

The Art and Science of Transportation Research in the AI Era

# Welcome to ASTRAI

Meng Cai



A stray  
/ə streɪ/

Ashtray  
/ˈæʃ treɪ/

# Learning goals



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- #1** Understand what ASTRAI is about
- #2** Understand what you need to do in ASTRAI
- #3** Become familiar with git and GitHub
- #4** Be able to clone (i.e., download) the course repo

# Agenda



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**#1**

ASTRAI

**#2**

git

# Agenda



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**#1**

ASTRAI

#2

git



## #1.1 The ASTRAI team



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Responsible professor



Prof. Eva Kaßens-Noor, Ph.D.

Contact person, instructor



Meng Cai, Ph.D.

Instructor



Hiba Karam, M.Sc.

Teaching assistant



Ezra Garcia

This course has been developed with the assistance of ChatGPT-4o and ChatGPT-o1.

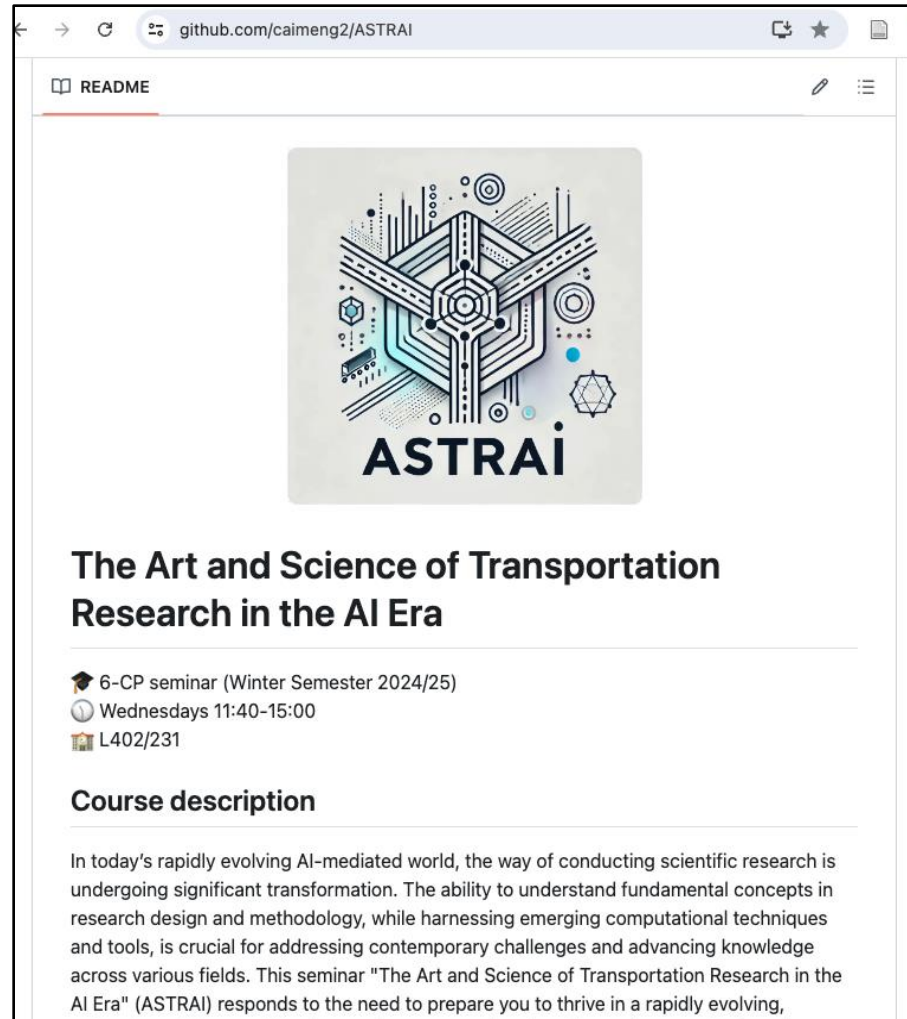
## #1.2 Basic info



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What: 6-CP seminar

When: Wednesdays 11:40-15:00

Where: L402/231

Contact: [cai@verkehr.tu-darmstadt.de](mailto:cai@verkehr.tu-darmstadt.de)

Course website:

<https://github.com/caimeng2/ASTRAI>

No course Moodle page. We will send you messages through TUCaN.

Course contents on  
GitHub page!

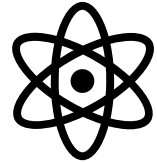
## #1.3 What is ASTRAI



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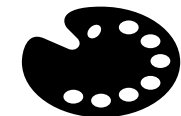
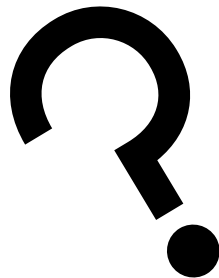
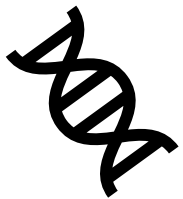


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The Art and Science of Transportation Research in the AI Era

What does it mean?



## #1.3 What is ASTRAI



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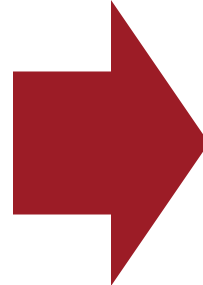


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### The Art and Science of Transportation **Research in the AI Era**

#### Research processes:

- Finding a research topic
- Defining a research question
- Conducting a literature review
- Designing a methodology
- Collecting data
- Analyzing data
- Interpreting results
- Report preparation and presentation of findings



- Interdisciplinary topics
- Data-driven
- AI-powered literature review
- New methods and tools
- New data sources, automated data collection, real-time data
- Easier and better visualization
- AI-assisted writing



## #1.3 What is ASTRAI



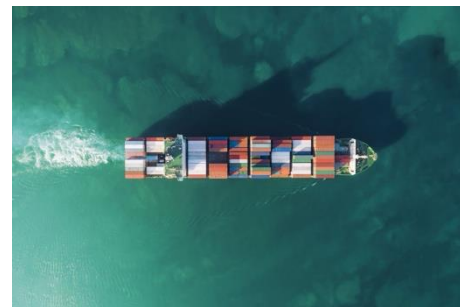
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### The Art and Science of **Transportation** Research in the AI Era

The examples are mostly transportation-related, but the techniques and methods are transferable across disciplines.



Picture sources: Microsoft stock images.

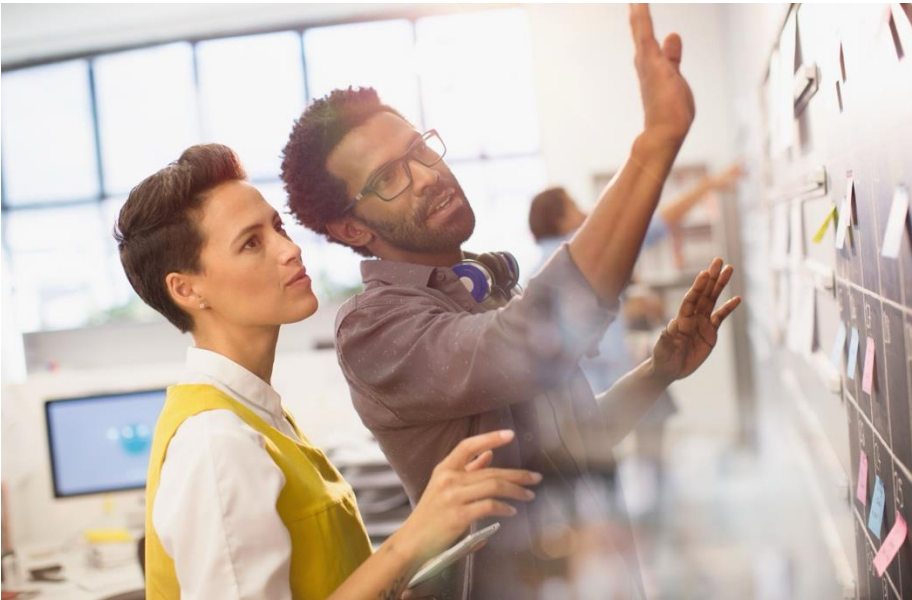
## #1.3 What is ASTRAI



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### The **Art** and Science of Transportation Research in the AI Era



Picture sources: Microsoft stock images.



"Art" refers to the creative aspects of research

- Asking the right questions
- Developing novel approaches
- Finding innovative solutions
- Effectively communicating through compelling visuals



## #1.3 What is ASTRAI

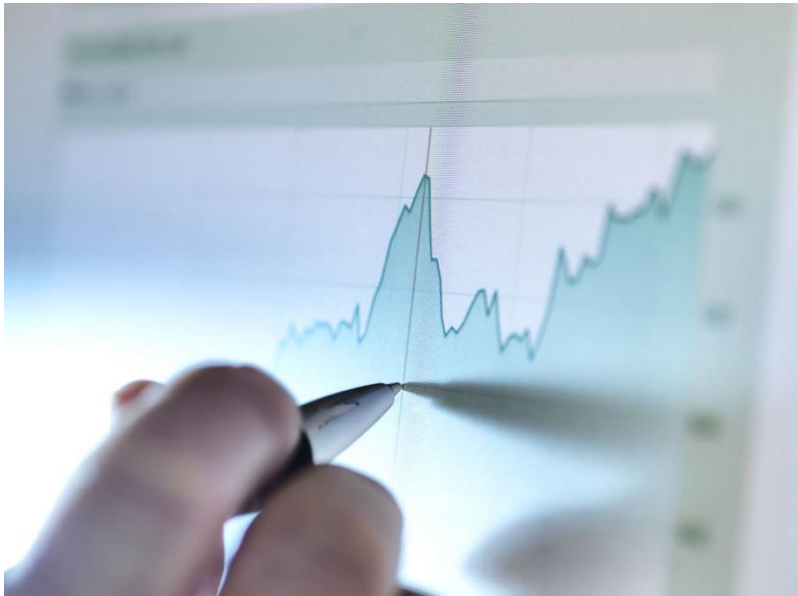


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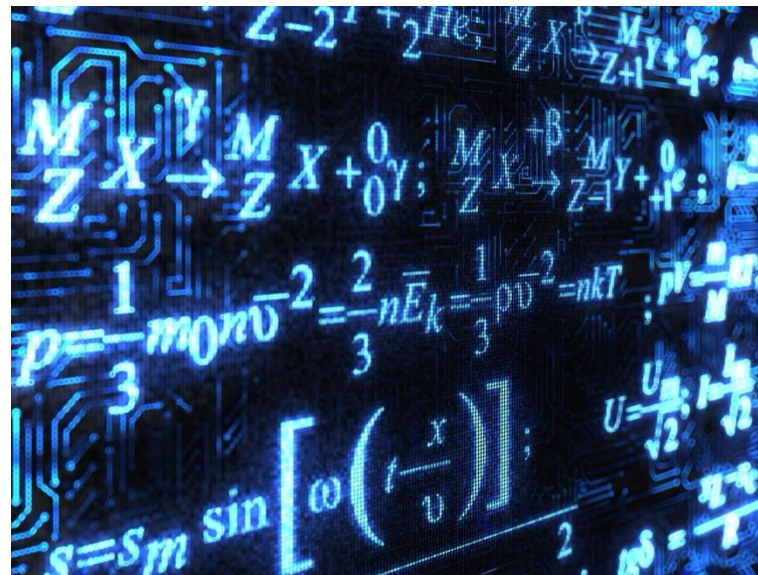


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### The Art and **Science** of Transportation Research in the AI Era



Picture sources: Microsoft stock images.



"Science" refers to the tools, techniques, and knowledge foundation for research

- Developing a good research design
- Having robust methodologies
- Leveraging advanced computational tools
- Be able to tell if the answers provided by AI are correct

## #1.4 ASTRAI vision

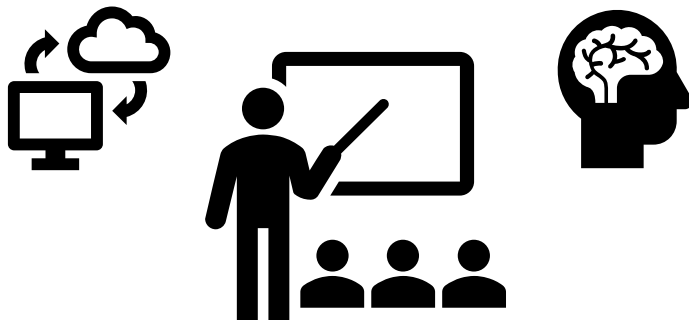


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To develop the right **mindset**:

- work across disciplines instead of domain-specific fields
- Stay updated
- Maintain a healthy skepticism of AI-generated results, recognizing limitations
- Address ethical issues proactively in research design and implementation
- Open science



To develop new **skillsets**:

- Programming proficiency
  - Understand and code in commonly used languages such as Python, R, and Git
- Big Data handling
  - Practice techniques for data cleaning, processing, and analyzing, using databases such as SQL
- Data visualization
  - Present data insights effectively via visualization tools like PowerBI



## #1.5 What ASTRAI is NOT



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- It is not a lecture course.
- It is not a programming course.
- It is not aimed at making you a programmer, a computer scientist, or a computational engineer

Instead

- We act as supporters rather than traditional teachers
- Less lecturing, more doing
- Open dialogue is encouraged



Picture sources: Microsoft stock images.

## #1.6 Learning outcomes



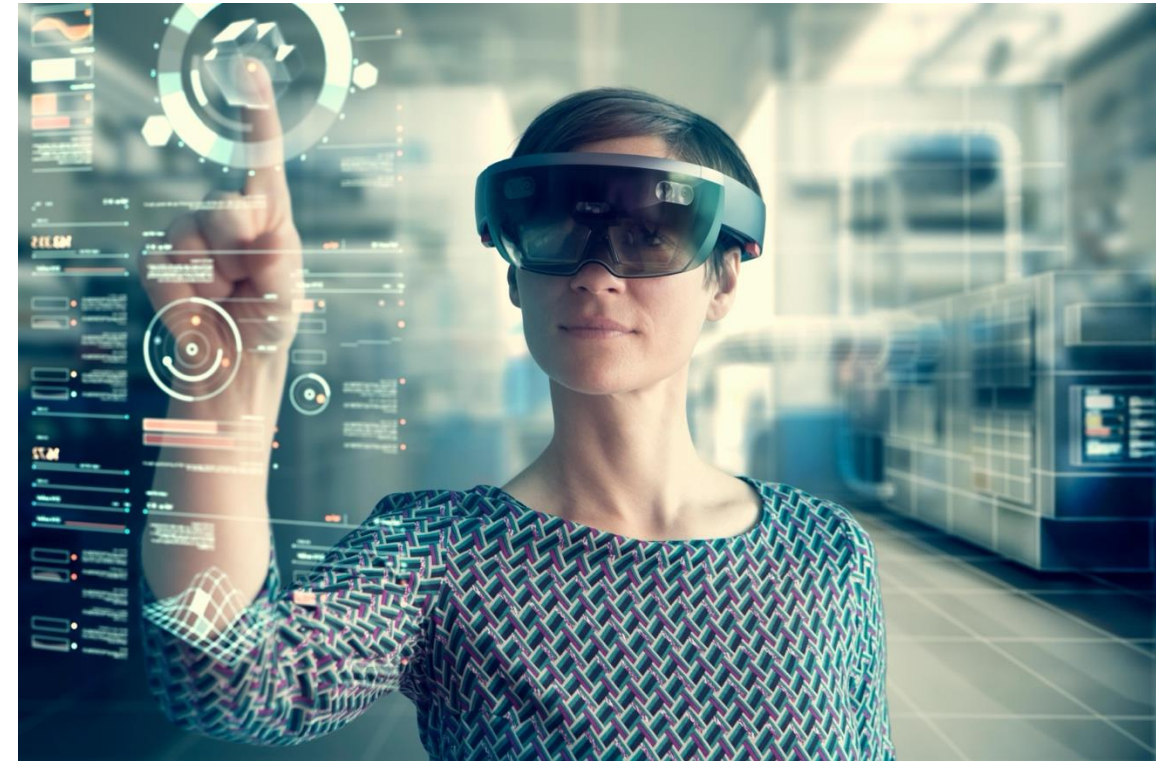
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By the end of the course, you will:

- Understand the fundamental concepts in research design and methodology
- Effectively formulate research questions and design a study
- Develop proficiency in data science tools and techniques



Picture sources: Microsoft stock images.

## #1.7 What you need to do



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### Participation

- Attend class every week
- Bring your laptop and power cord

### Pre-class requirement

From time to time, install software and/or setup accounts

### In-class activities

Practice coding, debugging, etc

### Student-led learning (YOU-lead)

Choose, study, and teach to your peers a computational tool (e.g., R) or a use case of a tool (e.g., analyzing survey data with R)

### Final examination

Develop a one-page research proposal incorporating computational methods

## #1.8 YOU-lead ASTRAI

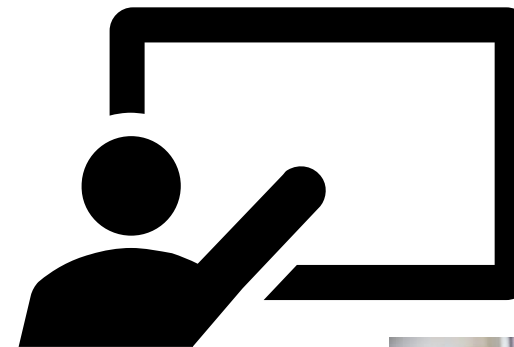


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- The topics can be anything (within the scope of this course) that you find interesting or useful. They can be a use case of what you have learned from the class or a new tool
- Include what, why, how, and activities
- You don't have to use slides
- Limited slots
- Improve your final grade by up to 0.4 points
- **Sign up in class in week 5**





## #1.9 Final examination



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### A concise, one-page research proposal:

1. A brief literature review
2. Clear research questions
3. Methodology incorporating computational tools/techniques
4. Discussion of the limitations of methods

### Grading:

- Literature review (20%)
- Research questions (20%)
- Methodology (20%)
- Limitations (20%)
- Writing (20%)

**Deadline:** Feb 21, 2025

**Detailed instructions:** <https://github.com/caimeng2/ASTRAI/blob/main/examination.pdf>



## #1.10 Tentative schedule



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- Week 1 (Oct 16, 2024): Welcome to ASTRAI
- Week 2 (Oct 23, 2024): Python basics
- Week 3 (Oct 30, 2024): Web scraping
- Week 4 (Nov 6, 2024): Data wrangling
- Week 5 (Nov 13, 2024): Open-source tools, signing up for YOU-lead
- Week 6 (Nov 20, 2024): Research design and methodology
  
- From week 7: Mixed with YOU-lead

# Agenda



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#1

ASTRAI

#2

git

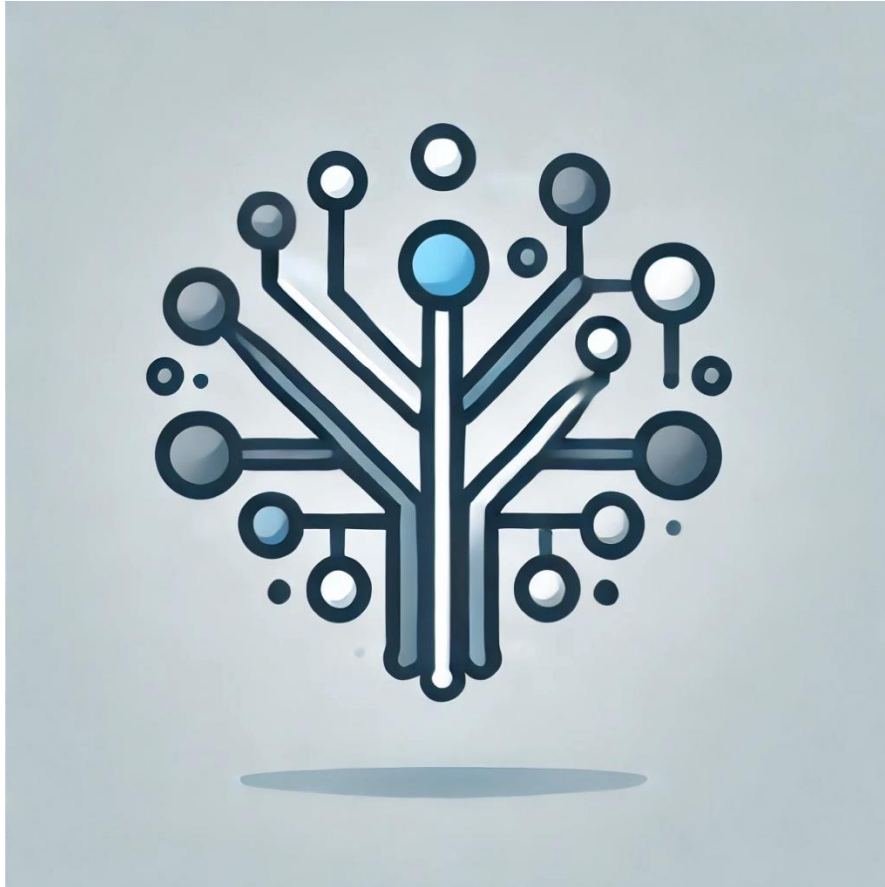
## #2.1 What is git



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- Git is a version control system
- It is widely used in software development
- With Git, you can:
  - Track changes to files over time
  - Manage multiple versions of a project
  - Revert files to previous versions
  - Work simultaneously with others without overwriting each other's changes



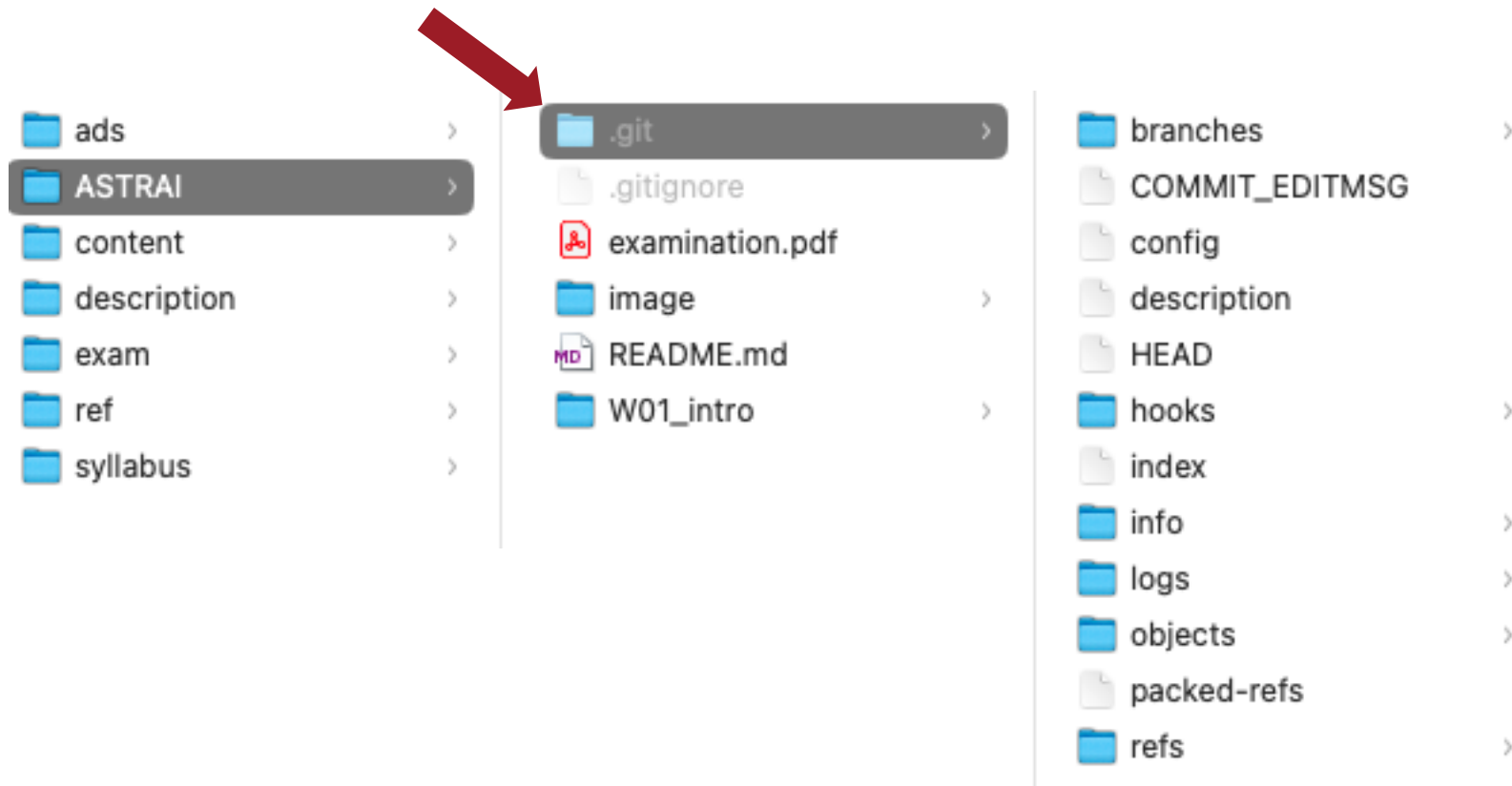
## #2.1 What is git



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## #2.2 What is GitHub

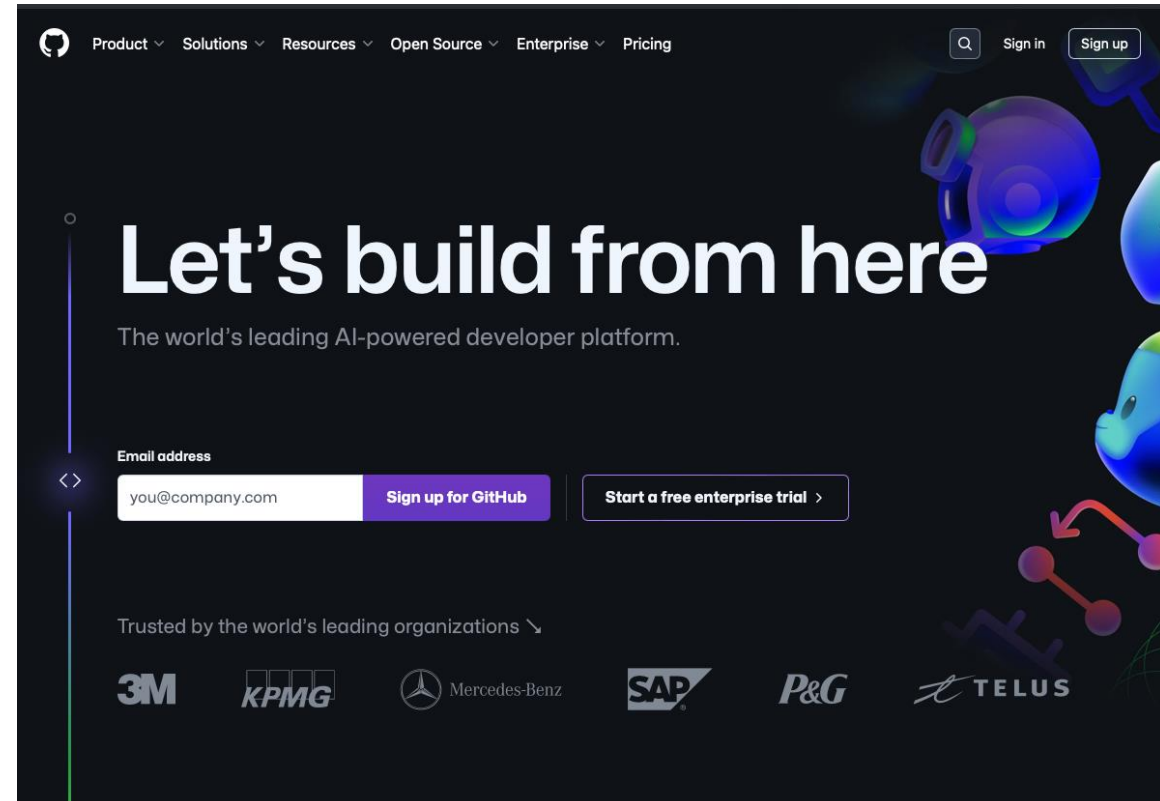


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GitHub is a web-based platform  
for managing Git repositories



## #2.2 What is GitHub



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2 files changed +1 -1 lines changed

```
@@ -1,5 +1,5 @@
1 1 <p align="center">
2 - 
2 + 
3 3 </p>
4 4
5 5 # The Art and Science of Transportation Research in the AI Era
```

caimeng2 / ASTRAI

<> Code Issues Pull requests Actions Projects Wiki Security

### Commits

main All users All time

Commits on Oct 10, 2024

change img path b1037fe  
caimeng2 committed 4 minutes ago

Commits on Sep 18, 2024

typo c98146a  
caimeng2 committed 3 weeks ago

logo b5e55dd  
caimeng2 committed 3 weeks ago

pix f495b48  
caimeng2 committed 3 weeks ago

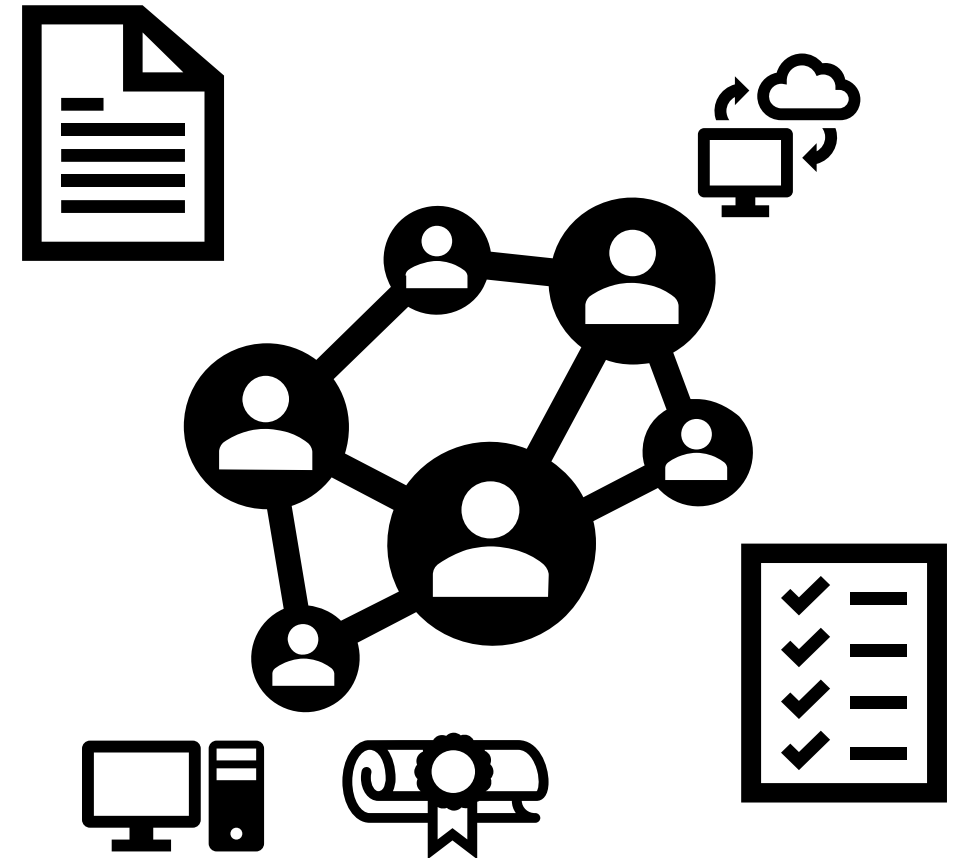
Commits on Sep 10, 2024

replace md with pdf 7d8ab9d  
caimeng2 committed last month

## #2.3 Why use git/GitHub



- Collaboration: Enables users to collaborate more efficiently.
- Version history: Every change is recorded, and you can revert to previous versions if needed.
- Branching & merging: Allows users to create different branches for new features or bug fixes, without affecting the main codebase.
- Open source contributions: GitHub makes contributing to open-source projects simple and accessible.
- Backups: Code stored on GitHub acts as a backup and is accessible from anywhere.





## #2.4 Why we use git/GitHub



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- In the spirit of open science
- It is an invaluable tool for anyone working with code
- It keeps the course materials backed up and accessible from any device
- It might seem complicated at first, but it's easier to learn than most people think
- It enables us to build the course together

The screenshot shows a web browser displaying the GitHub repository page for 'caimeng2/ASTRAI'. The browser's address bar shows 'github.com/caimeng2/ASTRAI'. The repository page has a 'README' tab selected. The main content area features a large, stylized graphic of a circuit board with the word 'ASTRAI' in bold, black letters below it. Below the graphic, the title 'The Art and Science of Transportation Research in the AI Era' is displayed. Under the title, there is a list of course details: '6-CP seminar (Winter Semester 2024/25)', 'Wednesdays 11:40-15:00', and 'L402/231'. A section titled 'Course description' follows, containing a paragraph about the seminar's focus on AI-mediated research and transportation.

github.com/caimeng2/ASTRAI

README



**ASTRAI**

### The Art and Science of Transportation Research in the AI Era

6-CP seminar (Winter Semester 2024/25)  
Wednesdays 11:40-15:00  
L402/231

#### Course description

In today's rapidly evolving AI-mediated world, the way of conducting scientific research is undergoing significant transformation. The ability to understand fundamental concepts in research design and methodology, while harnessing emerging computational techniques and tools, is crucial for addressing contemporary challenges and advancing knowledge across various fields. This seminar "The Art and Science of Transportation Research in the AI Era" (ASTRAI) responds to the need to prepare you to thrive in a rapidly evolving,

## #2.5 git terminology



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**Repo:** A git repository is a folder or directory that contains all the files and the complete history of changes for a project. There can be a local repository (on your computer) and a remote repository (hosted on platforms like GitHub)

**Clone:** To create a copy of a remote repository on your local machine.

**Fork:** Forking creates a copy of a repository on a remote platform such as GitHub. This copy is independent of the original and you can make changes to it without affecting the original project.

**Commit:** A commit is a snapshot of the changes made to the files in a repository at a specific point in time.

**Push:** When you want to upload your local changes to the remote repository, you push them.

**Pull:** To update your local repository with changes from a remote repo, you pull those changes. This is typically done before pushing your own changes to ensure you have the latest update.

**Pull request:** In the context of GitHub, a pull request is a way to propose changes to a repository. It allows collaborators to review and discuss the proposed changes before merging them into the main branch.

Adapted from: [https://medium.com/@unaware\\_harry/all-about-git-terminology-d9c91ea0a734](https://medium.com/@unaware_harry/all-about-git-terminology-d9c91ea0a734)

More info: <https://git-scm.com/docs/gitglossary>

## #2.6 Common git commands



Command	Function	Syntax
<b>git init</b>	starts a new repository	git init
<b>git clone</b>	duplicates a remote repository to your local machine	git clone <repository-url>
<b>git status</b>	shows the current status of the working directory and staging area	git status
<b>git add</b>	adds files to the staging area, preparing them for commit	git add <file-name> git add . # Add all files
<b>git commit</b>	commits changes in the staging area to the repository, recording a snapshot of the project history	git commit -m "commit message"

## #2.6 Common git commands



Command	Function	Syntax
<b>git push</b>	pushes changes to a remote repository	git push origin <branch-name>
<b>git pull</b>	fetches changes from a remote repository and merges them into the current branch	git pull origin <branch-name>
<b>git branch</b>	lists all branches or creates a new branch	git branch # List all branches git branch <new-branch-name> # Create a new branch
<b>git checkout</b>	switches to another branch or commit	git checkout <branch-name>
<b>git merge</b>	merges a branch into the current branch	git merge <branch-name>

## #2.7 Activity: fork ASTRAI repo



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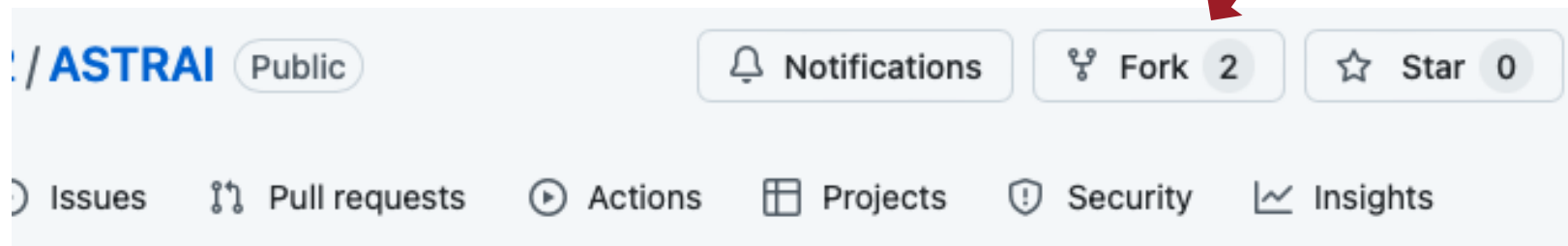


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**Step 1:** Sign up for an account at <https://github.com>

**Step 2:** Sign in to your account

**Step 3:** Go to ASTRAI repo and click the “Fork” button





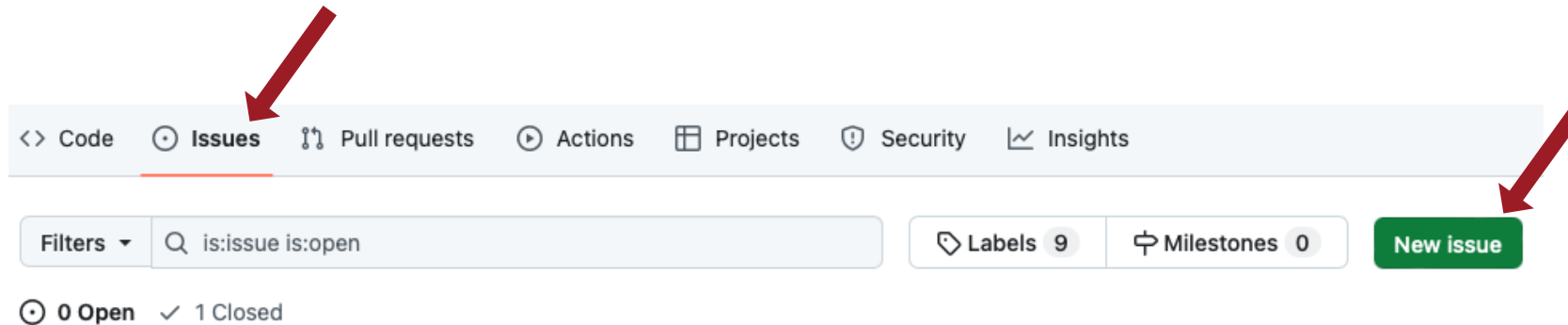
## #2.7 Activity: submit an issue to ASTRAI



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**Step 1:** Go to ASTRAI repo

**Step 2:** Click on “Issues”

**Step 3:** Click on the “New issue” button

**Step 4:** What do you wish to accomplish through ASTRAI? Share your thoughts and hit “Submit new issue.” **Note: The issues are public. Do not share any sensitive information there.**

## #2.7 Activity: Install git



Instructions: <https://github.com/git-guides/install-git>

### ▪ macOS/ Linux:

- Use the built-in **Terminal** application.
- You can open the terminal by searching for “Terminal” in your applications menu.

### ▪ Windows:

- You can use **Git Bash**, which comes with Git for Windows.
  - Download Git from <https://git-scm.com/downloads>
  - Install it. During installation, you'll be given the option to use Git Bash.
  - Git Bash provides a Unix-like terminal for Windows users, so the commands work the same as in Linux/macOS.

Type in “**git --version**” to check if you have git installed

## #2.7 Activity: clone ASTRAI repo



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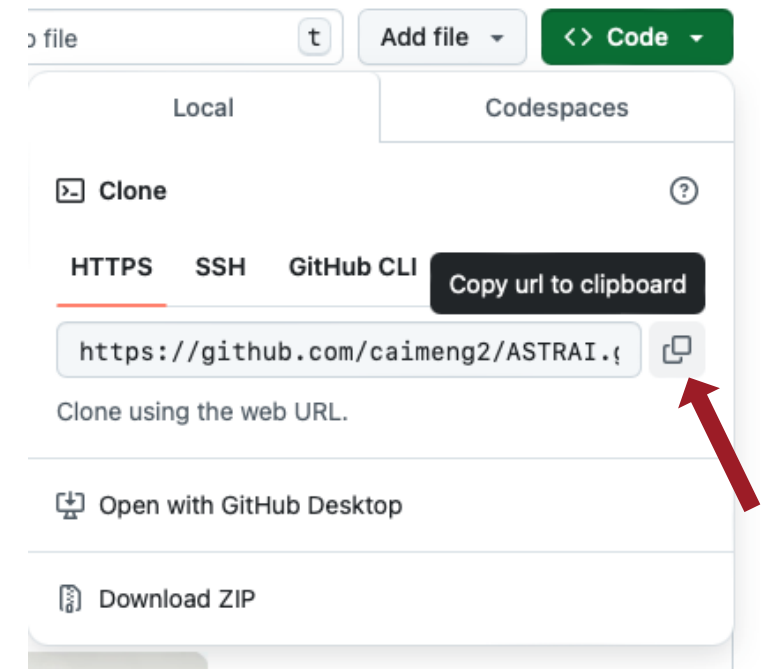
<https://github.com/caimeng2/ASTRAI>

**Step 1:** Open Terminal or Git Bash

**(Step 2:** Change the directory: `cd xx`)

**Step 3:** Type in Terminal or Git Bash :

**`git clone https://github.com/caimeng2/ASTRAI.git`**



## #2.8 Questions?



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Take a moment to review the repo.  
Do you have any questions or concerns?

# Learning goals



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- #1** Understand what ASTRAI is about
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