BGGN 240 / BIPN 162

Last day!

Final project presentations

- Sign up for final project slot (June 10th) on Canvas!

Final Showcase	**10 to >5.0 pts** **Meets all expectations** Student is present & participates at final showcase	**5 to >0.0 pts** **Meets some expectations** Student attends final showcase but description of project is unclear	**0 pts** **Does not meet expectations** Student does not attend final showcase	10 pts

- Final projects due on Canvas (one submission per group) by **June 10th @ 11:30 am**
  - Make sure all of your code is visible.
  - PDF or HTML

Reminders

- SET Evaluations due before 8 am on Saturday, June 8th 🙏
- Submit your **a4 Revision** on Canvas before Wednesday night (June 12th)
  - If you lost points on the interpretation questions (Questions 2b, 9, and 12), you have an opportunity to recover half credit!
  - For each of these questions you lost points on, please provide an explanation of what led you to your original answer, as well as a revised interpretation for why the other answer is correct.
  - You only need to fill out the questions for which you would like to revise.

So, how did we do?

Course Objectives

- Develop hypotheses specific to big data environments in neuroscience
- Design a neural data science experiment and excavate data from open sources
- Integrate data from multiple datasets to answer a biological question
- Describe the fundamentals of statistical machine learning tools used in neuroscience
- Dissect data analysis sections of computational / data-heavy neuroscience papers
- Interpret results from common methods in neural data science

In this course, we'll be developing conceptual & technical skills in parallel:

How different neural data sets are collected, preprocessed, and analyzed

Programming, math, and statistics skills necessary for data science

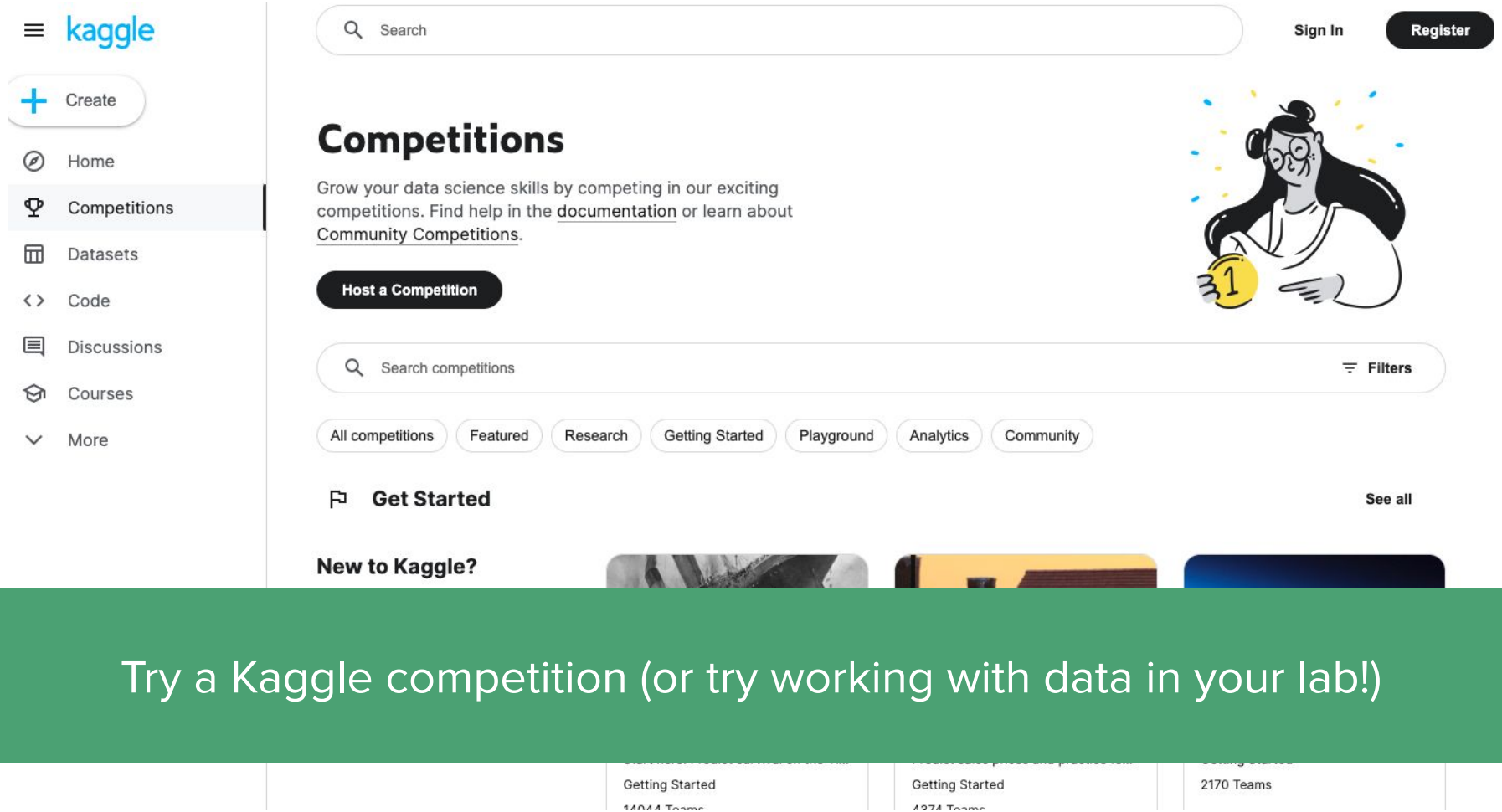
We initially expected to see differences between electrophysiology and morphology features in the young and old groups, especially since we were examining metrics that were also analyzed in relevant literature; however, we found no significant differences. Because of this we feel that a more ‘data science’ approach would have been to iterate through all available measurements in our dataset to hypothesize on how aging affects neurons (and not the other way around).

Data science is more than just statistical analysis; it involves integrating knowledge from various fields and presenting it through data.

We’re pretty limited on what questions we can actually ask based on the experimental designs/data collection of the datasets we encounter. This is pretty different from other experimental sciences, so it feels unique to data science.

In your words...

How can I keep learning?

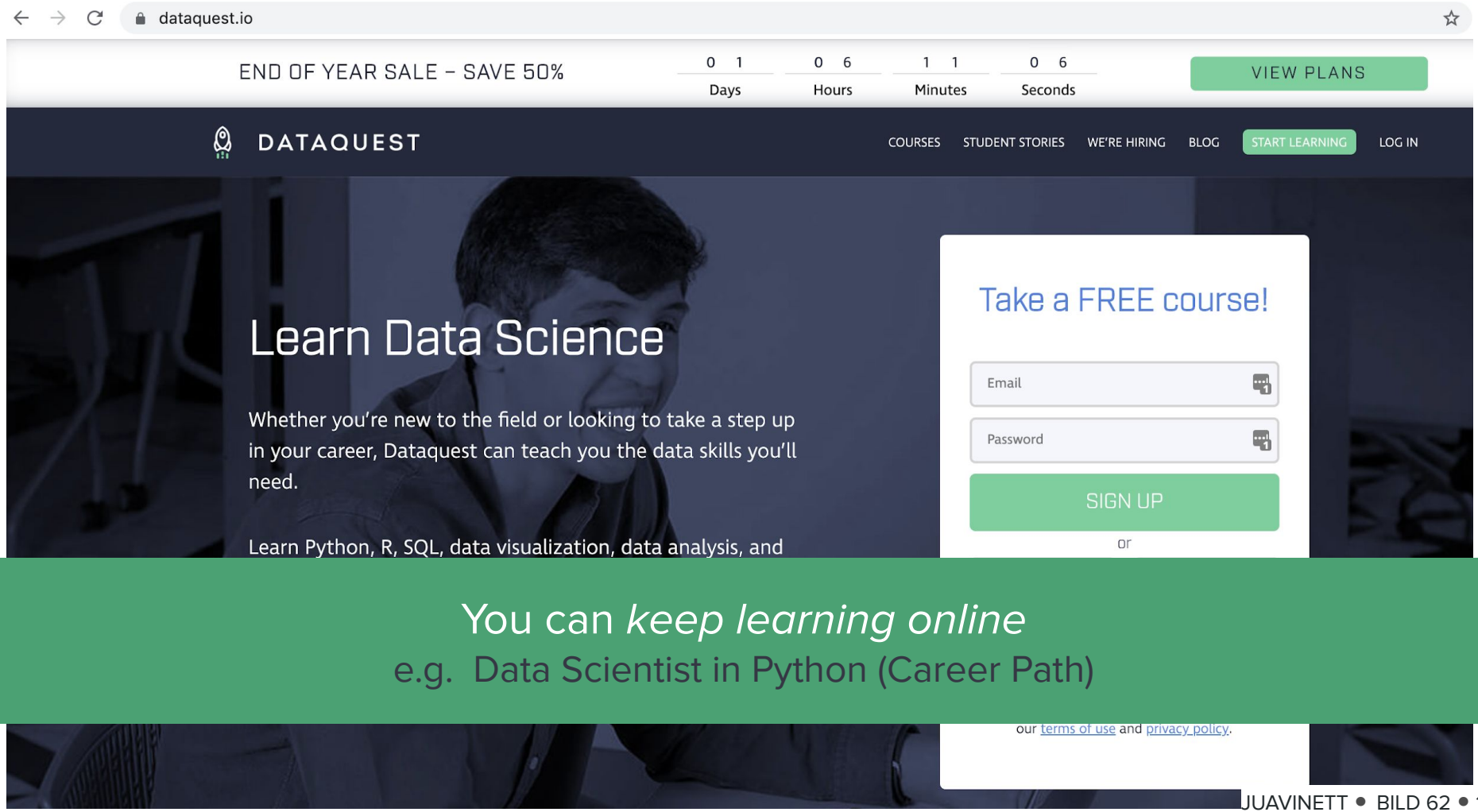


Try a Kaggle competition (or try working with data in your lab!)

Topics and Subjects

Course Title	Course Description	Course Link	Next Course Dates
Computational Neuroscience	The curriculum integrates cutting-edge advances in machine learning and causality research with state-of-the-art modeling approaches in neuroscience.	See Course Details and Upcoming Dates	July 8-26, 2024
Deep Learning	Our Deep Learning (DL) course grew out of the realization that there is a real need for teaching an ethically responsible hands-on TA-guided code-first DL curriculum that emphasizes how DL can be used to advance science and achieve better scientific insights.	See Course Details and Upcoming Dates	July 8-26, 2024
Computational Tools for Climate Science	Through this program, students will gain skills and knowledge in the areas of climate science and impact, computational methods, data access, and scientific practices.	See Course Details and Upcoming Dates	July 15-26, 2024
NeuroAI	What are common principles of natural and artificial intelligence? The core challenge of intelligence is generalization. Neuroscience, cognitive science, and AI are all questing for principles that help generalization.	See Course Details and Upcoming Dates	July 15-26, 2024

Neuromatch Courses: https://neuromatch.io/



You can *keep learning online*

e.g. Data Scientist in Python (Career Path)

Other online courses

[Applied Computational Genomics @ U. of Utah - YouTube]

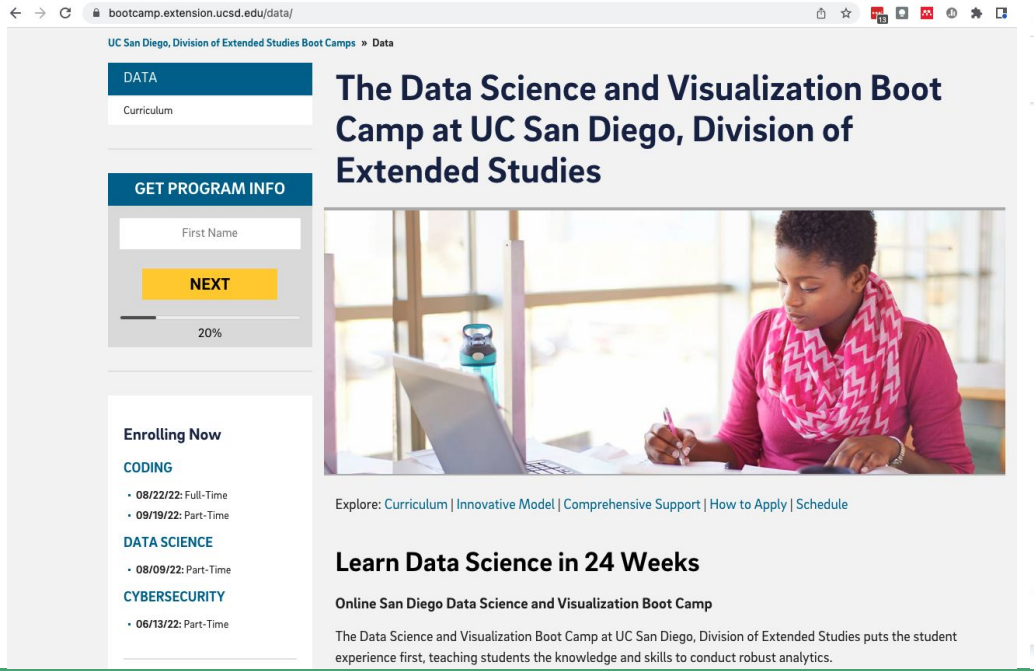
[MIT Deep Learning in Life Sciences - Spring 2021 - YouTube]

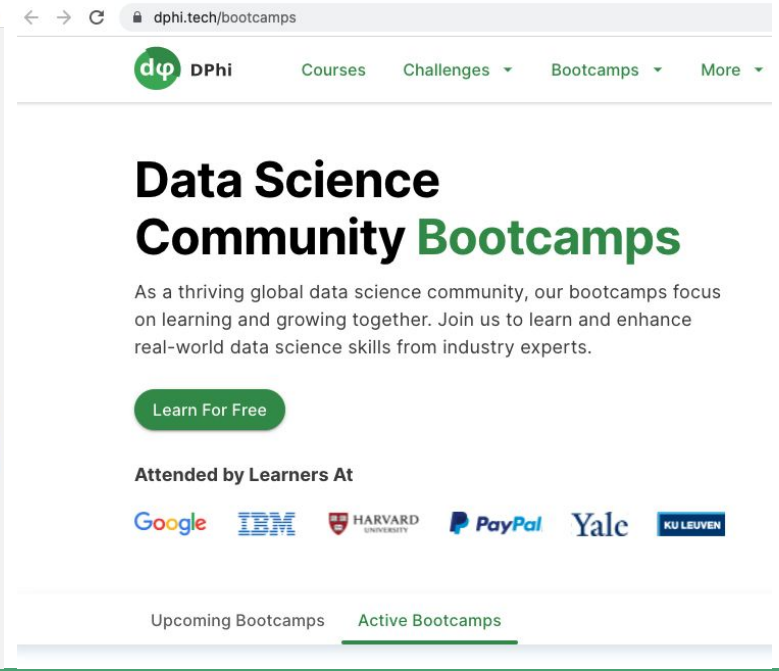
[Missing Semester IAP 2020 - YouTube]

[https://carpentries.org/workshop]

[Hypermodern Python · Claudio Jolowicz s/]

List curated by Fernando Pozo (Original Tweet)

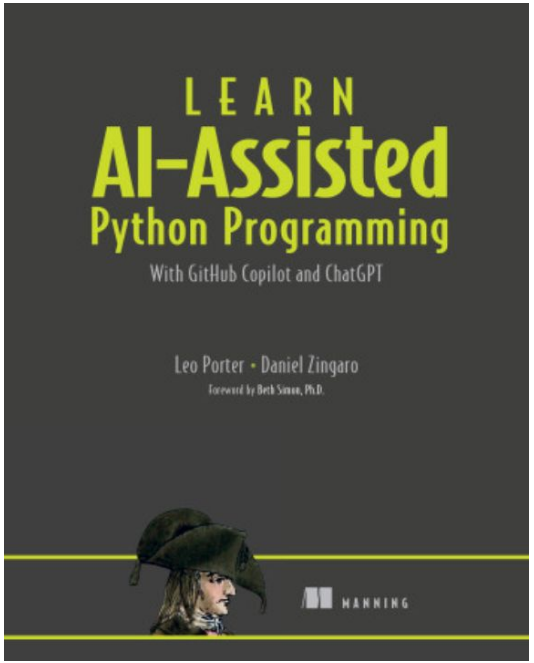




Sign up for a Data Science bootcamp

Continue learning alongside AI assistants

Just make sure you *understand* what the code is doing!!!!



Porter & Zingaro (2023) *Learn AI-Assisted Python Programming* — *entire book on using Copilot & VS Code!*

Brain Meets AI: Pioneering the Future of Neuroinformatics

Harnessing groundbreaking instruments and methodologies, we are mapping brain architecture and functionality at an extraordinary resolution and scale, producing vast datasets. This surge of information demands innovative computational approaches and broad collaborations, setting the stage for AI-driven discovery. The 2024 INCF Assembly will highlight the transformative impact of state-of-the-art technology and collective ingenuity on our comprehension of the brain. Immerse yourself in the cutting edge of brain science, where innovative tools, shared expertise, and the pursuit of understanding meet to decode the essence of intelligence.

SESSION 1

FAIR neuroscience

SESSION 2

Technologies for large-scale computation and team science

SESSION 3

Applications of AI to neuroscience research

SESSION 4

Closing the discovery loop and digital twins

Follow the work & events of different groups advocating for data standards & open science (e.g. incf)

Courses at UCSD

Biology classes

BIMM 143. Bioinformatics Laboratory (4). Bioinformatics is the analysis of big data in the biosciences. This course provides a hands-on introduction to the computer-based analysis of biomolecular and genomic data. Major topic areas include advances in sequencing technologies, genome resequencing and variation analysis, transcriptomics, structural bioinformatics, and personal genomics. This course will utilize free, web-based bioinformatics tools and no programming skills are required. Prerequisites: BILD 1 and BILD 4 or BIEB 123 or BIMM 101.

BIMM 149. Computation for Biologists (4). Course will provide students with the computational tools and problem-solving skills that are increasingly important to the biosciences. Students learn to program in a modern general-purpose programming language and write their own programs to explore a variety of applications in biology including simulations, sequence analysis, phylogenetics, among others. Prerequisites: BILD 1 and BILD 2.

BIPN 164 Computational Models and Theories in Neuroscience. This course covers mathematical models of neurons, synapses, and neural networks. We will introduce theoretical frameworks of brain activity and function to understand neural computation and control of behavior. We will discuss network dynamics, synaptic plasticity, learning and memory. Students will apply modeling approaches to address scientific questions and make predictions for experiments. Prerequisites: MATH 10A or MATH 20A and MATH 10B or MATH 20B and MATH 11

Cognitive science classes

COGS 9. Introduction to Data Science (4). Concepts of data and its role in science will be introduced, as well as the ideas behind data-mining, text-mining, machine learning, and graph theory, and how scientists and companies are leveraging those methods to uncover new insights into human cognition.

COGS 118A. Supervised Machine Learning Algorithms (4). This course introduces the mathematical formulations and algorithmic implementations of the core supervised machine learning methods. Topics in 118A include regression, nearest neighborhood, decision tree, support vector machine, and ensemble classifiers. COGS 118A-B may be taken in either order. Prerequisites: COGS 18 or CSE 8B or CSE 11 and MATH 18 or MATH 31AH and MATH 20E and MATH 180A and COGS 108 or COGS 109 or COGS 118B or CSE 150 or CSE 151 or CSE 158 or ECE 174 or ECE 175A or consent of instructor.

COGS 118B. Introduction to Machine Learning II (4). This course, with COGS 118A, forms a rigorous introduction to machine learning. Topics in 118B include maximum likelihood estimation, Bayesian parameter estimation, clustering, principal component analysis, and some application areas. COGS 118A-B may be taken in either order. Prerequisites: CSE 8B or CSE 11 and MATH 18 or MATH 31AH and MATH 20E and MATH 180A or consent of instructor.

Cognitive science classes (*continued*)

COGS 118C. Neural Signal Processing (4). This course will cover theoretical foundations and practical applications of signal processing to neural data. Topics include EEG/field potential methods (filtering, Fourier (spectral) analysis, coherence) and spike train analysis (reverse correlation, spike sorting, multielectrode recordings). Some applications to neural imaging (optical microscopy, fMRI) data will also be discussed. Prerequisites: MATH 18 or MATH 31AH, COGS 14B or PSYC 60, and COGS 108 or COGS 109.

COGS 118D. Mathematical Statistics for Behavioral Data Analysis (4). Statistical methods for analyzing behavioral data. A mathematically sophisticated course covering both classical and Bayesian statistical methods for estimation, hypothesis testing, regression, and model comparison. Emphasis on both mathematical understanding of statistical methods as well as common applications. Prerequisites: MATH 18 or MATH 31AH and MATH 180A or consent of instructor.

COGS 119. Programming for Experimental Research (4). This course will help students in the behavioral sciences (cognitive science, psychology, linguistics, neuroscience, and related fields) learn how to program experiments and analyze and present data. Prerequisites: COGS 14B and MATH 18 or MATH 31AH and MAE 8.

A path into advanced COGS classes…

Course name & description	**MATH 189** Quantitative techniques for analyzing big data	**COGS 118A** Supervised Machine Learning Algorithms	**COGS 118B** Introduction to Machine Learning	**CSE 158** Data Mining
Prerequisites	MATH 18 or 20F or 31AH MATH 20C MATH 183 *Uses R?*	COGS 18 MATH 18 MATH 20E MATH 180A COGS 108/109 *Uses Python*	CSE 8B or CSE 11 MATH 18 MATH 20E MATH 180A	DSC 40B DSC 80 MATH 183

Also *tons* of Data Science courses (restricted but allow students in if space)

DSC 120. Signal Processing for Data Analysis (4): This course will focus on ideas from classical and modern signal processing, with the main themes of sampling continuous data and building informative representations using orthonormal bases, frames, and data dependent operators. Topics include sampling theory, Fourier analysis, lossy transformations and compression, time and spatial filters, and random Fourier features and connections to kernel methods. Sources of data include time series and streaming signals and various imaging modalities. Prerequisites: MATH 18 or MATH 31AH and MATH 20C and DSC 40B.

DSC 140A. Probabilistic Modeling and Machine Learning (4): The course covers learning and using probabilistic models for knowledge representation and decision-making. Topics covered include graphical models, temporal models, and online learning, as well as applications to natural language processing, adversarial learning, computational biology, and robotics. Prior completion of MATH 181A is strongly recommended. Prerequisites: DSC 80 and ECE 109 or ECON 120A or MAE 108 or MATH 180A or MATH 183 or MATH 186. Restricted to students with upper-division standing.

DSC 140B. Representation Learning (4): This course is an introduction to machine learning which explores techniques for learning suitable representations from data. Topics include clustering, dimensionality reduction, manifold learning, principal component analysis, spectral embeddings, multilayer perceptrons, autoencoders, convolutional and recurrent neural networks, and other aspects of deep learning. The course focuses on the underlying mathematical principles, but some attention is also given to implementation. Prerequisites: DSC 80, ECE 109 or ECON 120A or MAE 108 or MATH 180A or MATH 183 or MATH 186.

DSC 148. Introduction to Data Mining (4): This course mainly focuses on introducing current methods and models that are useful in analyzing and mining real-world data. It will cover frequent pattern mining, regression and classification, clustering, and representation learning. All participants should be comfortable with programming, and with basic optimization and linear algebra. Prerequisites: DSC 40B or CSE 12, DSC 80 or CSE 15L, MATH 180A or MATH 181A or MATH 183 or CSE 103 or ECE 109 or ECON 120A. Students may not receive credit for DSC 148 and CSE 158 or CSE 158R.

Neural Data Science Careers

Many different career paths require data science skills

“Data Scientist”

“Applied ML Scientist”

“Machine Learning Engineer”

“Principal Investigator”

“Research Scientist”

Barrington James

Medical Imaging Data Scientist

California, United States · 3 weeks ago · Over 100 applicants

$170K/yr - $200K/yr · On-site · Full-time · Associate

201-500 employees · Staffing and Recruiting

Skills: Imaging Science, MRI, +9 more

Responsibilities

- Build and validate machine learning models to predict and assess image quality.
- Develop methods and analyze data to measure and report on image quality.
- Implement quality control procedures and support efforts to validate imaging systems.
- Analyze phantom data and innovate solutions for technical challenges in imaging systems.
- Collaborate with national/international bodies and researchers on image quality issues.
- Communicate progress and findings through reports, presentations, and scientific publications.

Requirements

- PhD (or relevant Master's with experience) in Physics, Medical Physics, Biomedical Engineering, Data Science, etc.
- Familiarity with interventional clinical workflows and x-ray systems (2D & 3D image processing).
- Expertise in fluoroscopy/X-ray imaging (metrics, reconstruction, hardware).
- Strong background in image/data science with machine learning, model observers, or human observer studies.
- Proficiency in programming (MATLAB/Python) and scientific literature comprehension.
- Excellent communication with clients, regulators, and diverse audiences (presentations, reports, articles).

Clinical Neurotechnology Research Assistant

Stanford University | Stanford, CA | $35.58 - $46.15 an hour

You must create an Indeed account before continuing to the company website to apply

Apply now

Full job description

Stanford University is seeking a Clinical Neurotechnology Research Assistant (Physical Science Research Professional 1) to support our BrainGate2 feasibility study of intracortical neural interface systems for persons with tetraplegia.

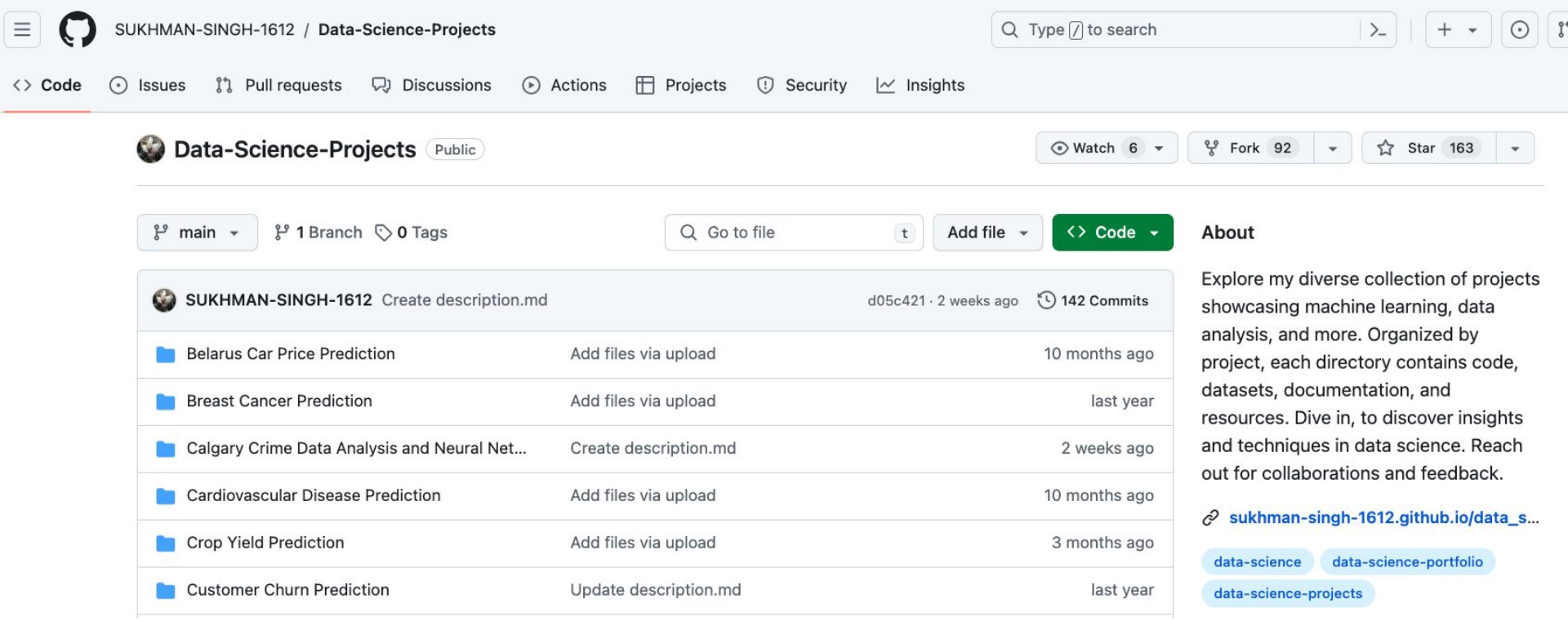
The Clinical Neurotechnology Research Assistant is primarily responsible for the performance of clinical neurotechnology research in the homes of clinical trial participants with tetraplegia (quadriplegia). These responsibilities include the careful execution and documentation of research sessions studying the safety and efficacy of investigational medical devices and novel, neurally-controlled assistive interfaces ("brain-computer interfaces") for people with paralysis or communication impairments.

DESIRED QUALIFICATIONS:

- Bachelor's degree with coursework in engineering, biology or neuroscience.
- 1-2 years related experience in neuroscience or electrical or computer engineering.
- Extraordinary interpersonal skills and ability to work as part of a complex, multi-institutional team.

...

- Experience with Python and Matlab / Simulink environments is advantageous.



Start building a portfolio on GitHub!

Thank you, Jeffrey!

Thanks for a great quarter.