



Introduction

Data Science and Machine Learning Workshop

@ICALEPCS2021

Manuel Gonzalez-Berges (CERN)
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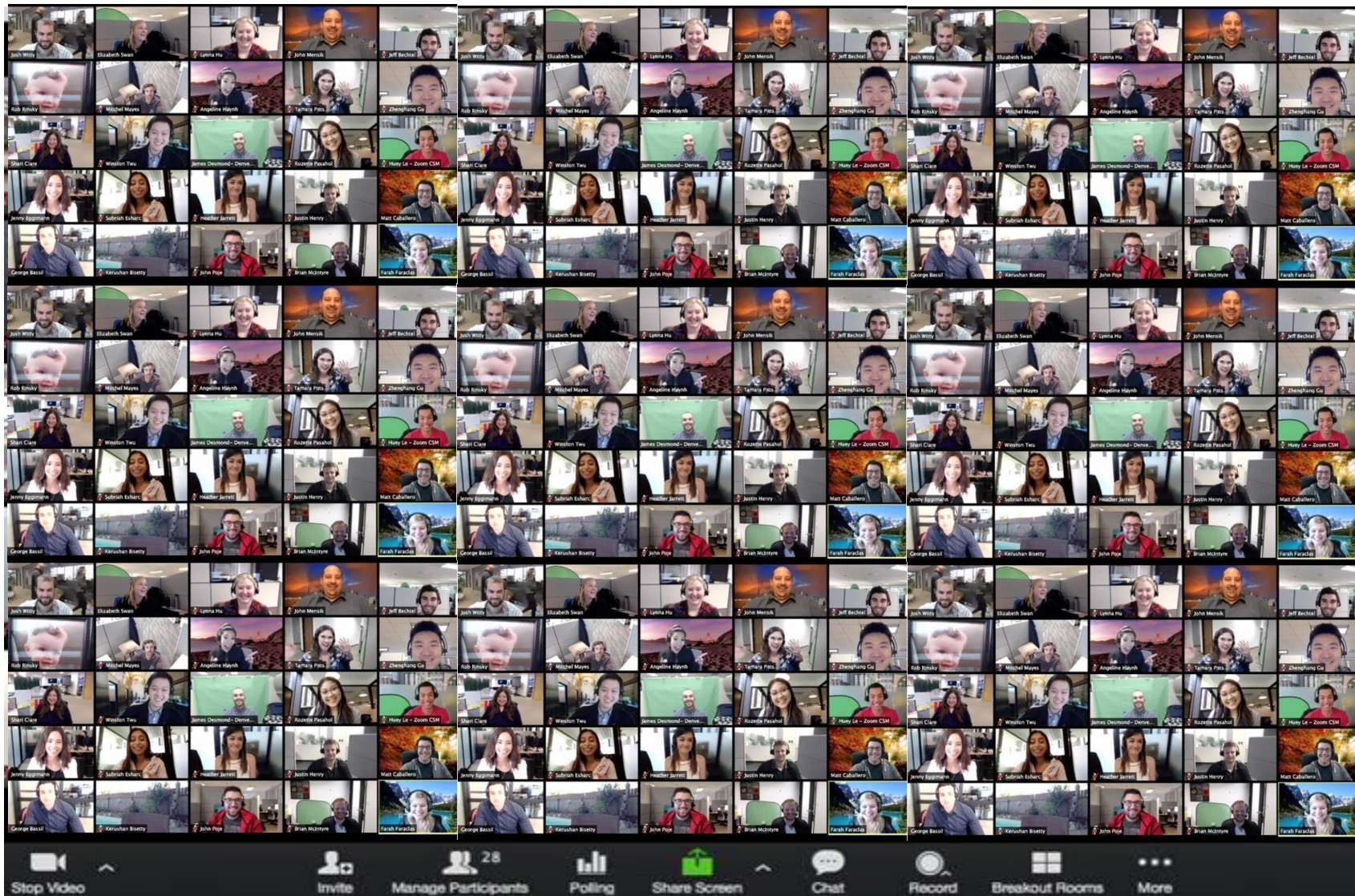
Past workshop at ICALEPCS2019



+100 Registered



Workshop at ICALEPCS2021



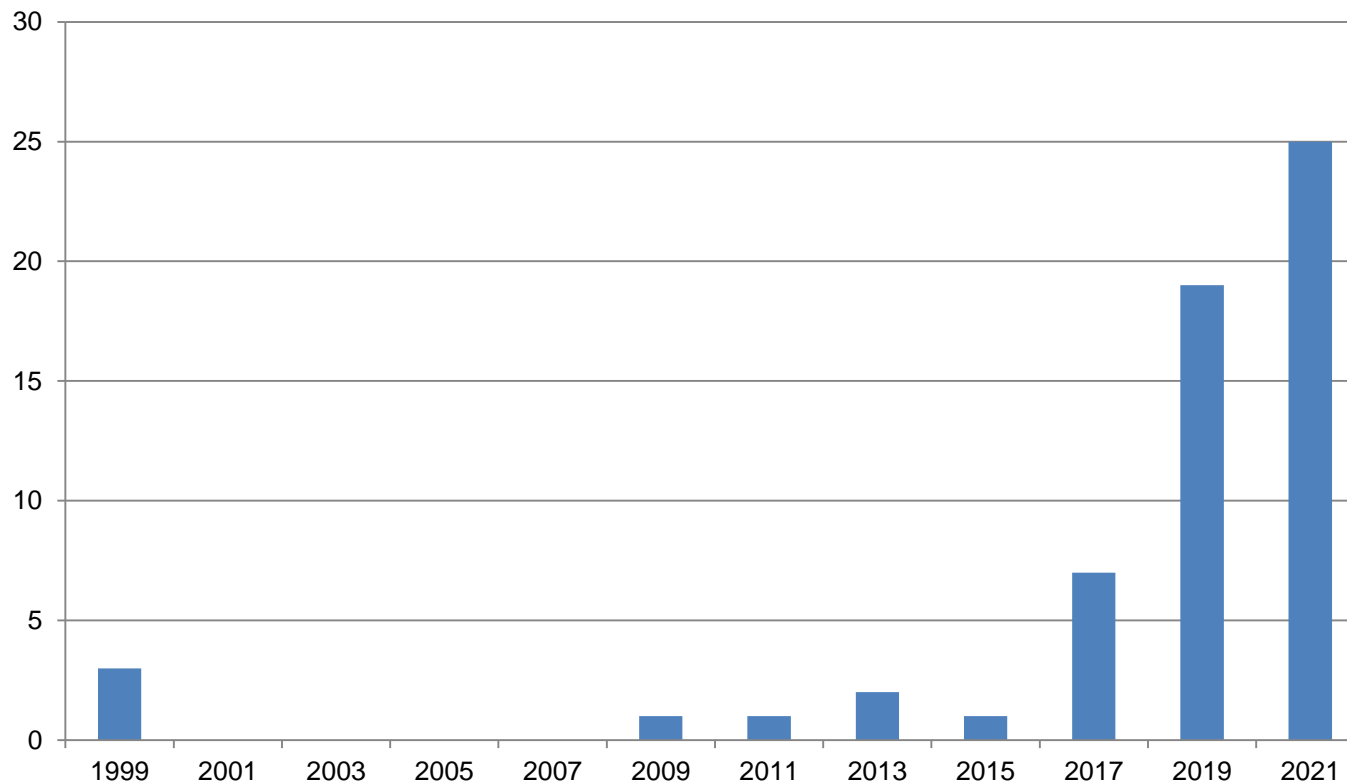
+200 Registered



DS & ML at ICALEPCS conferences

Keywords: *Expert Systems, Machine Learning, Artificial Intelligence, Artificial Neural Networks, Genetic Algorithms, ...*

Number of Papers





Past ICALEPCS tracks with ML papers

- ✓ ICALEPCS 2013 →
 - ***Knowledge-based Techniques***

- ✓ ICALEPCS 2015 →
 - ***Feedback Systems, Tuning***

- ✓ ICALEPCS 2017 →
 - ***Feedback Control and Process Tuning***
 - ***Data Analytics***
 - *(ML mentioned in track descriptions for the first time)*

- ✓ ICALEPCS 2019 →
 - ***Data Analytics –***
 - ***Feedback Control and Process Tuning***
 - ***Experiment Control***

- ✓ ICALEPCS 2021 →
 - ***Data Analytics***
 - ***Feedback Control, Machine Tuning & Optimization***
 - ***Experiment Control***
 - ***Timing Systems, Synchronization & Real-Time Apps***



Theme of the workshop: Implementation and Operation

Conclusions of the past workshop: The "ICALEPCS" ML community is growing and so do the number of real applications in physics facilities. Be prepared to use ML in your work: ML is not magic nor a toy, and applying ML to the real world is often not trivial

Questions and issues:

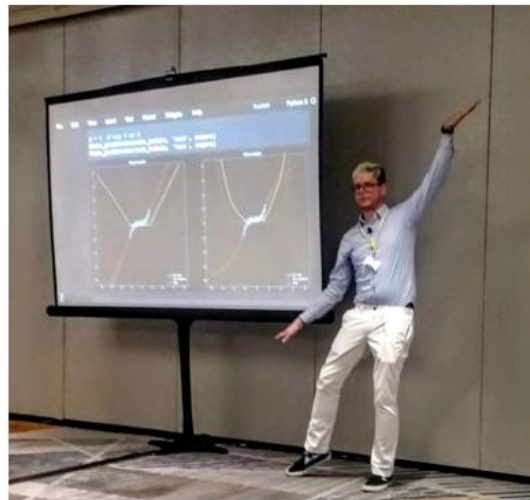
- ✓ DS&ML techniques have been mature for many years, but are their **implementation** on accelerators and physics facilities **mature** as well?
- ✓ Good results; but are they **still R&D or stable applications** routinely used during operations?
- ✓ Real usage of applications during routine operations **running automatically or run by non-expert people**.
- ✓ ML learning applications can be very effective with respect to classical techniques, but **are they easy to train/validate**?
- ✓ In the field of **model-less performance optimization**, is **ML competitive with standard algorithms** such as Gradient Descent, Nelder-Mead, Powell, Conjugate Gradient, Gaussian Process, ...?
- ✓ Can we rely on black-box ML models for **safe operations**?
- ✓ What are the **main areas of improvement** in order to make ML applications become really useful (training, hyperparameters tuning, robustness, ...)?



Workshop Format

- ✓ No tutorials
- ✓ Past presentations and tutorials:
 - Indico site: <https://indico.cern.ch/event/828418/>
 - <https://www.youtube.com/c/AlfredoCanziani/videos>

Supervised Learning *Unsupervised Learning*



Alfredo Canziani
New York University



Reinforcement Learning



Gianluca Valentino
University of Malta












Style of the workshop

- ✓ Informal and interactive
- ✓ Present successful and unsuccessful stories: lessons learned
- ✓ Practical issues and problems encountered: experts advice
- ✓ Starting point to continue discussions during the conference or later

Agenda

| | |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Workshop Introduction <i>Remote</i> | <i>Manuel Gonzalez Berges et al.</i> 12:00 - 12:10 |
| Machine learning for accelerators: a physicist approach <i>Remote</i> | <i>Pierre Schnizer</i>  12:10 - 12:45 |
| AI/ML Operational challenges at SLAC's accelerators & Collaborating Facilities <i>Remote</i> | <i>Auralee Linscott Edelen</i> 12:45 - 13:20 |
| ML and optimization algorithms for CERN accelerators <i>Remote</i> | <i>Verena Kain</i> 13:20 - 13:55 |
| Break <i>Remote</i> | 13:55 - 14:10 |
| LSTM model for the automatic LHC collimator alignment <i>Remote</i> | <i>Gabriella Azzopardi</i>  14:10 - 14:35 |
| Report on the Artificial Intelligence workshop at EuXFEL <i>Remote</i> | <i>Danilo Ferreira de Lima</i>  14:35 - 14:50 |
| Automatic Serial Femtosecond Crystallography online analysis with Reinforcement Learning <i>Remote</i> | <i>Danilo Ferreira De Lima</i>  14:50 - 15:10 |
| Report on LEAPS Integrated Platform workshop <i>Remote</i> | <i>Marco Calvi</i>  15:10 - 15:30 |
| Machine Learning for the Tune Estimation in the LHC <i>Remote</i> | <i>Leander Grech</i>  15:30 - 15:50 |
| Peek to some recent ML Activities at DESY <i>Remote</i> | <i>Raimund Kammering</i> 15:50 - 16:00 |
| Machine Learning for Failure Detection on RF Cavities <i>Remote</i> | <i>Antonin Sulc</i>  16:00 - 16:10 |
| Submitted Topics & Problems for discussion <i>Remote</i> | 16:10 - 16:25 |
| Conclusion <i>Remote</i> | 16:25 - 16:30 |

Overview

Group Picture

Projects



Some participation guidelines...

- ✓ Keep your micro muted

- ✓ Raise your hand in the Zoom menu to ask a question
 - Enable video & unmute when organizers give you the floor

- ✓ For any technical issue -> contact conference staff in the chat

- ✓ If you want to show any slide in the last discussion session, let Marco & Manuel know in the chat in advance.

- ✓ Workshop Feedback
 - Zoom after workshop, email, during the conference

DATA



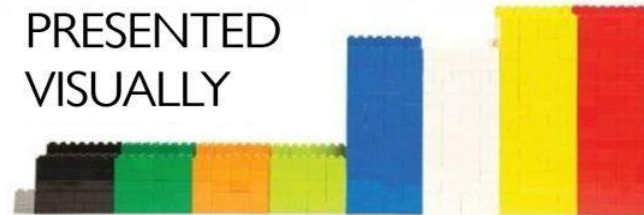
SORTED



ARRANGED



PRESENTED VISUALLY



EXPLAINED WITH A STORY



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