LECTURE 1: Introduction and Preview

ML-4430: Machine learning approaches in climate science

21 Apr 2021
Outline

Getting to know each other

1. Who am I?
2. Who are you?

Evaluation Criteria

3. Weekly recaps
4. Project presentation
5. Project report

What’s in store

2. Lecture plan
3. Teaching Methods
4. Learning Targets

Miscellaneous

4. A few comments
5. Online resources
6. Q & A
Bedartha Goswami

- Research group leader, since 2020
- PhD in “Climate Physics,” University of Potsdam, 2015
- Physicist by training
- Nonlinear time series analysis; (Bayesian) statistics; classical learning; complex networks
Round of introductions

➢ Briefly introduce yourself (< 1 minute)
   ➢ What is your name?
   ➢ What are you studying?
   ➢ What is your background?
   ➢ Why do you want to take up this course?
1. Getting to know each other → Who are you?
1. Getting to know each other → Who are you?
Gender

Non-binary
33.3%

Female
33.3%

Male
66.7%

1. Getting to know each other → Who are you?
**Outline**

1. Getting to know each other
   - Who am I?
   - Who are you?

2. What’s in store
   - Lecture plan
   - Teaching methods
   - Learning targets

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   - Weekly recaps
   - Project presentation
   - Project report

4. Miscellaneous
   - A few comments
   - Online resources
   - Q & A
2. What’s in store → Lecture plan

- **21 April**: Introduction and Preview
- **28 April**: An introduction to weather and climate
- **5 May**: Measurement of weather and climate
- **12 May**: Models of the weather and climate
- **19 May**: Important climatic systems
- **26 May**: Pfingstpause (Pentecost break)
- **2 June**: Classical learning approaches for weather and climate
- **9 June**: Deep learning approaches for weather and climate
- **16 June**: Climate network approaches for weather and climate
- **23 June**: Machine learning approaches in paleoclimate
- **30 June**: Tutorial lecture
- **7 July**: Introduction to scientific communication
- **14 July**: Guest lecture by Peter Dueben, ECMWF, UK
- **21 July**: Presentations I
- **28 July**: Presentations II

**ML Approaches in Climate Science**
- **21 April**: Introduction and Preview
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Lecture timings
➢ Wednesdays, 10:00 – 12:00

Office timings for discussion
➢ Wednesdays, 15:00 – 17:00
➢ Send an email to me
➢ We will meet on Zoom

Lecture material (slides, papers, etc.)
➢ Course webpage
  ➢ https://machineclimate.de/teaching/summer2021/

Deadline for project ideas
➢ 31 May 2021
The lectures should be ...
- Interactive, dialogic, participatory
- Please ask questions!

We will also read ...
- Journal articles to know the SOTA
  - Articles will be sent around the week before

Weekly recaps before every lecture
- Presented by groups of 4 students
  - Chosen after the lecture

Evaluation based on
- Project: equal weight to oral presentation and written report (three quarters)
- Weekly recaps (one quarter)
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Evaluation based on
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WORKLOAD
- 3 ECTS Course
- 90 h in total for the entire semester
  - 90 h = 30 h lecture + 60 h self study
- 6 h per week for 15 weeks
  - 6 h = 2 h lecture + 4 h self study
2. What’s in store → Learning target

- Basic understanding of climate
- How do we measure the climate
- What are the important climatic systems that make the world ‘tick’
- What are the classical and SOTA ML approaches that have found use in climate science
- How to read a scientific article on a climate topic
- How to write a scientific paper on a climate topic
2. What's in store → Learning target

- Basic understanding of climate
- How do we measure the climate
- What are the important climatic systems that make the world ‘tick’
- What are the classical and SOTA ML approaches that have found use in climate science
- How to read a scientific article on a climate topic
- How to write a scientific paper on a climate topic

I WILL BE REALLY HAPPY IF ...

- You can understand and absorb climate science SOTA literature
- You can identify open questions in climate science
- You are motivated to apply SOTA ML techniques to address open questions in climate science
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Weekly recaps

- Recaps of the core course lectures
  - Lectures 2 – 9

- Implies we will have recaps at the start of lectures 3 – 10

- 4 students assigned at the end of lectures 2 – 9

- At the start of Lectures 3 – 10
  - 4 presentations of 5 minutes each
ABOUT THE TERM PROJECT

➢ List of topics
  ➢ Before Lecture 2 (27 April)
  ➢ You can also choose your own
  ➢ Choose early and discuss with me

➢ Project must include
  ➢ SOTA literature survey
  ➢ Clear hypothesis
  ➢ Validation using climate data sets
  ➢ Clear interpretation of results

➢ Project may include
  ➢ Reproduction of earlier results
  ➢ Testing new ideas
  ➢ Topical review
Project presentation

➢ Topic has to be chosen before 31 May

➢ Start early → topics need refinement

➢ Presentation of 15 mins total
  ➢ 12 mins talk + 3 mins Q&A

➢ Presentations in English

➢ Evaluation criteria:
  ➢ Clarity
  ➢ Creativity
  ➢ Integrity
  ➢ Results not important
Project report

- Details of the term project
- Written like a scientific paper (L11)
- Report typed out using LaTeX
  - Format will be provided soon
- Report in English
- Evaluation criteria:
  - Clarity
  - Creativity
  - Integrity
  - Results not important

3. Evaluation Criteria → Project report
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A few comments

- This course is not about
  - Climate change
  - Environment

- The lectures do not directly involve
  - *Coding*, but the project will require you to code (most likely)
  - *Textbooks*, but we will use many journal articles and book chapters

- You will not become climate experts at the end, but masters of the basics
Online resources related to the course

➢ Course webpage
  ➢ https://machineclimate.de/teaching/summer2021/

➢ YouTube (unlisted) playlist “Intro to Climate Science”
  ➢ https://www.youtube.com/watch?v=lrPS2HiYVp8&list=PLHcgIwZgPw17-qEPuhClxp-6afchvNhbN

➢ AMS Short courses
  • Python for Climate and Meteorology
    • Day 1: https://youtu.be/uQZAEPnUZ5o
    • Day 2: https://youtu.be/vVQxr6UaCl4
    • Day 3: https://youtu.be/8TFohhk4xzI
    • Day 4: https://youtu.be/_aFxBF3Jezs