

# Building “Geographic Data Science...”

Dani Arribas-Bel [@darribas]



**The  
Alan Turing  
Institute**

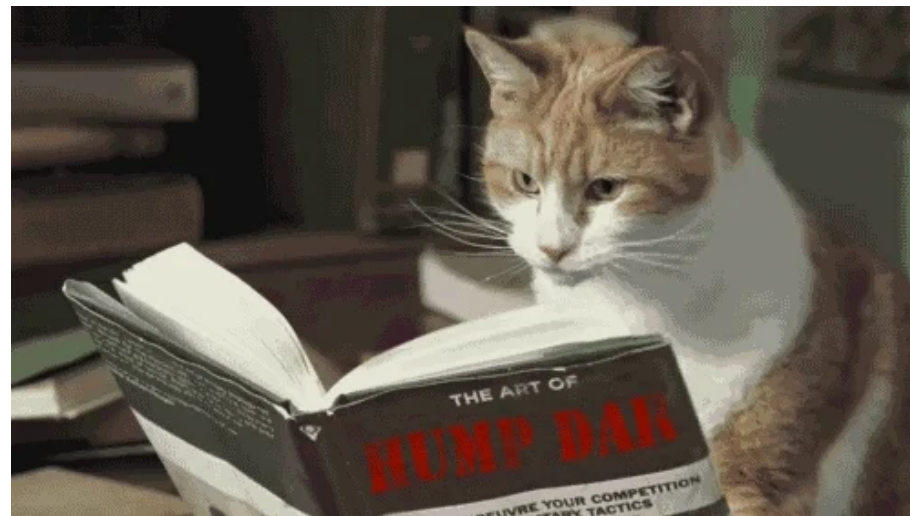


# This talk



[darribas.org/gdsbook\\_overview/202110](https://darribas.org/gdsbook_overview/202110)

# We have a book!



via GIPHY

# Almost...




via GIPHY

Coming “soon” but...

# Coming “soon” but...

... you can already:

- <https://geographicdata.science>
- 
- <https://github.com/gdsbook/book>



# The Authors



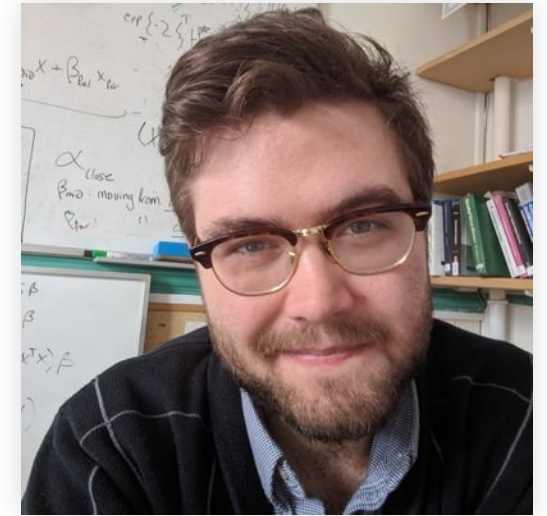
@sreyog

Serge Rey



@darribas

Dani  
Arribas-Bel



@levijohnwolf

Levi Wolf

# Today

- *Why?* – Vision
- *What?* – Book
- *How?* – Community

*Why?*

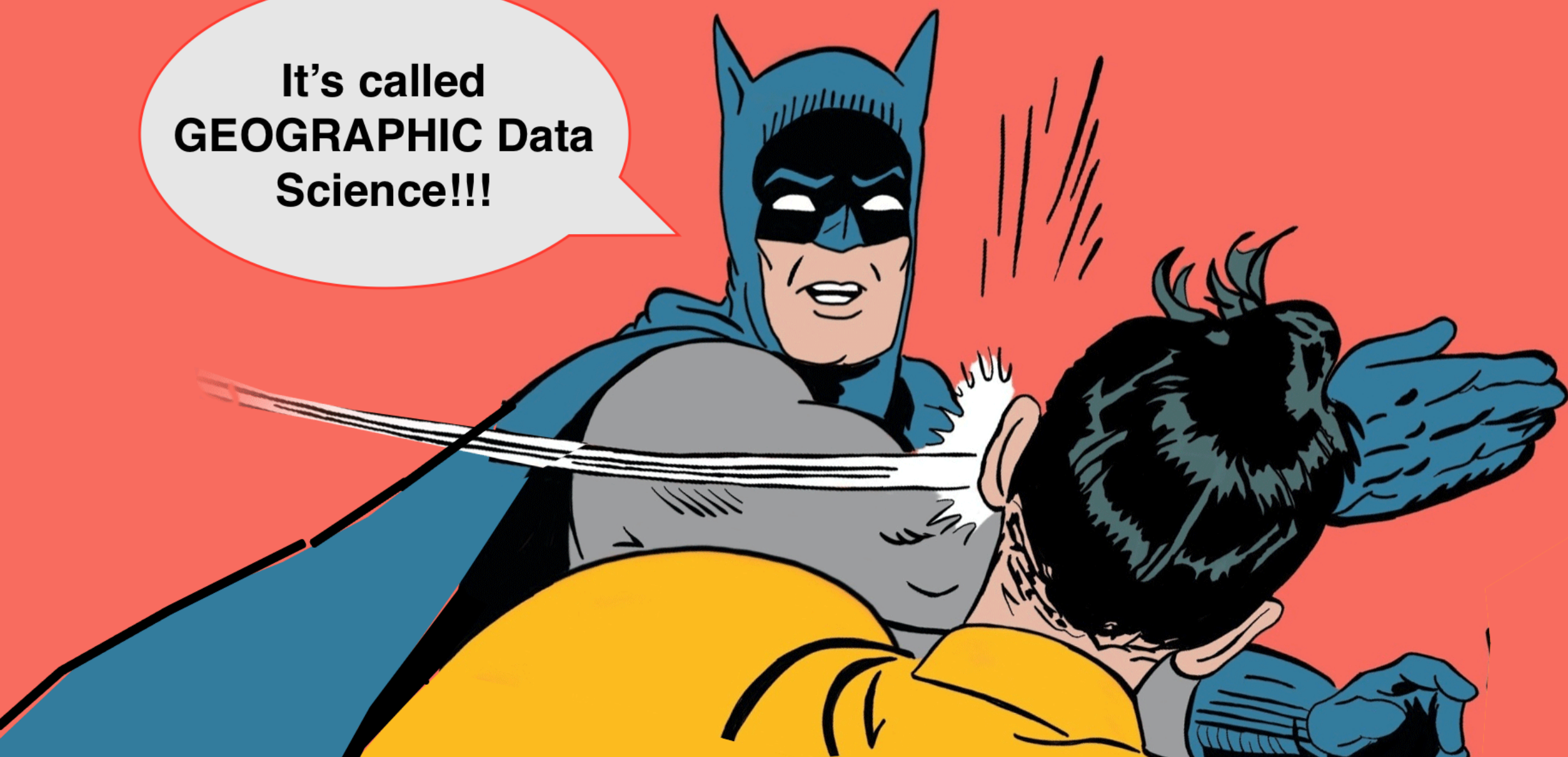


Data, data, data

Data Science

...

**It's called  
GEOGRAPHIC Data  
Science!!!**



# Geographic Data Science

geographical analysis

*Geographical Analysis* (2021) **53**, 61–75

Special Issue

## Geographic Data Science

Alex Singleton , Daniel Arribas-Bel 

Department of Geography and Planning, University of Liverpool, Liverpool, L69 7ZT, U.K.

*It is widely acknowledged that the emergence of “Big Data” is having a profound and often controversial impact on the production of knowledge. In this context, Data Science has developed as an interdisciplinary approach that turns such “Big Data” into information. This article argues for the positive role that Geography can have on Data Science when being applied to spatially explicit problems; and inversely, makes the case that there is much that Geography and Geographical Analysis could learn from Data Science. We propose a deeper integration through an ambitious research agenda, including systems engineering, new methodological development, and work toward addressing some acute challenges around epistemology. We argue that such issues must be resolved in order to realize a Geographic Data Science, and that such goal would be a desirable one.*

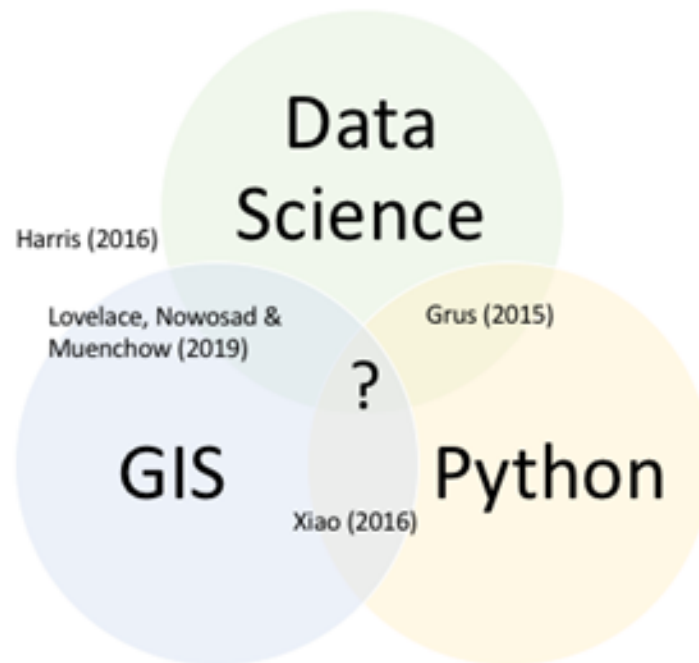


# Geographic Data Science

- GIScience ↔ Data Science
- Foster innovation (avoid reinventing the wheel)
- Grow a community around collaboration ( $1+1>2$ )
  - Diverse ( $\neq$  white male engineer)
  - Inclusive (*embrace different perspectives*)
  - Welcoming (*make it easy to join... and stay*)

*What?*

# The Book is...



# The Book is *not*...

- A GIS starter
- An introduction to programming
- An in-depth volume (rather *in-breath*)

# The Book is for...

- Data Scientists who work on spatial problems
- GIScientists who want to “update”
- (Social) Scientists getting started in geospatial





## Geographic Data Science with Python

Search this book...

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scientists

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Spatial Data

Spatial Weights

**PART II - SPATIAL DATA  
ANALYSIS**



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# GIScience + Data Science

- geopandas
- rasterio
- pysal
- osmnx
- contextily
- pandas
- xarray
- scikit-learn
- matplotlib
- seaborn

# Bonus: Datasets

**AirBnb**

Download files

Download dataset listing file

```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

Download dataset listing file with prices

```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

**Airports**

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```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

scale	latitude	type	name	abbrev	location	gsi_code	lat_code
0	9	Airport	small	Schweid	LLH	terminal	VLD

**Brexit**

Brexit dataset

This dataset contains results for the Brexit vote at the local authority district, and administrative boundaries.

brexit\_vote.csv

Source: Electoral Commission

Reference: [http://www.electoralcommission.org.uk/\\_data/assets/file/014/21133/Brexit-vote-results.csv](http://www.electoralcommission.org.uk/_data/assets/file/014/21133/Brexit-vote-results.csv)

Processing: no processing was required for this dataset, see original source for additional information

Local Authority District boundaries

**Countries**

Download files

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url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

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```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

**H3 Grid**

Build a H3 grid for the San Diego region

Infrastructure

To create a container that includes the following on a file called `h3_grid.sh`

```
#!/bin/bash
set -e
mkdir -p /tmp/h3
cd /tmp/h3
curl -O https://github.com/uber/h3/releases/download/4.1.0/h3-4.1.0-linux-amd64.tar.gz
tar xzf h3-4.1.0-linux-amd64.tar.gz
cd h3
./h3.sh
```

And build the container by running the following from the same folder where the file is stored:

```
docker build -t h3 .
```

**Mexico**

This dataset contains decadal GDP figures for Mexican states, from 1940-2000.

Source: <https://data.icecube.msu.edu/data/status/>

Reference: <https://data.icecube.msu.edu/data/status/>

Processing: no processing was required for this dataset, see original source for additional information

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**Texas**

Download files

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```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

Download dataset listing file with prices

```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

**Texas**

This dataset includes geometries for Texas counties.

Source: <https://data.icecube.msu.edu/data/status/>

Reference: <https://data.icecube.msu.edu/data/status/>

Processing: no processing was required for this dataset, see original source for additional information

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**Tokyo Photographs**

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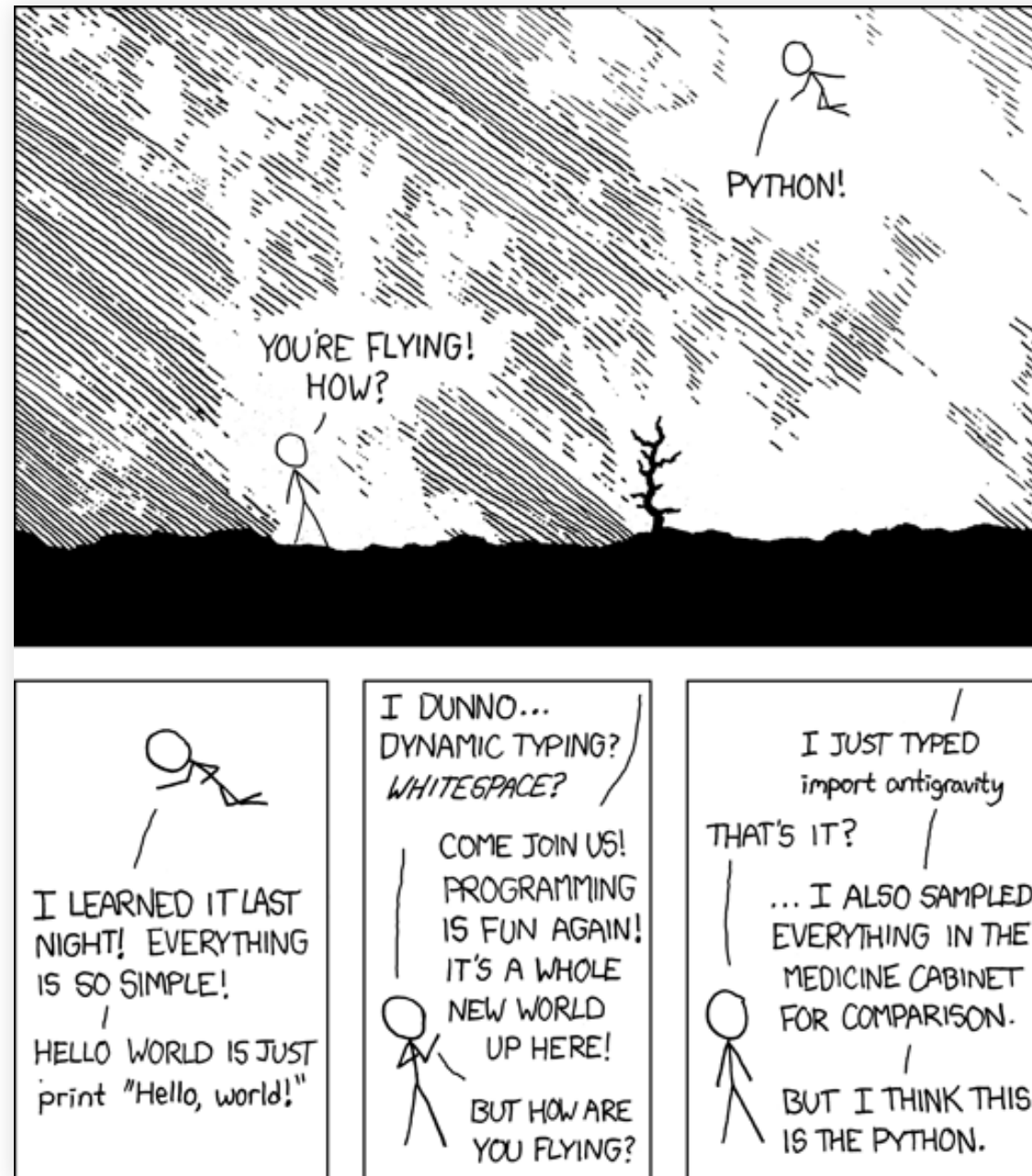
```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

Download dataset listing file with prices

```
url = "https://data.icecube.msu.edu/data/status/"
url = "https://data.icecube.msu.edu/data/status/"
```

*How?*

# Python



Source

# Radically Open

Welcome! | Geographic Data Science with PySAL and the PyData Stack

[Authors](#) [Book](#)

## Welcome!

### Geographic Data Science with PySAL and the PyData Stack

This is the site for the book "Geographic Data Science with PySAL and the PyData Stack", by Sergio J. Rey, Dani Arribas-Bel and Levi J. Wolf. Here you can find out about the latest news regarding the book, read more about the [authors](#), or jump straight to the [book](#).

### Latest news

Oct 30, 2020  
[Geographic data science on the road!](#)

Apr 21, 2020  
[New Data Section available online](#)

Aug 29, 2019  
[Work in progress...](#)

Aug 24, 2019  
[Hello world!!!](#)

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---

Geographic Data Science with PySAL and the PyData Stack

Sergio J. Rey, Dani Arribas-Bel & Levi J. Wolf  
[geographicdatascience@gmail.com](mailto:geographicdatascience@gmail.com)

This book serves as an introduction to a whole new way of thinking systematically about geographic data, using geographical analysis and computation to unlock new insights hidden within data.

[🔄](#) [🐦](#) [📡](#)

GitHub - gdsbook/book: This book serves as an introduction to a whole new way of thinking systematically about geographic data, using geographical analysis and computation to unlock new insights hidden within data.

gdsbook / book

Code Issues 23 Pull requests 5 Actions Projects Security Insights

master

actions-user GA build of book HTML 12 days ago 341

.github	Change GA commit message to clarify further	2 months ago
data	Fix data downloads and update gds_env for ...	2 months ago
docs	GA build of book HTML	12 days ago
figures	Complete draft of ch01	11 months ago
infrastructure	Fix titles so they look OK on side TOC	2 months ago
notebooks	GA build of book HTML	12 days ago
.gitignore	Ignore NASADEM .hgt files	8 months ago
.nojekyll	Create .nojekyll	2 years ago
Dockerfile	Removed paired markdowns on Binder setup	2 months ago
LICENSE	restructure of infrastructure to move to new JB	2 months ago
Makefile	Remove CNAME (taken care of in parent rep...	2 months ago
README.md	Update README.md	15 months ago
appveyor.yml	add substance and infrastructure	2 years ago

About

This book serves as an introduction to a whole new way of thinking systematically about geographic data, using geographical analysis and computation to unlock new insights hidden within data.

[geographicdata.science](#)

- [data-science](#)
- [data-analysis-python](#)
- [geographical-information-system](#)
- [geographic-data](#)
- [spatial-analysis](#)
- [spatial-statistics](#)
- [statistics](#)
- [spatial-data-analysis](#)

Readme

View license

Commits - gdsbook/book · GitHub

gdsbook / book

Code Issues 23 Pull requests 5 Actions Projects Security Insights

master

Commits on Nov 6, 2020

- GA build of book HTML actions-user committed 12 days ago ✓ 7375dca
- Merge pull request #102 from ljwolf/ch2 Verified darribas committed 12 days ago ✓ 4762249
- update spatial data chapter with additional structure ljwolf committed 12 days ago 63adeb9

Commits on Oct 21, 2020

- GA build of book HTML actions-user committed 29 days ago ✓ d8631b1
- Merge pull request #100 from darribas/master Verified ljwolf committed 29 days ago ✓ d24db1a
- GA build of book HTML actions-user committed 29 days ago 0400d49
- Ch.12: Remove DEM code to go to blog: fix header hierarchy for cluste... darribas committed 29 days ago 6bbfacb

Commits on Oct 16, 2020

- add sketch of spatial data chapter ljwolf committed on Oct 16 e67db76

Commits on Sep 21, 2020

- GA build of book HTML actions-user committed on Sep 21 310ead1
- Add refs page darribas committed on Sep 21 39d1da4
- interim build

# Code as text; text as code

Geographic Data Science with Python

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To illustrate, the figure below has the tightest single alpha shape shown in green and the original source points shown in black. The "bounding" circles shown in the figure all have a radius of 8652 meters. The circles are plotted where our "bounding" disk touches two or three of the points in the point cloud. You can see that the circles "cut into" the convex hull, shown in blue dashed lines, up until they touch two (or three) points. Any tighter, and the circle would disconnect one of the points on the boundary of the alpha shape.

```
from descartes import PolygonPatch #to plot the alpha shape easily
f,ax = plt.subplots(1,1, figsize=(9,9))

# Plot a green alpha shape
ax.add_patch(PolygonPatch(alpha_shape, edgecolor='green',
                           facecolor='green', alpha=.2, label = 'Tightest alpha shape'))

# Include the points for our prolific user in black
ax.scatter(*coordinates.T, color='k', marker='.', label='Source Points')
# Add a basemap
ax.imshow(basemap, extent=basemap_extent)

# plot the circles forming the boundary of the alpha shape
for i, circle in enumerate(circles):
    # only label the first circle of its kind
    if i == 0:
        label = 'Bounding Circles'
    else:
        label = None
    ax.add_patch(plt.Circle(circle, radius=alpha, facecolor='none', edgecolor='r', label=label))

# add a blue convex hull
ax.add_patch(plt.Polygon(convex_hull_vertices,
                        closed=True,
                        edgecolor='blue', facecolor='none',
                        linestyle='--', linewidth=2,
                        label='Convex Hull'))

plt.legend()
```

<matplotlib.legend.Legend at 0x7f413c088c10>

Merge pull request #100 from darribas/master

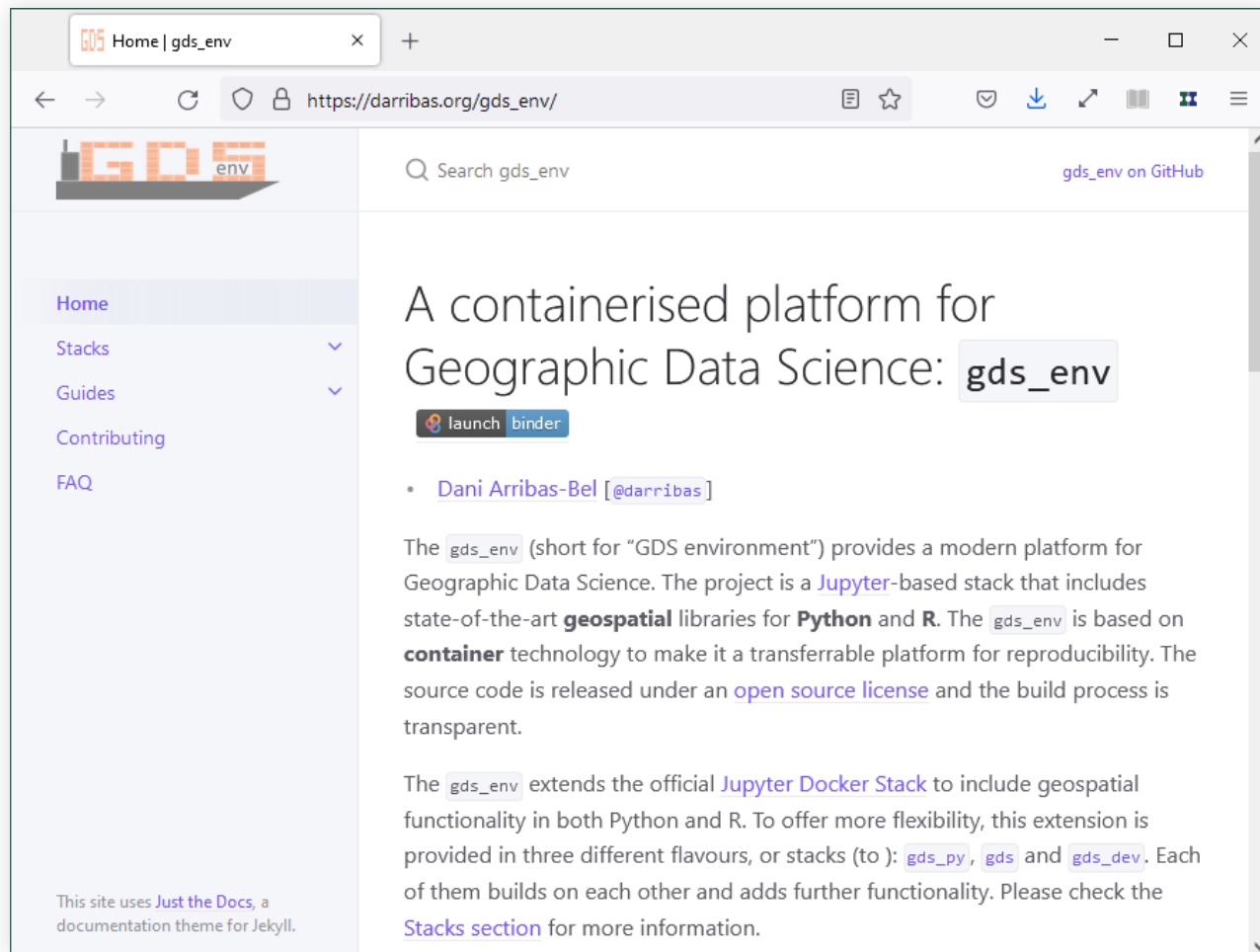
master d24db1a

Build Jupyter book on: push 6

build-html-and-deploy succeeded 29 days ago in 2m 50s

- Set up job 4s
- Checkout 13s
- Setup Miniconda 1m 59s
- Build HTML 29s
- Commit files 0s
- Push changes 4s
- Post Setup Miniconda 1s
- Post Checkout 0s
- Complete job 0s

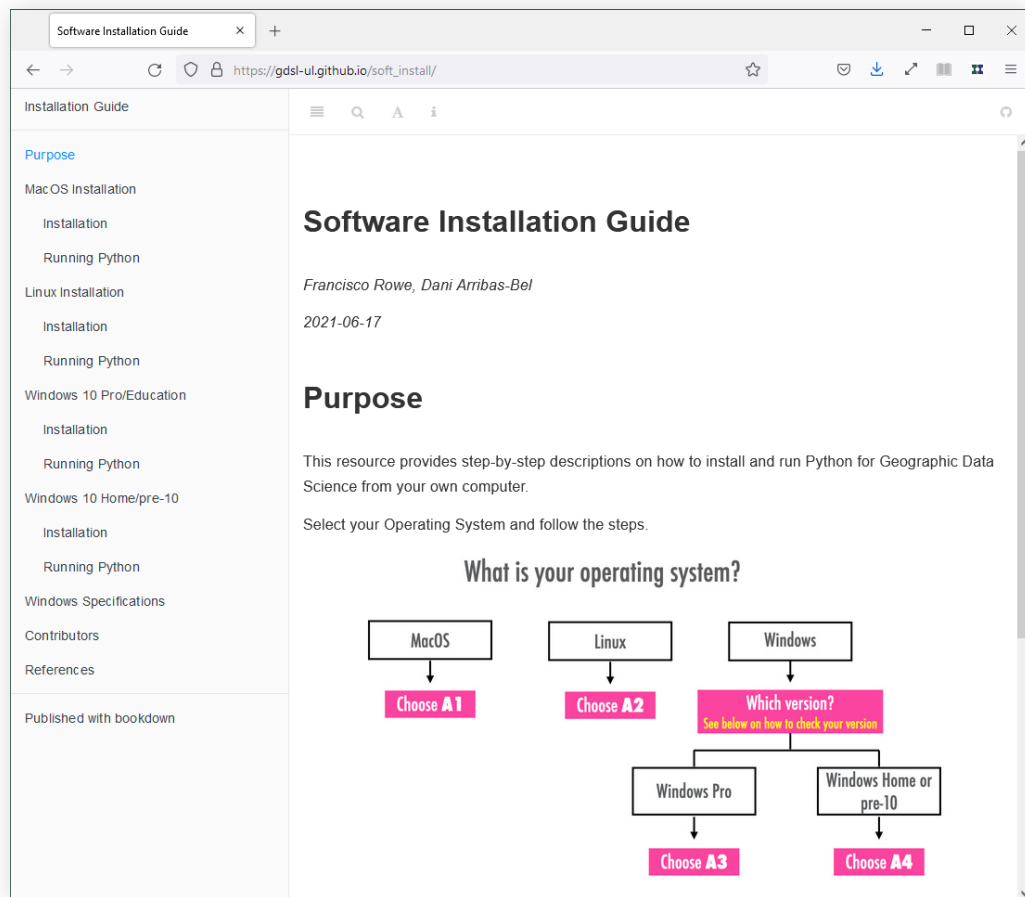
# Runs *anywhere*...



darribas.org/gds\_env



... by anyone



`gds1-ul.github.io/soft_install`

# Try it out...

Spatial Feature Engineering — X +

https://geographicdata.science 90%

← → ↺

🔒 https://geographicdata.science 📄 90% ⋮ 🛡️ ☆

📄 ↗️ 📖 ☰

←

**Spatial Feature Engineering**

Launch Binder

Binder

Colab

Geographic Data Science with Python

🔍 Search this book

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In machine learning and data science, we are often equipped with *tons* of data. Indeed, given the constellation of packages to query data services, free and open source data sets, and the rapid and persistent collection of geographical data, there is simply too much data to even represent coherently in a single, tidy fashion. However, we often need to be able to construct useful *features* from this rich and deep sea of data.

Where data is available, but not yet directly *usable*, *feature engineering* helps to construct useful data for modelling a

Contents

What is spatial feature engineering?

Feature Engineering Using Map Matching

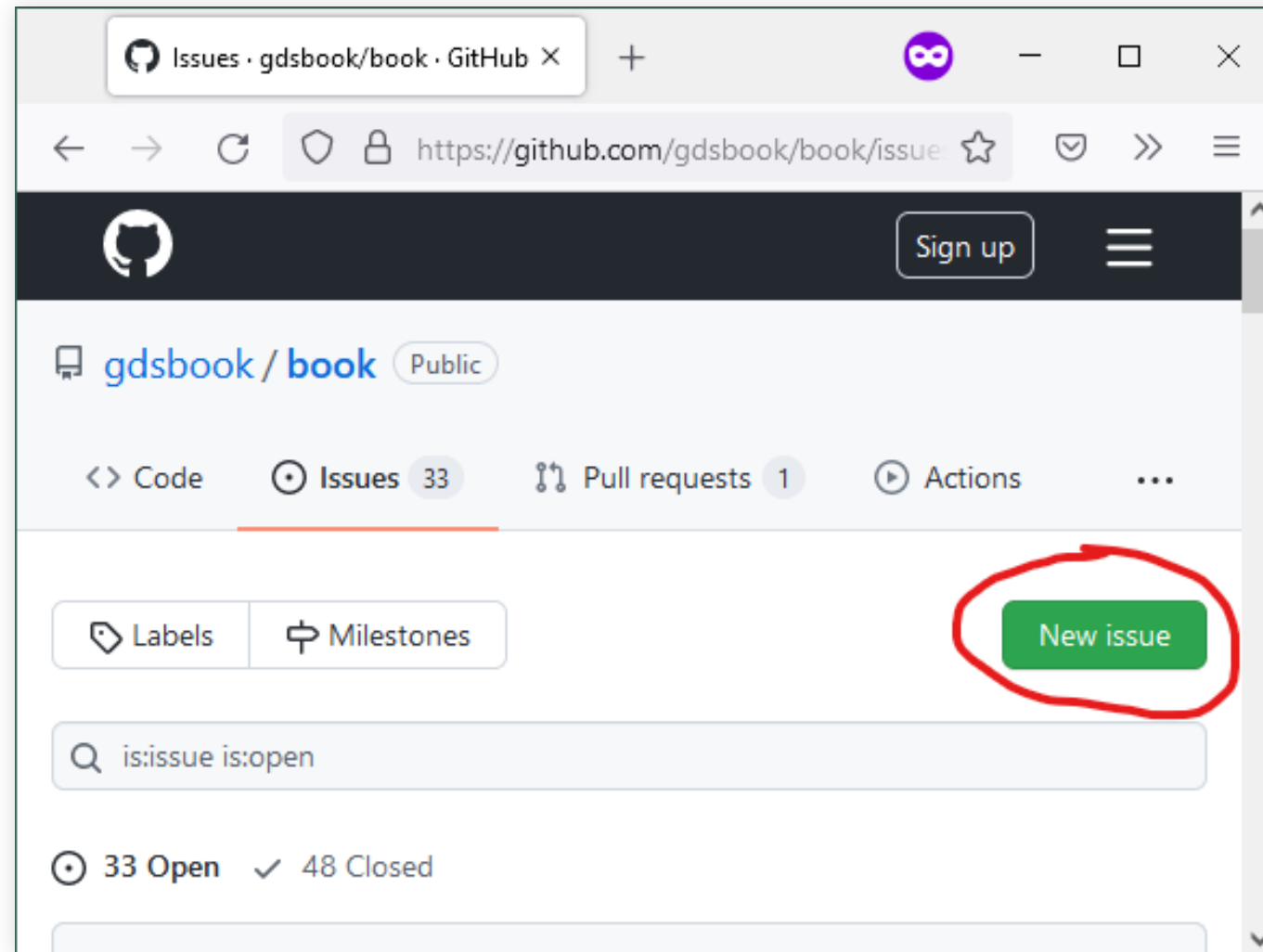
Feature Engineering using Map Synthesis

Conclusion

Questions

https://mybinder.org/v2/gh/gdsbook/book/master?urlpath=lab/tree/notebooks/12\_feature\_engineering.ipynb

# ...and make it better!!!



`github.com/gdsbook/book/issues/new`

# Building “Geographic Data Science...”

Dani Arribas-Bel [@darribas]



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**The  
Alan Turing  
Institute**



Geographic  
Data Science  
Lab

[PDF version of these slides]



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