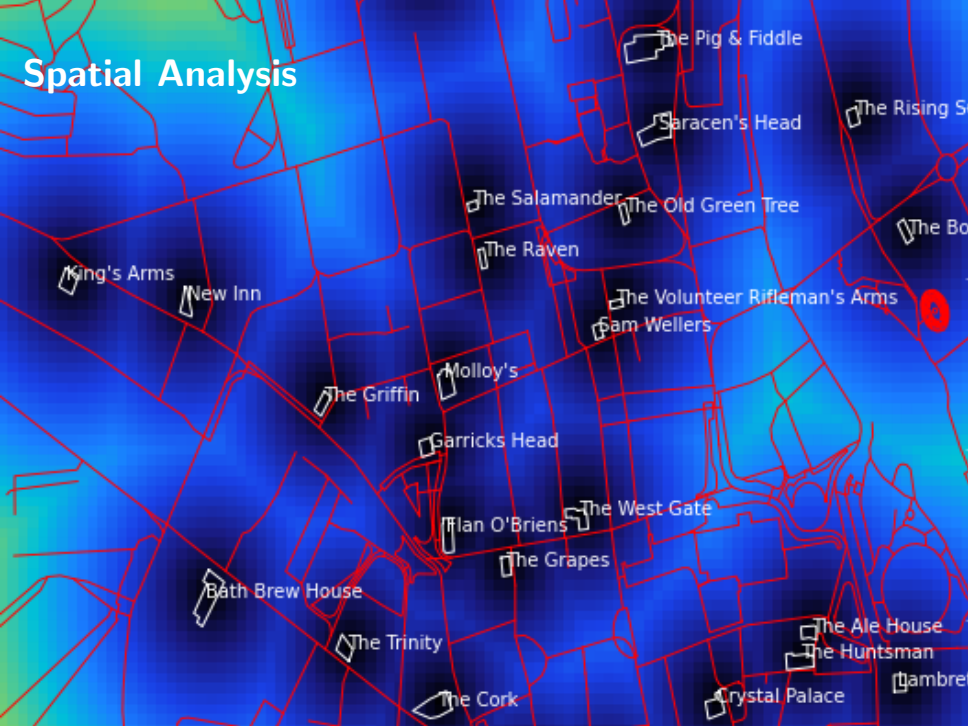
Crystal Palace

Lambret

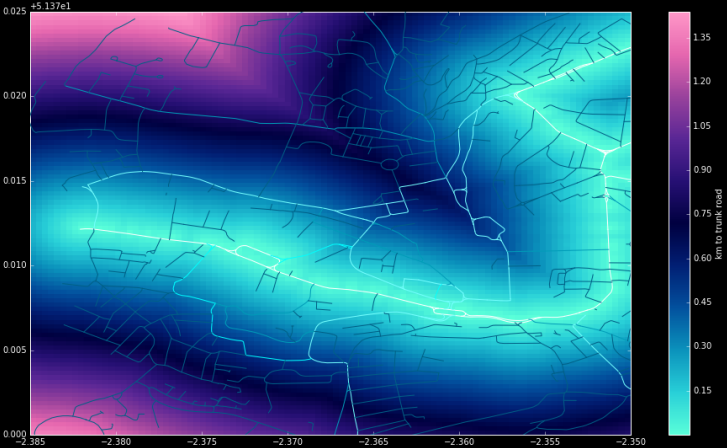
Spatial Analysis



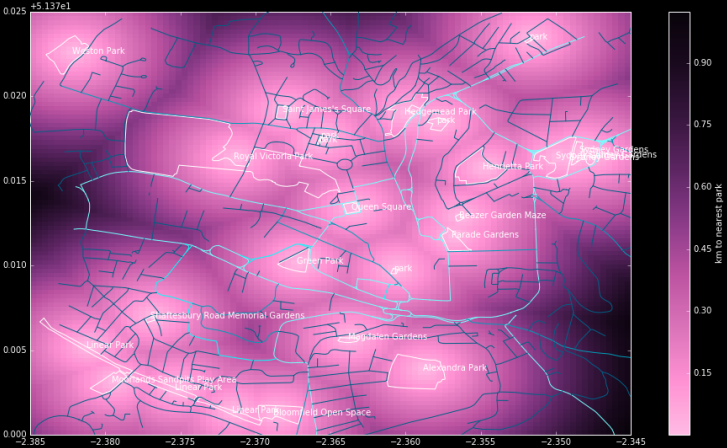
Spatial Analysis



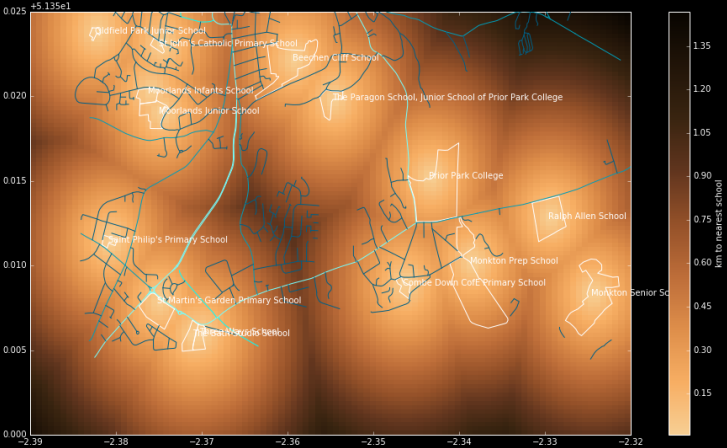
Data/Spatial Analysis



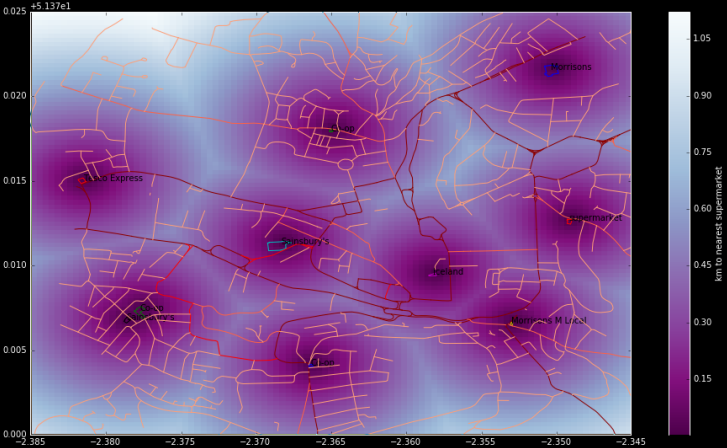
Data/Spatial Analysis



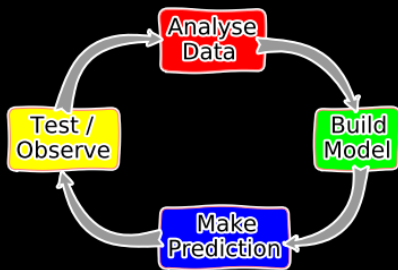
Data/Spatial Analysis



Data/Spatial Analysis



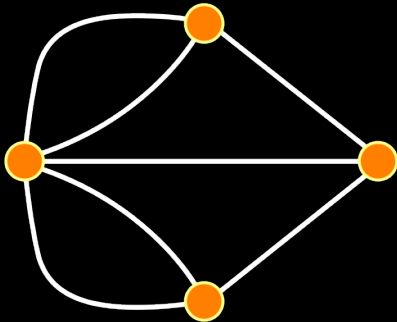
Developing a Scientific Theory



Network Models

Network Science / Complex Systems Science

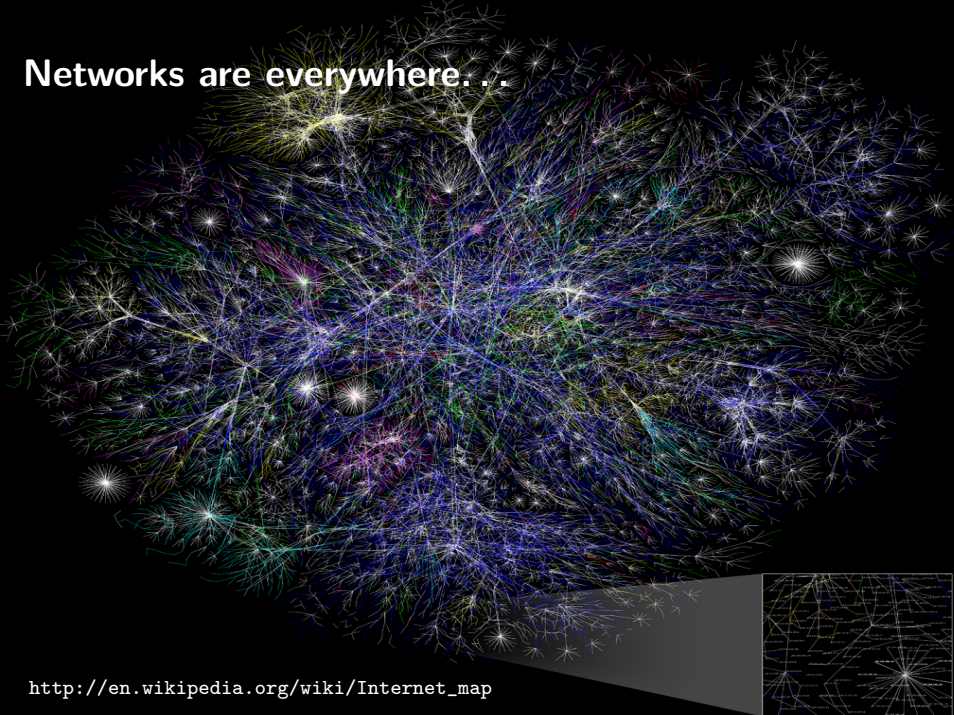
- ▶ The study of how things connect / interact



Graph Theory

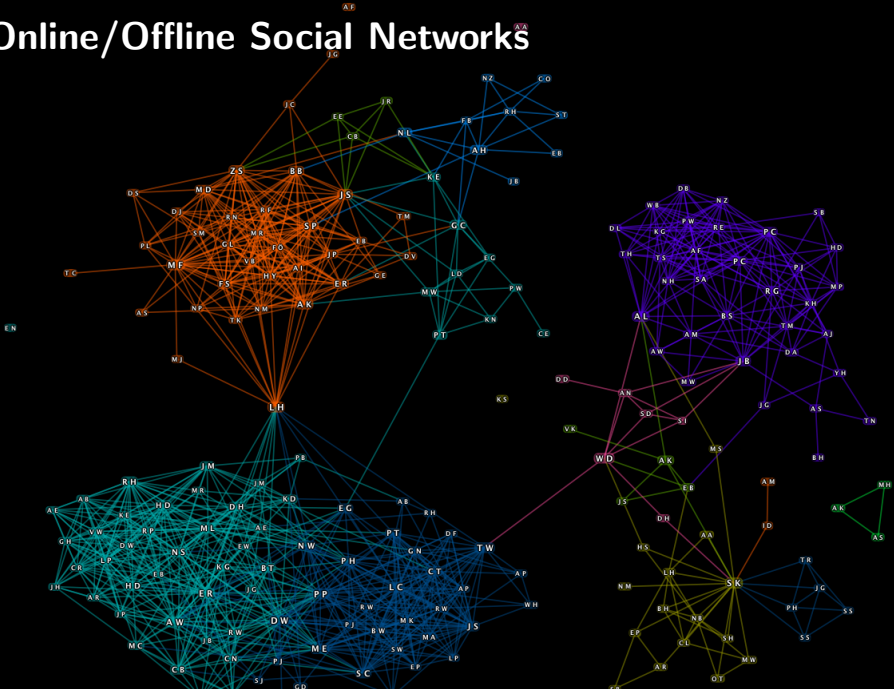
- ▶ Nodes: Individuals
- ▶ Edges: Links / Connections

Networks are everywhere. . .

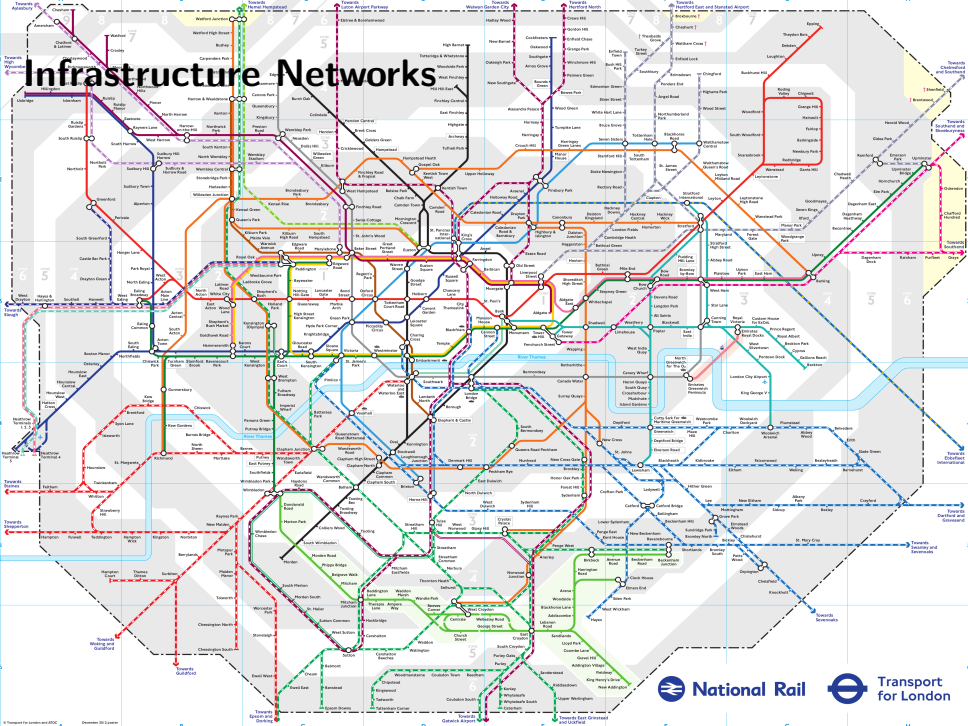


http://en.wikipedia.org/wiki/Internet_map

Online/Offline Social Networks



Infrastructure Networks



Interconnected Urban Networks

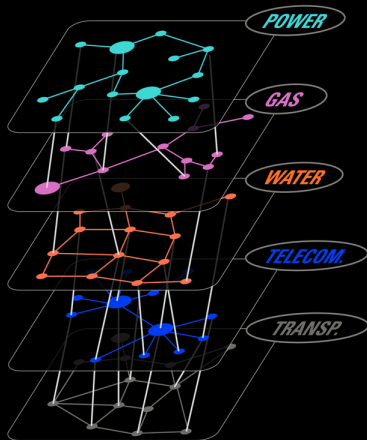
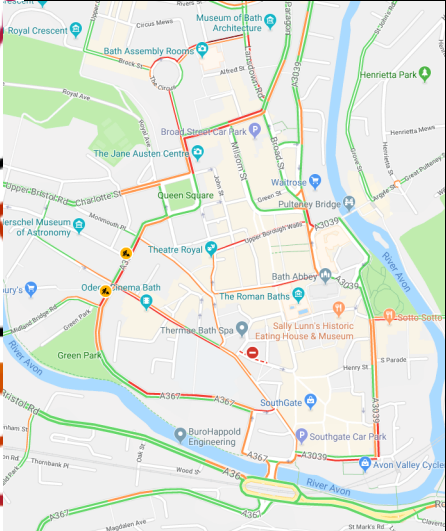


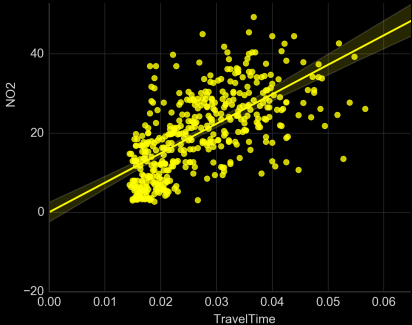
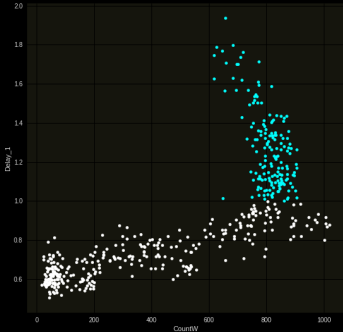
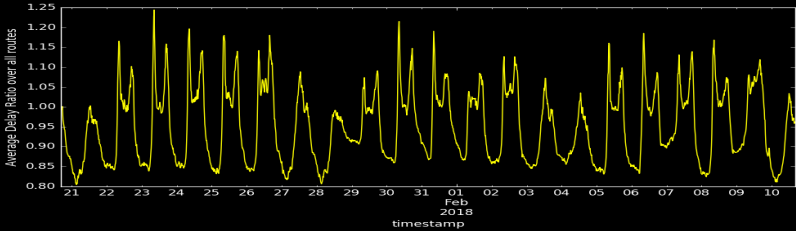
Figure: © Leonardo Dueñas-Osorio.

From: <https://simonsfoundation.org/features/science-news/treading-softly-in-a-connected-world/>

Connectivity and Traffic in Bath



Traffic Flow & Pollution in Bath



What Math Can Tell Us About Technology's Spread Through Cities

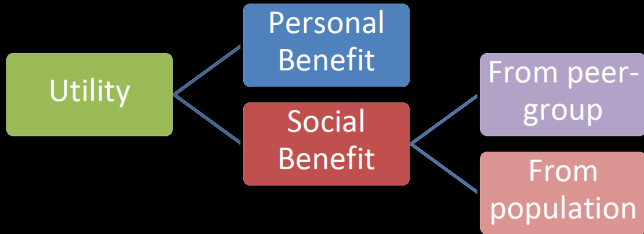
EMILY BADGER APR 10, 2013 COMMENTS



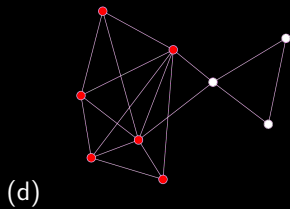
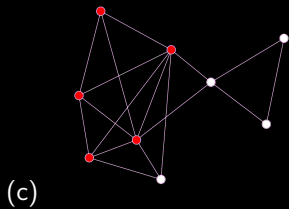
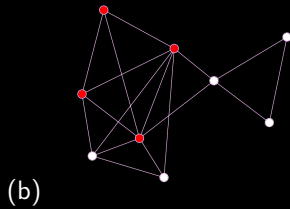
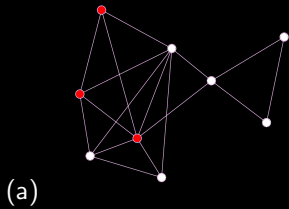
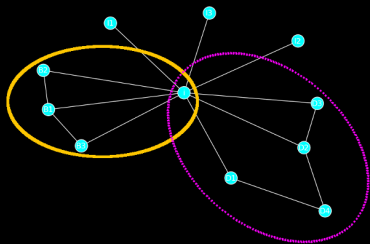
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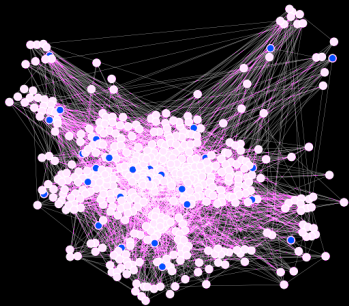
Sociologists have been studying social networks for some 50 years, trying to understand how groups of people connect to each other and how new ideas and tools travel between them. Our understanding of these networks is rapidly evolving, though. "Now," says [Nick McCullen](#), a researcher based in the UK, "physicists and mathematicians have been getting in on the game with their computer models." And the

Modelling the Spread of Innovation

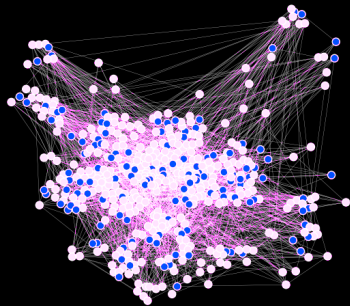


- ▶ Perceived *usefulness* of innovation: $u = \alpha p + \beta s + \gamma m$

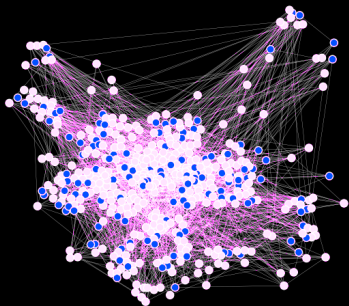




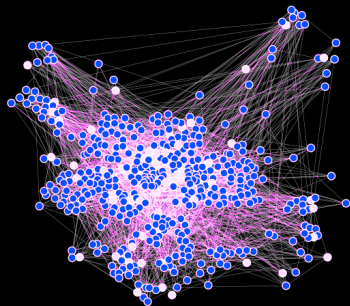
t1



t2

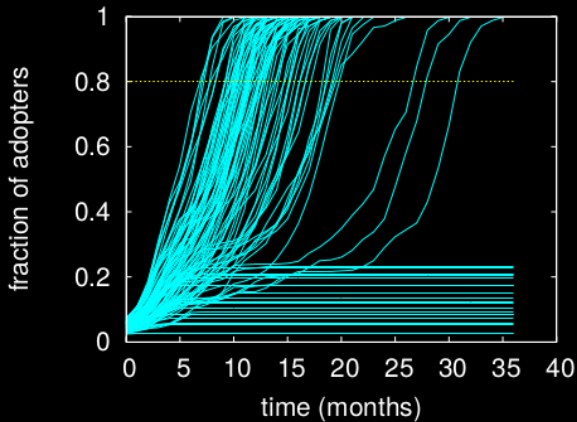
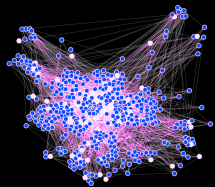
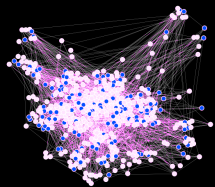


t3



t4

Simulating and comparing scenarios



Continuing the Cycle...

