DATA CARPENTRY

MAKING DATA SCIENCE MORE EFFICIENT

Cornell University June 2017

Sponsored by Cornell Statistical Consulting Unit

Instructors

- Erika Mudrak (CSCU)
- Lynn Johnson (CSCU)
- Stephen Parry (CSCU)
- David Kent (Food Science)

Assistants

- Emily Davenport (Molecular Biology and Genetics)
- Francoise Vermeylen (CSCU)
- Kevin Packard (CSCU)
- Michael Ko (CSCU)

Goal:
A Data Carpentry workshop teaches the core skills for working with data effectively and reproducibly.

Community driven effort

Staff

- **Executive Director**
  Tracy K. Teal, PhD, Michigan State University
- **Associate Director**
  Erin Becker, PhD
- **Program Coordinator**
  Maneesha Sane
- **Deputy Director of Assessment**
  Kari Jordan, PhD

Steering Committee Members

- Karen Cranston, PhD, Principal Investigator, Open Tree of Life
- Hilmar Lapp, Director of Informatics, Duke Center for Genomic & Computational Biology
- Aleksandra Pawlik, PhD, Training Lead, Software Sustainability Institute
- Karthik Ram, PhD, rOpenSci co-founder, Berkeley Institute for Data Science Fellow
- Ethan White, PhD, Associate Professor, University of Florida

Open source materials

https://github.com/datacarpentry/datacarpentry/

Sentiments on data within the NSF BIO Centers (BEACON, SESYNC, NESCent, iPlant, iDigBio)

- I usually manage data in Excel and it's terrible and I want to do it better.
- I'm organizing GIS data and it's becoming a nightmare.
- My advisor insists that we store 50,000 barcodes in a spreadsheet, and something must be done about that.
- I'm having a hard time analyzing microarray, SNP or multivariate data with Excel and Access.
- I want to use public data.
- I work with faculty at undergrad institutions and want to teach data practices, but I need to learn it myself first.
- I'm interested in going in to industry and companies are asking for data analysis experience.
- I'm trying to reboot my lab's workflow to manage data and analysis in a more sustainable way.
- I'm re-entering data over and over again by hand and know there's a better way.
- I have overwhelming amounts of data.
- I'm tired of feeling out of my depth on computation and want to increase my confidence.

Notes before we start

- **Website:** https://emudrak.github.io/2017-06-14-cornell/
  - Will have links to lessons after we go through them

- **Etherpad:** http://pad.software-carpentry.org/2017-06-14-cornell
  - Instructor will update with current code and monitor questions,
- Can you see the screen? Insight…
- Bathrooms, breaks…

Two kinds of questions

Raise your hand for a question that everyone could benefit

Sticky note when your code doesn't work and you need a helper to come

Reproducible Research

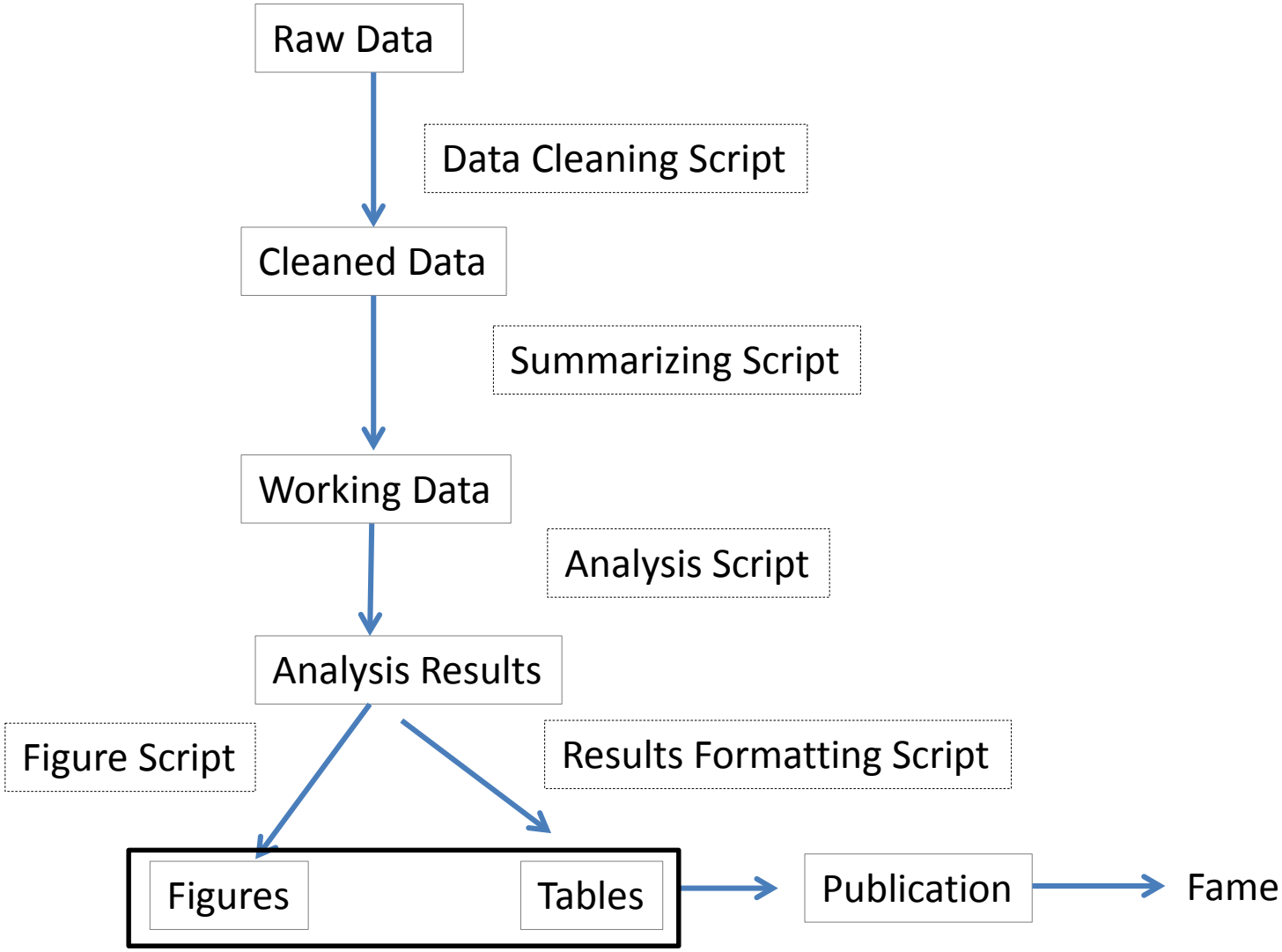
Well documented

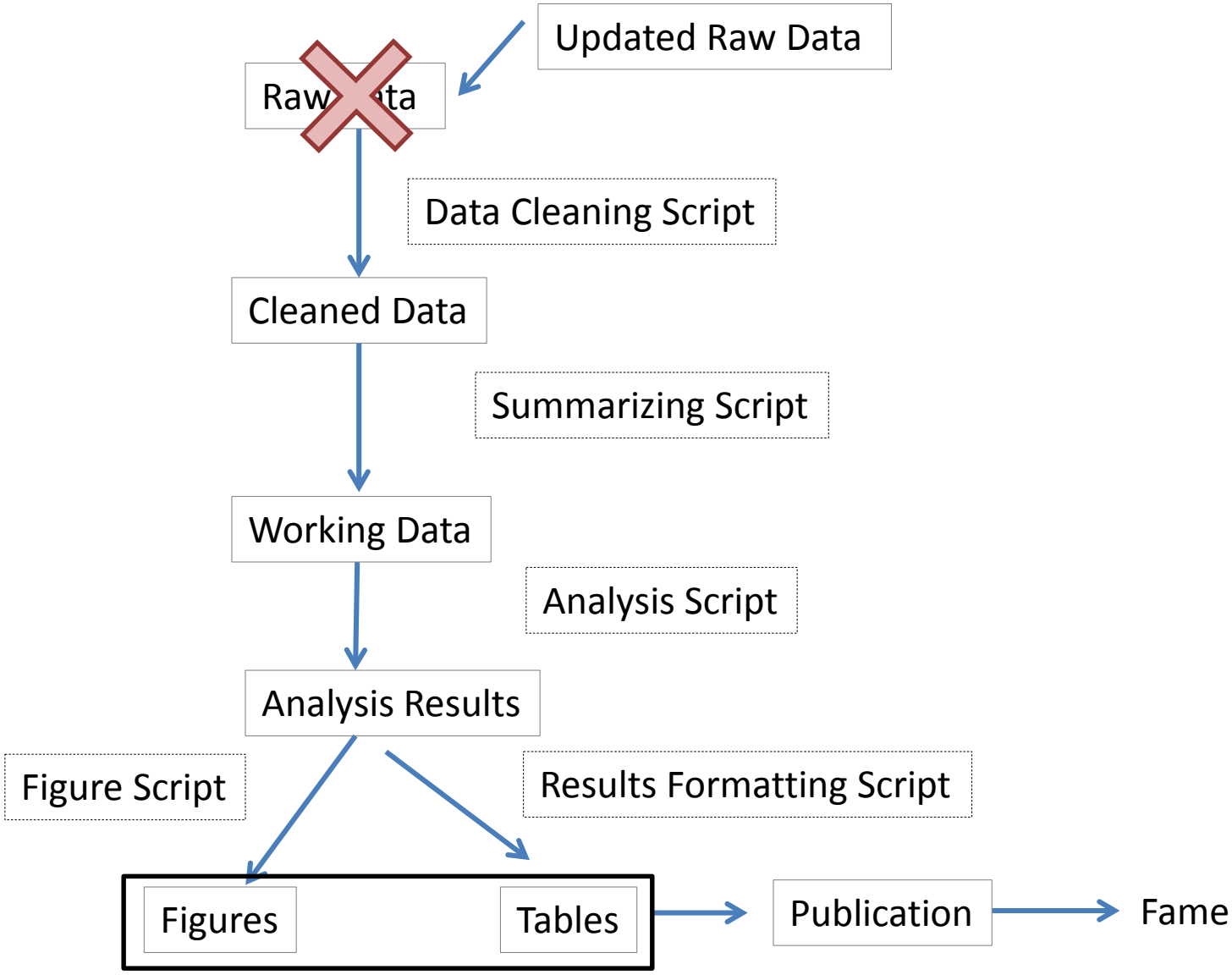
and

Repeatable

Reproducible Research

- Data analysis
  - Data and analysis can be re-created by anyone
    - Including you in the future!
    - Repeat analysis on updated data
    - Repeat analyses on similar datasets
  - Scripted data management and analysis
    - Manages and analyzes
    - Provides a record of what was done
    - Easy to edit and re-run


Raw Data
Data Cleaning Script
Cleaned Data
Summarizing Script
Working Data
Analysis Script
Analysis Results
Figure Script
Results Formatting Script
Figures
Tables
Publication
Fame


Updated Raw Data
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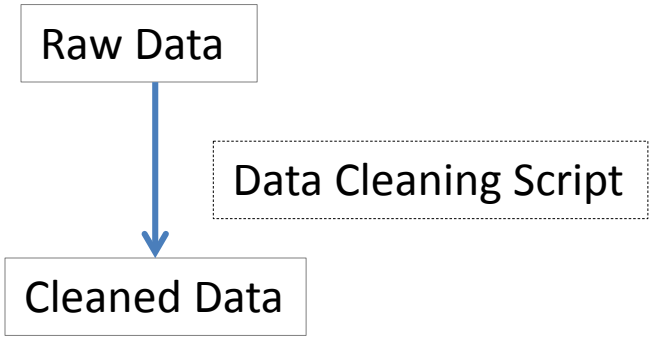
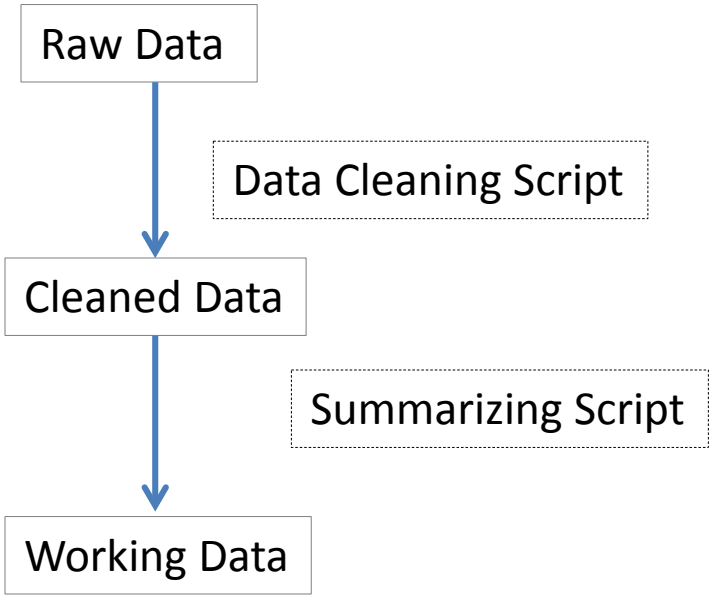
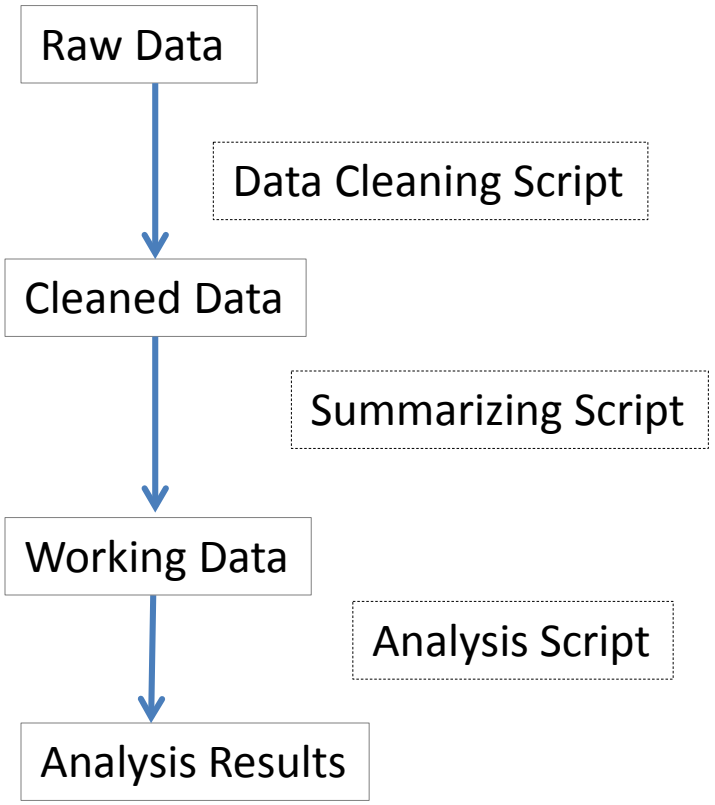


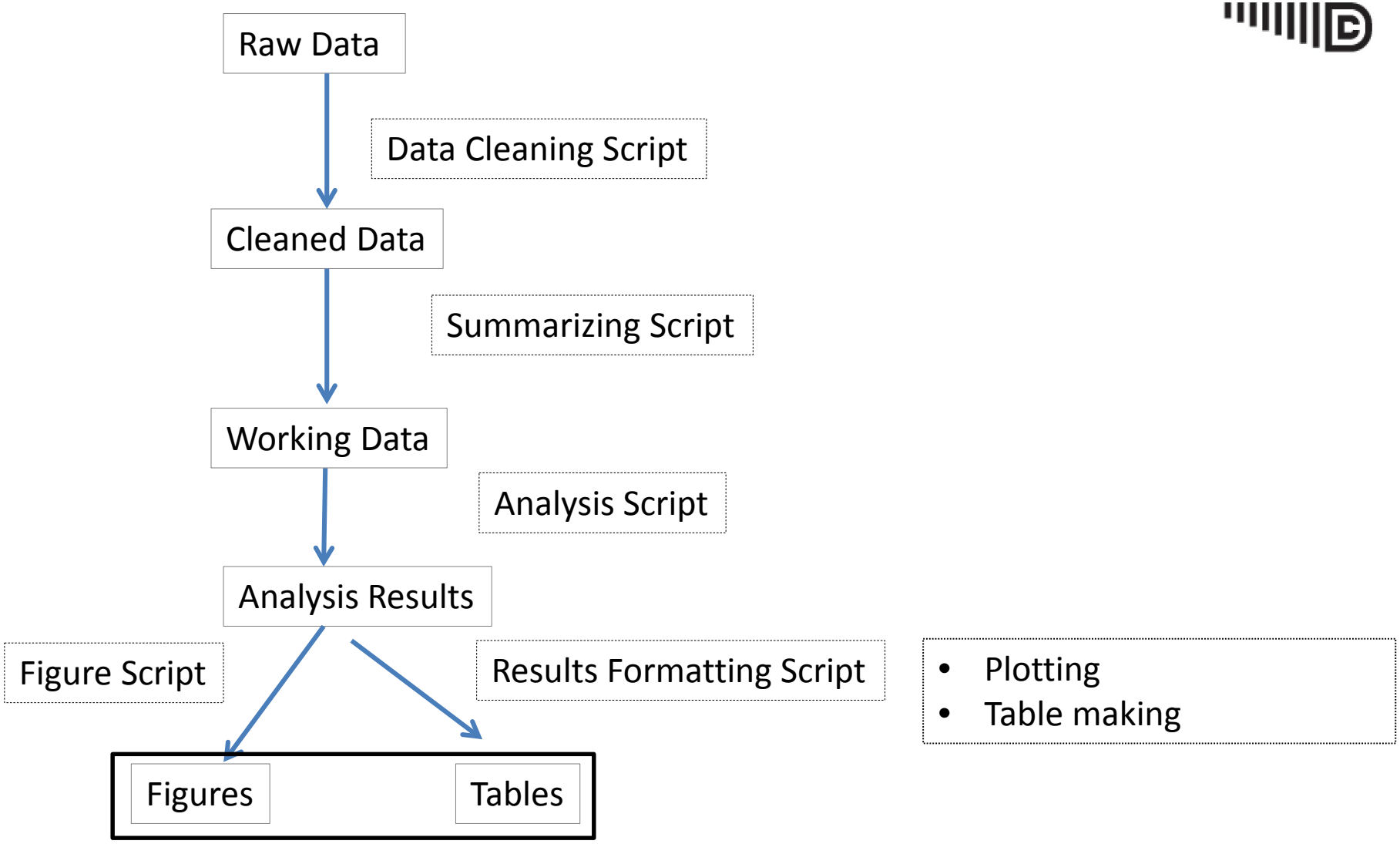
- Univariate & Bivariate EDA
- Find/Replace values
- Merge grouping labels
- Re-code variables
- Fix typos
- Standardize entries
- Convert dates
- Convert variable formats
- Missing values



- Subset data for particular project
- Transform variables
- Average, min, max by group
- imputation



- Linear Models
- Mixed Models
- Search for Correlates
- Loop!
- General Functions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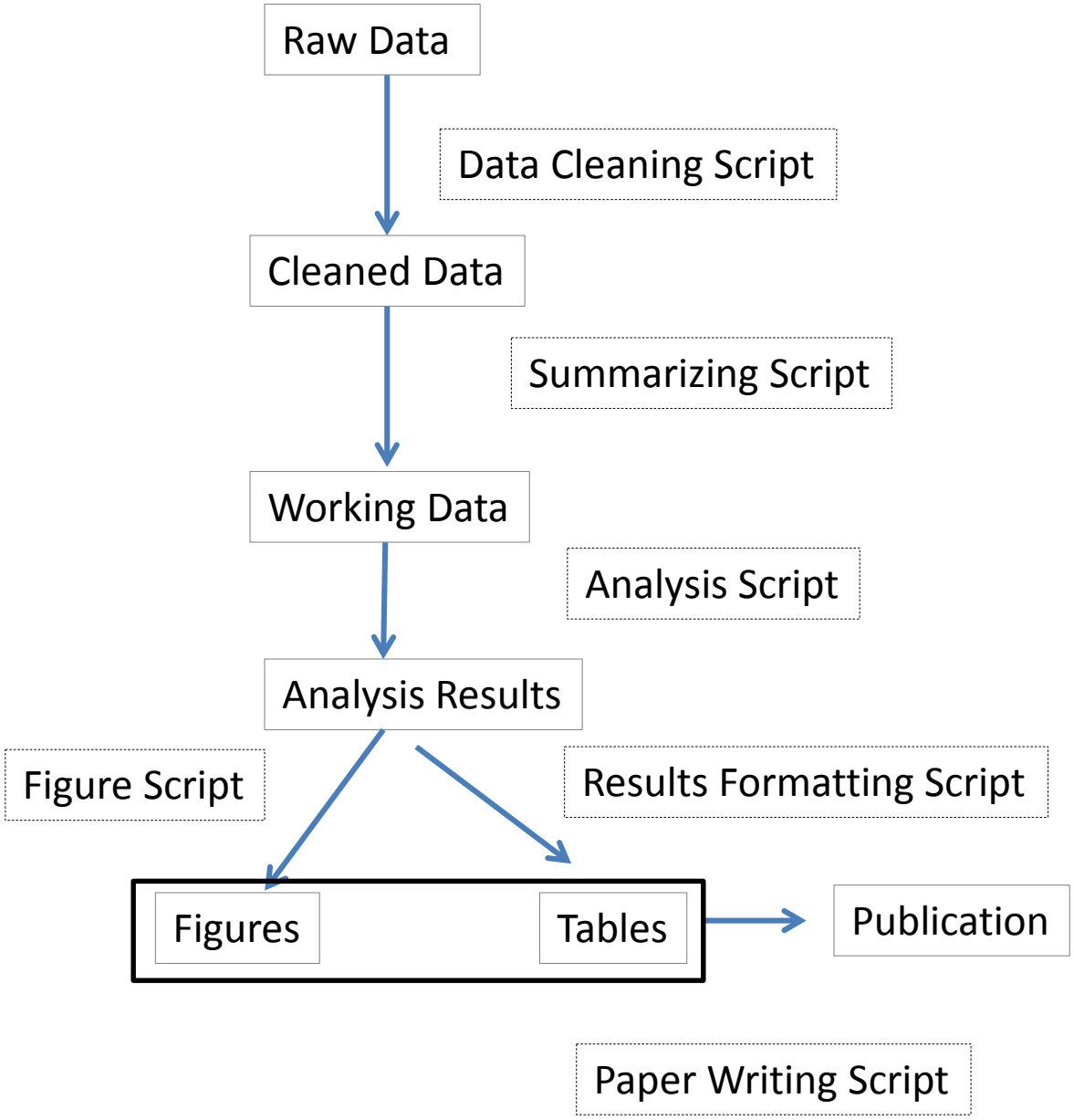
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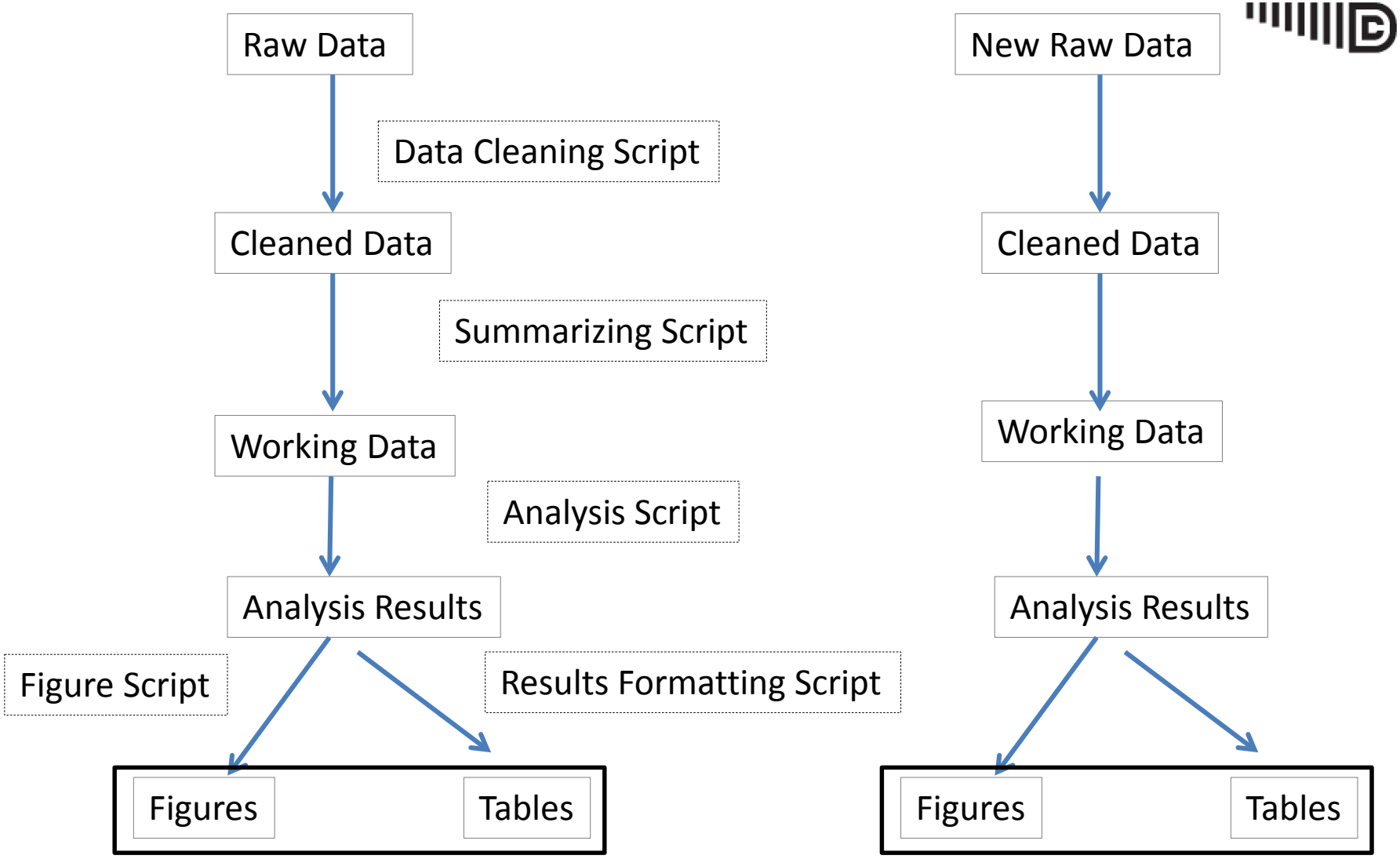
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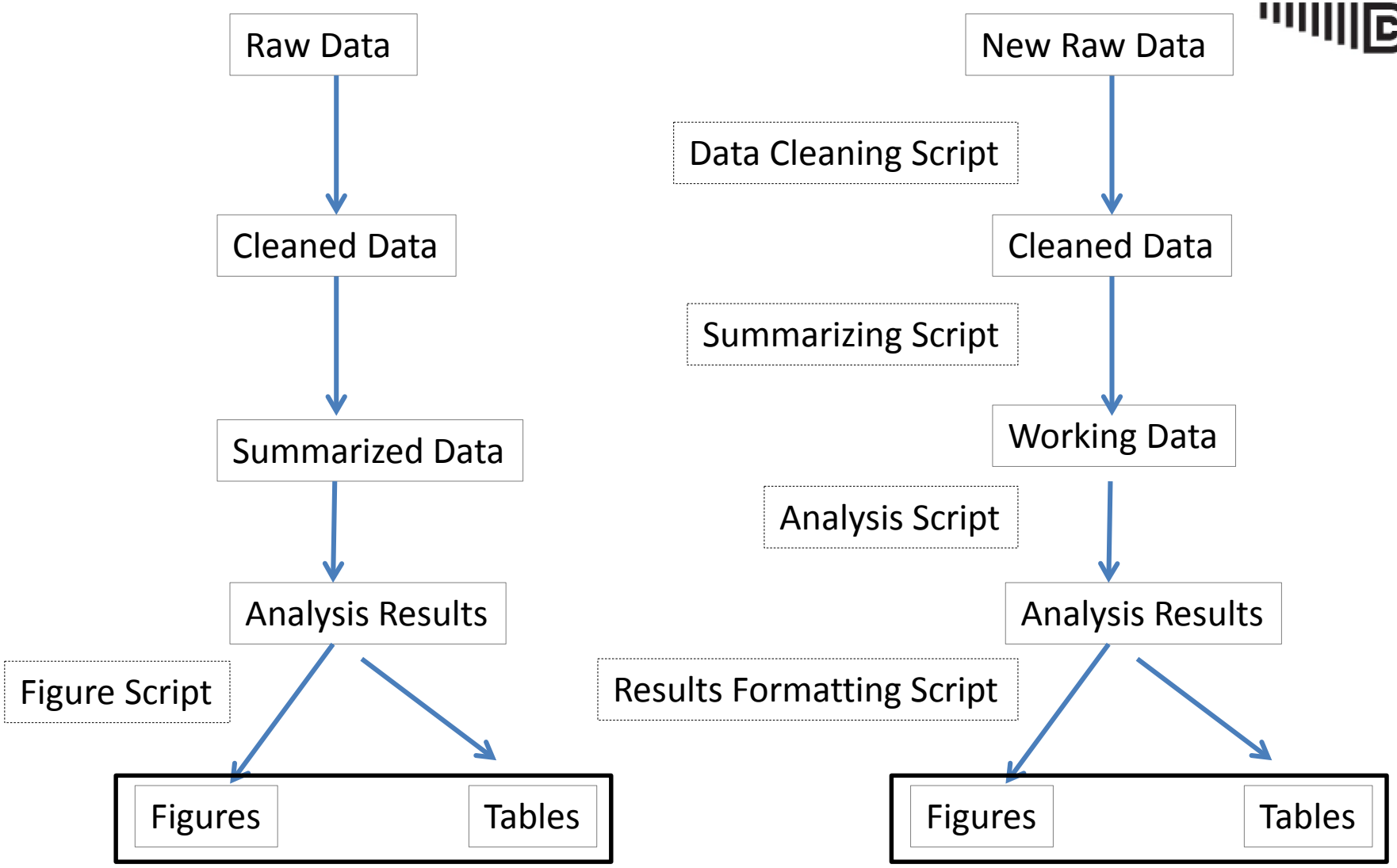
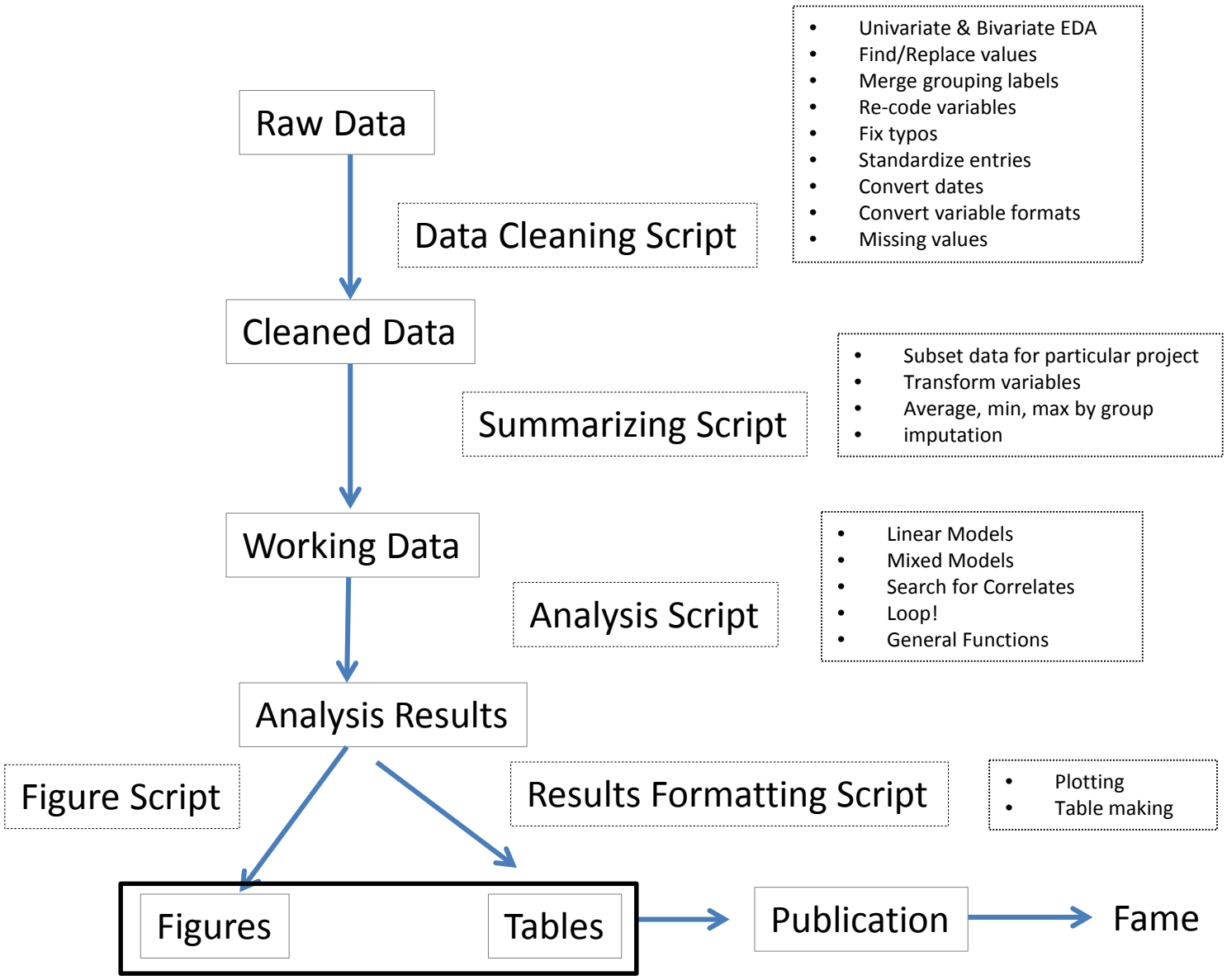
Re-use and edit scripts for new projects

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- Subset data for particular project
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Analysis Script

- Linear Models
- Mixed Models
- Search for Correlates
- Loops!
- General Functions

Results Formatting Script

- Plotting
- Table making

Wednesday morning

Excel

OpenRefine

Wednesday Afternoon

R: ggplot

R: dplyr

Thursday Morning

R: loops & functions

R: Rmarkdown, knitr and reports

Thursday Afternoon

Python

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