Introduction to Scientific Computing and Data Science

Scientific Computing

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Summer 2023

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Course Goals

- Overview of topics in **scientific computing**, **data science**, and **machine learning**
- Apply these topics to your own research
- Familiarize yourself with the tools and software

Course Survey

Topics

- Programming Foundations
- Computer Science and Math Foundations
- Overview of Scientific Computing
- Exploratory Data Science and Visualization
- Machine Learning
- Deep Learning

Tools

- Python
- NumPy, SciPy, Pandas
- Matplotlib, Seaborn
- Scikit-Learn, Scikit-Image
- PyTorch

Course Logistics

Refer to the current year's course syllabus for more details.

We will typically split the class into the following components:

- Lectures: Twice a week
- Homework: Once a week
- Office Hours: Typically once a week with demand

Grading is typically split as follows:

- Homework: 80%
- Participation + Other: 20%

Communication

- Email: stefan.abi-karam@ahschool.com
  - Absence, Personal Concerns, Project Questions and Feedback
  - Please use your Heritage email address as well
- Google Classroom
  - **Homework Assignments**
  - Class meeting link
  - Class announcements and changes
- Campuswire
  - **Questions about Homework**
- Office Hours
  - **Questions about Homework**
  - **Questions about Projects**
- Slack
  - Project Questions and Feedback, Quick Updates, Meeting Links and Reminders

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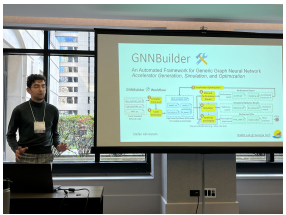
About Your Teacher

- Graduated from American Heritage in 2018
- B.S. in Electrical Engineering in 2021
- M.S. in Electrical Engineering in 2022
- Ph.D. + Research Faculty 2023 and beyond

Research: My research is focused on hardware acceleration of machine learning algorithms and applied machine learning for hardware design tools and emerging technologies.



About Your Teacher

More Details

- SHARC Lab, ECE, Georgia Tech
- CIPHER Lab, Georgia Tech Research Institute
- Georgia Tech Undergraduate Admissions

Hobbies

- Meteorology
- Music Production and Analog Music Synthesis
- Sailing
- Hobby Electronics and Programming
- Reading

About Your Teacher

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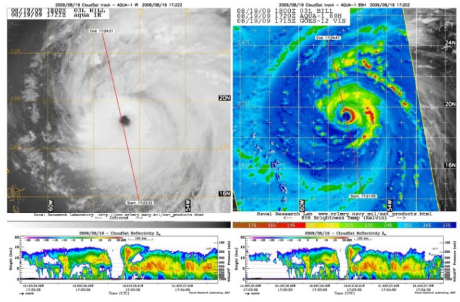
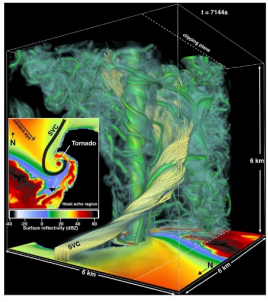
What is Computing?

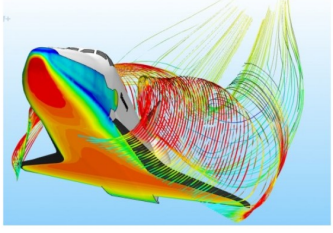
Computer Science is no more about computers than astronomy is about telescopes.

—Edsger W. Dijkstra

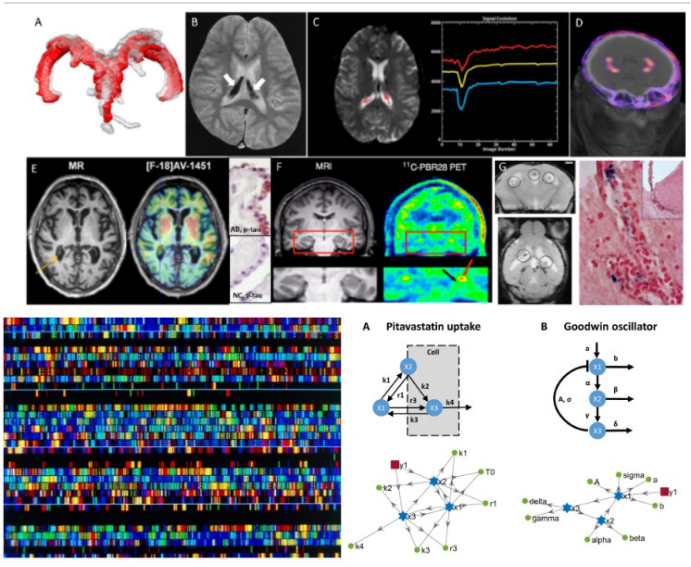
Scientific Computing - Earth Science and Engineering







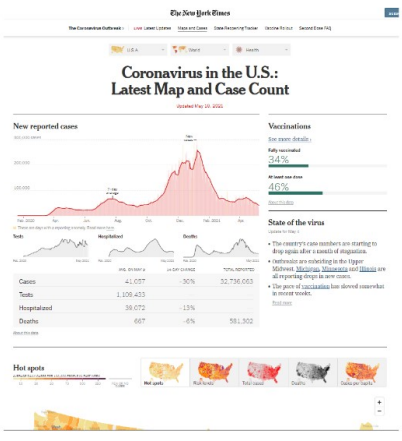
Scientific Computing - Biology and Medicine

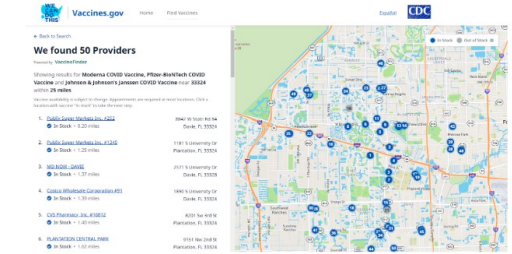


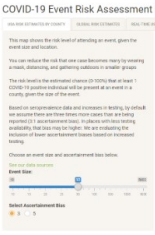
What is Data Science?

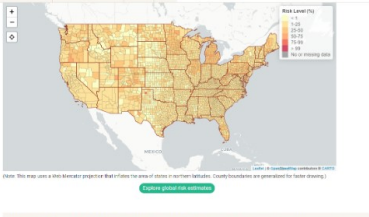
Data is the new oil.

Data Science - COVID-19

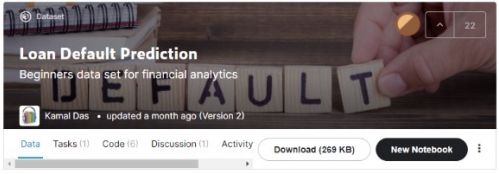


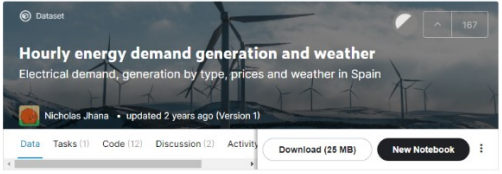






Data Science - General Applications





What is Machine Learning?

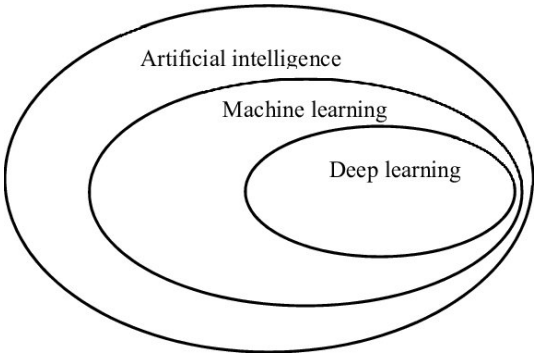
AI is the new electricity.

—Andrew Ng

In the same way that electricity transformed our world, AI will transform our world and will be incorporated into every aspect of our lives.

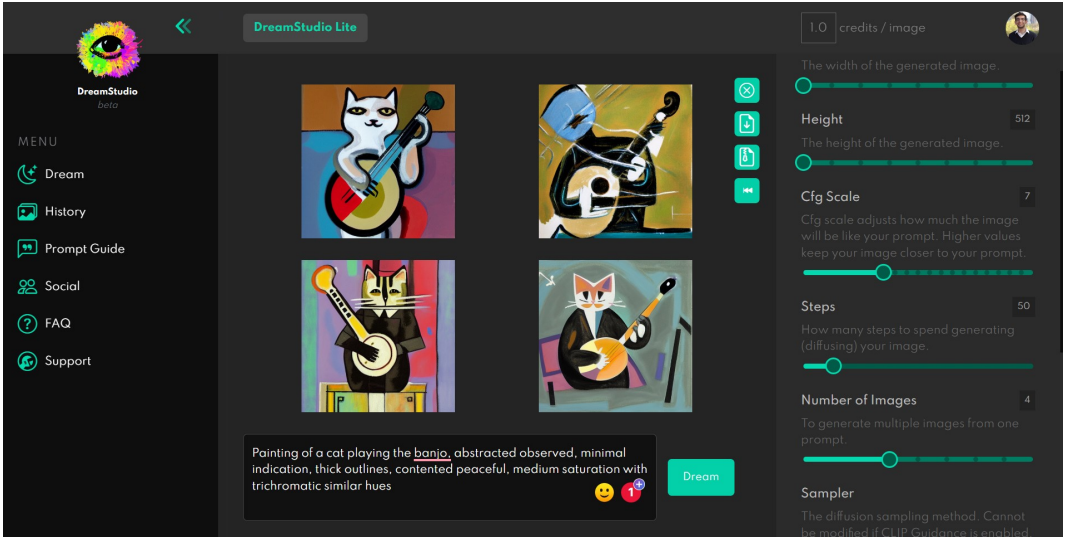
AI vs. Machine Learning vs. Deep Learning

- **AI:** The study of how to make computers intelligent.
- **Machine Learning:** A subfield of computer science that gives computers the ability to learn without being explicitly programmed.
- **Deep Learning:** A subfield of machine learning that uses neural-network-like structures and large amounts of data to learn.

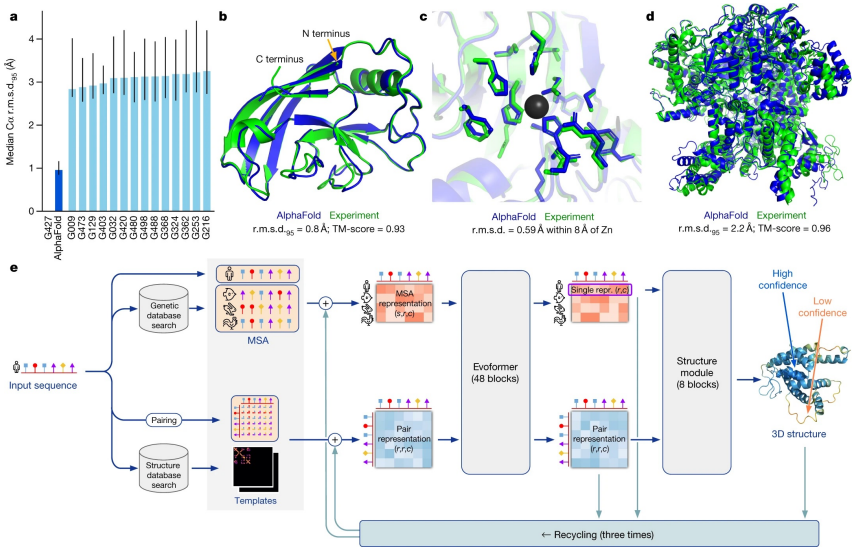


Machine Learning - Self-Driving Cars

Machine Learning - Generative Models



Machine Learning - Protien Folding



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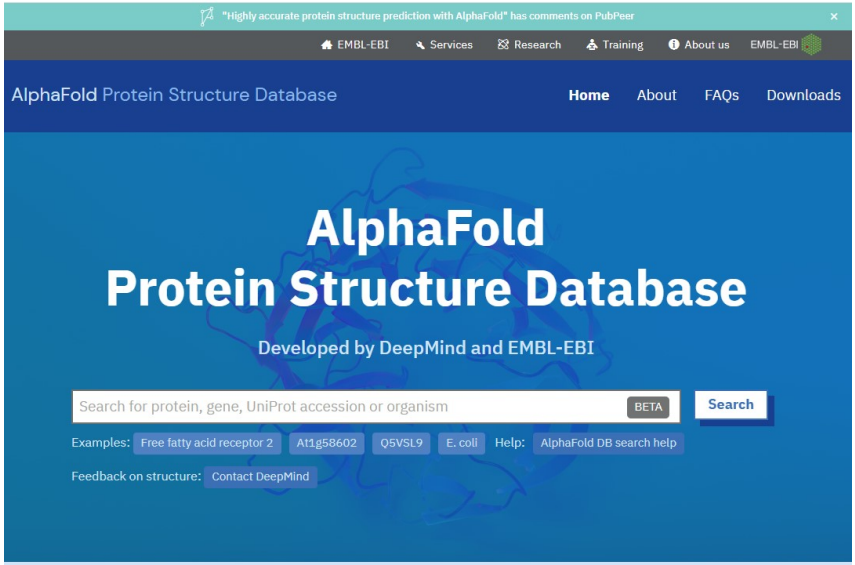

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Closing Advice

- Find connections between your interest and what we will cover and explore those connections; always keep that in the back of your mind.
- There is no such thing as a dumb question; if you have a question or a gap in your understanding, ask about it as soon as possible.
- I am flexible about a lot of things if you come to me early and talk to me directly.
- I have a good sense of humor, so any class or research memes are encouraged.