

Introduction to Data Science

Cody Carroll

BSDS 100 - Lecture 1



Outline

- Course Overview & Syllabus
- What is Data Science?

Course Overview & Syllabus



Course Description and Syllabus

The syllabus and course description can be found here:

<https://github.com/codycarroll/Intro-DS-F23>

All lecture notes and assignments will be posted here over the semester.



Nice to meet ya!

- Texas → Japan → CA
- Ph.D. in Statistics from UC Davis
 - Statistical research expertise: statistical analysis of curves
 - Other applied DS interests: CA wildlife, conservation, computer vision & deep learning

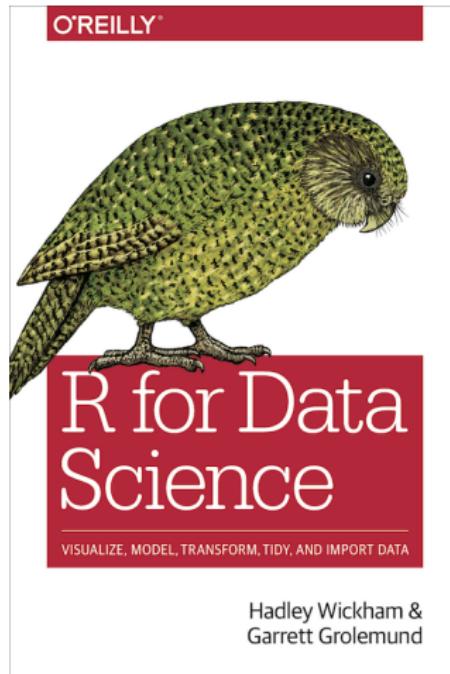




About the Instructor

I teach jointly across Math and MSDS:

- BSDS 100 - Intro to Data Science with R
- MATH 372 - Linear Regression
- MATH 371 - Statistics with Applications
- MSDS 610 - Communication for Analytics
- MSDS 630 - Advanced Machine Learning
- MSDS 699 - Machine Learning Lab



Available online here: <http://r4ds.had.co.nz/index.html>



Other Resources



The Best Place for Answers to R Questions?



Part II: What is Data Science?



What is Data Science?

- **Wikipedia:** “the extraction of knowledge from data.”
- A precise definition is a bit unclear and has faced much controversy...
- Practitioners tend to agree on the *components* of data science:
 - gathering and cleaning data
 - database management
 - exploratory analysis
 - predictive modeling
 - data summary and visualization

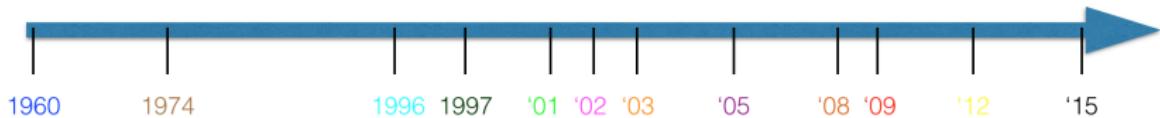


Where is Data Science?



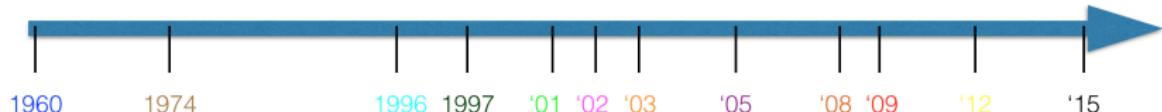
- Twitter

The Evolution of Data Science



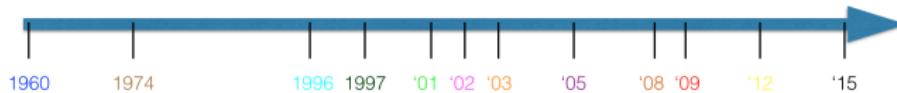
- 1960: Peter Naur (CS Ph.D.) published *Datalogy: the science of data and its place in education*.
- 1974: Peter Naur published *Concise Survey of Computer Methods*.
 - defines data science as “the science of dealing with data, once they have been established.”
 - continues to say that “... the relation of the data to what they represent is delegated to other fields and sciences.”

The Evolution of Data Science



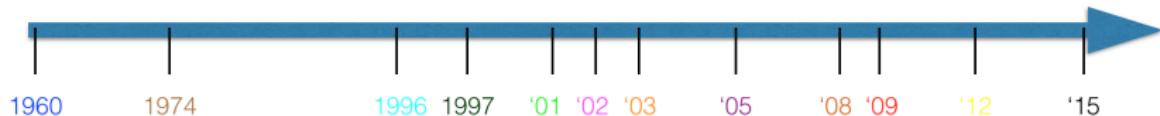
- **1996:** International Federation of Classification Societies meet in Tokyo and for the first time include “data science” in the conference title: “Data science, classification, and related methods.”
- **1997:** C.F. Jeff Wu gave the inaugural lecture “Statistics = Data Science?” for appointment to the H. C. Carver Professorship at the University of Michigan.

The Evolution of Data Science



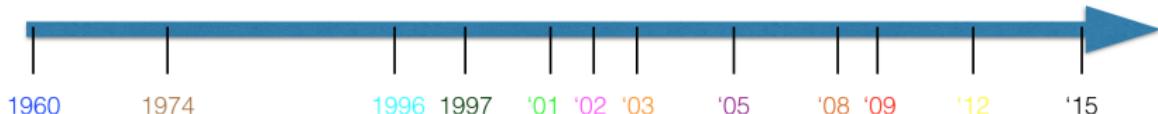
- **2001:** William Cleveland (Bell Labs) published *Data Science: An Action Plan for Expanding the Technical Areas of the Field of Statistics*.
 - "Faculty members should devote their careers to advances in computing with data and who form partnerships with computer scientists."
- **2002:** *Data Science Journal* is launched
 - Focus on data systems, publications on internet, and applications
- **2003:** *Journal of Data Science* is launched
 - Focus on application of statistical and quantitative methods

The Evolution of Data Science



- **2005:** National Science board redefines data scientists:
 - "The information and computer scientists, data and software programmers, disciplinary experts, ... who are crucial to successful management of a digital data collection whose primary activity is to conduct creative inquiry and analysis"
- **2008:** DJ Patil (LinkedIn) and Jeff Hammerbacher (Facebook) coined the term "data scientist" to define their jobs

The Evolution of Data Science



- **January, 2009:** Hal Varian (chief economist at Google) writes that "... the sexy job in the next 10 years will be statisticians."
- **October, 2012:** Harvard Business Review publishes "Data Scientist: The Sexiest Job of the 21st Century."
- **February 5th, 2015:** DJ Patil appointed as the first Chief Data Scientist in the White House.



Recent trends

- 2021: DS jobs starting to shift toward Data Engineering tasks
- 2022: A big correction in tech industry - DS market tightens
- 2023+ : Recovery?



Applications



Marketing analytics, sports analytics, biotechnology, social experiments, e-commerce, government analysis, ...



Why Data Science?

- Size, complexity, and amount of data
 - Over 80 trillion gb of data generated in 2022; up from 130 billion in 2005!
 - **Big data** requires innovative techniques for analysis

Why Data Science?



DATA SCIENCE US

SALARY AND DAY RATE BREAKDOWNS

PERMANENT – AVERAGE ANNUAL SALARY

Role Type	Entry Level	Mid-Level	Principal/Manager Level	Technical Lead/Director	VP and above
Annual Base Salary - \$USD East • West • Mid					
Data Science – ML Modelling	\$132k \$128k \$100k	\$160k \$161k \$118k	\$196k \$201k \$168k	\$253k \$243k \$213k	\$360k \$260k \$240k
Deep Learning & AI	\$132k \$110k n/a	\$173k \$173k \$119k	\$208k \$228k \$160k	\$252k \$249k \$202k	\$321k \$269k \$250k
ML Engineering – Deployment & Infrastructure	\$138k \$117k \$120k	\$180k \$156k \$140k	\$228k \$201k \$198k	\$287k \$252k \$244k	\$340k \$283k \$283k
MLOps	\$133k \$108k \$120k	\$189k \$156k \$140k	\$232k \$198k \$178k	n/a \$250k \$250k	n/a \$269k n/a
Natural Language Processing	\$138k \$115k n/a	\$176k \$155k \$155k	\$215k \$195k \$195k	\$250k \$225k \$225k	n/a \$262k n/a

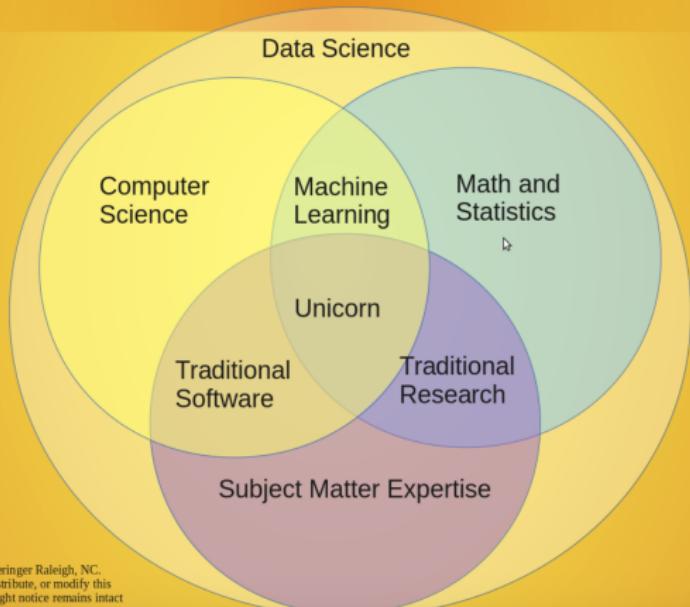
CONTRACT – AVERAGE DAY RATES

Role Type	Entry Level	Mid-Level	Principal/Manager Level	Technical Lead/Director	VP and above
Hourly Contract Rate - \$USD East • West					
Data Science – ML Modelling	\$65 \$65	\$80 \$75	\$95 \$105	\$120 n/a	\$150 n/a
Deep Learning & AI	\$65 \$55	\$85 \$85	\$100 \$115	\$120 n/a	\$150 n/a
ML Engineering – Deployment & Infrastructure	\$70 n/a	\$90 \$80	\$100 \$100	\$130 n/a	\$150 n/a
MLOps	\$65 n/a	\$90 \$85	\$100 \$100	n/a n/a	n/a n/a
Natural Language Processing	\$70 n/a	\$85 \$75	\$100 \$100	\$120 n/a	n/a n/a

Harnham's US 2023 Data & AI Salary Guide



Data Science Venn Diagram v2.0



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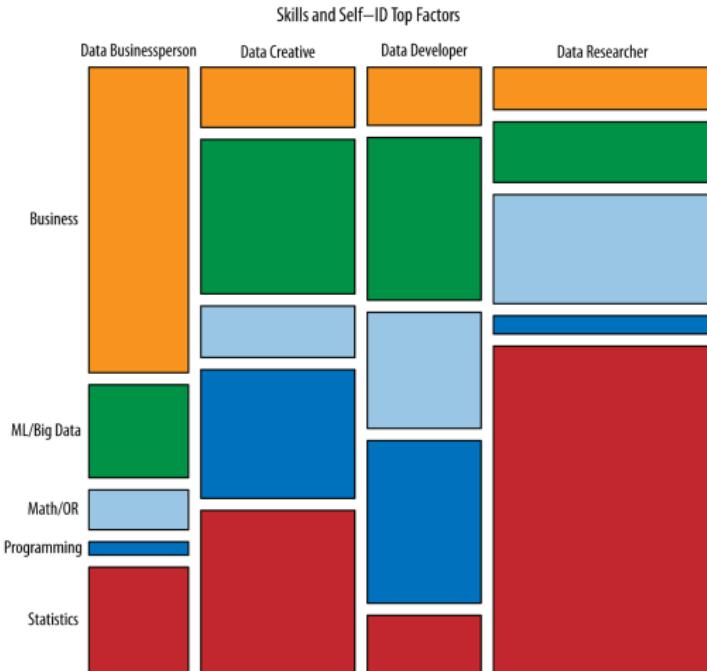
Data Scientists: The unicorn industries want?



- The field is inherently interdisciplinary
 - mathematical statistics
 - computer science
 - domain expertise
- The elusive “unicorn”: all three skills
 - In 2014, these jobs go unfilled for 6 months or longer on average
- Has lead to the development of data science *teams*
 - hope is to merge skills of analysts



The Analysts of Data Science



"Analyzing the Analyzers (2013) by Harry, Murphy, and Vaisman."



Data Science in Academia

[ABOUT USF](#) [DESTINATIONS](#) [GATEWAYS](#) [SEARCH](#)

USF College of Arts and Sciences

ARTS AND SCIENCES
Undergrad Programs
Grad Programs
Faculty
Research & Creative Scholarship
Curricula
Study Abroad
Institutes & Centers
Dean's Welcome
Dean's Scholar Award
Lab Safety

THE MAJOR IN Data Science

Welcome
Get involved in the emerging Bachelor of Science degree in data University of San Francisco. This interdisciplinary major provides mathematics and quantitative skills problem solving for data-intensive biology, computer science, and m

The core courses in the BBDS major are in mat units distributed among these two departments

NYU

Master of Science in Data Science

PROGRAM OVERVIEW
Introduction to the MS in Data Science at NYU

SCHOOL OF INFORMATION STUDIES SYRACUSE UNIVERSITY

Future Students
Undergraduate
Graduate
Certificate of Advanced Study
CAS in Cultural Heritage Preservation
CAS in Data Science
Applied Data Science Open Online Course
CAS in e-Government Management and Leadership

UNDERGRADUATE PROGRAMS

Berkeley School of Information

datascience@berkeley

Master of Information and Data Science
The UC Berkeley School of Information is about the only program in the country offering a Master of Information and Data Science online. Answer the questions below to learn more.

Georgetown University

Graduate Analytics Program

Home Page
What is Data Science
Academics
Admissions
FAQ – Frequently Asked Questions
Faculty
Resources

data

Master of Science in Analytics Concentration in Data Sciences (MS-DS Program)

UPCOMING EVENTS
No events found

CAS in Data Science

The Certificate of Advanced Study (CAS) in Data Science at the Syracuse University School of Information Studies (SISch) is a 15-credit graduate-level certificate designed for students currently pursuing another graduate degree or professional certificate. Data Science focuses on teaching you specialized analytical, data mining and management, data visualization and general systems management, but the curriculum can be tailored to fit your education or career goals.

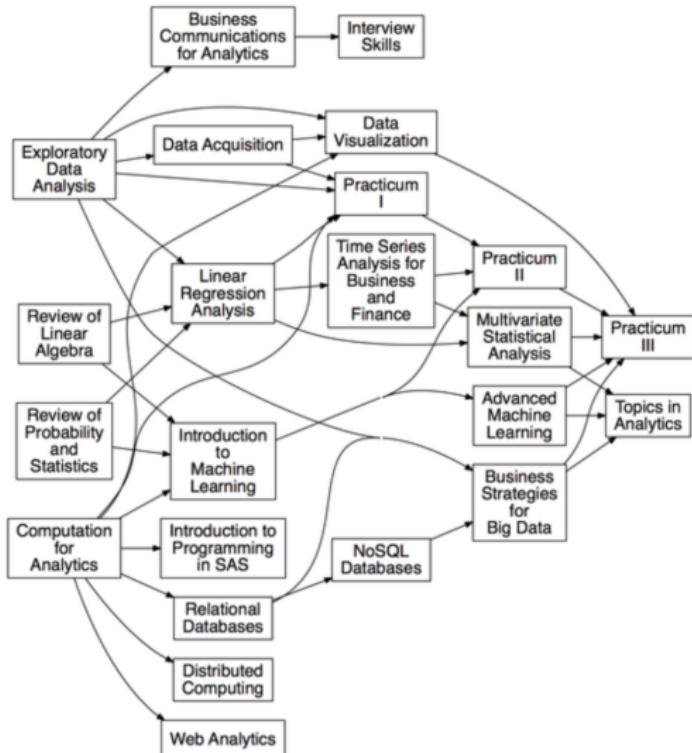
[Apply Now](#) [Application Checklist](#)

Available On-campus | Online | Full-time | Part-time

Data scientists are crucial to solving big data problems in areas as diverse as clinical research, defense intelligence, customer behavior, medical diagnosis, and risk management. The CAS in Data Science at the SISch was the first New York State-approved certificate of its kind, and gives a competitive edge to students and professionals alike by equipping you with a mixture of the technical and theoretical skills. As the field grows, Data Science graduates are shaping the first wave of data science practices and

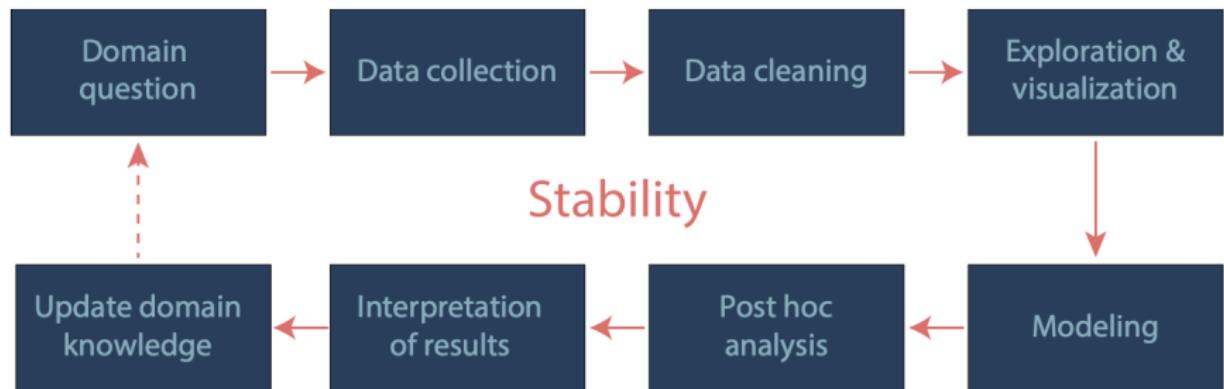


Academic Programs





The Data Science Life Cycle



Yu and Kumbier 2020



- ➊ **Data wrangling:** gather, clean, and sample data
- ➋ **Database management:** access big data quickly and reliably
- ➌ **Data exploration:** summarize, visualize, and contextualize data to make a hypothesis
- ➍ **Make predictions:** statistical and machine learning methods
- ➎ **Communicate the results:** more visualization, presentations, summaries



Resources for Exploring DS

- [Flowingdata.com](#)
 - Contemporary visualization and data manipulation techniques
- [Kaggle.com](#)
 - Kaggle competitions: can win money for solving problems
- [Coursera.org](#)
 - Free online courses in data science and machine learning
 - 972 courses. Great resource for coding, data analysis, etc.
 - Recent notable course: "The Data Scientist's Toolbox."