

ML for Fundamental Physics School 2024



August 12, 2024

<https://indico.physics.lbl.gov/event/2850/overview>



Organizing Committee:

Aishik Ghosh (UCI/LBL), Elham E Khoda (SDSC/UCSD), Sascha Diefenbacher (LBL), Ben Nachman (LBL),
Oz Amram (Fermilab), Maris Arthurs (SLAC), Steven Farrell (NERSC/LBL),
Daniel Whiteson (UCI), Shih-Chieh Hsu (UW)



Origin story...

US ATLAS Machine Learning Training Event 2022

Jul 27 – 29, 2022
LBL
US/Pacific timezone

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Overview
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Contribution List
Registration
Participant List
Logistical Information

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This US ATLAS Machine Learning (ML) Laboratory (hybrid mode). All talks and encouraged for participants, if they are

Overview:

We will introduce fundamental concepts of essential open-source ML packages. The deployment of the trained models in ATLAS invited talks from ATLAS members who use cases in other experiments and other into the larger ML4Science world.

US ATLAS Machine Learning Training 2023

25–28 Jul 2023
LBL
US/Pacific timezone

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Overview
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Accommodation

The second iteration of the US ATLAS Machine Learning (ML) training event will be hosted at Lawrence Berkeley National Laboratory. All talks and tutorials will be given in person. The workshop is open to all ATLAS collaborators.

Overview:

We will introduce fundamental concepts of machine learning accompanied by hands-on tutorials of the essential open-source ML packages. The program will cover particle physics specific use cases and deployment of the trained models in Athena/FPGAs, with lots of hands-on examples. There will be invited talks from ATLAS members who have previously deployed ML for different tasks in ATLAS.

Incorporating feedback:

1. “Enjoyed the slow paced, interactive tutorials. Keep that format!”
2. “Teach us generative models!”

Impact: Several participants went on to become ML experts! Two of our speakers are former participants Try to guess by end of the week ;)

The first ML for Fundamental Physics School!



Machine Learning For Fundamental Physics School

Lawrence Berkeley National Lab
August 12 - 16, 2024



Machine Learning for Fundamental Physics School 2024

12-16 Aug 2024
US/Pacific timezone

Enter your search term

Overview

Timetable

The Machine Learning for Fundamental Physics (ML4FP) School will be hosted at Lawrence Berkeley National Laboratory. All talks and tutorials will be given in person, and participants can register to participate in-person or virtually. Following two very successful US ATLAS Machine Learning (ML) training events in 2022 and 2023, this year the program is open to all of particle

Grateful to US ATLAS for providing funding to organize it and support US ATLAS students!
Specifically thank Mike & Viviana

Thanks to NERSC for providing computing support!

In addition to Steve, we thank Rolin, Wahid, Rebecca & the user support team

Big thanks to LBL staff, especially Adam for helping with logistics in preparation and during the school

Vinicius for support beyond his own talk :)

Schedule: Day-1

Introduction to Machine Learning: Theory and Practice

Lectures on fundamental ML concepts

Hands-on tutorials on building your first
neural networks (with Pytorch and
Tensorflow)

08:30	→ 09:00	Welcome Presentation Speakers: Aishik Ghosh (UCI), Elham E Khoda (University of California, San Diego), Sascha Di
09:00	→ 10:30	Introduction to Machine Learning: Part I Speaker: Joshua Bloom (University of California, Berkeley)
10:30	→ 11:00	Coffee Break
11:00	→ 12:00	Tutorial: Intro to Neural Networks I Speakers: Jay Chan (LBNL), Johannes Wagner (University of California, Berkeley), Oz Amram
12:00	→ 13:30	Lunch
13:30	→ 14:00	Tutorial: Intro to Neural Networks II Speakers: Jay Chan (University of Wisconsin-Madison), Johannes Wagner (University of Californ
14:00	→ 15:30	Introduction to Machine Learning: Part II Speaker: Dennis Noll (Lawrence Berkeley National Lab. (US))
15:30	→ 16:00	Coffee Break
16:00	→ 18:00	Tutorial: ML tools for HEP data Speakers: Jay Chan (University of Wisconsin-Madison), Johannes Wagner (University of Californ

Schedule: Day-2

ML methods well-suited for particle physics

An overview of ML in HEP

Transformers for variable size HEP data

Generative Models for simulation and more

09:00	→ 10:00	Application: Transformers I Speaker: Alex Shmakov (UCI)
10:00	→ 10:30	Coffee Break
10:30	→ 12:00	Application: Transformers II Speaker: Alex Shmakov (UCI)
12:00	→ 13:30	Lunch
13:30	→ 14:30	Overview of ML in particle physics Speaker: Benjamin Nachman
14:30	→ 14:45	Break
14:45	→ 15:45	Applications: Generative Models I Speaker: Sascha Diefenbacher (Lawrence Berkeley National Laboratory)
15:45	→ 16:15	Coffee Break
16:15	→ 17:30	Application: Generative Models II Speaker: Sascha Diefenbacher (Lawrence Berkeley National Laboratory)

Schedule: Day-3

Developing algorithms to address particle physics problems

Uncertainty quantification & mitigation

Differentiable physics code

Unfolding of detector effects

Industry talk !

09:00	→ 10:00	Uncertainties Speaker: Aishik Ghosh
10:00	→ 10:15	Coffee Break
10:15	→ 12:30	Differentiable Programming Speaker: Sean Gasiorowski (SLAC)
12:30	→ 14:00	Lunch
14:00	→ 15:30	Unfolding Speaker: Vinicius Mikuni
15:30	→ 16:00	Coffee Break
16:00	→ 17:00	Industry Talk Speaker: Kanishka Rao (Google)
17:00	→ 18:00	Networking Event
18:30	→ 20:30	Dinner

Schedule: Day-4

Some other advanced topics

Anomaly detection

Optimal transport

ML at Scale vs Efficient ML Inference

09:00 → 10:30 **Anomaly Detection**

Speaker: Oz Amram (Fermilab)

10:30 → 11:00

Coffee Break

11:00 → 12:30 **Optimal Transport**

Speaker: Nathan Suri (Yale University)

12:30 → 14:00

Lunch

14:00 → 15:00 **ML at Scale**

Speaker: Steven Farrell (NERSC/LBL)

15:00 → 15:15

Break

15:15 → 16:15 **Efficient ML I**

Speaker: Elham E Khoda (University of California, San Diego)

16:15 → 16:30

Coffee Break

16:30 → 17:30 **Efficient ML II**

Speaker: Elham E Khoda (University of California, San Diego)

17:30 → 17:50 **Closeout: General Session**

Speakers: Aishik Ghosh, Benjamin Nachman, Elham E Khoda (University of California), Sascha Diefenbacher (Lawrence Berkeley National Laboratory), Steven Farrell

Schedule: Day-5

Collaboration-specific sessions

ATLAS (Led by Elham, Sascha & Aishik)

CMS (Led by Oz)

LZ (Led by Maris)

Reconvene all together for closeout

09:00 → 17:15 **Parallel Session: ATLAS**

[Gitlab Repo](#) [Zoom](#)



09:00 → 17:15 **Parallel Session: CMS**

09:00 **CMS Specific Session**

[CMS Specific Indico](#) [Zoom Link](#)



09:00 → 17:15 **Parallel Session: LZ**

09:00 **LZ Specific Session**

[LZ twiki](#)



17:00 **Closeout & Final Remarks**

Speakers: Aishik Ghosh, Benjamin Nachman, Maris Arthurs (SLAC/Stanford), Oz Amram (Berkeley National Laboratory), Steven Farrell

Computing and Logistics

Register immediately

NERSC training accounts (see email we sent), before the tutorial session!

Remember to manually close your jupyter sessions!

Slack workspace:

Join channel **#day1** to discuss today's tutorials, ask technical questions

#social to plan your evenings

Please Fill the Survey!

Initial Survey:

Fill it now (should not take more that 2-3 mins)

[Initial Survey Form](#)



SCAN ME

Internet

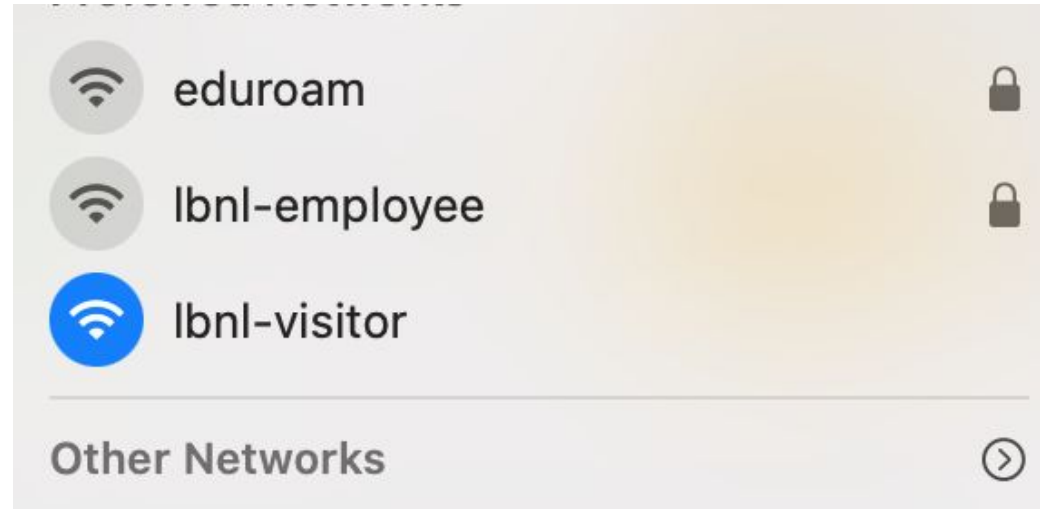
Two options:

1. **lbnl-visitor**

It should work out out the box

2. **eduroam**

Use the existing config from your institution



Lunch/Dinner spots around the university campus

Lunch breaks are 1.5 hours

UC North Gate: Euclid Ave & Hearst Ave

Food truck inside LBNL

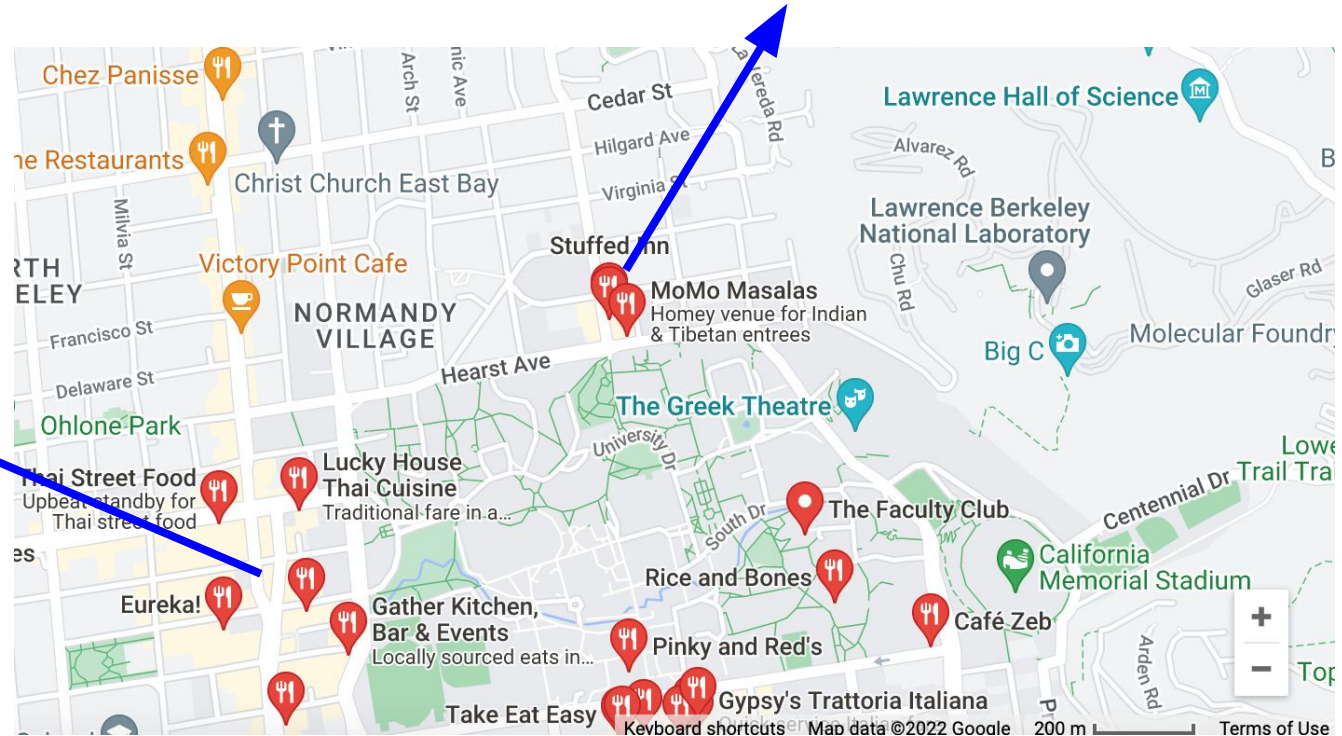
<https://food.lbl.gov/>

Avoid lines, order online!

Downtown area /
Stattuck

Can use [LBNL shuttles](#)

Doordash delivers here



Things you could explore in the evening

- Restaurants in Downtown Berkeley: Mexican at [Comal](#), Cajun at [Angeline's Louisiana Kitchen](#), Japanese at [Ippuku](#)
- Restaurants around Oakland: Jamaican at [Kingston 11](#), Latin American at [Cholita Linda](#), Dominican at [Alamar](#), ask the locals for other recommendations
- Jazz in East Bay, eg. [Yoshi's](#)

- Enjoy the sunset view from the LBNL guesthouse
- Many hiking trails (like Berkeley fire trails, Muir Woods close to SF)

Code of conduct

Want an inclusive,
welcoming environment

We will abide by [IRIS-HEP](#)
[CoC](#)

<https://iris-hep.org/about/code-of-conduct>

1. **Be friendly and patient.**
2. **Be welcoming.** We strive to be a community that welcomes and supports people of all backgrounds and identities. This includes, but is not limited to, members of any race, ethnicity, culture, national origin, color, immigration status, social and economic class, educational level, sex, sexual orientation, gender identity and expression, age, physical appearance, family status, technological choices, academic discipline, political views, religion, mental ability, and physical ability.
3. **Be considerate.** Your work will be used by other people, and you in turn will depend on the work of others. Any decision you take will affect users and colleagues, and you should take those consequences into account when making decisions. Remember that we're a world-wide community. You may be communicating with someone with a different primary language or cultural background.
4. **Be respectful.** Not all of us will agree all the time, but disagreement is no excuse for poor behavior or poor manners. We might all experience some frustration now and then, but we cannot allow that frustration to turn into a personal attack. It's important to remember that a community where people feel uncomfortable or threatened is not a productive one. Respect the work of others. We recognize the acknowledgment/citation requests of the original authors. As authors, we are explicit about how we want our own work to be cited or acknowledged.
5. **Be careful in the words that you choose.** Be kind to others. Do not insult or put down other community members. Harassment and other exclusionary behavior are not acceptable. This includes, but is not limited to:
 - Violent threats or violent language directed against another person
 - Discriminatory jokes and language
 - Posting sexually explicit or violent material
 - Posting (or threatening to post) other people's personally identifying information ("doxing")
 - Personal insults, especially those using racist or sexist terms
 - Unwelcome sexual attention
 - Advocating for, or encouraging, any of the above behavior
 - Repeated harassment of others. In general, if someone asks you to stop, then stop.
6. **When we disagree, try to understand why.** Disagreements, both social and technical, happen all the time and the IRIS-HEP community is no exception. Try to understand where others are coming from, as seeing a question from their viewpoint may help find a new path forward. And don't forget that it is human to err: blaming each other doesn't get us anywhere, while we can learn from mistakes to find better solutions.
7. **A simple apology can go a long way.** It can often de-escalate a situation, and telling someone that you are sorry is an act of empathy that doesn't automatically imply an admission of guilt.

Thanks!

Thanks to all of you in the room for coming in person

Thanks to remote participants for finding time and joining the program