Data Handling: Import, Cleaning and Visualisation

Lecture 1 :

Introduction

Dr. Aurélien Sallin

Welcome to Data Handling 2023!

- Go to this page (or use the QR code): https://tinyurl.com/data-handling2023
- Use one row to respond to the questions in the column headers (see the first two rows for examples).


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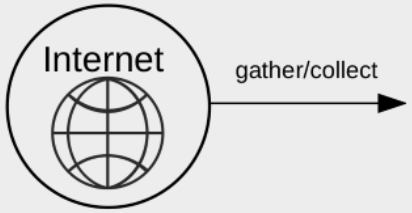
Data (science) pipeline

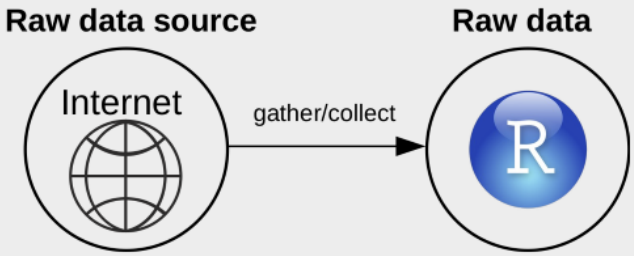
Raw data source

Data (science) pipeline

Raw data source



Data (science) pipeline



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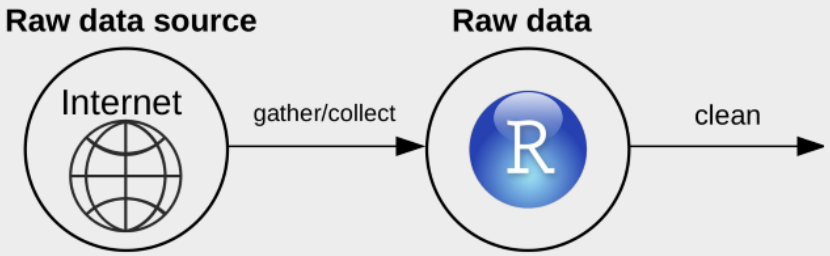

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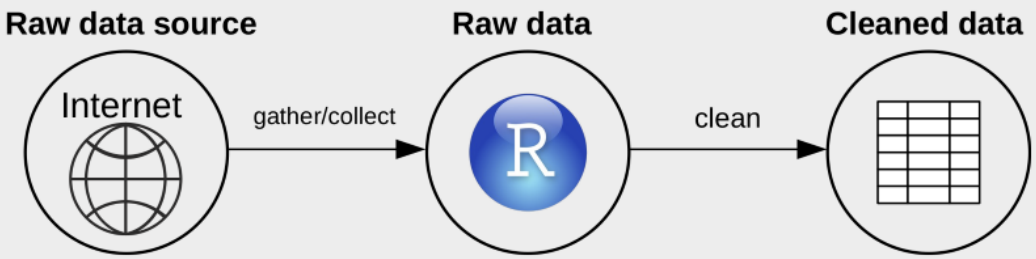

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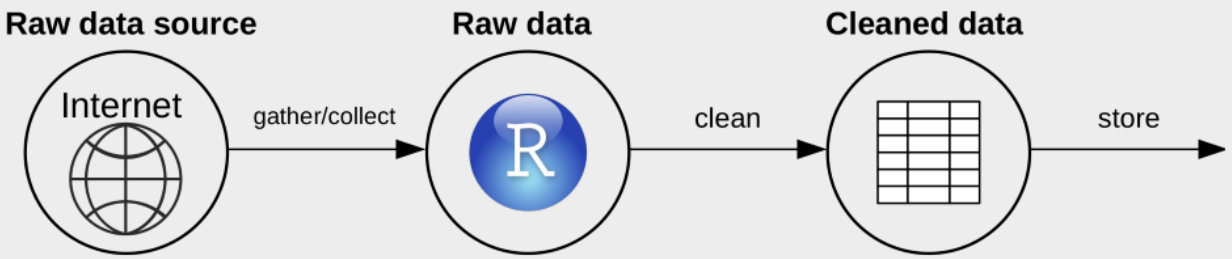

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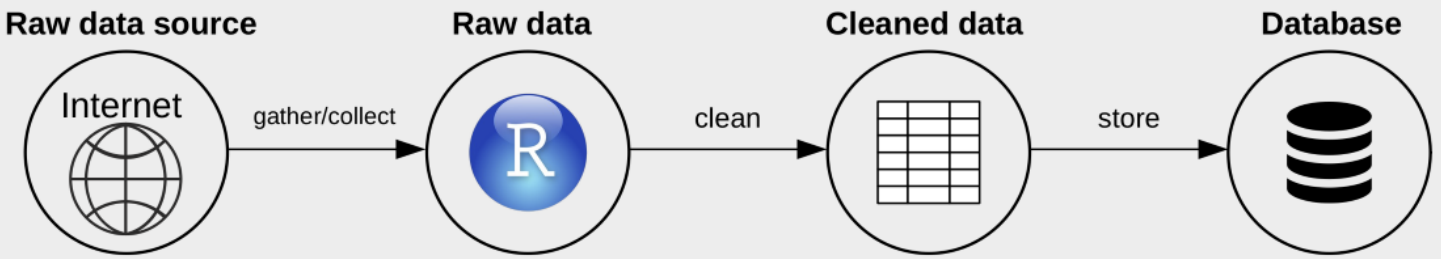

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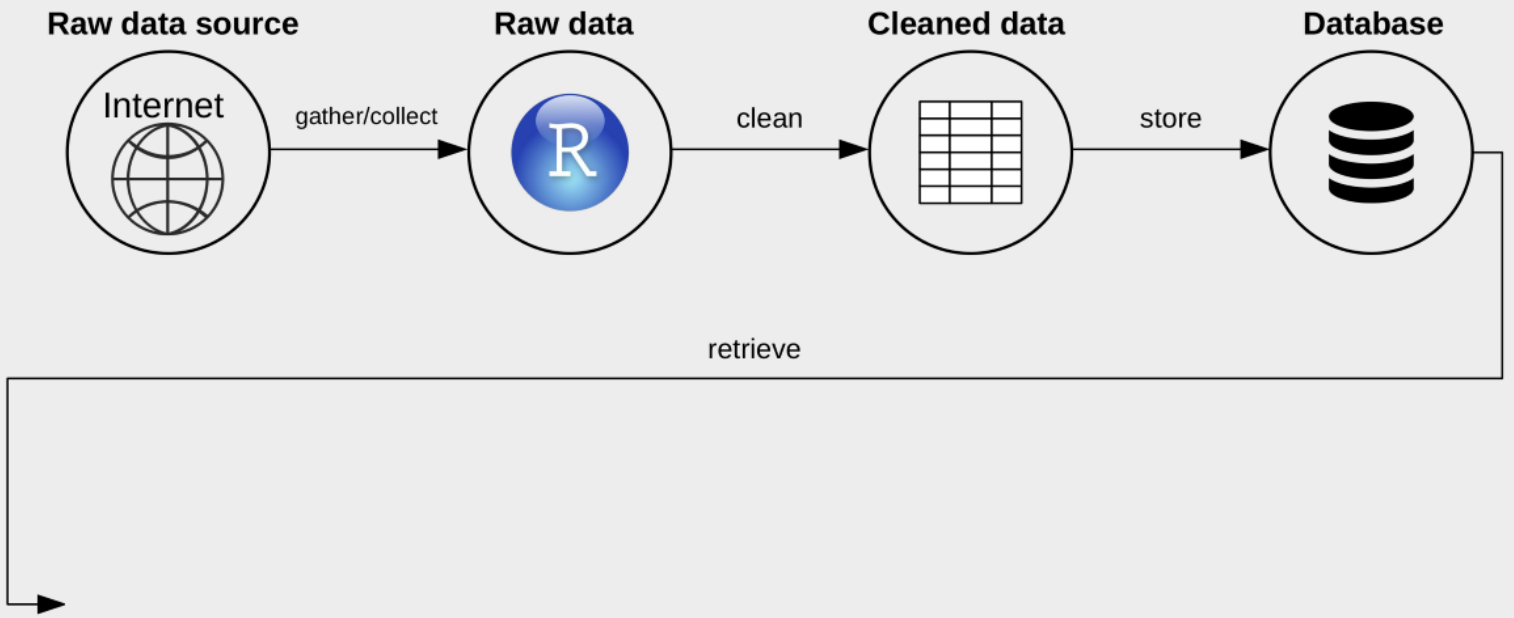

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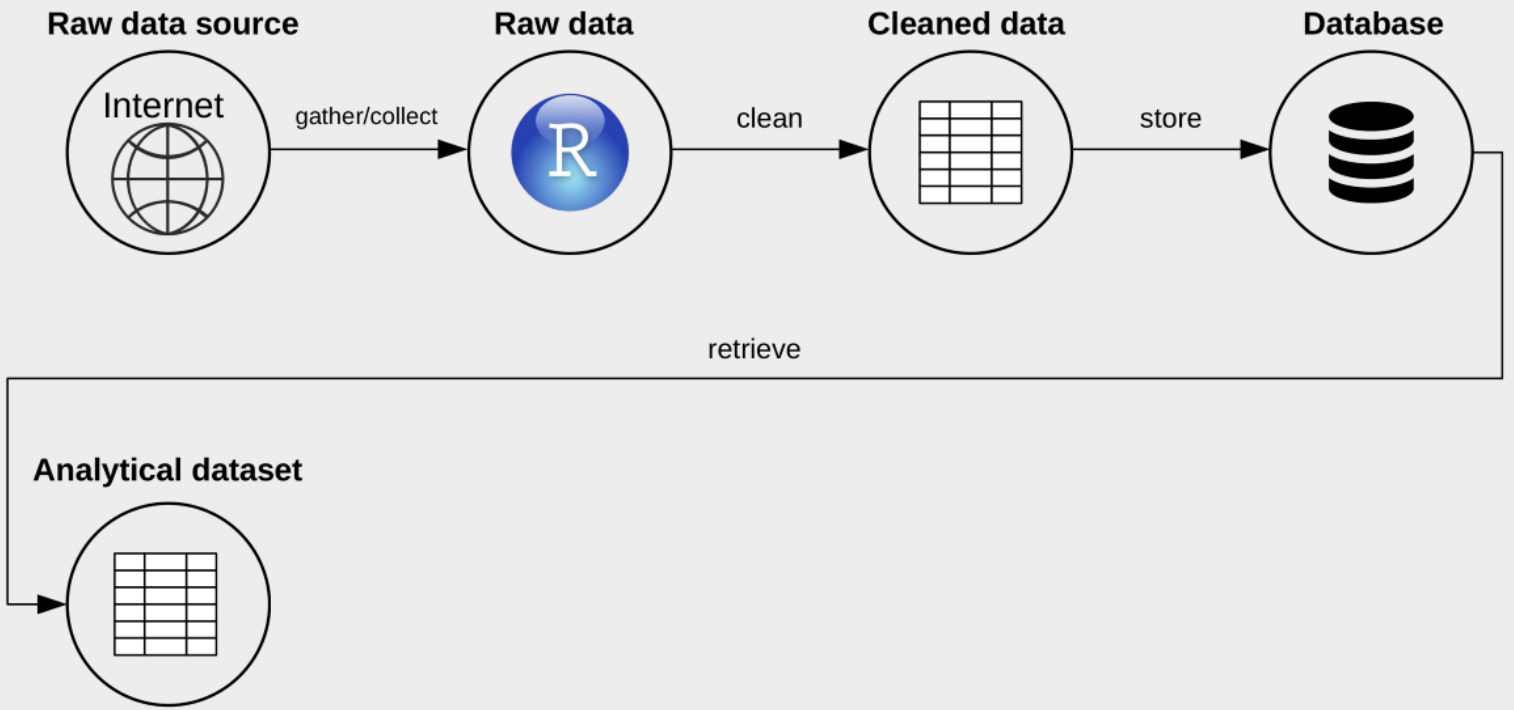

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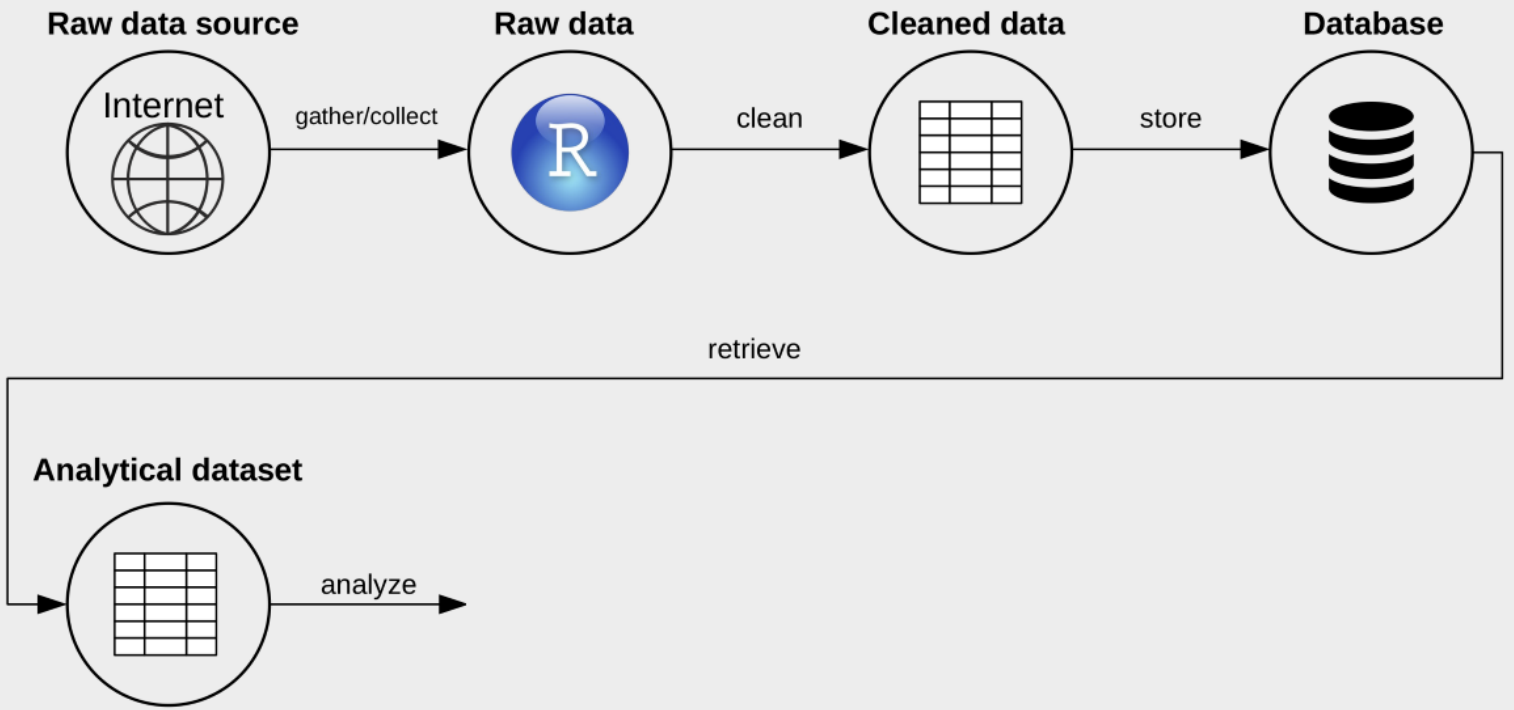

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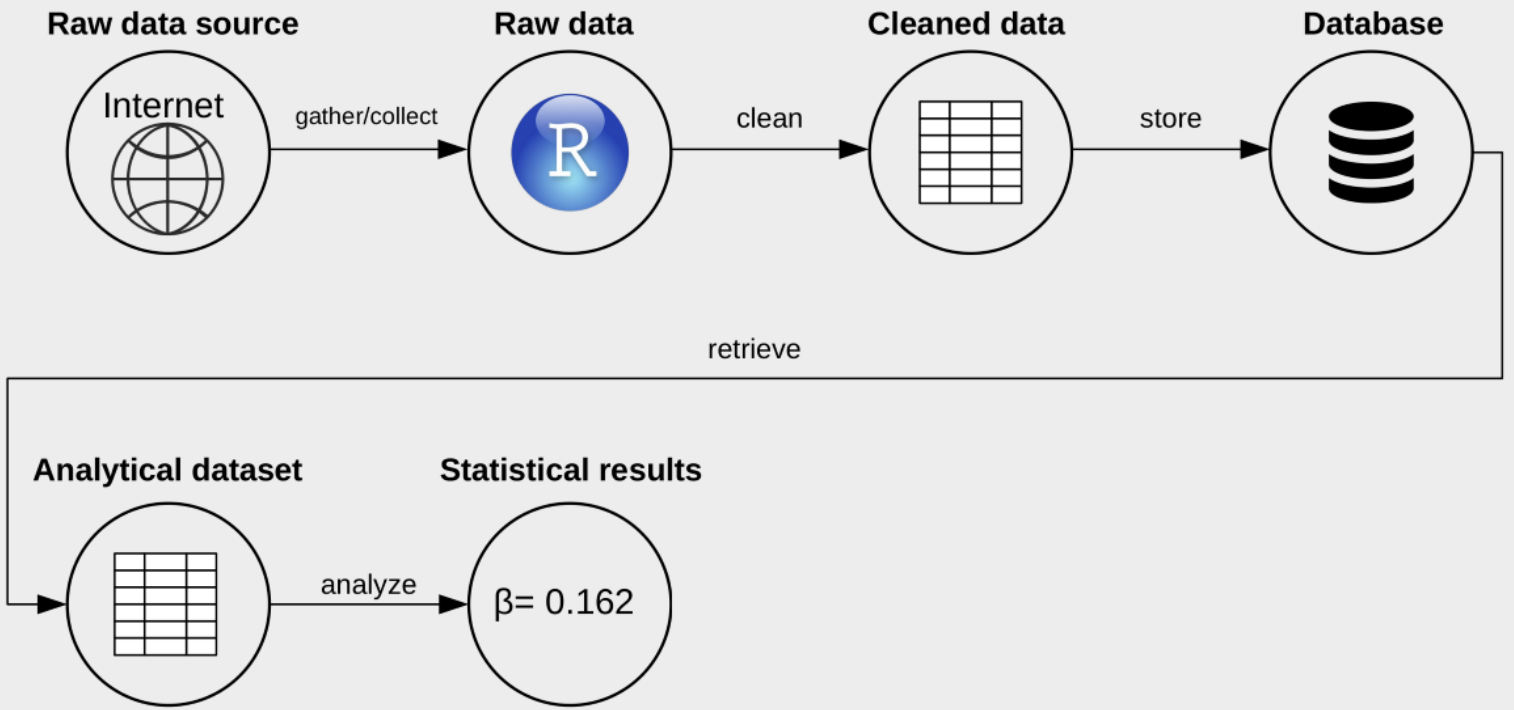

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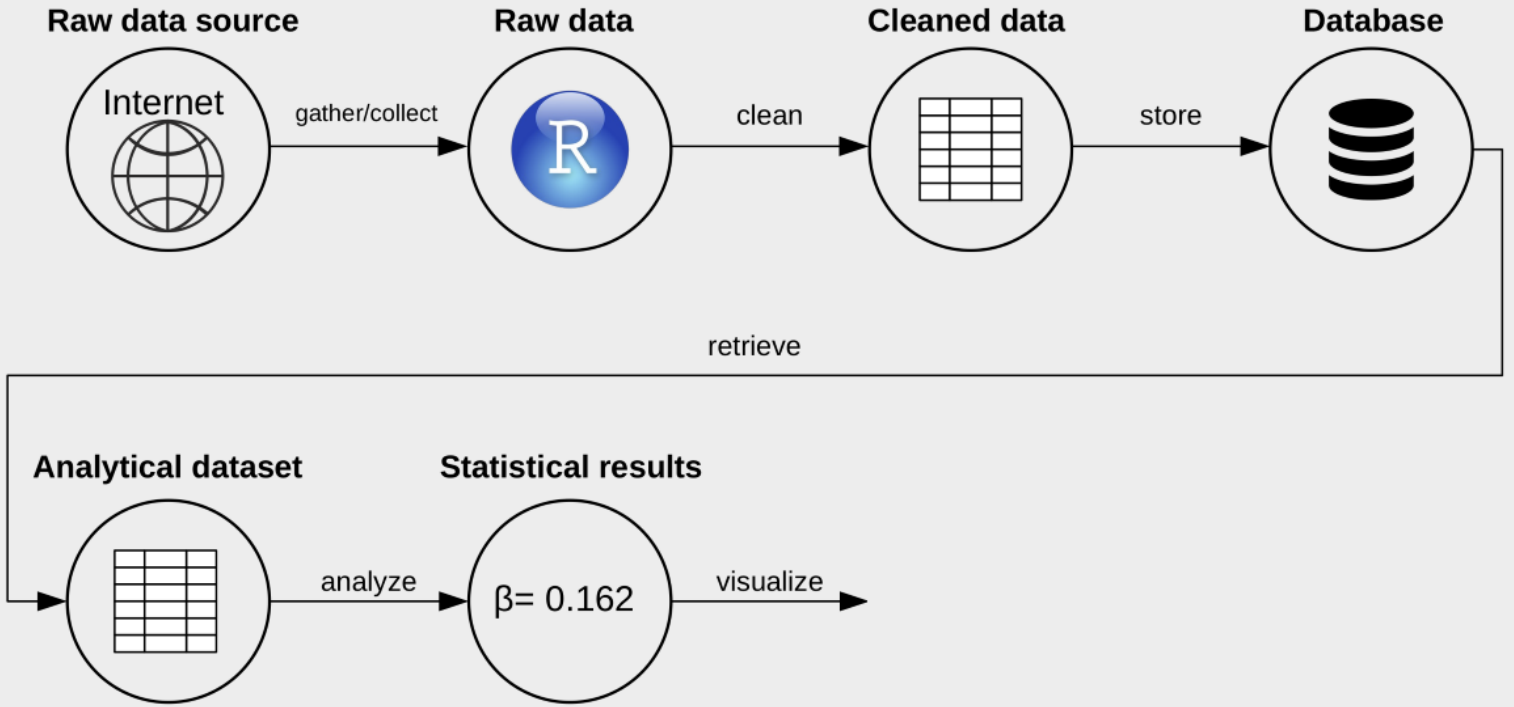

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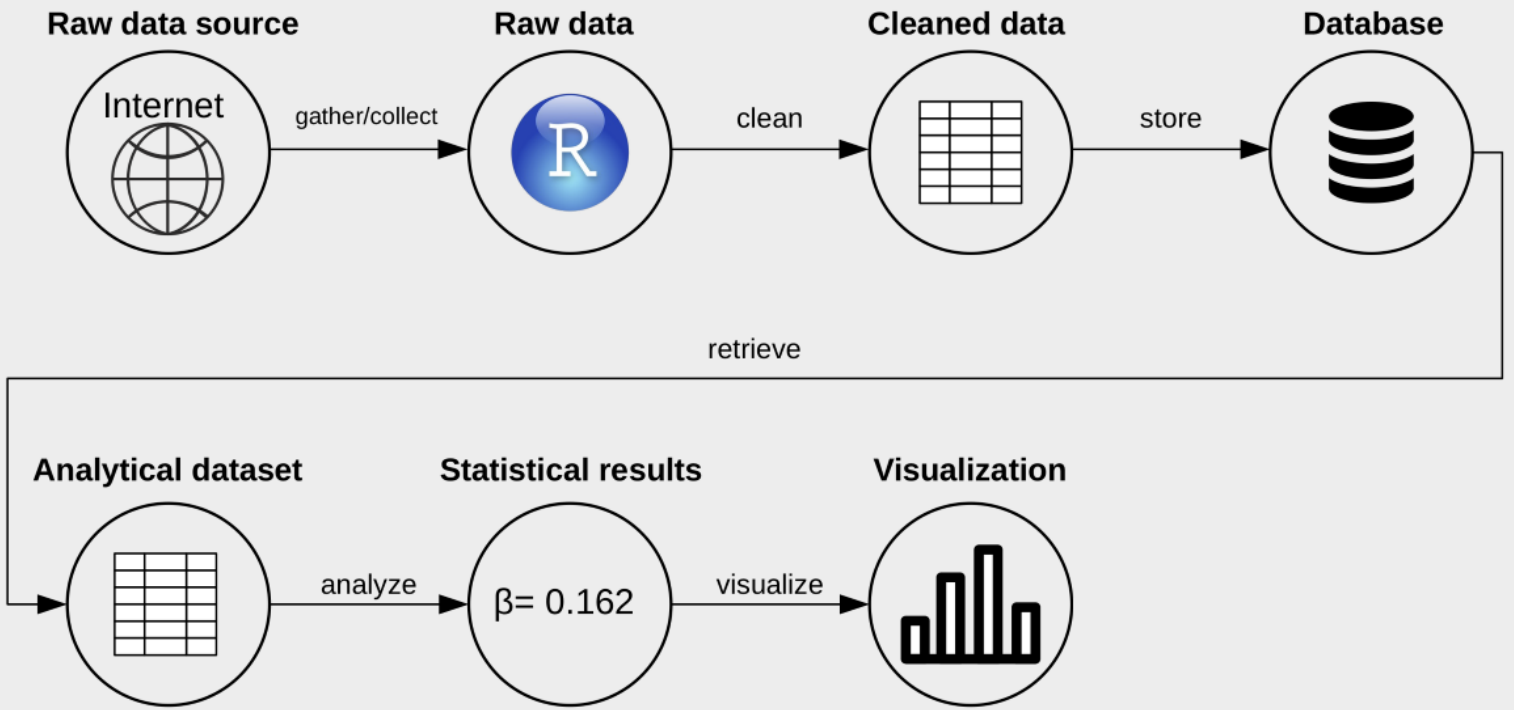

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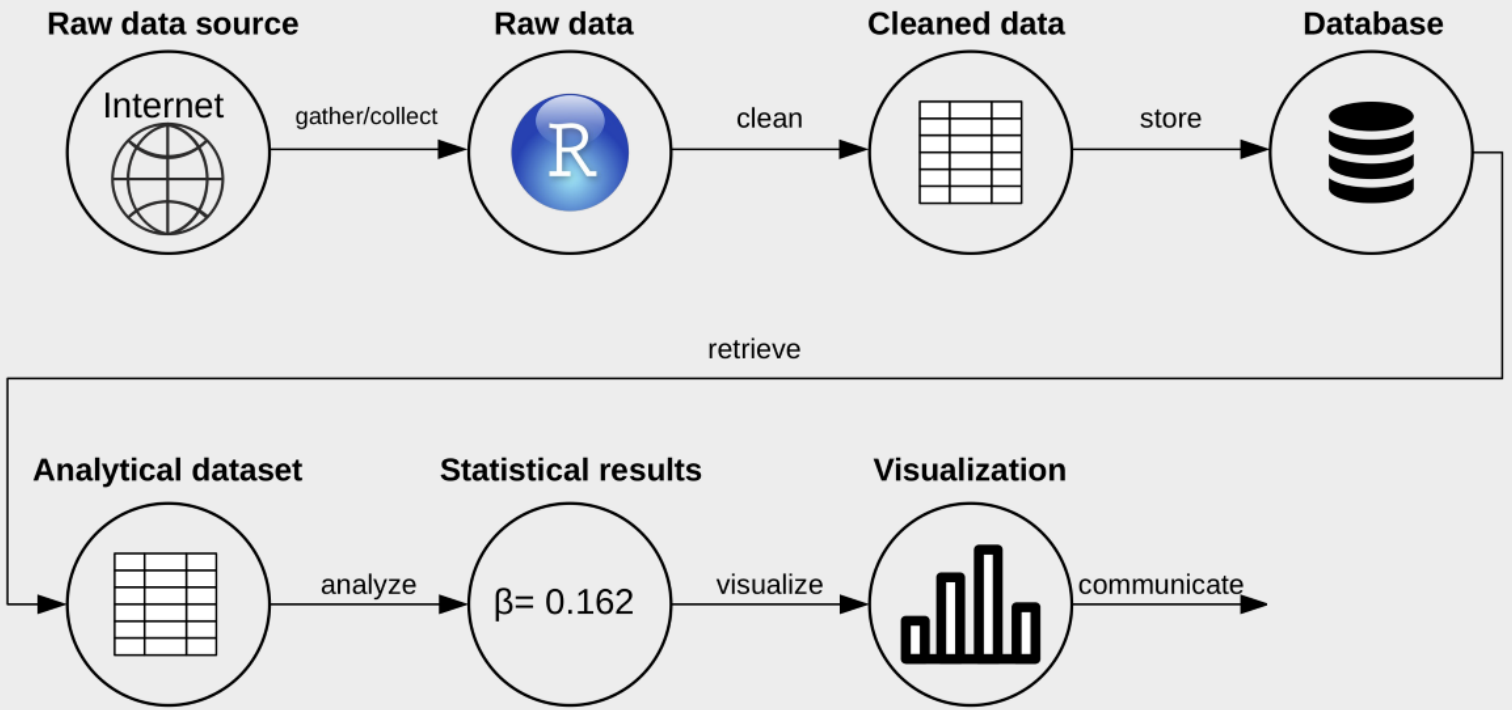

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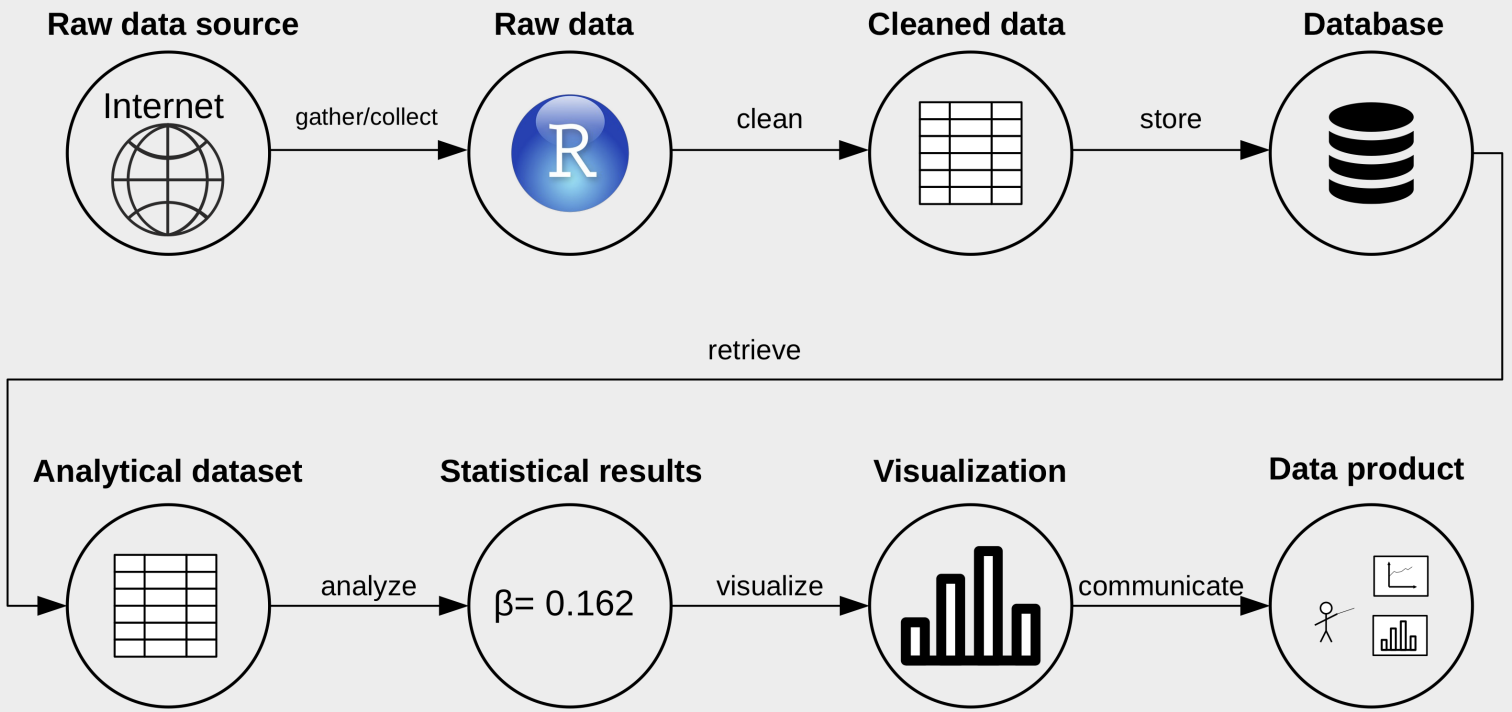


Background

‘Data Science’?

“This coupling of scientific discovery and practice involves the collection, management, processing, analysis, visualization, and interpretation of vast amounts of heterogeneous data associated with a diverse array of scientific, translational, and inter-disciplinary applications.”

University of Michigan ‘Data Science Initiative’, 2015

But, what about statistics?!

“Seemingly, statistics is being marginalized here; the implicit message is that statistics is a part of what goes on in data science but not a very big part. At the same time, many of the concrete descriptions of what the DSI will actually do will seem to statisticians to be bread-and-butter statistics. Statistics is apparently the word that dare not speak its name in connection with such an initiative!”

David Donoho (2015). 50 years of Data Science

What's new about all this?

"All in all, I have come to feel that my central interest is in data analysis, which I take to include, among other things: ..."

What's new about all this?

"All in all, I have come to feel that my central interest is in data analysis, which I take to include, among other things: procedures for analyzing data, techniques for interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all the machinery and results of (mathematical) statistics which apply to analyzing data."

What's new about all this?

John Tukey (**The Future of Data Analysis**, 1962!)

Technological change

Relevance for modern economic research

SOCIAL SCIENCE

Computational Social Science

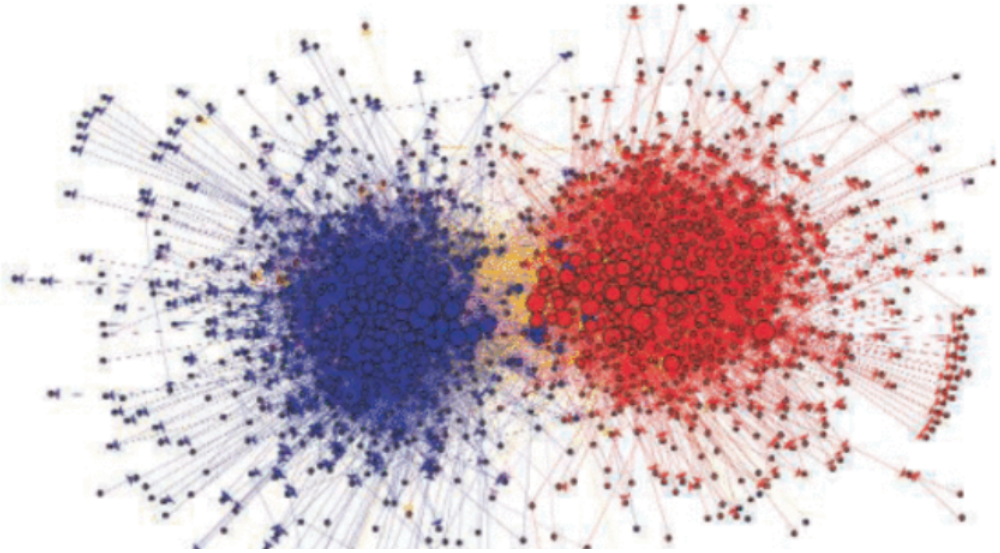
A field is emerging that leverages the capacity to collect and analyze data at a scale that may reveal patterns of individual and group behaviors.

David Lazer,[1] Alex Pentland,[2] Lada Adamic,[3] Sinan Aral,[2,4] Albert-László Barabási,[5] Devon Brewer,[6] Nicholas Christakis,[1] Noshir Contractor,[7] James Fowler,[8] Myron Gutmann,[3] Tony Jebara,[9] Gary King,[1] Michael Macy,[10] Deb Roy,[2] Marshall Van Alstyne[2,11]

We live life in the network. We check our e-mails regularly, make mobile phone calls from almost any location, swipe transit cards to use public transportation, and make purchases with credit cards. Our movements in public places may be captured by video cameras, and our medical records stored as digital files. We may post blog entries accessible to anyone, or maintain friendships through online social networks. Each of these transactions leaves digital traces that can be compiled into comprehensive pictures of both individual and group behavior, with the potential to transform our understanding of our lives, organizations, and societies.

The capacity to collect and analyze massive amounts of data has transformed such fields as biology and physics. But the emergence of a data-driven "computational social science" has been much slower. Leading journals in economics, sociology, and political science show little evidence of this field. But computational social science is occurring—in Internet companies such as Google and Yahoo, and in government agencies such as the U.S. National Security Agency. Computational social science could become the exclusive domain of private companies and government agencies. Alternatively, there might emerge a privileged set of academic researchers presiding over private data from which they produce papers that cannot be critiqued or replicated. Neither scenario will serve the long-term public interest of accumulating, verifying, and disseminating knowledge.

What value might a computational social science—based in an open academic environment—offer society, by enhancing understanding of individuals and collectives? What are the



Relevance for modern economic research

Journal of Economic Perspectives—Volume 26, Number 2—Spring 2012—Pages 189–206

Using Internet Data for Economic Research

Benjamin Edelman

The data used by economists can be broadly divided into two categories. First, structured datasets arise when a government agency, trade association, or company can justify the expense of assembling records. The Internet has transformed how economists interact with these datasets by lowering the cost of storing, updating, distributing, finding, and retrieving this information. Second, some economic researchers affirmatively collect data of interest. Historically, assembling a dataset might involve delving through annual reports or archives that had not previously been organized into a format ready for research. In some cases

Relevance for modern economic research

Journal of Economic Perspectives—Volume 28, Number 2—Spring 2014—Pages 3–28

Big Data: New Tricks for Econometrics[†]

Hal R. Varian

Computers are now involved in many economic transactions and can capture data associated with these transactions, which can then be manipulated and analyzed. Conventional statistical and econometric techniques such as regression often work well, but there are issues unique to big datasets that may require different tools.

Relevance for modern economic research

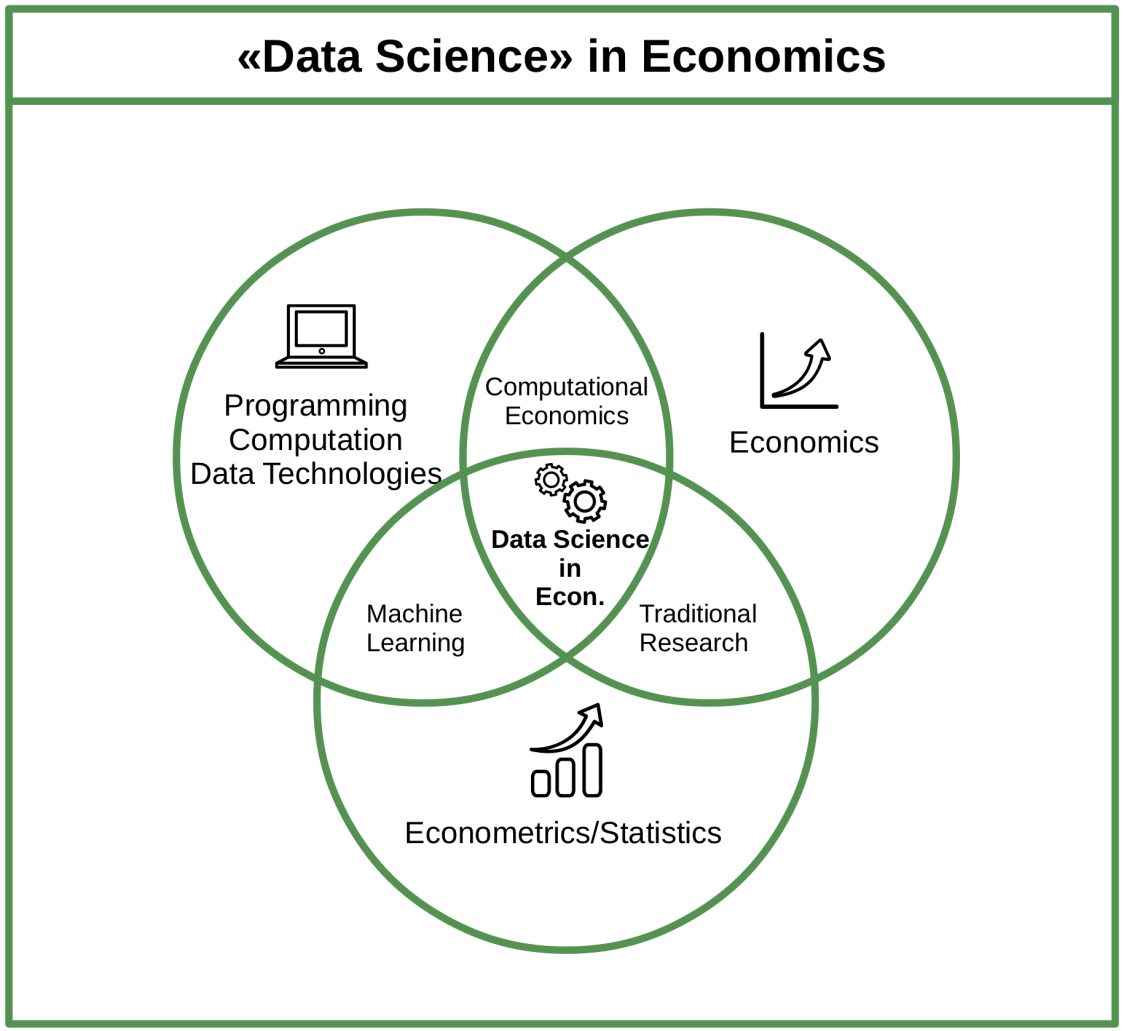
Journal of Economic Literature 2019, 57(3), 535–574
https://doi.org/10.1257/jel.20181020

Text as Data†

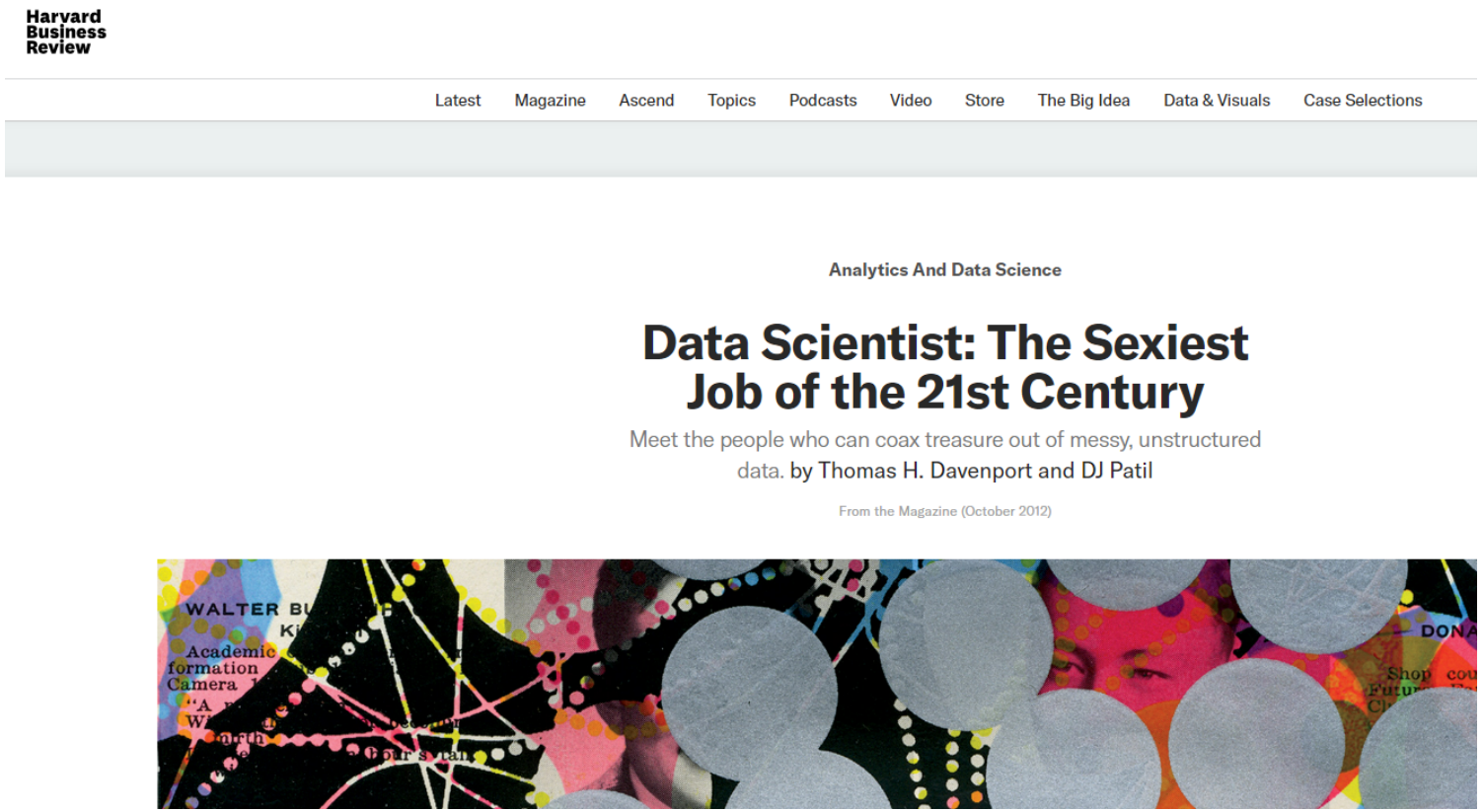
Matthew Gentzkow, Bryan Kelly, and Matt Taddy*

An ever-increasing share of human interaction, communication, and culture is recorded as digital text. We provide an introduction to the use of text as an input to economic research. We discuss the features that make text different from other forms of data, offer a practical overview of relevant statistical methods, and survey a variety of applications. (*JEL* C38, C55, L82, Z13)

Data science in economics skill set



Data science as a life skill



Data science as a life skill

"More than anything, what data scientists do is **make discoveries while swimming in data.** … As they make discoveries, they communicate what they've learned and suggest its implications for new business directions. Often they are **creative in displaying information visually and making the patterns they find clear and compelling**…

They advise executives and product managers on the implications of the data for **products, processes, and decisions**.

What kind of person does all this? **Think of him or her as a hybrid of data hacker, analyst, communicator, and trusted adviser. The combination is extremely powerful — and rare.**"

Organisation of the Course

Our Team - At Your Service

Matthias Rösti

Andrea Burro

Aurélien Sallin

Introduction: Aurélien Sallin

- 2022-today: Expert in Health Care Research and Member of Management, SWICA Health Organization, Winterthur
- 2022-today: Post-Doc researcher and lecturer, HSG
- 2018-2022: PhD Economic and Finance, HSG

Previously:

UNI FR

Päpstliche Schweizergarde
Garde Suisse Pontificale
Guardia Svizzera Pontificia
Guardia Svizra Papala

Introduction: Aurélien Sallin

Research at SWICA

- Using Real-World Data from claims to assess effectiveness of health technological tools
- Using (Causal) Machine Learning to evaluate the effect of health policies on doctors' prescription behaviors
- Financing models for mandatory health care in Switzerland

Other Research in Economics of Education

- Missclassification rates for gifted students
- Evaluation of Special Education programs

Course Structure

Course concept: lectures

- Lectures (Thursday morning)
  - Background/Concepts
  - Illustration concepts
  - Illustration of ‘hands-on’ approaches

Course concept: special lectures

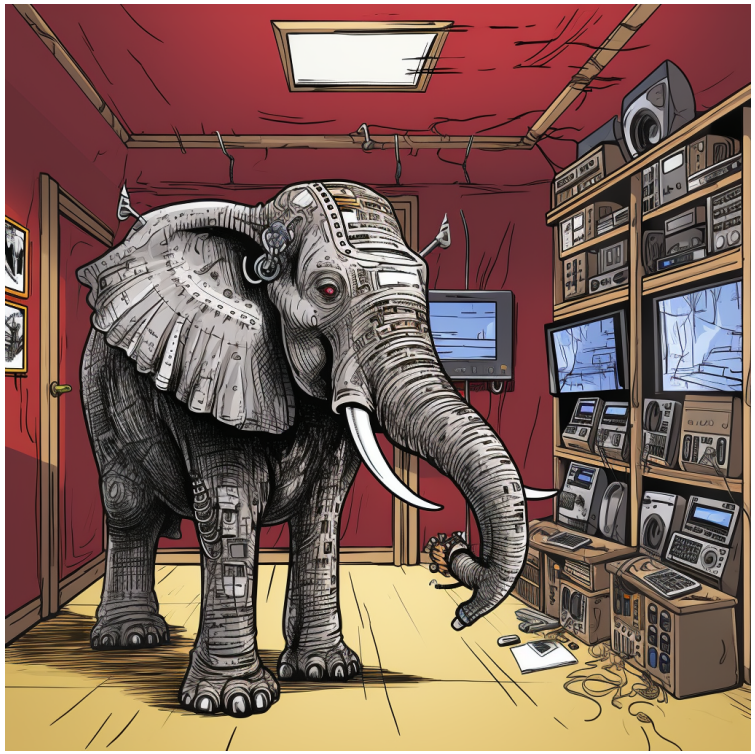
- **30.11.2023: Industry Insights**
  - Matteo Courthoud, PhD: Senior Economist at Zalando

- **14.12.2023: Federal Administration Insights**
  - Florian Chatagny, PhD: Head of Data Science Team, Federal Finance Administration

Course concept: exercises

- Exercise sheets (handed out every other week)
  - Some conceptual questions
  - Hands-on exercises/tutorials in R
  - Detailed solution videos
  - **First Exercises (set up R/RStudio) is available on StudyNet/Canvas today**

The Elefant in the Room



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# the symbolic representation of Artificial Intelligence as being the
# "elefant in the room", comic cartoon style - Variations (Strong)
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Course concept

- Learning mode in this course: Prepare with reading, visit the lecture, recap key concepts in lecture notes (self-study), work on exercises, watch solution video, come to exercise session, repeat…
- Strongly encouraged: (virtual) learning groups!
  - Biweekly exercises provide opportunity.
  - Tackle the tricky exercises together!

Course concept: exercise sessions

- In-class exercise sessions (bi-weekly evening sessions)
  - Discussion of exercises and additional input
  - Recap of concepts
  - Q&A, support
  - time for more coding!

Part I: Data (Science) fundamentals

Date	Topic
21.09.2023	Introduction: Big Data/Data Science, course overview
28.09.2023	Programming with R
05.10.2023	An introduction to data and data processing
05.10.2023	Exercises/Workshop 1: Tools, programming
12.10.2023	Data storage and data structures
12.10.2023	Exercises/Workshop 2: Data storage and data structures
19.10.2023	Web data, text, and images
26.10.2023	Data sources, data gathering, data import
26.10.2023	Exercises/Workshop 3: Web data, text, and images

Part II: Data gathering and preparation

Date	Topic
16.11.2023	Data preparation and manipulation
23.11.2023	Basic statistics and data analysis with R
23.11.2023	Exercises/Workshop 4: Data gathering, data import
30.11.2023	Guest Lecture: Matteo Courthoud (Senior Economist and Data Scientist @Zalando)

Part III: Analysis, visualisation, output

Date	Topic
07.12.2023	Visualisation, dynamic documents
07.12.2023	Exercises/Workshop 5: Data preparation and applied data analysis with R
14.12.2023	Guest Lecture: Florian Chatagny (Head of Data Science @Federal Finance Administration in Bern)
21.12.2023	Exercises/Workshop 6: Visualization, dynamic documents
21.12.2023	Summary, Wrap-Up, Q&A, Feedback
21.12.2023	Exam for Exchange Students

Core course resources

- All information and materials (notes, slides, course sheet, syllabus, etc.) are available on StudyNet/Canvas.
- Core materials will also be made available on Nuvolos.

Main textbooks

Data Handling Pocket Reference

Murrell, Paul (2009). **Introduction to Data Technologies**, London: Chapman & Hall/CRC.

Wickham, Hadley and Garred Grolemund (2017). **R for Data Science**, 1st Edition. Sebastopol, CA: O'Reilly.

Baumer, Kaplan and Norton (2023). **Modern Data Science with R**, 2nd Edition.

Further resources

- Stackoverflow
- Get inspired in the R blogsphere
- ChatGPT

Exam information

- Central, written examination: **digital, BYOD!**, we will have an instructional session by the head of the digital examinations team (data TBD).
- Multiple choice questions.
- A few open questions.
- Theoretical concepts and practical applications in R (questions based on code examples).

Exam information II

- We will release samples of multiple choice questions via Quizzes on Canvas/Studynet (exact same format and style of exam questions).
- Exchange students who need to take the exam before the central exam block:
  - Date, time place, : **21.12.2023, 16:15-18:00, room tbd**.
  - Questions: **matthias.roesti@unisg.ch**

And now this…

DEVELOPING EMPLOYEES

Prioritize Which Data Skills Your Company Needs with This 2×2 Matrix

by Chris Littlewood

OCTOBER 18, 2018 **UPDATED** OCTOBER 23, 2018

Q&A

References