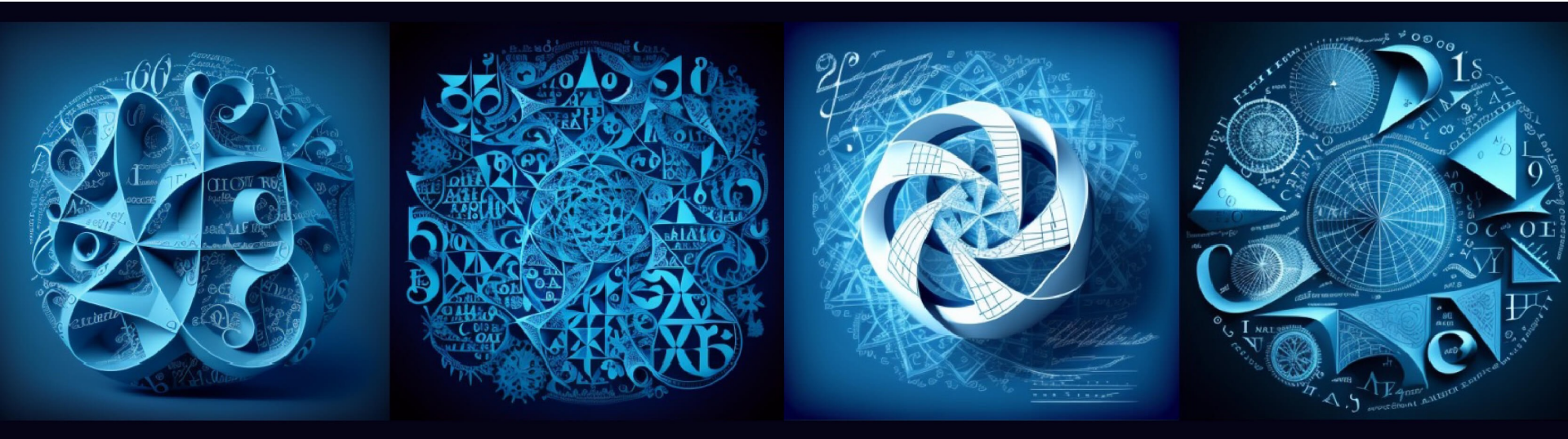
ECE 594n: Equivariant, Geometric and Topological Deep Learning

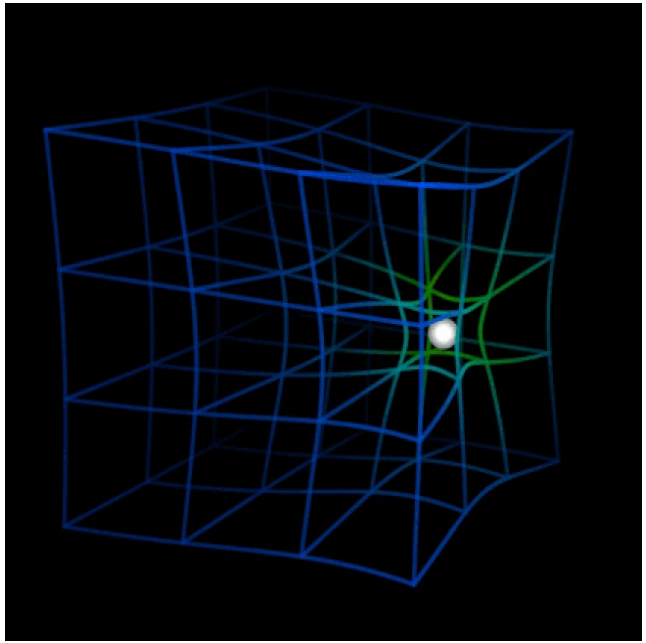
How to Read an AI Research Paper

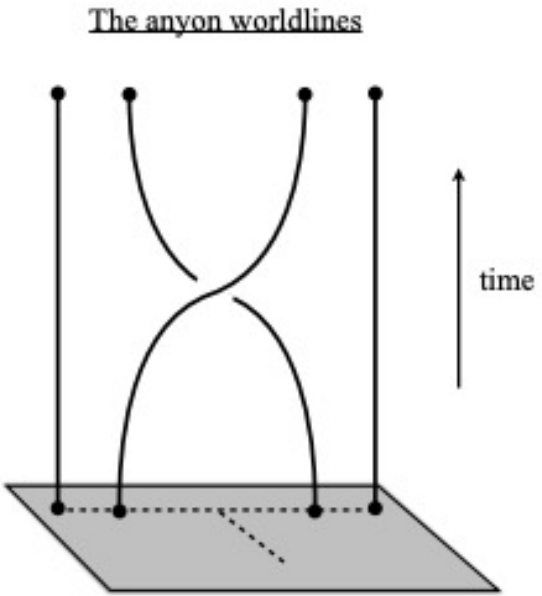
How to Use GitHub

Nina Miolane, Assistant Professor @ Geometric Intelligence Lab

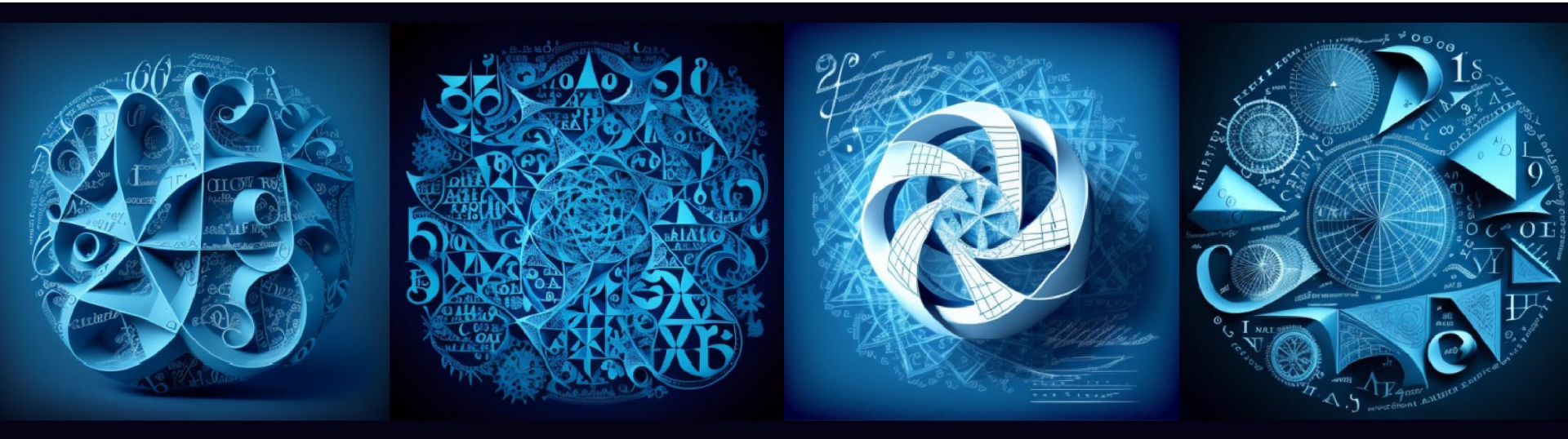


Scientists have successfully leveraged concepts of
Geometry, Topology, Equivariance (Group Theory),
To explain the most intricate natural phenomena.

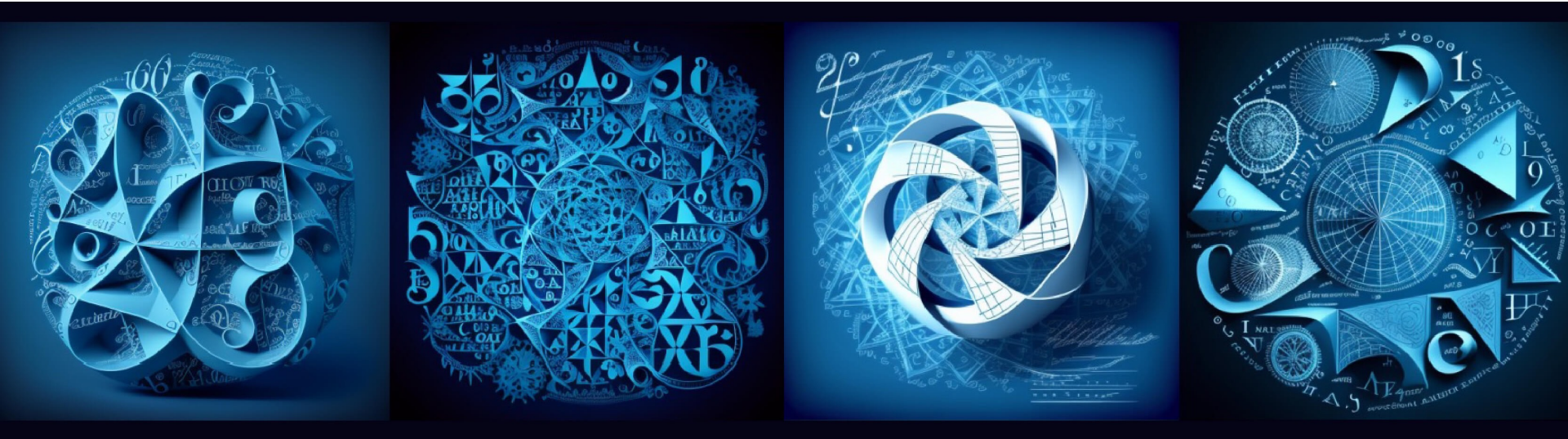




Can we use similar concepts to understand and build AI?



The goal of this class is to read, understand and apply cutting-edge research in equivariant, geometric, and topological deep learning.



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- HW Paper:
  - Present (30 minutes) a paper in class. Re-Code it. 50%.
- HW Project:
  - Analyze data with Equivariant, Geometric or Topological Deep Learning. 30%.
- Participation in class: 20%

Outline for Today:

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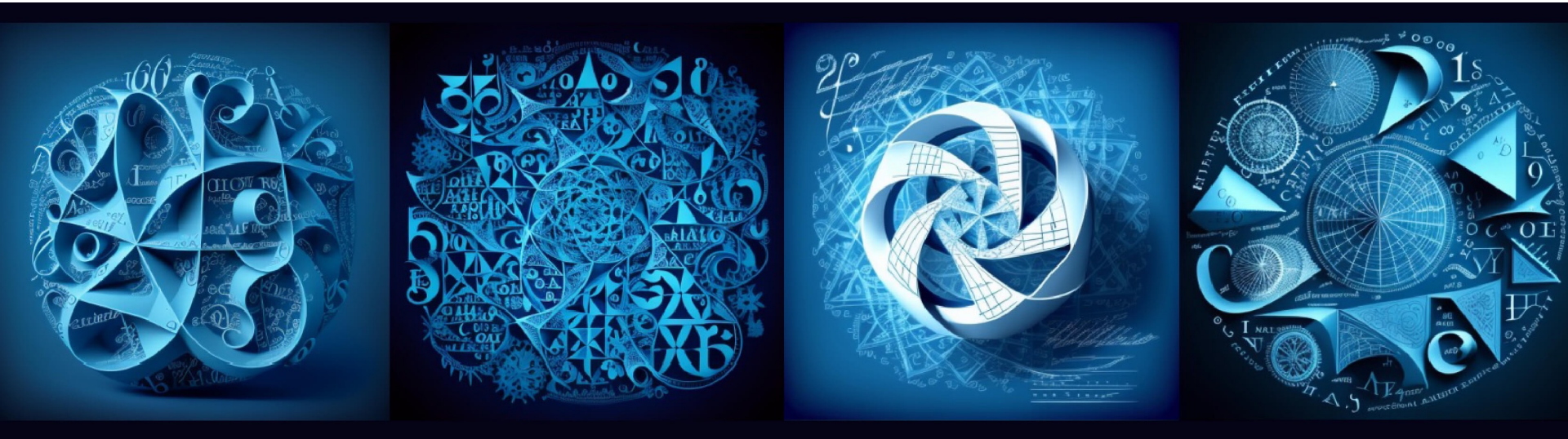
2. *How to Use GitHub*



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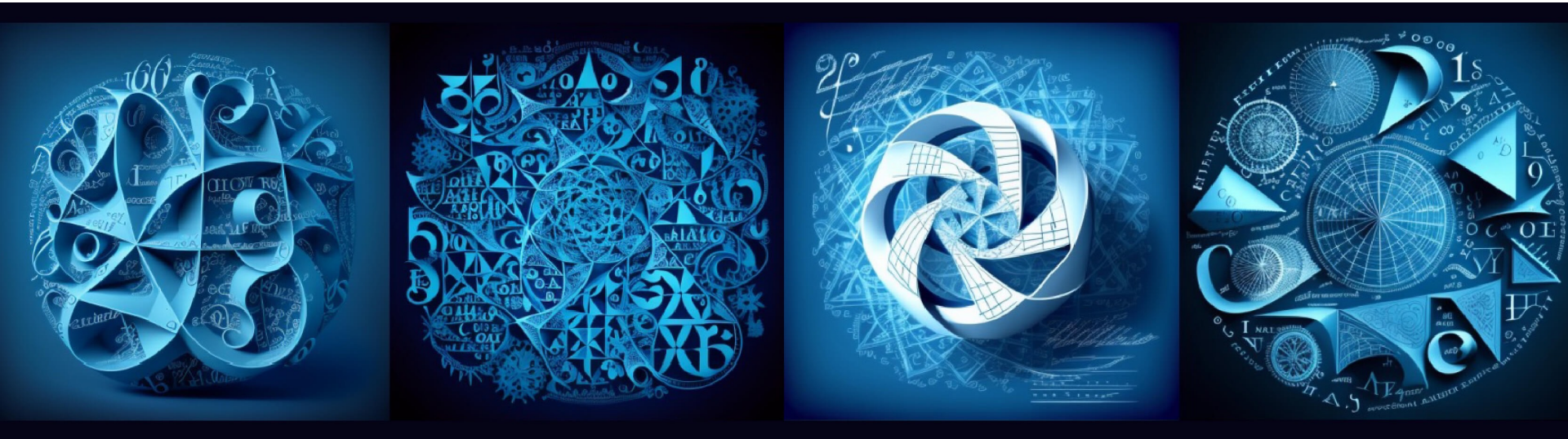
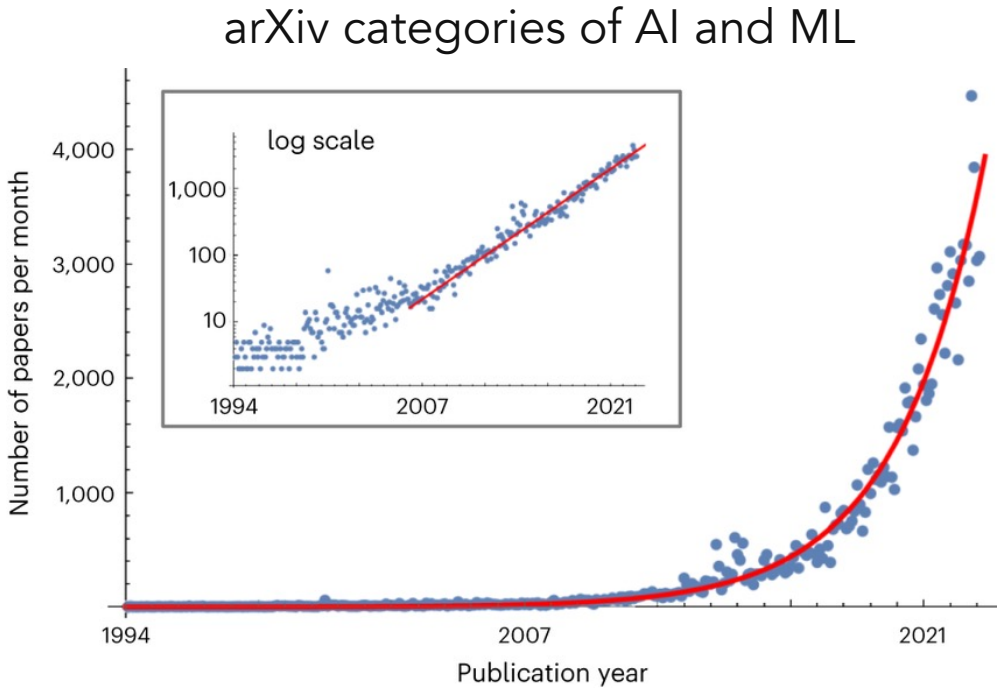


Why Reading AI Research Papers?



- AI Research Grows Exponentially.
- Doubling rate of papers =~23 months.
- To Keep Track: read AI research papers.

Krenn et al. (2023) Forecasting the future of artificial intelligence with machine learning-based link prediction in an exponentially growing knowledge network. Nature Machine Intelligence.

Why Reading AI Research Papers?

Researchers and engineers spend a great deal of time reading papers:
- Typically hundreds of hours every year.

Having a method to read research papers allows you:
- To be more efficient.
- To write your own papers.

Meanwhile, the skill of reading papers is rarely taught. This leads to much wasted effort. This is what we tackle with this class!

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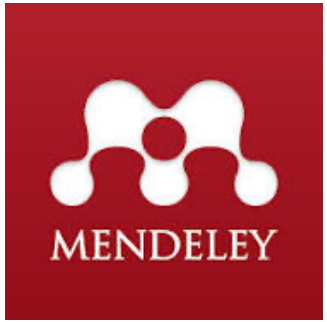
- Examples of bibliography managers:
  - Zotero
  - Mendeley

Trick: use the same as your colleagues!



How To Read A Paper? A Three Pass Approach

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…with the intention of answering these questions:

- Category: what type of paper is it? Theory, method, survey, benchmark?
- Data: which type of data or applications does this paper apply to?
- Paper Quality: is the paper clearly written and presented?

Example:

- Cohen, Welling. Group Convolutional Neural Networks. (2016).

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- *If a reviewer* cannot understand the gist after one pass, the paper will likely be rejected.

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Second Pass: Grasp the Content

1. Look at the Figures:
    - What do you understand from them?
2. Look at the Equations:
    - What do they tell you? What questions do you have?

Remark: Note: All figures should be explained in your presentation of your paper.

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Third Pass: Delve Into The Paper

1. Look for an online video.
2. Try to recreate the paper.
3. Read the paper from start to end.
4. Read related papers or textbook that introduce concepts that you are not familiar with.
5. Run the code.

Questions?

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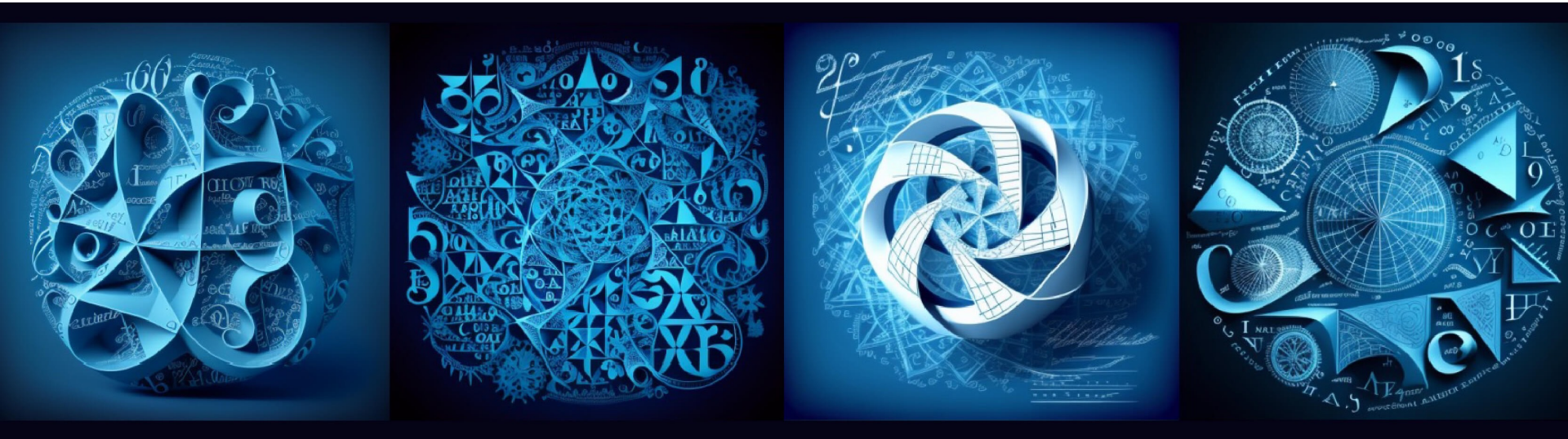

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Git = open-source version control software that lets multiple people make separate changes to documents at the same time. It keeps track of historical changes to your code and provides tools to allow multiple people to make changes to the code without stepping on each others toes.

Why GitHub?

- The single most useful tool for AI research.

- Key to collaborative work, origin of the tech-world's success.

GitHub: The Many Versions of Your Code

Online remote
Name: “origin”

ece594n/

https://github.com/geometric-intelligence/ece594n

Local
On your laptop

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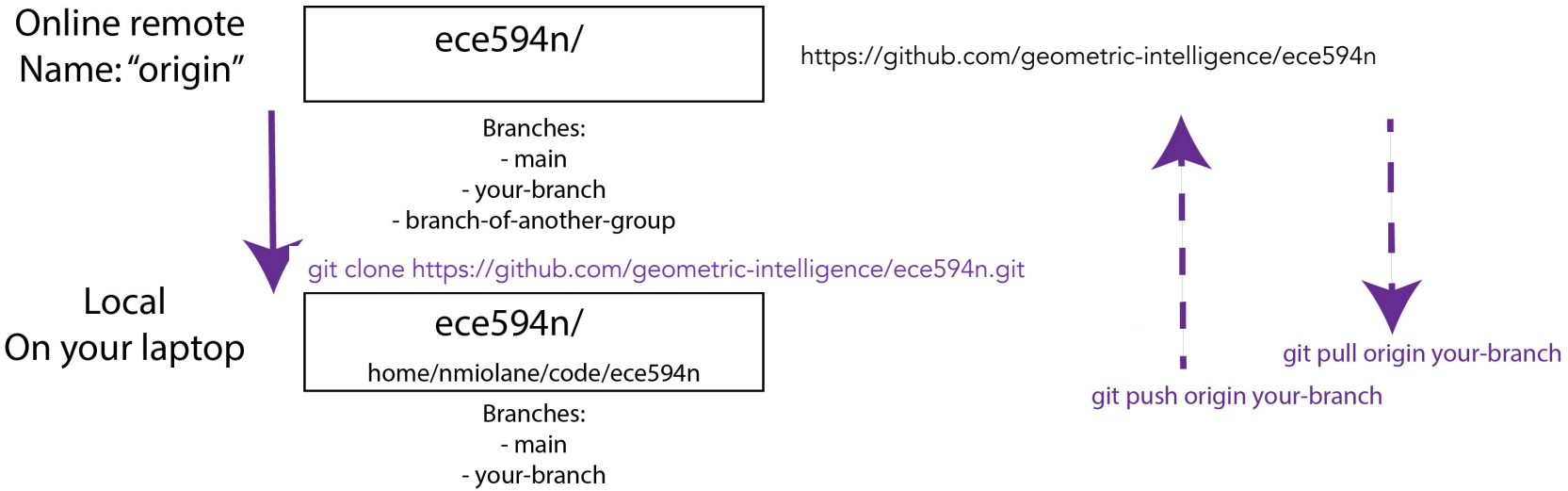

Introduction to GitHub.

- Create a GitHub account: https://github.com/.

Demo:

- Explore the repository of the class, look at branches.
- Clone the repository, look at branches.

List local branches:	git branch
Go to local branch:	git checkout your-branch
Create and go to local branch:	git checkout -b your-branch
Add files for commit:	git add /home/nmiolane/code/ece594n/hw_geomviz/myfolder/myfile.py
Commit:	git commit -m "Add unit tests for the file myfile.py"

Conda: Manage your Environments

- GitHub only manages the file history.
- Conda is a software that provides package, dependency, and environment management for any language.

- An environment is a directory that contains a specific collection of packages that you have installed. For example, it consists of a Python version, and specific Python packages.

- Run conda env list to see which environments you have.

Introduction to Conda

Demo

- Download Anaconda https://www.anaconda.com/download
- Install with bash [name-of-downloaded-file].sh
- Create an environment.yml file (example)
- Run conda env create –f environment.yml
- Run conda activate [name-of-your-env]

Lint: Code like a Pro

- Coding follows international coding style. For Python, it's PEP8:

https://peps.python.org/pep-0008/

- Linting highlights syntactical and stylistic problems in your Python source code, which often helps you identify and correct subtle programming errors or unconventional coding practices that can lead to errors.

- We use: black, isort and flake8.

Introduction to Linting

Demo:

- Create a python file and put some code.
- Run black .
- Run isort .
- Run flake8 .

Next: Paper presentations!

- The person presenting comes at 12 pm: final opportunity to ask questions about the paper.
- The class will be 12.20 – 1.20 pm.
- On Mondays, office hours until 2 pm.

Recommendations:

- Re-explain every concept (even if it was in another paper).
- Don’t forget that you can use YouTube videos!

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