Session summary:
Machine Learning and Data Assimilation in Heliophysics: Capturing the Current Picture

Three questions of focus for the session:

1) What role are the ML and DA techniques currently playing in the enhancement of Space Weather prediction capabilities?
2) What types of broadly-defined problems in Heliophysics (beyond the direct application to Space Weather prediction) require the involvement of the ML and DA techniques?
3) What are the current demands in ML-ready data sets and related quality standards in the community?

Two scene-setting speakers:

- Ruizhu Chen (Stanford) “Mapping the Sun’s Far-Side Magnetic Flux from Near-side Helioseismic Measurements by Deep Learning”
- Alberto Sainz Dalda (BAERI/LMSAL) “Machine Learning and Data Assimilation in Heliophysics: Capturing the Current Picture”

Discussion topics (part 1)

Quality of the training data

- What limits do the uncertainties in the training data imply on your ML model?

Transferability of learning

- How to apply the algorithm trained on one type of the data set to another data?

Interpretability of models

- Can we understand how the ML makes the decisions, and what can we learn from the ML models?

Discussion topics (part 2)

ML-ready data preparation

- Is there a demand in the community for the data sets ready for ML applications?

Ability of ML models to generalize

- How to ensure that the model captures the patterns in the data but not your training data set?

Assessment of complex models

- How to ensure that the ML solution is “close” to the ground truth, and how to define the closeness?

Conclusion

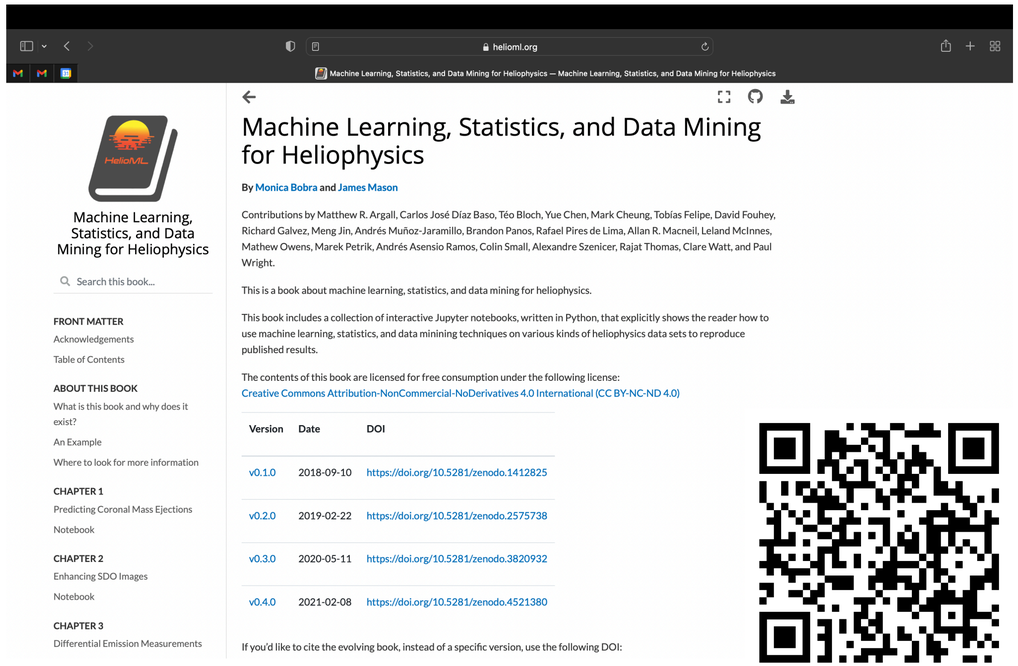
We do not necessarily need ML to do great science

However, ML is a great (and, in some cases, necessary) tool to do a great science

Please find the resources kindly shared by Alberto Sainz Dalda in the following slides

MACHINE LEARNING AND DEEP LEARNING FOR THE SUN

RESOURCES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Differential Emission Measurements
Machine Learning, Statistics, and Data Mining for Heliophysics
By Monica Bobra and James Mason
Contributions by Matthew R. Argall, Carlos José Díaz Baso, Téo Bloch, Yue Chen, Mark Cheung, Tobías Felipe, David Fouhey, Richard Galvez, Meng Jin, Andrés Muñoz-Jaramillo, Brandon Panos, Rafael Pires de Lima, Allan R. Macneil, Leland McInnes, Mathew Owens, Marek Petrik, Andrés Asensio Ramos, Colin Small, Alexandre Szenicer, Rajat Thomas, Clare Watt, and Paul Wright.
This is a book about machine learning, statistics, and data mining for heliophysics.
This book includes a collection of interactive Jupyter notebooks, written in Python, that explicitly shows the reader how to use machine learning, statistics, and data minining techniques on various kinds of heliophysics data sets to reproduce published results.
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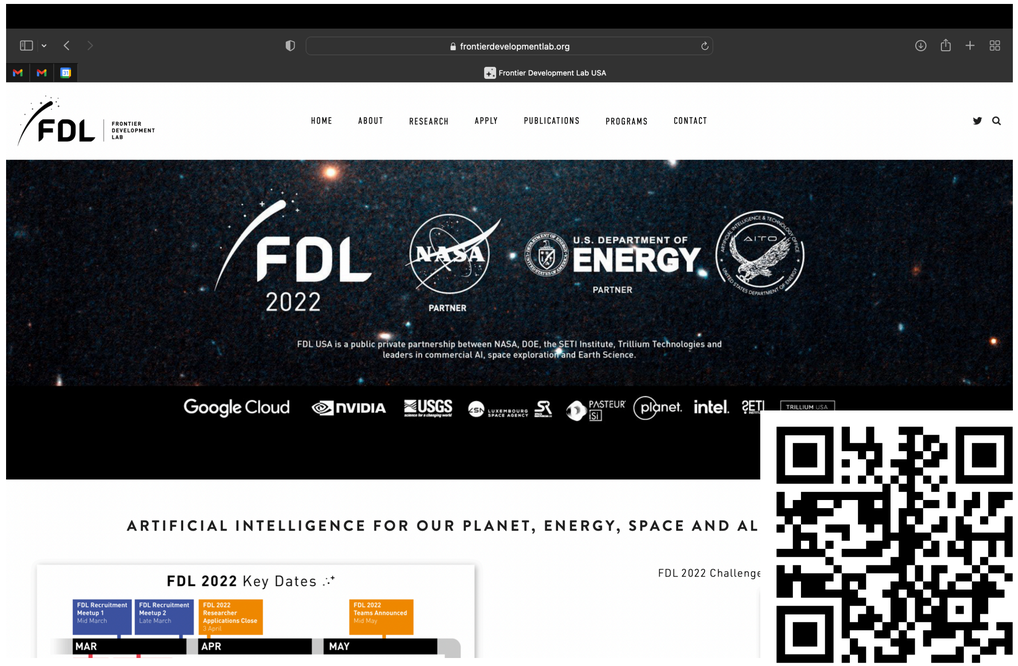
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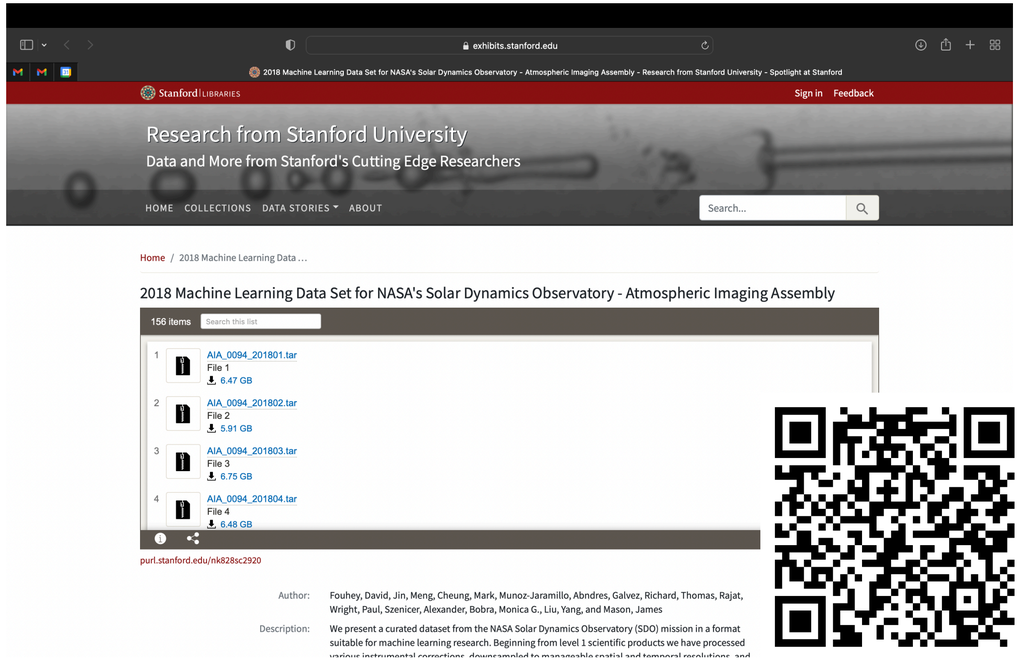
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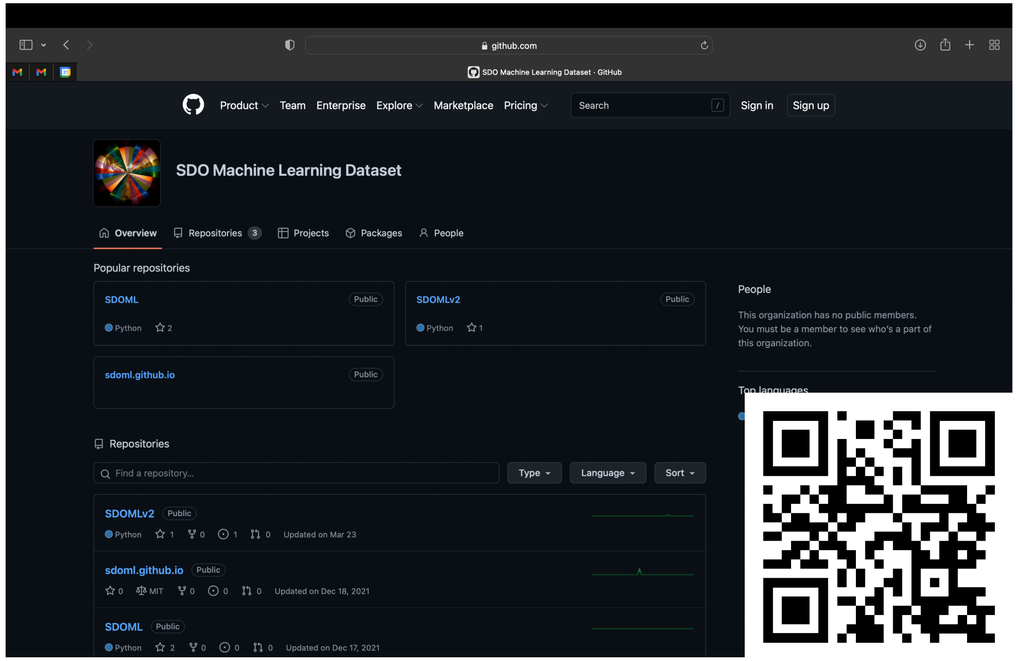
Author:
Fouhey, David, Jin, Meng, Cheung, Mark, Munoz-Jaramillo, Abndres, Galvez, Richard, Thomas, Rajat, Wright, Paul, Szenicer, Alexander, Bobra, Monica G., Liu, Yang, and Mason, James
Description:
We present a curated dataset from the NASA Solar Dynamics Observatory (SDO) mission in a format suitable for machine learning research. Beginning from level 1 scientific products we have processed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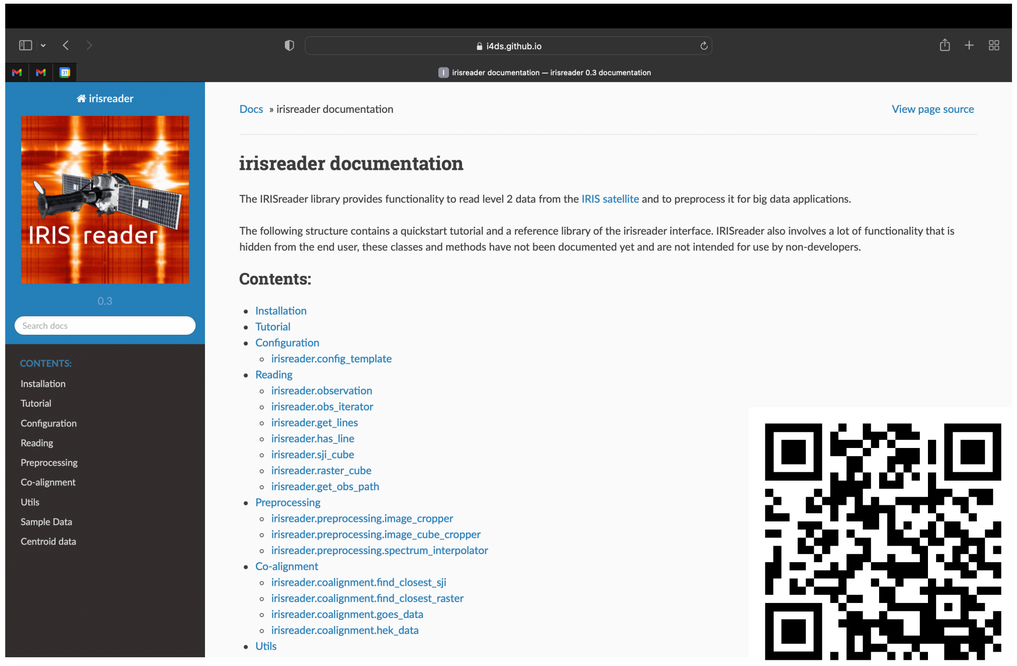

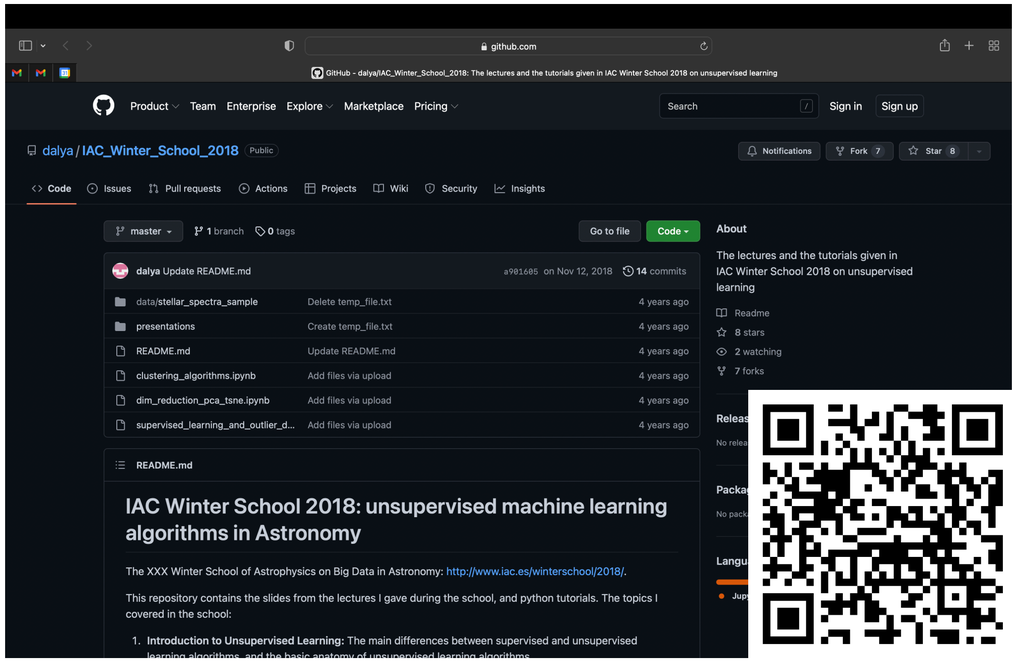

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