

# Data Analysis for Cognitive Neuroscience 2023/24



**Universitat  
Pompeu Fabra**  
*Barcelona*

Klaus Wimmer

[kwimmer@crm.cat](mailto:kwimmer@crm.cat)

Alexandre Hyafil

[ahyafil@crm.cat](mailto:ahyafil@crm.cat)

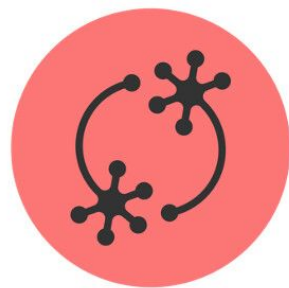


# Inspirations

Albert Compte

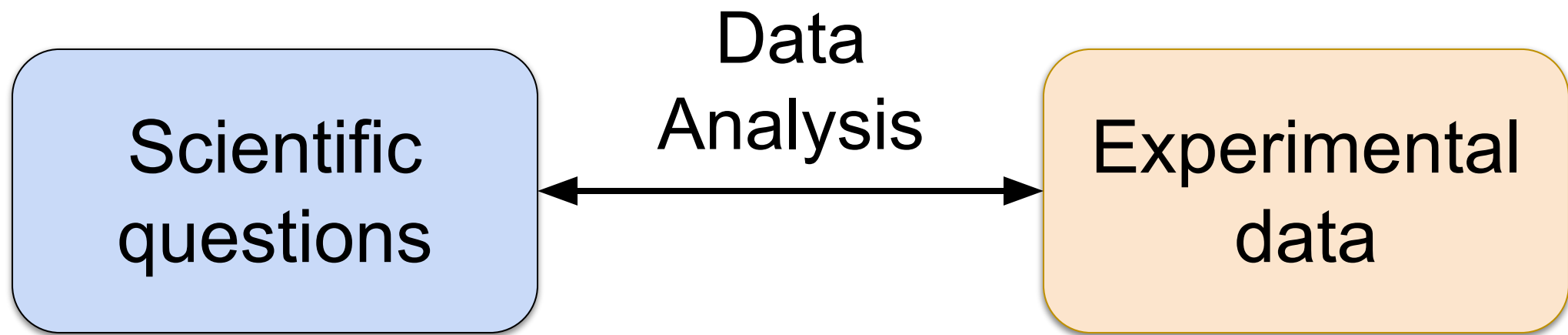


[www.bambschool.org](http://www.bambschool.org)



**neuromatch**  
academy

<https://academy.neuromatch.io/>



# What is the aim of this course?

- Data analysis is fun!
- Data analysis is creative!
- Data analysis has constraints:
  - rigor
  - some structure
    - data checking / cleaning
    - preprocessing
    - exploratory data analysis
    - statistical inference
    - model-based analyses
    - presentation of results
- Learn specific general-purpose techniques

# How will we achieve that??

- Working on **real data** as examples
- Using **Python** as a programming language
- We will learn: statistical inference, linear models, logistic regression, dimensionality reduction, cluster analysis (exploratory), spike train analysis
- A specific homework/class dynamics:
  - assignments to prepare at home and discuss in class
  - online quizzes

# Classroom / Assignments dynamics

- Before each class: we'll send the theoretical material (mostly videos) to be watched *prior* to the class
- During the class:
  - we'll make a short recap and address your questions
  - Then we'll start doing the tutorial in class
- After the class: You will have to complete it and send it before the next Wednesday

Feel free to work your tutorials in pairs, during and after class, but each student needs to upload their assignment

# Why learn coding?

- Because it opens a world of opportunities for data analysis, programming experiments, etc., that are simply not possible with button-clicking solutions (SPSS, Presentation,...)
- Because you reach a deeper understanding of the analysis
- Because this has become a very valuable asset in the industry (specifically Python for data scientists)

# Coding in the era of ChatGPT

- AI is your friend, but the type of friend you can never really trust
- Which is why you need to build the ability to evaluate ChatGPT's output and dialogue with it
- Speeds up learning and can allow you to focus more on the big picture
- But never trust it!



# Schedule

Date	Topic	Discuss in class/Submit	Get	Teacher
January 11	Introduction to Python		Assignment 0	Alex & Klaus
January 18	Descriptive statistics	Assignment 0	Assignment 1	Klaus
January 25	Linear models			Alex
February 1	Psychometric curves	Assignment 1	Assignment 2A	Klaus
February 8	Logistic regression		Assignment 2B	Klaus
February 15	Statistical inference	Assignment 2A,B	Assignment 3	Alex
February 22	Modeling Recap			Alex
<b>February 27 (Tuesday)</b>	Spike train analysis	Assignment 3	Assignment 4	Alex
March 7	Dimensionality reduction / Decoding	Assignment 4	Assignment 5 Papers for journal club	Klaus
March 14	Journal club (paper discussion)			Alex & Klaus
April?	Exam	Assignment 5		



## General Course Information



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Schedule, program and evaluation



Course Homepage on Github

All information about the course will be on github. By clicking on the URL you will get to a readme file that contains the information about how to get started in Python and several Python tutorials. In the future, we will post the assignments there as well.

## before January 12



Basic Python programming quiz

Marca com a feta

Before the course starts on January 12, do the quick quiz about your Python programming skills, so you know if you need to do an extra push before the class starts (**see the link to our github page above for links to tutorials etc.**). We will not consider this quiz for the final evaluation of the course. It is just for you to see where you stand and what concepts you should be familiar with in order to benefit from the class. If you

<https://github.com/wimmerlab/MBC-DataAnalysis/>

## MBC-DataAnalysis

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This is the repository for the materials of the Data Analysis class at the UPF Masters for Brain & Cognition taught by Klaus Wimmer & Alex Hyafil, largely using material from Albert Compte.

## Coding in Python

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Why should a cognitive psychologist / neuroscientist learn how to code? See the arguments in these different sources:

- "The next generation of neuroscientists needs to learn how to code" [article from Neuron journal](#)
- "Why it's important to learn to code in contemporary biology?" [article from Wire](#)
- "Why every (psychology) student should learn to code" [blog post](#)

You can brush up your Python skills by following one (or some) of these suggested Python tutorials:

- [Introduction to Python](#) from the Department of Cognitive Science of UC San Diego
- [Python for Everybody Specialization](#) (free Coursera course starts Dec 20)
- [LearnPython.org](#)
- [Datacamp - Intro to Python for Data Science](#)
- Python training at the [Neuromatch Academy: Day 1](#) and [Day 2](#), tutorials with videos
- Introductory material from the "[Advanced Scientific Programming in Python](#)" summer school
- If your master's project relies heavily on programming or you continue along with a PhD, we strongly recommend reading quietly through Patrick Mineault's wonderful [Good Research Code Handbook](#)

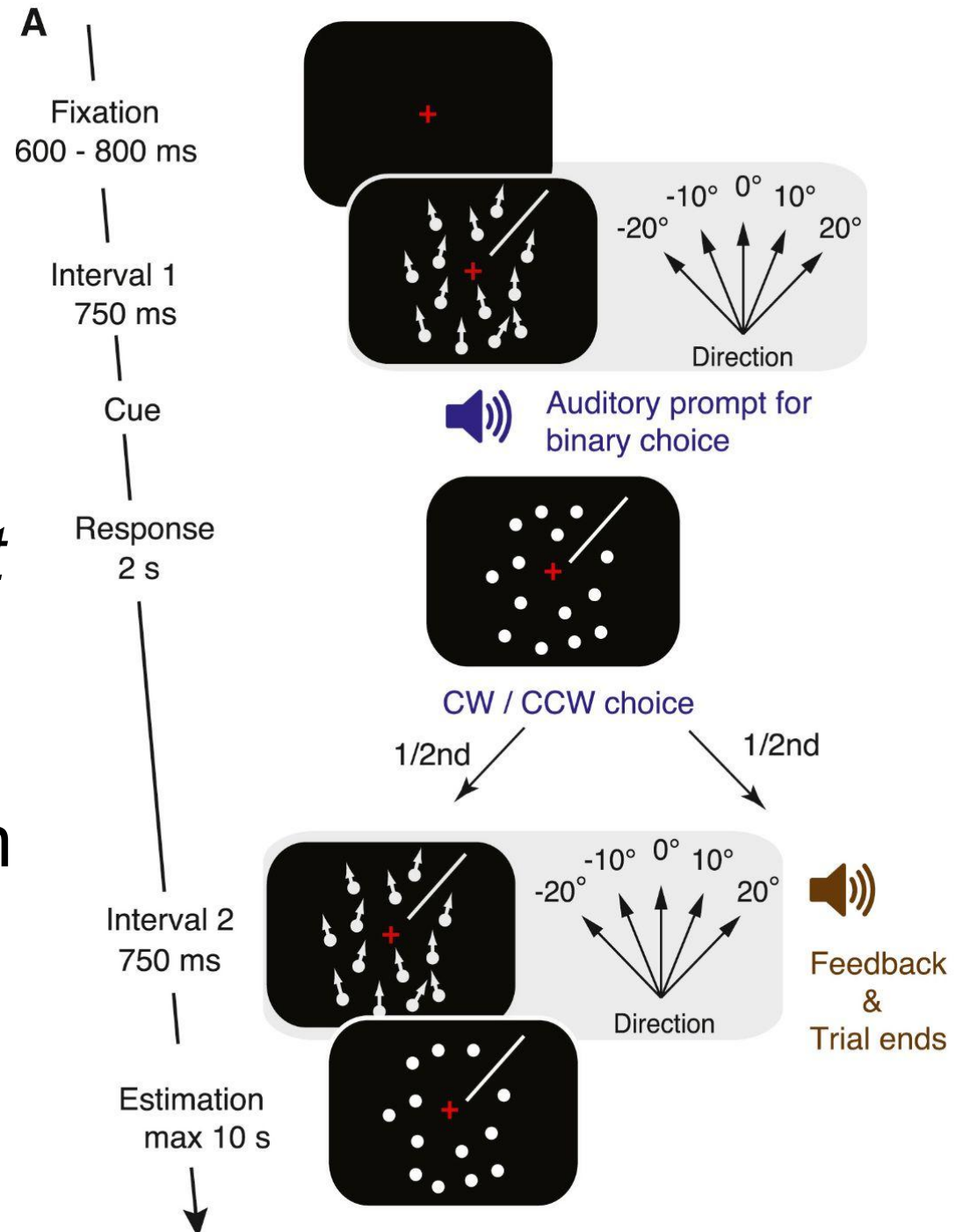
# Evaluation

The grade of the course will be computed based on:

- 1) **completed assignments.** Within-deadline submission and quality of the assignments will count towards **60% of the grade.**
- 2) **final exam.** At the end of the 2nd trimester there will be an exam, it will include both a Python Notebook assignment and an online test similar to what we will have done through the course. It will count towards **40% of the grade.**

# Dataset 1: behavioral data

- Talluri et al. *Current Biol* 2018
- combined discrimination/estimation task
- 14 subjects
- confirmation bias



# Assignment 0

## Things to learn about Python

- Basic maths
- Arrays
- Indexing (most analyses rely on computing something or one or several subsets of the dataset)
- Plotting
- Functions and scripts
- Dataframes (a fantastic tool to handle datasets)

# Assignment 1

- Descriptive statistics
  - Measures of centrality
  - Measures of dispersion
- Statistical inference
  - T-tests
  - Permutation tests