

Sharing Experiences in Teaching Spatial Data Science

A Higher Education Webinar



The willingness to experiment with innovative approaches to GIS has yielded benefits for numerous field-based teaching and research activities across the university.

— Peter Knoop | University of Michigan

Presenters



Dr. Trisalyn Nelson
UC Santa Barbara



Dr. Song Gao
University of Wisconsin -
Madison



Dr. Ilya Zaslavsky
UC San Diego



Dr. Lauren Bennett
Esri



Canserina Kurnia, M.L.A.
Esri

Spatial Data Science Programs: Opportunities and Challenges

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Spatial Data Science Programs



- BSc in Geomatics



**Arizona State
University**

- BSc in GIS (online and on campus)
- Masters in GIS
- BS in Data Science - spatial emphasis



- BA in GIScience
- Spatial Studies Minor
- PhD in Geography: GIScience & Geoinformatics

UC SANTA BARBARA

Thoughts on Decisions and Challenges

- Audience and size
- Teaching programming/statistics
- Prerequisites (equity implications)
- Student recruitment

UC SANTA BARBARA

Trisalyn@ucsb.edu



Teaching Spatial Data Science

Dr. Song Gao

Geospatial Data Science Lab

University of Wisconsin – Madison

<https://geods.geography.wisc.edu/>

New Data Science Major and Spatial Data Science Curriculum

<https://datascience.wisc.edu/>



New Data Science Major and Spatial Data Science Curriculum

Foundational Data Science Courses

[STAT 240](#)  Introduction to Data Modeling I

[STAT 340](#) Introduction to Data Modeling II

[COMP SCI 220](#)  Data Science Programming I

or [COMP SCI 300](#)  Programming II

[COMP SCI 320](#) Data Science Programming II

[LIS 461](#) Data and Algorithms: Ethics and Policy

[GEOG 573](#) Advanced Geocomputing and Geospatial Big Data Analytics

[GEOG 574](#) Geospatial Database Design and Development

Statistical Modeling

Machine Learning

Complete one of the following:

[COMP SCI/
ECE/ME 532](#) Matrix Methods in Machine Learning¹

[COMP SCI/
ECE/ME 539](#) Introduction to Artificial Neural Networks

[COMP SCI 540](#) Introduction to Artificial Intelligence

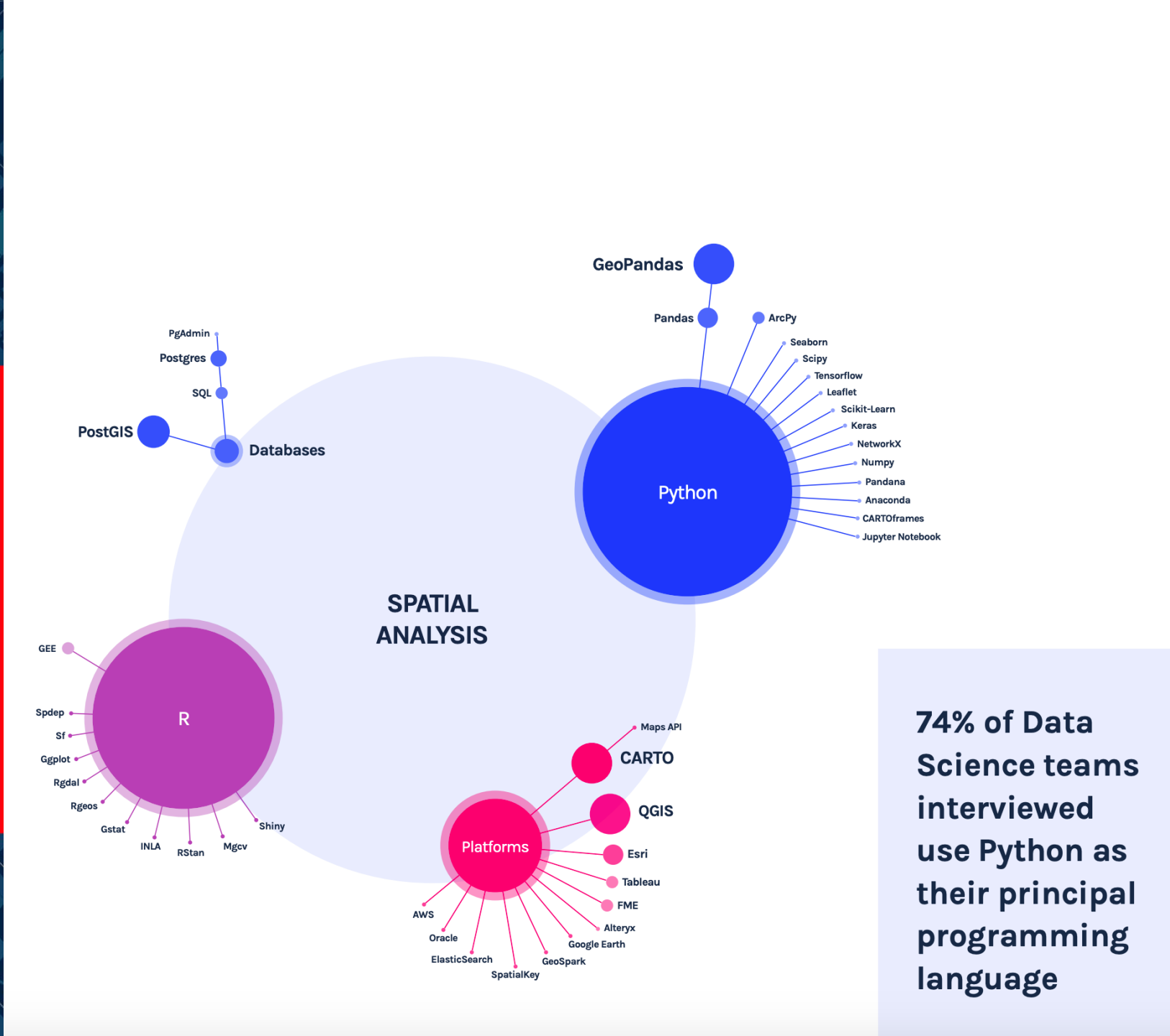
[MATH 535](#) Mathematical Methods in Data Science

[STAT 451](#) Introduction to Machine Learning and Statistical Pattern Classification

[STAT 453](#) Introduction to Deep Learning and Generative Models

Becoming a Spatial Data Scientist

Everything you need to know to become a spatial expert



74% of Data Science teams interviewed use Python as their principal programming language

Two different groups of mindsets

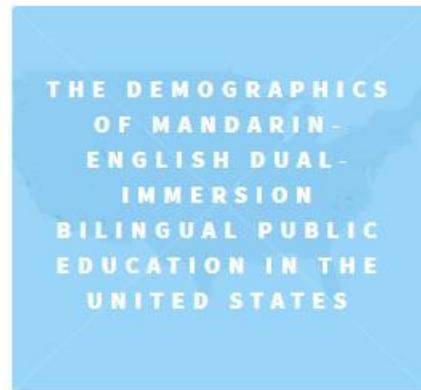
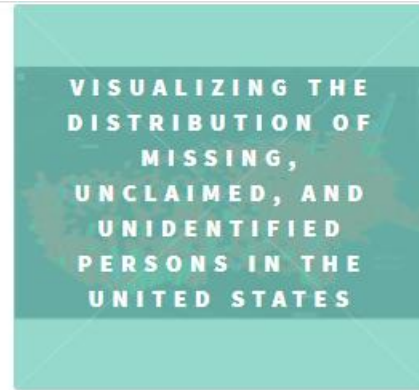
Geography elected

Data Science elected



Image Source: <https://www.ptcnews.tv/why-should-you-choose-data-science-as-your-career-en>

Final Projects



Learned from experiences

- Acknowledge differences in thinking, knowledge, and skills
- Engage with real-world problems/applications
- Students love code examples

Higher Ed Guide to Esri E-Learning for Spatial Data Science



Overview

Spatial data science allows analysts to extract deeper insight from data using a comprehensive set of analytical methods and spatial algorithms, including machine learning and deep learning techniques. Spatial data science topics may be included in a range of courses, including data science, business, and GIS.

This guide is an aid for instructors who want to use authoritative Esri web-based learning resources as part of college or university courses. This list is not a comprehensive curriculum, nor is it a course outline. It is intended to help instructors quickly identify and select those resources that best support their goals and students. Listed items are available as of September 2021 and are expected to be available through at least December 2021. **New listings are in orange.**

Full descriptions can be found at the links provided. All items listed are web courses unless otherwise noted. The complete Esri catalog can be found at esri.com/training/catalog. The information provided in this guide is subject to change without notice. Please email GIStraining@esri.com or call (800) 447-9778, ext. 5757 with questions about courses.

You and your students may be eligible for unlimited access to the entire collection of self-paced e-Learning (web courses, training seminars, and more) if your institution has a qualifying product with a current maintenance subscription. To determine if this applies to you, contact your Esri software license administrator, [check online](#), or email educationinfo@esri.com.

This guide is organized into three main sections:

- **Learning Plans:** Esri-curated sets of e-Learning offerings with a suggested order.
- **Technology:** Individual e-Learning offerings that provide foundational concepts and skills to support spatial data science workflows.
- **Capabilities:** Individual offerings about specific spatial data science analysis techniques.

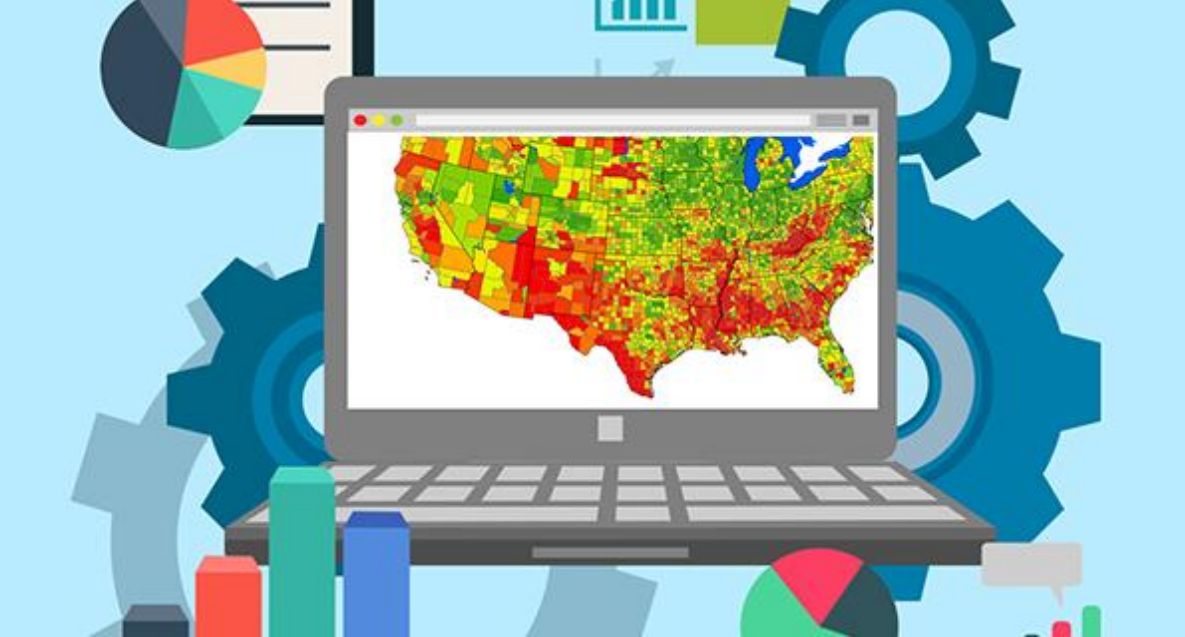
Thank you!



Geospatial Data Science Lab



UW-Madison



“Spatial Data Science and Applications” at UC San Diego

DSC 170 * Spring 2019

Syllabus Links and Resources Schedule Staff Hours Pair Programming

SPATIAL DATA SCIENCE AND APPLICATIONS

ABOUT THIS COURSE

Welcome to DSC 170 at UC San Diego! This course will introduce spatial data management techniques and spatial analysis methods. We will learn how to build models involving such data. An online GIS (Geographic Information System) will be used to illustrate core concepts and techniques, and practice spatial analysis.

Prerequisites: DSC-80 (Practice of Data Science). We will assume that you are familiar with Python, Pandas, Matplotlib and Numpy. Familiarity with “non-spatial” data science is helpful but not required.

COURSE TIME & LOCATION

Instructor: Ilya Zaslavsky, <izaslavsky@ucsd.edu> (Ilya)

Instructional Assistants: Ashin George <asg043@eng.ucsd.edu> (Ashin) Hammad

DSC 198 Spring 2020

Syllabus Projects, Lectures, Resources Schedule

EXPLORING COVID-19 PANDEMIC WITH DATA SCIENCE

ABOUT THIS COURSE

DSC198 is a workshop-style course focused on several types of data science applications, mostly in spatial data science but extending to other areas, from information visualization to recommender systems. It will be largely driven by problems that are made urgent by the pandemic. Because of this, a precise topic sequence is hard to lay out at the start. The situation changes rapidly, and we need to be flexible. We will identify several seed projects that teams of students will attack, working alongside the instructors. These projects may change as we go.

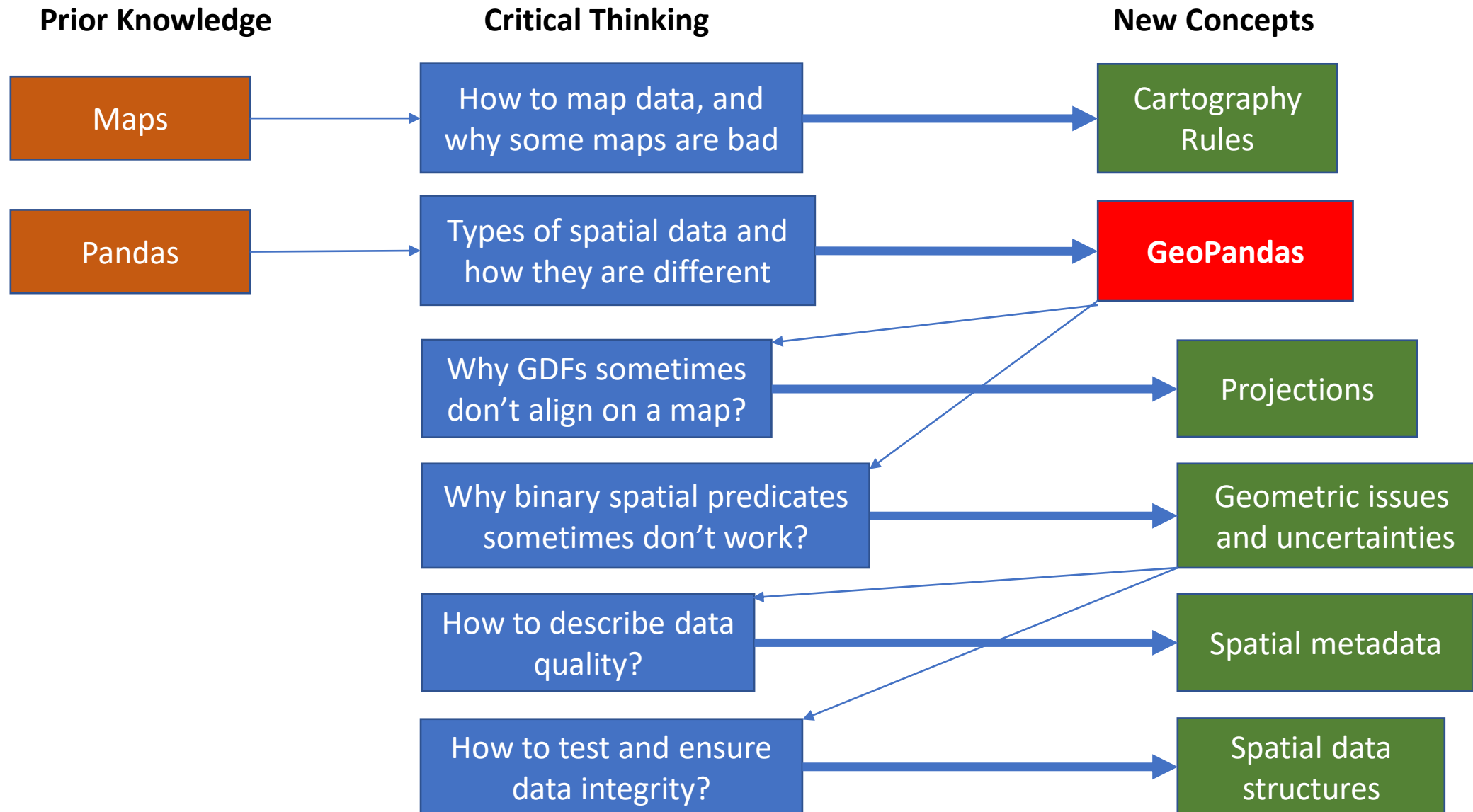
Ilya Zaslavsky

Director, Spatial Information Systems Lab
San Diego Supercomputer Center, UCSD

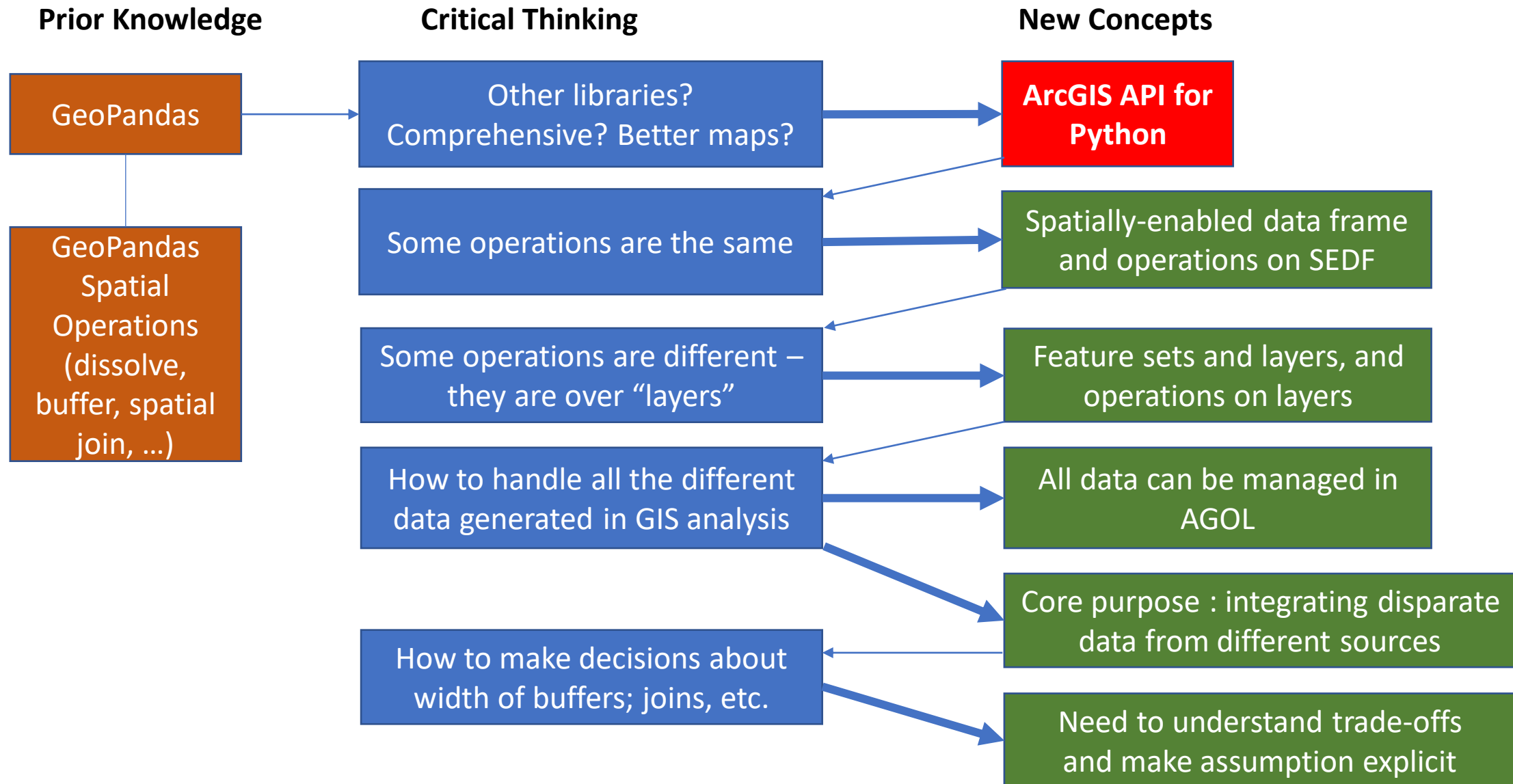
Teaching “spatial” to data scientists

- Massive enrollments in data science programs across the US: need curriculum building on skills and knowledge from DSC courses
- DSC170 is an upper division elective for UCSD data science majors:
 - Students have 2+ years of Python and machine learning
 - Coding requirements makes it difficult to attract students from other departments
- Practical project-based approach, with real data and problems from several domains
- Open-source and commercial spatial data libraries + AI libraries; intense on-line interactions outside lectures and discussions
- Direct interaction with ESRI developers – extremely helpful!
- A trove of notes and workarounds discovered by students – and shared with ESRI

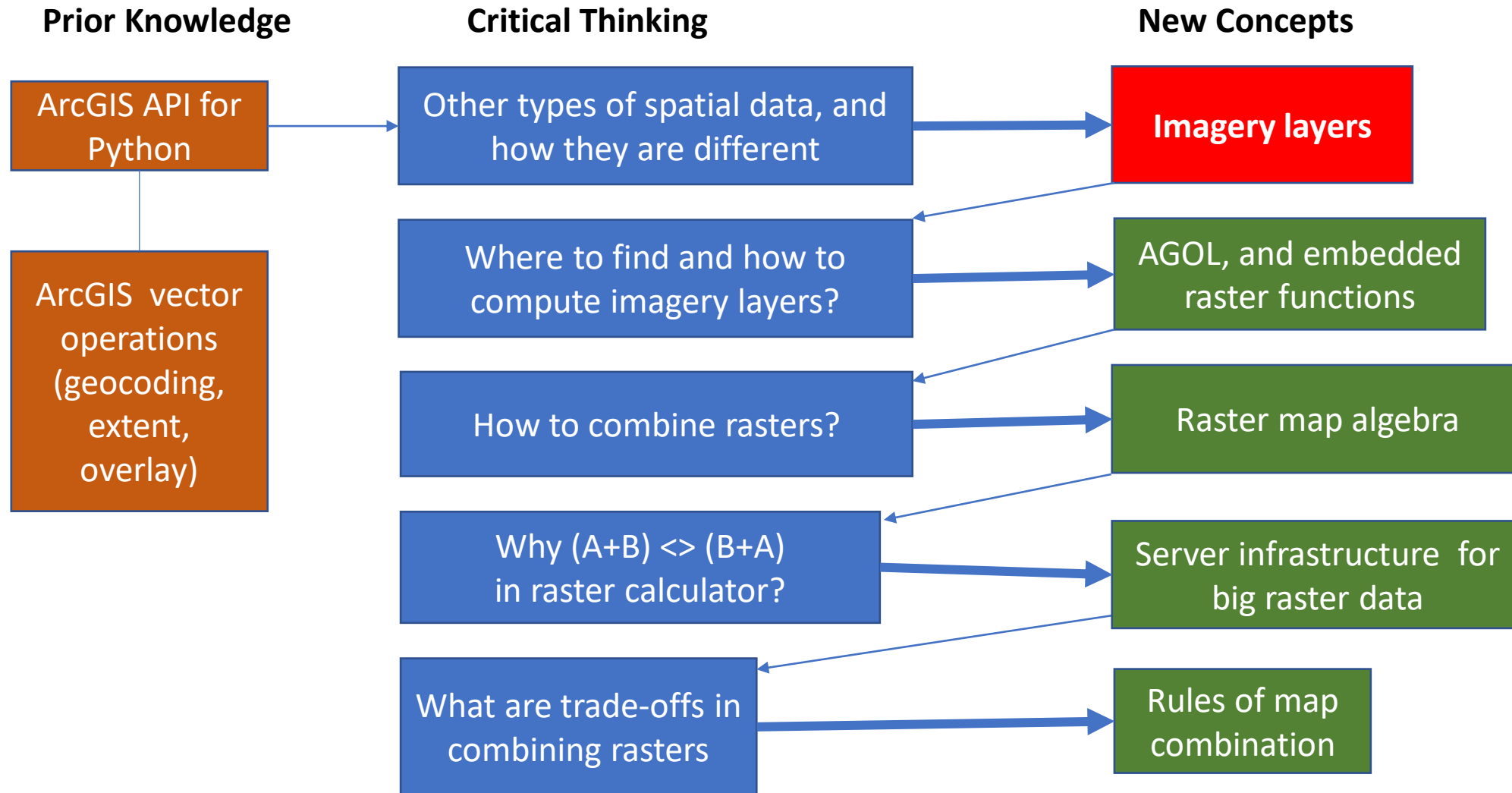
DSC170 Course Recap: the basics



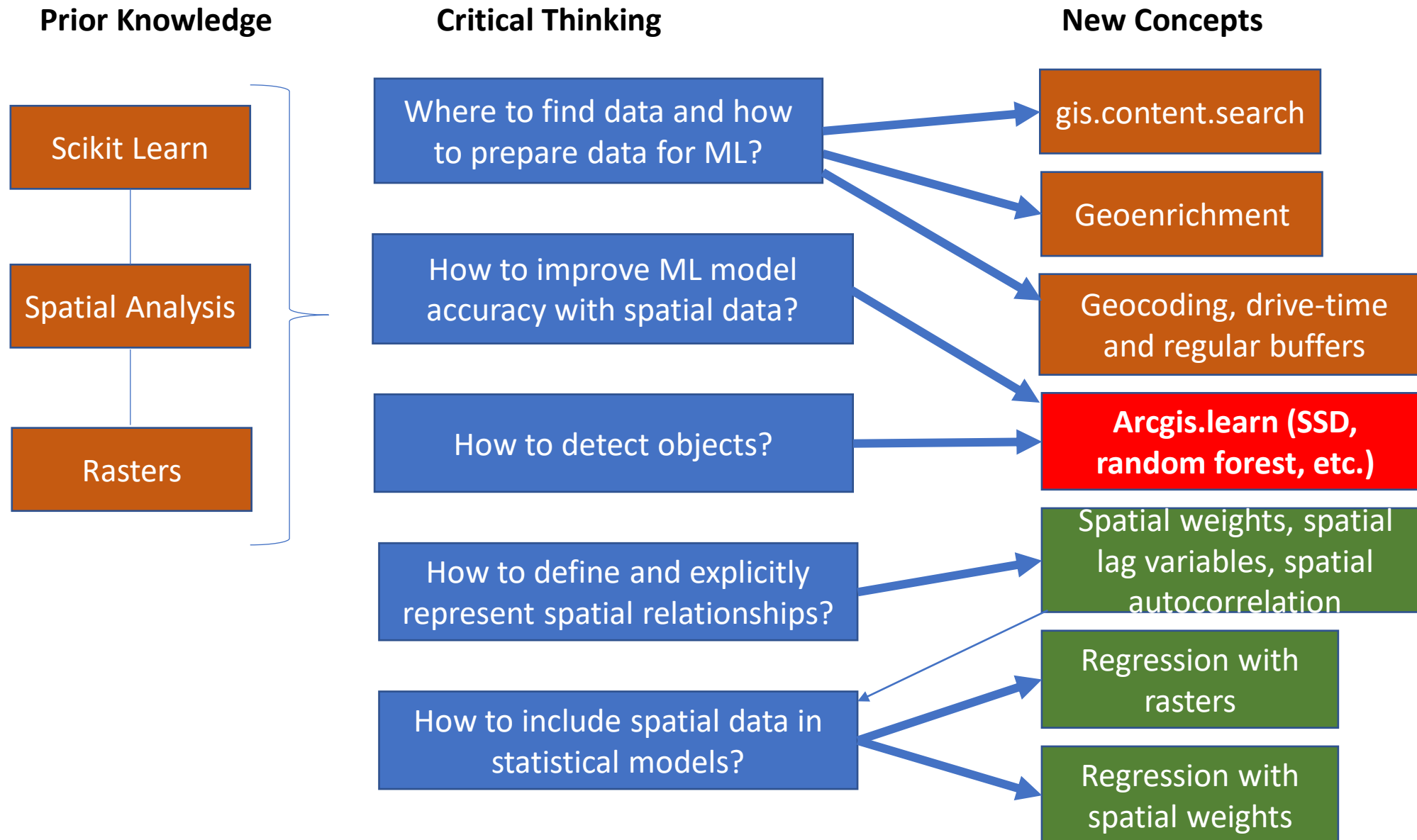
DSC170 Course Recap: feature analysis



DSC170 Course Recap: imagery



DSC170 Course Recap: towards machine learning



GIS for
Science,
Vol. 3

Now in
Print!

TEACHING SPATIAL DATA SCIENCE AND DEEP LEARNING

Fueled by massive GIS data repositories, deep learning and neural networks enable data scientists to apply machine learning techniques to a growing range of real-world problems. Education leaders at the University of California San Diego are training a new generation of geo-literate scientists. This chapter explores the short history of deep neural networks, describes the teaching approach at UCSD, and examines several practical applications at the intersection of GIS and AI.

By Ilya Zaslavsky, UCSD; and Dmitry Kudinov, Esri



Results of an automated damage assessment of homes after the devastating 2013 Woolly Fire in Southern California. Red outlines show damaged structures; blue undamaged.



Undergraduate Research Fellow | Data Science | UC San Diego
9mo •

...this was my class!

So much praise deserves to be sent to Prof. [Ilya Zaslavsky](#) and Mr. [Dmitry Kudinov](#) for making this unforgettable journey a reality.

This openness for a research institution to collaborate with industry partners such as [#Esri](#) and [#Microsoft](#) is exemplary of the reasons I'm proud to be a data science student at the [Halicioğlu Data Science Institute, UC San Diego](#)—and of what to expect from HDSI in the future!



Esri, Microsoft join UC San Diego teaching practical geospatial data science and deep learning

medium.com

Student feedback

During summer internship, I was stood out because of the speciality in spatial data when we took over a project which analyzes the national power network in China, and I was the only one in the team who had experience in geopandas and arcgis

Spatial data science for COVID-19 analysis and modeling

DSC 170 Past Projects

Overview Content Members Settings

Add items to group

COVID-19

Filters

1 - 5 of 5

- Group categories
 - No group categories yet
 - Categories allow group members to organize items consistently and provide a simple way to browse content in the group.
 - Set up group categories
- Item type
 - Maps
 - Layers
 - Scenes
 - Apps
 - Tools
 - Files
 - Insights
 - Notebooks
- Location
- Date modified
- Tags
- Sharing

Analysis of Food Delivery and Decreasing Covid-19 Exposure

Notebook by DSC_admin

Made by Oscar Jimenez and Bailey Man

Created: Jan 29, 2021 Updated: Jul 13, 2021 View Count: 20

Assessing the Effects of Pampas Grass in Orange County: How Do We Prevent or Deal With It?

Notebook by DSC_admin

Made by Hasan Liou

Created: Jan 30, 2021 Updated: Jul 13, 2021 View Count: 14

COVID-19 Risks for School Reopening in Different Areas

Notebook by DSC_admin

Made by Songling Lu and Jiali Qian

Created: Jan 30, 2021 Updated: Jul 13, 2021 View Count: 10

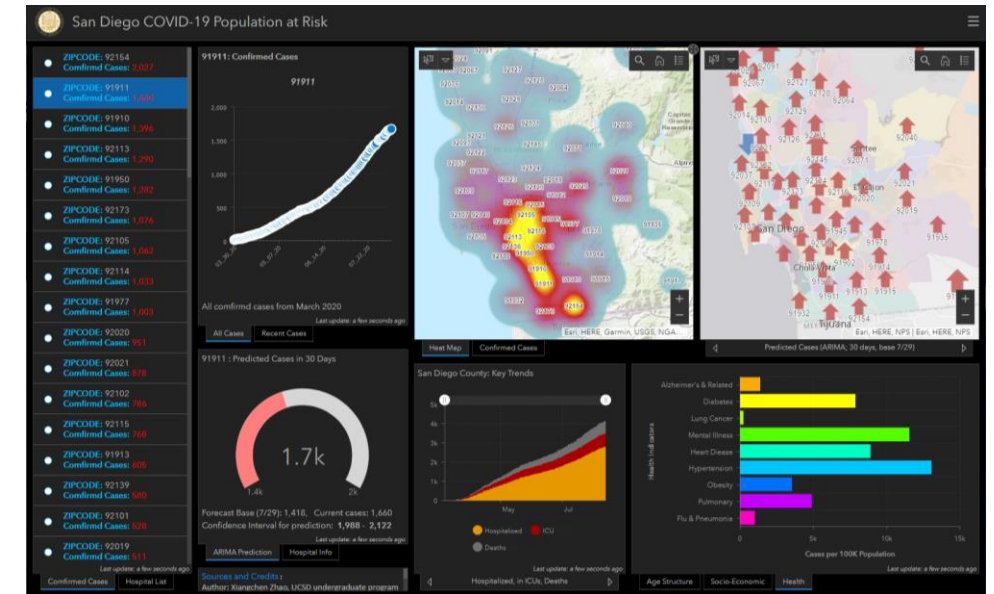
Risk of Covid-19 and Ethnicity in San Diego

Notebook by DSC_admin

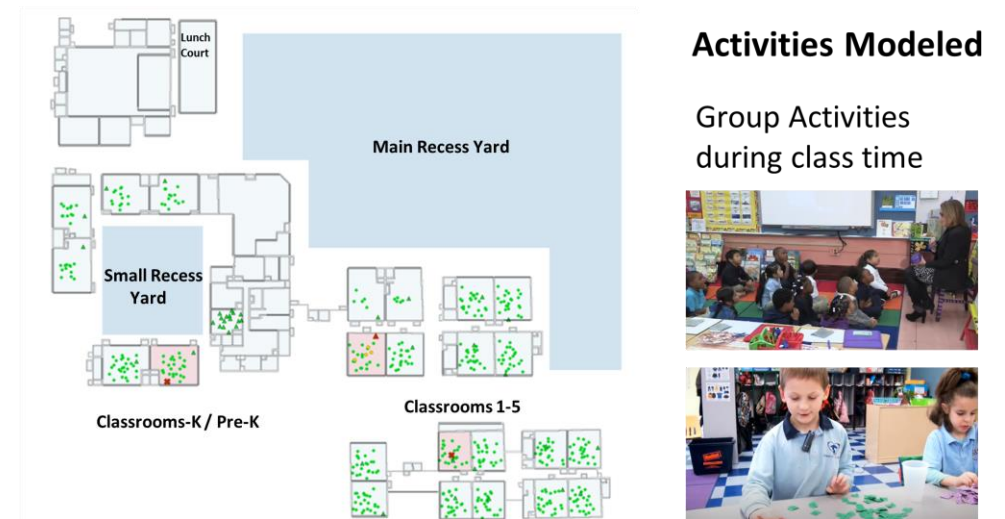
Made By Zhou Li and Caiwei Wang

Created: Jan 30, 2021 Updated: Jul 13, 2021 View Count: 16

Spatial Correlation of Positive Tests of COVID 19 and Zip Codes in San Diego



COVID-19 Predictive Modeling Dashboard



Spatially-explicit agent-based model of COVID-19 in schools

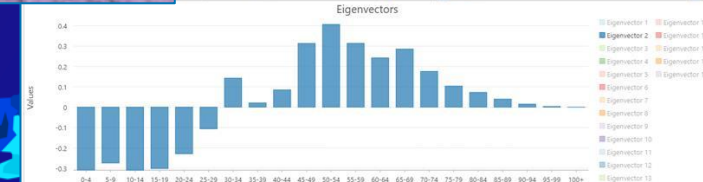
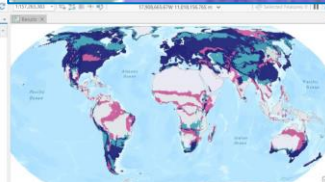
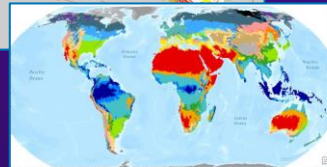
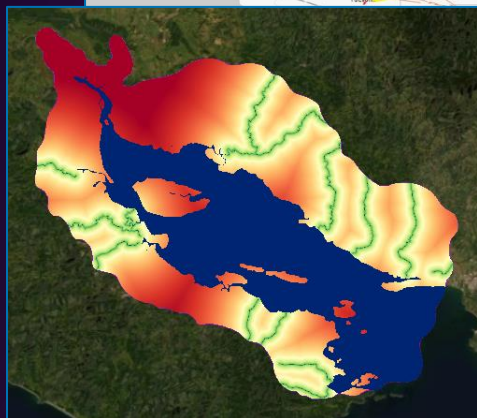
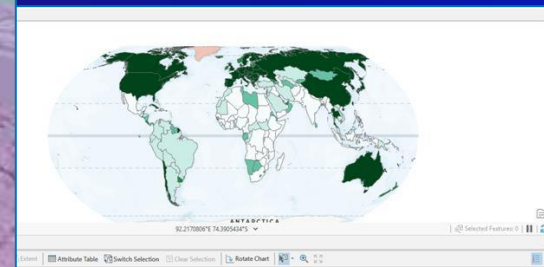
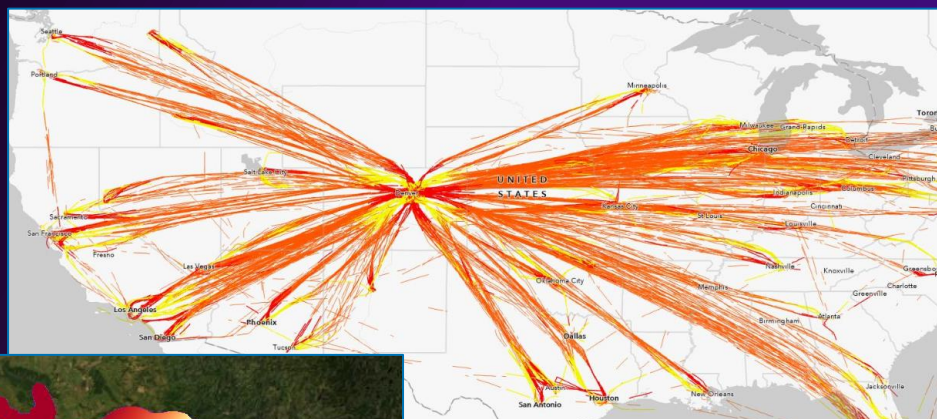
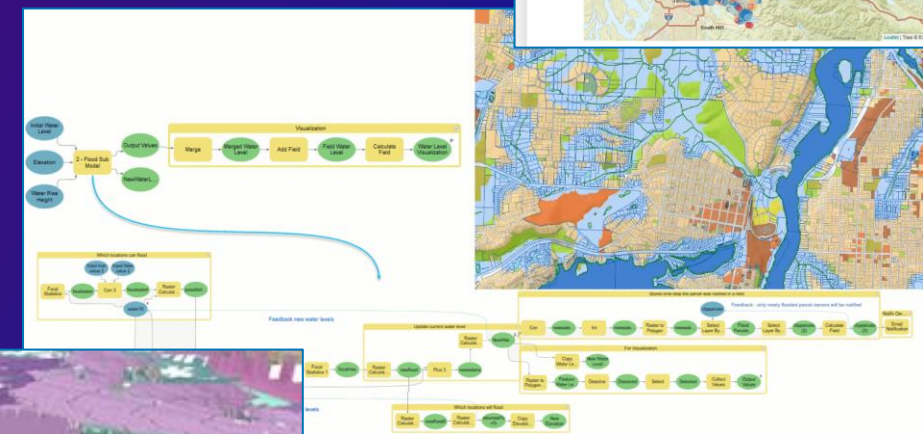
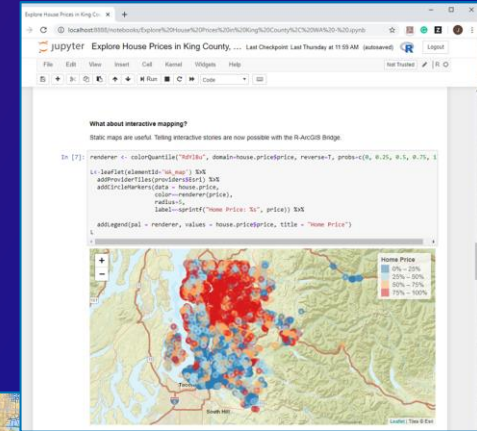
DSC170 final student projects are publicly available

Are GIS analysts already data scientists?

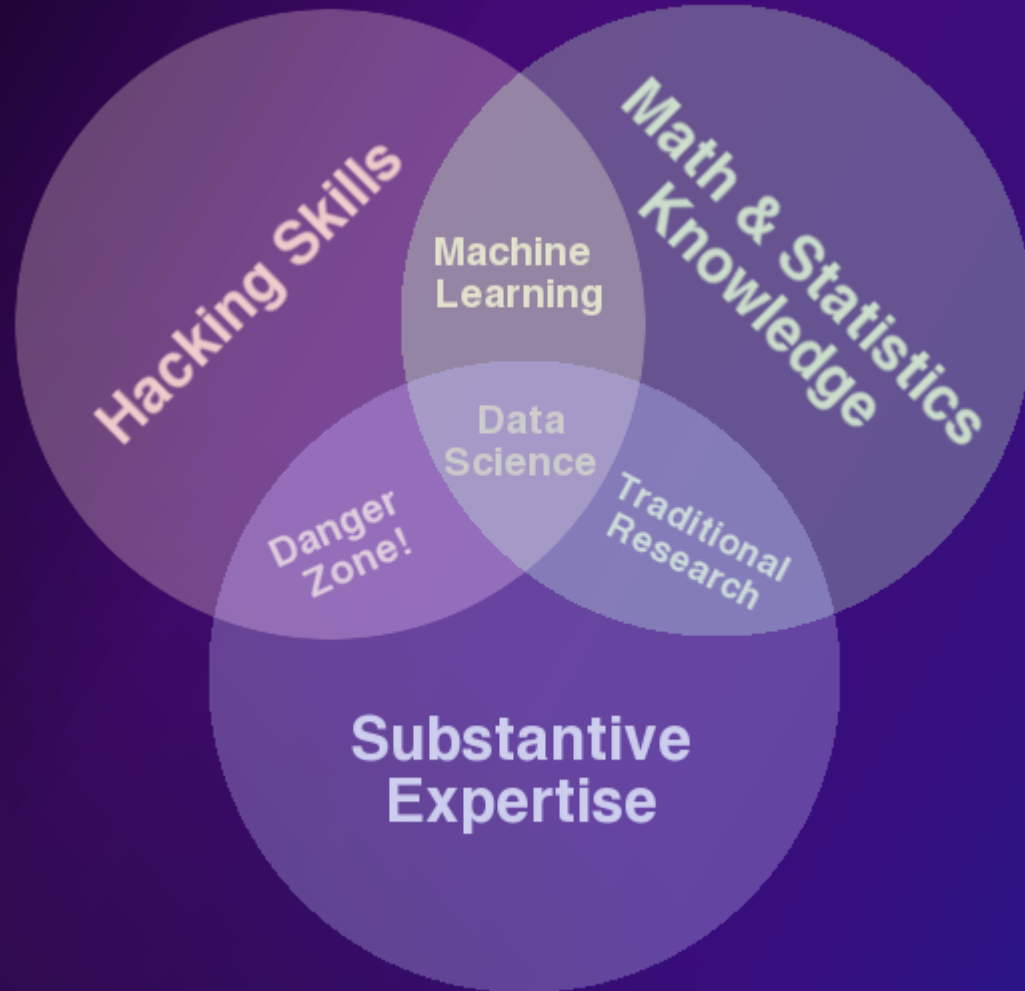
Lauren Bennett, PhD

What does the GIS community do?

- We solve the world's most complex spatial problems
- We apply a myriad of tools and approaches to tackle diverse problems
- We use the best available methods and technology
- We work across domains and industries



What is a data scientist?

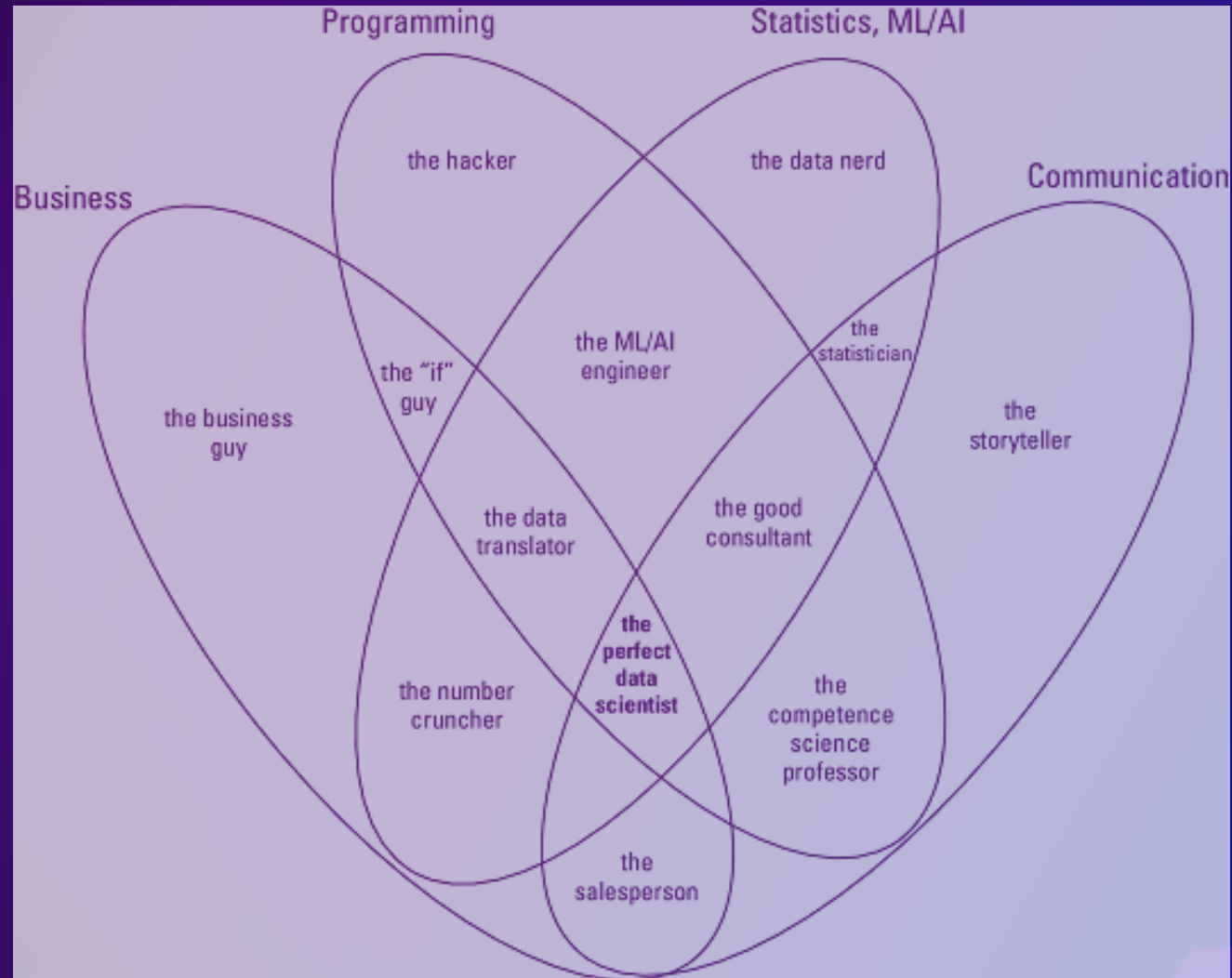


To me, data plus math and statistics only gets you machine learning, which is great if that is what you are interested in, but not if you are doing data science. Science is about discovery and building knowledge, which requires some motivating questions about the world and hypotheses that can be brought to data and tested with statistical methods.

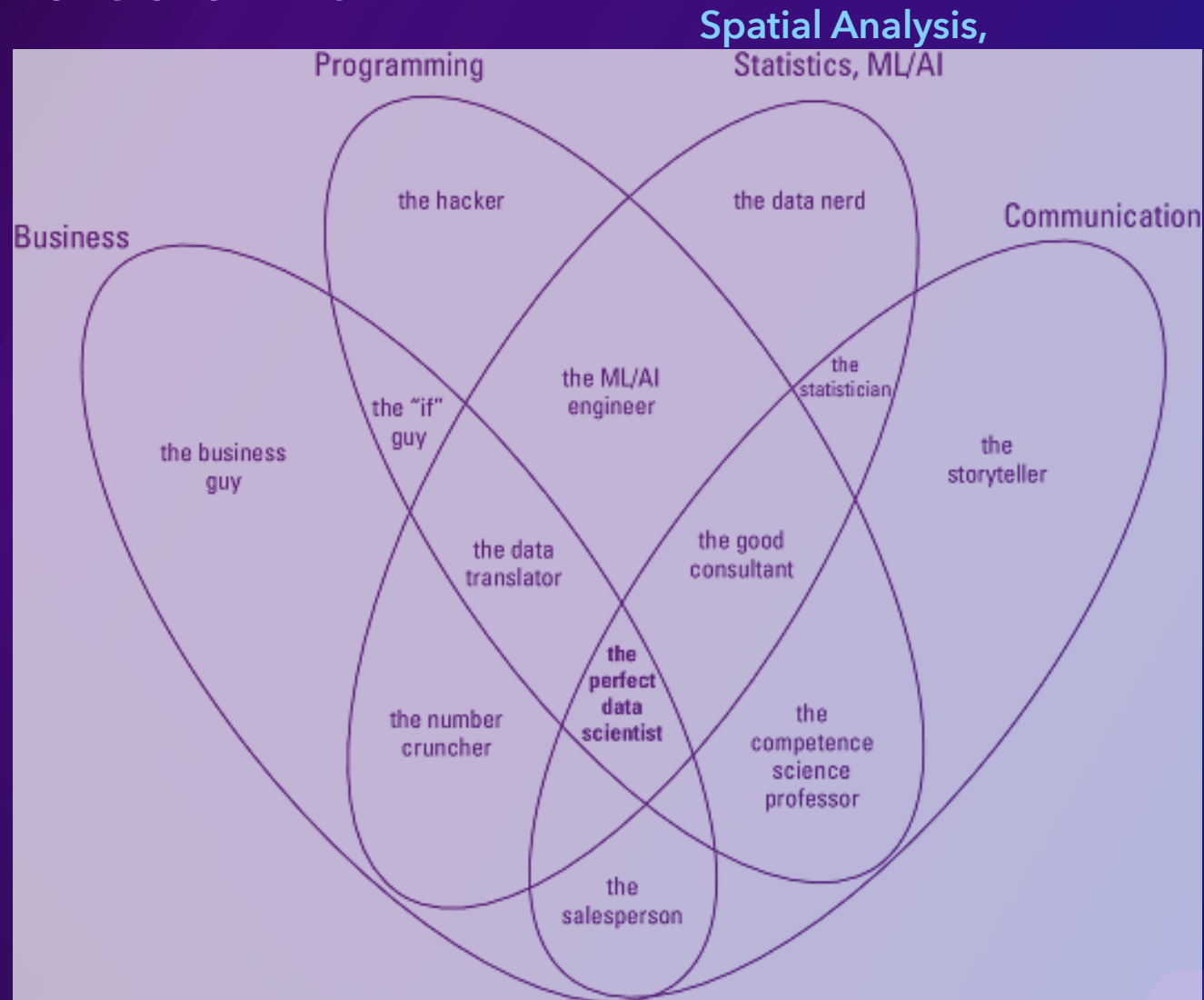
-Drew Conway



What is a data scientist?



What is a data scientist?



The building blocks of spatial data science



Data
Engineering



Visualization
& Exploration



Spatial
Analysis



Machine Learning
& AI



Big Data
Analytics



Modeling
& Scripting



Sharing
& Collaboration



Advancing Spatial Science



Data
Engineering



Visualization
& Exploration



Spatial
Analysis



Machine Learning
& AI



Big Data
Analytics



Modeling
& Scripting



Sharing
& Collaboration



Advancing Spatial Science



Data
Engineering



Visualization
& Exploration



Spatial Approach



Modeling
& Scripting



Sharing
& Collaboration

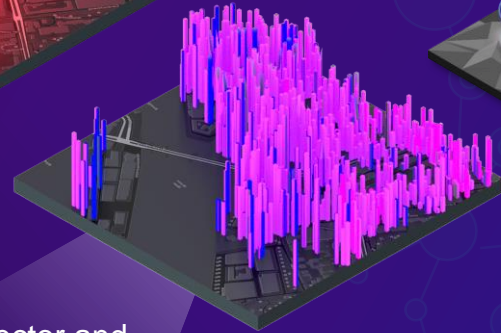
ArcGIS Advancing Spatial Science



AI, Machine Learning, Deep Learning



Raster Analysis, Deep Learning



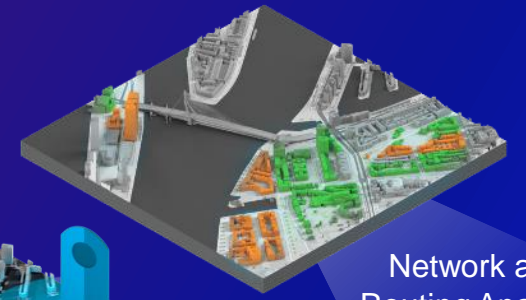
Big Vector and Tabular Data Analysis



Real-Time Analysis



Vector and Tabular Analysis, Spatial Statistics



Network and Routing Analysis

Focused on finding the right tools to solve your problem

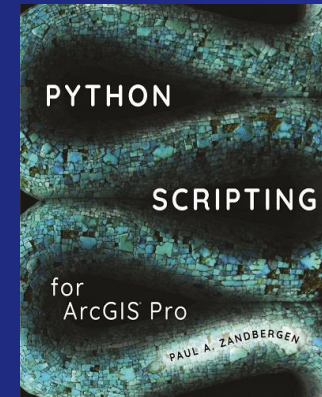


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Teaching and Learning Resources

- [Spatial Data Science in Higher Education](#)
- [Spatial Analysis and Data Science](#)
- [Spatial Statistics](#)
- [Spatial Data Science MOOC](#)
- [A Guide to Spatial Data Science Courses in Esri Academy](#)
- More ?
 - Contact ckurnia@esri.com



PATH

Teach with ArcGIS Notebooks

Use ArcGIS Notebooks as a teaching tool, from delivering class assignments to presenting analysis as a slideshow.

🕒 1 hr 6 min

MOOC

Spatial Data Science: The New Frontier in Analytics

[Register](#) ●●●●● (1) ❤️ 🔄 📄

Duration: 6 Weeks (2-3 hours of study per week)
Cost: Free

Start October 27, 2021

Thank you and please fill in the exit survey



To connect, please reach out to Canserina at:

ckurnia@esri.com