# An HPC-Driven Data Science Platform to Speed-up Time Series Data Analysis of Patients with the Acute Respiratory Distress Syndrome

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# Status Quo

- Advances in computing and storage technologies:
  - Large scale databases of medical data[1].
  - Availability of data for analysis and information mining[2,3].
  - Room for new applications of well-established Machine Learning (ML) and Deep Learning (DL) techniques[4,5].

- These advances have highlighted some major shortcomings:
  - Increased need for efficient data storage, versioning, and communication.
  - Increased need for computing power in medical big data analytics.

# Available Solutions

- Making the available technologies more accessible:
  - Medical Institutions gaining access to or setting up their own High Performance Computing (HPC) resources.
  - Cloud computing resources available through private vendors.
  - Medical data made available in open-source repositories for research purposes[1,2,3,6].

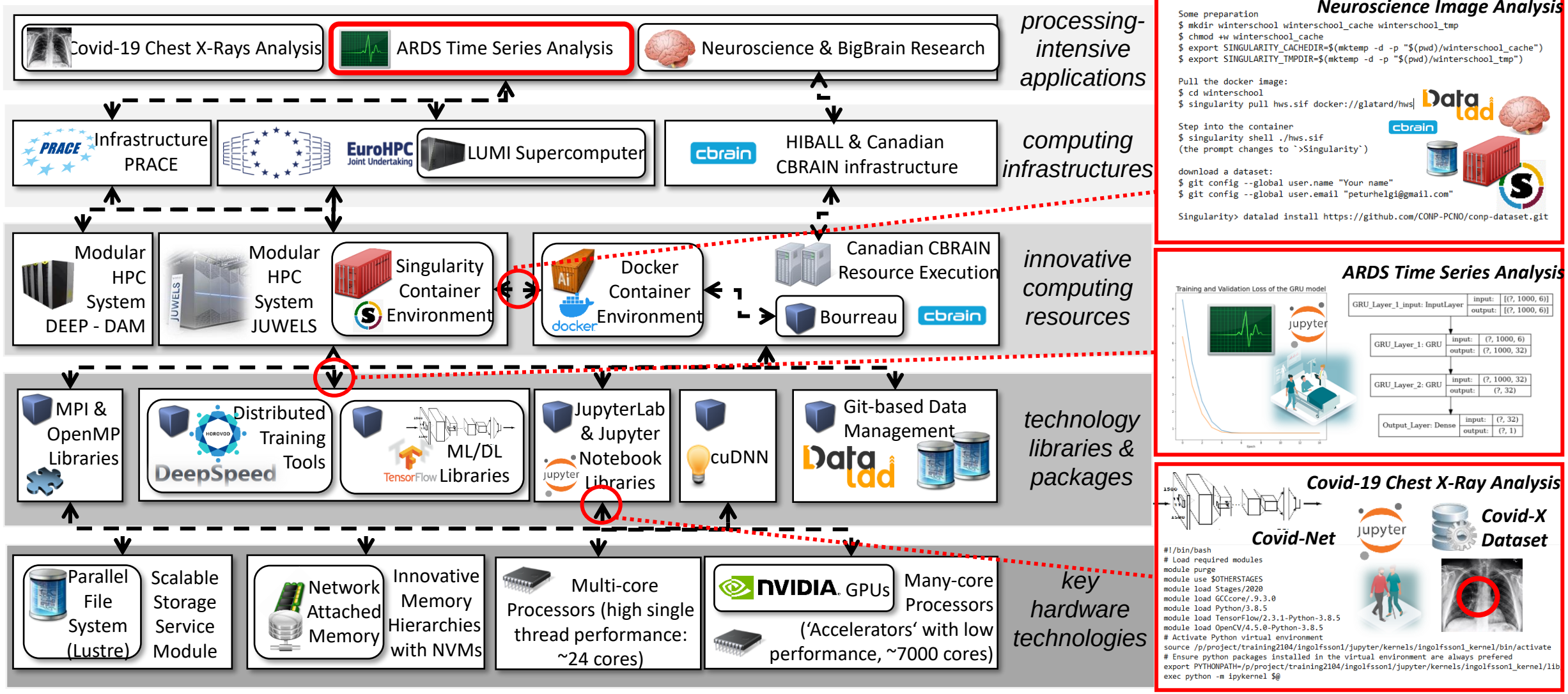
- However:
  - Medical staff can not be expected to become acquainted with HPC.
  - Large applications cripple the hardware of medical institutions.

# Proposed Solution

- Establish an HPC-enabled Platform:
  - Bridges the gap between research institutions and medical centres.
  - Makes use of high efficiency data storage, analysis, and transfer architecture.
  - Performs necessary computationally-intensive tasks on specialized hardware.
  - Keeps technical complexity at a low degree.

- We highlight an initial use case concerning missing value prediction in medical data, to assist in the detection of onset of Acute Respiratory Distress Syndrome (ARDS).

# Platform Blueprint

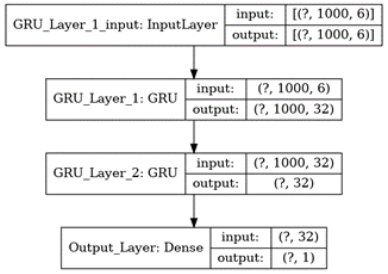


# SMITH and ARDS

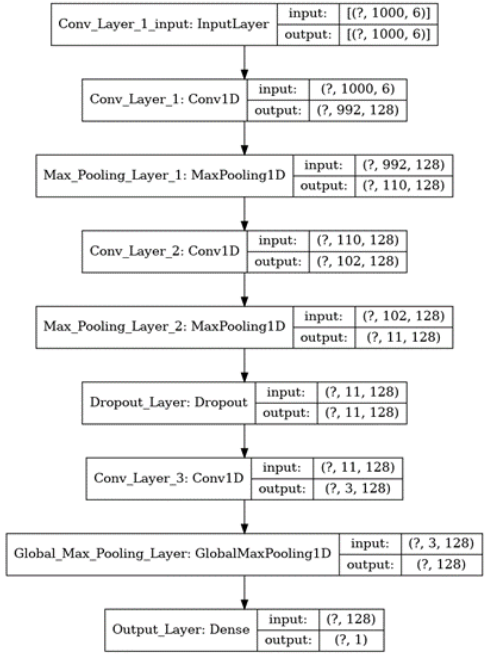
- Acute Respiratory Distress Syndrome (ARDS) is a rare condition that affects ICU patients, but has a high mortality rate[7,8].
- There is consensus on how to diagnose the condition, but not how to treat it[9].
- This is one of the use cases of the Smart Medical Information Technology for Healthcare (SMITH) consortium grouping major research institution in Germany[10].
- The aim is to develop algorithms that can efficiently and accurately diagnose the onset of ARDS, and potentially provide suggestions for treatment.

# Applying the Platform

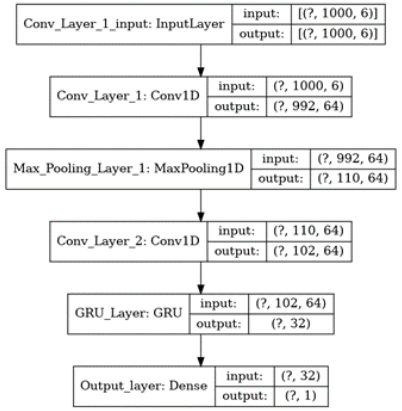
- Perform data cleaning and preparation using the established platform.
- Set up sequence analysis models using modules available through Keras and Tensorflow.
- Train a sequence prediction model on the cleaned time series data.




*a) GRU Model Structure*




*b) 1D-Conv Model Structure*




*c) Mixed Model Structure*

- Training results show promise in terms of speed-up and reduced prediction errors (compared to other methods)

# Conclusions

- ARDS time series prediction is one case study from the platform.
- The goal is to introduce HPC into healthcare applications, without the complexities that usually come with it.
- Currently setting up the frameworks for two further medical applications
- Also improving the use cases currently in place.

# Bibliography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