



IML Machine Learning Workshop IBM-CERN Deep Learning Projects

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PRESENTATION TOPICS

- IBM ML/DL Cloud services... how do they fit with CERN?
- Some example scenarios now underway with various scientific institutions
- Details on the current IBM-CERN “proof of concept” project: Nitro-DQM
- Beyond the PoC... the long term view

IBM Cloud and CERN

CERN is a world leader in high performance computing on Exabyte scale data sets... so how does IBM Cloud fit? Some examples...

- Complementary skills... IBM “Watson” AI, IBM DL team, etc.
- Publically accessible cloud applications for external HEP researchers – 24x7 collaborative data science environment
- ML/DL scenarios that can be implemented with infrequent ML training – train in the cloud, then repatriate for runtime use
- Exploratory PoCs - cheap and easy to spin up using IBM Cloud infrastructure: compute/storage, DLaaS on GPU clusters, etc.

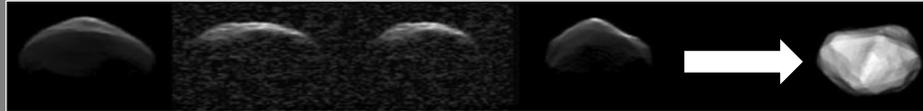


Case Study: Externally Accessible IBM-Cloud Environment for NASA Planetary Defense Research

1. Asteroid Threat Assessment: Generate wireframe models of asteroids using delay-Doppler radar data

Modeling the shape and dimensions of asteroids enables better orbit fitting and impact risk projections.

It currently takes a lot of human intervention to turn radar images into a 3D model

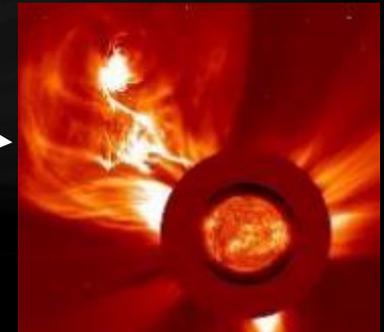


NASA wants to use DL services on the IBM cloud to improve that process.

2. Coronal Mass Ejections (solar flares): Often call the “*trillion dollar problem*” due to the huge projected cost of an unexpected solar flare impact (GPS obliterated, power grid melt down, death of space station crew, etc.)

NASA was concerned by [this very near miss in 2012](#):
“If it had hit earth, we would still be picking up the pieces.”

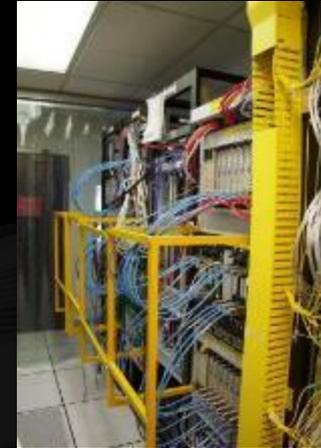
Using historic data to train a DL model could provide better impact severity predictions in the future



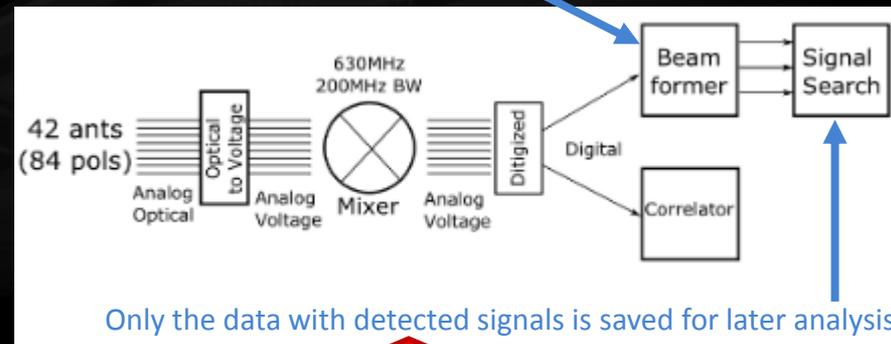
Case Study: Infrequent DL Training

SETI Institute Backgrounder

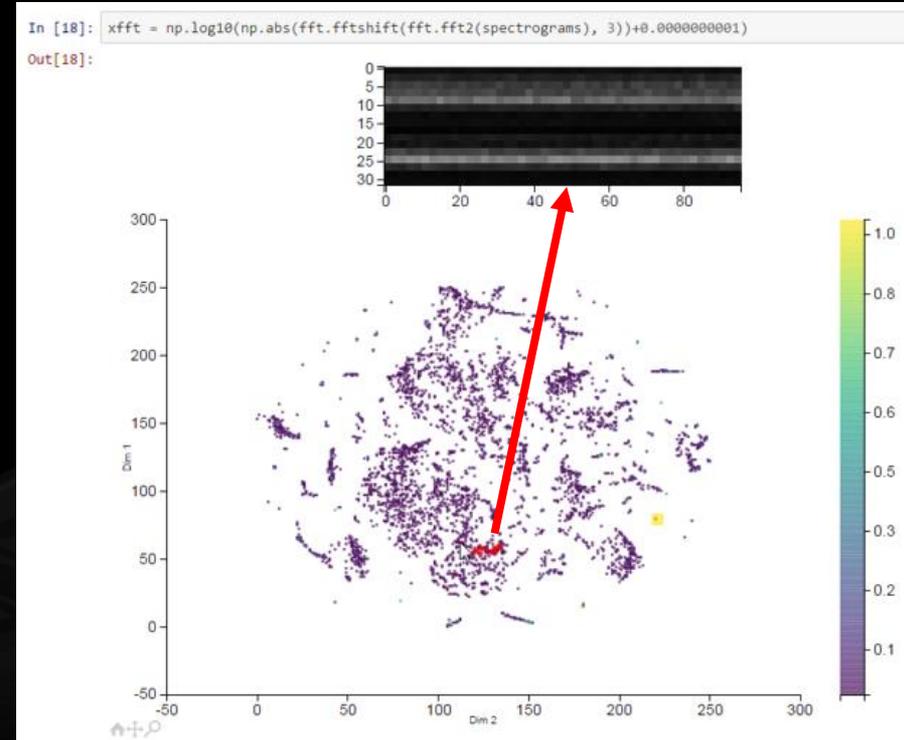
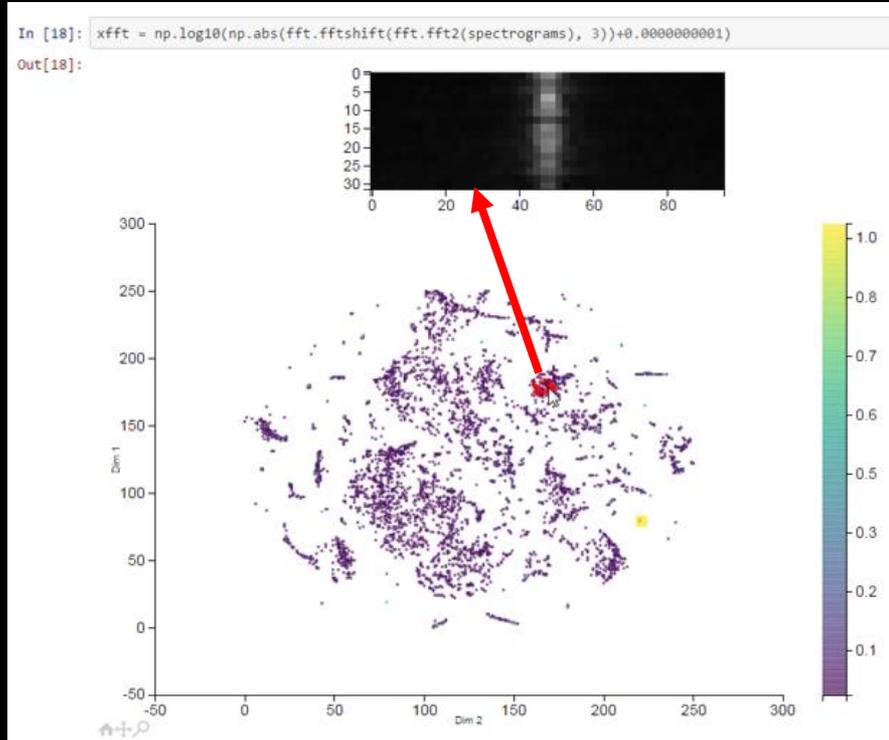
- Headquartered in Mountain View, CA. Founded 1984. 150 Scientists, researchers and staff.
- The mission of the SETI Institute is to explore the potential for extra-terrestrial life.... search for radio signal patterns which are not easily explained by human or natural origin.
- Allen Telescope Array (ATA) – 42 Phased Array Dishes in Northern California



4.5TB data every hour

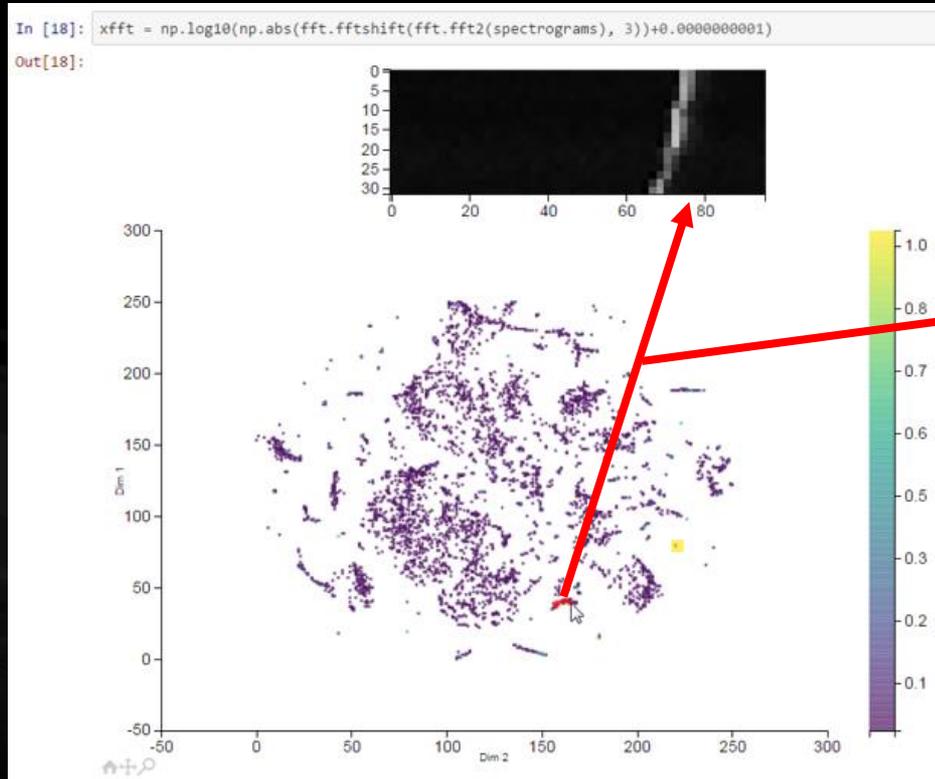


From raw antennae voltage data to classified signals, all with unsupervised deep learning...



Neural net model trained on the IBM DLaaS - Keras on 750 NVIDIA K80 GPUs

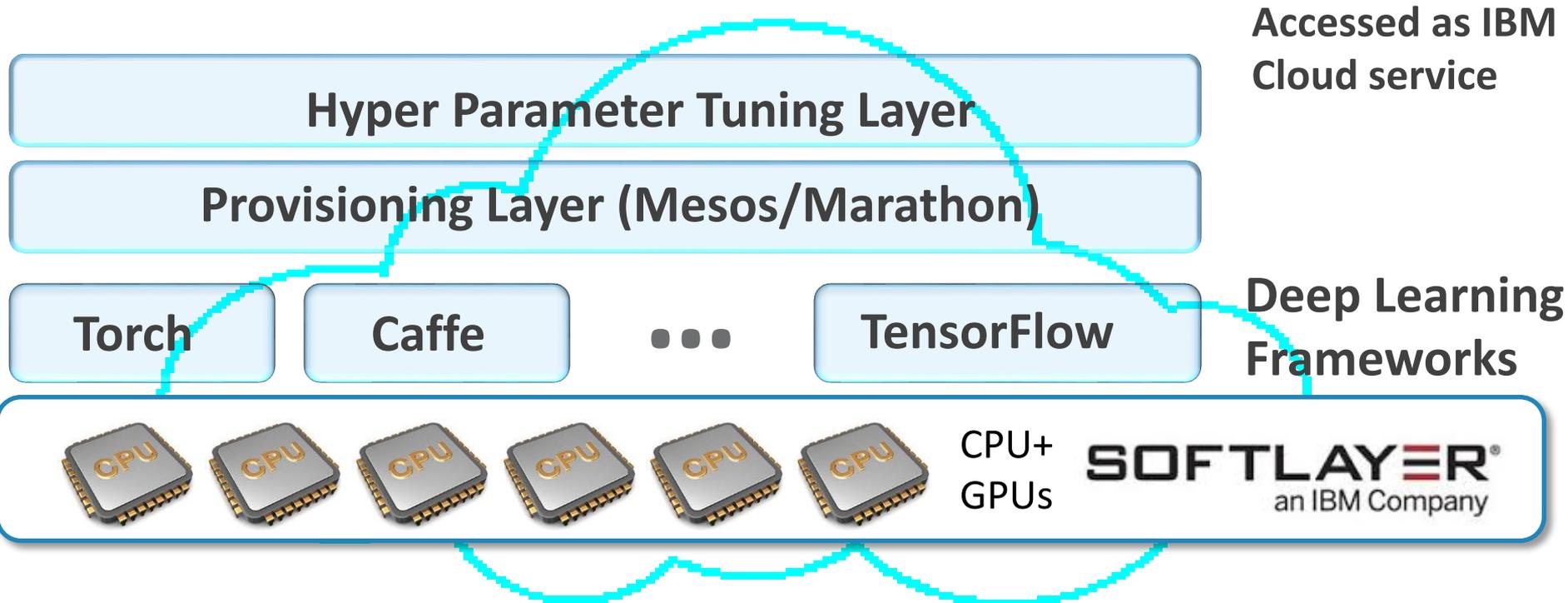
Migrate NN model to Apache Spark runtime server at the Allen Telescope Array Observatory



New incoming signal classified in real time as narrow-band with negative drift (relative deceleration)

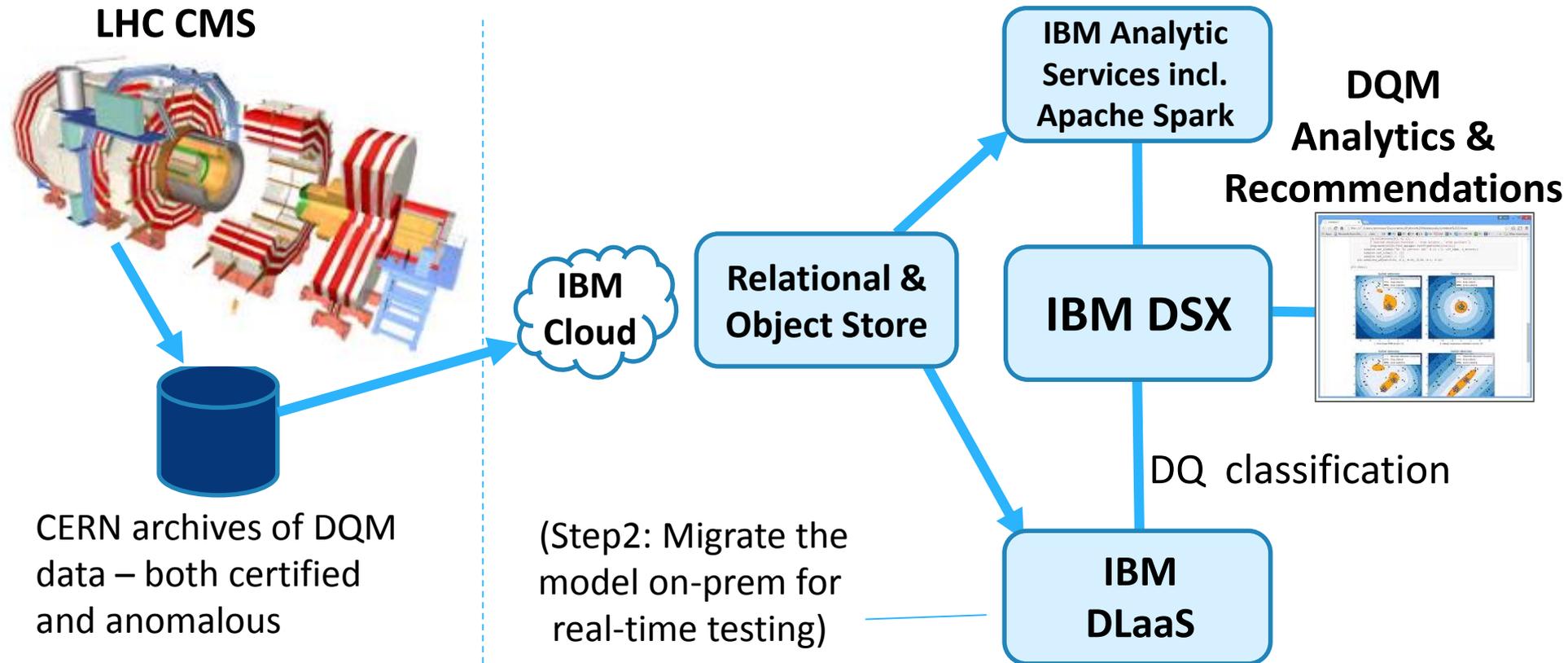
Case Study: Exploratory Proof-of-Concepts

Rapid provisioning of DLaaS environment for CERN-IBM collaborative development



Case Study: IBM-CERN “Nitro-DQM” PoC

Use the IBM Cloud to develop, train, test the NN model



Looking Ahead: IBM-CERN Deep Learning

- Other application areas, such as...
 - Calorimeter Pattern Recognition : DL classification to handle the increase granularity of next-generation calorimeters
 - Boosted Objects Imaging : Deep Learning models to perform pattern recognition to enhance particle jet disambiguation
- Other exploratory projects...
 - IBM Quantum Computing for Deep Learning (google “IBM quantum deep learning”)
 - IBM On-premises DL solutions (google “IBM PowerAI”)

Thank you!

Questions?