

PHY 835: Collider Physics Phenomenology

UW-Madison, Spring 2021

Instructor: Prof. Gary Shiu, shiu@physics.wisc.edu

Time and Place: TR 11:00am-12:15pm (online via zoom)

Text: Lecture notes (posted once a week)

References:

- [Collider Physics \(Updated Edition\)](#), by Vernon D. Barger and Roger J.N. Phillips
- [Deep Learning](#), by Ian Goodfellow, Joshua Bengio, Aaron Courville
- [Information Theory, Inference and Learning Algorithms](#), by David J.C. MacKay
- [A high-bias, low-variance introduction to Machine Learning for physicists](#), Phys. Rept. **810** (2019): 1-124, by Panjaj Mehta et al.
- [Data science applications to string theory](#), Phys. Rept. **839** (2020), 1-117, by Fabian Ruehle.
- [Machine learning and the physical sciences](#), Rev. Mod. Phys. **91** (2019) no.4, 045002, [arXiv:1903.10563 [physics.comp-ph]], by Giuseppe Carleo et al.

Resources:

This is a subject that you learn by experimenting – think of this course as a theory lab for you to try out various computational, statistical and mathematical methods.. The literature is vast and fast-changing. The above reference list is just a snapshot and you will likely find other useful and updated resources online. Hands on experience is more valuable than book knowledge. You learn mostly from practical examples. Get familiarize with Python and Jupyter (see Exercises below).

There is a biweekly online seminar series [Physics \$\cap\$ ML](#) on the intersection of physics and machine learning. You are encouraged to sign up for the mailing list at physicsmeetsml.org. Many of the talks are of relevance to this course.

Exercises: The purpose of the exercises is to get you familiarized with the methods/algorithms introduced in lectures. Your first assignment is to install some commonly used software packages and get familiarized with them (if you have not done so). You are encouraged to discuss with your classmates but you should submit your own solutions so as to ensure you internalize what you learned. You will be asked to grade each other's solutions submitted in Jupyter notebook format (so we can test run your code).

Paper or Presentation (for those signed up for 3 credits): You can give an oral presentation or write up a term paper on a topic related to Collider Physics and Machine Learning. I am happy to discuss with you and suggest possible topics. The [Physics \$\cap\$ ML](#) seminar series has many nice talks that would make a good topic for your oral presentation or term paper.