



Executive Summary - HPC Activities in Iceland & Training Needs

PROF. DR. – ING. MORRIS RIEDEL, UNIVERSITY OF ICELAND / JUELICH SUPERCOMPUTING CENTRE (JSC)

26TH APRIL, CASTIEL SMALL GROUP MEETING, ONLINE



@ProfDrMorrisRiedel



@Morris Riedel



@MorrisRiedel



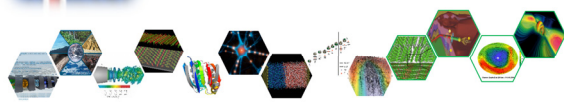
@MorrisRiedel



<https://www.youtube.com/channel/UCWC4VKHmL4NZgFfKoHtANKg>



IHPC National Competence Center
for HPC & AI in Iceland



EuroHPC
Joint Undertaking

EOSC
NORDIC

RAISE
Center of Excellence

ADMIRE



UNIVERSITY OF ICELAND
SCHOOL OF ENGINEERING AND NATURAL SCIENCES
FACULTY OF INDUSTRIAL ENGINEERING,
MECHANICAL ENGINEERING AND COMPUTER SCIENCE

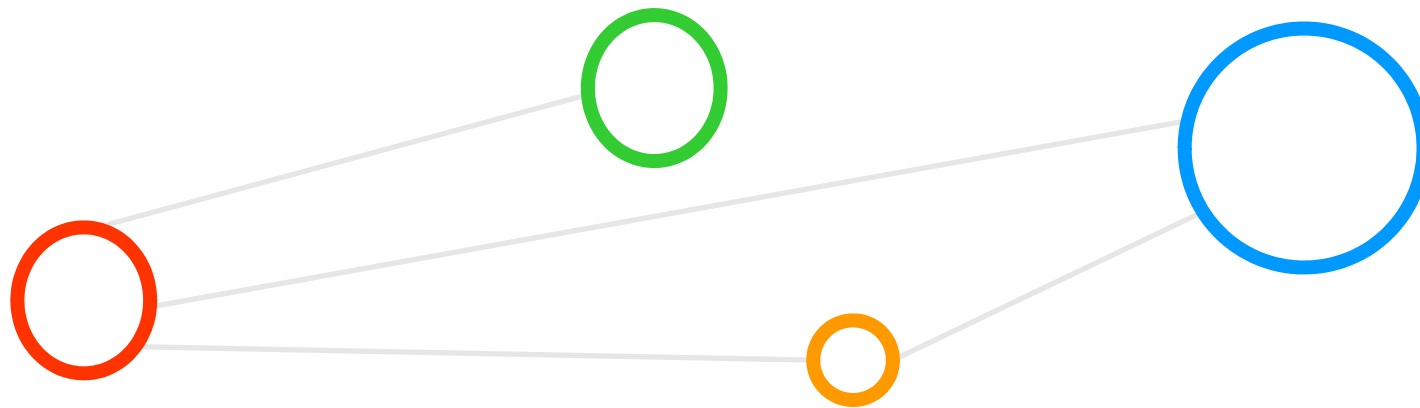
HELMHOLTZAI | ARTIFICIAL INTELLIGENCE
COOPERATION UNIT

DEEP
Projects



JÜLICH
Forschungszentrum | JÜLICH
SUPERCOMPUTING
CENTRE

Executive Summary – Major Icelandic HPC Activities



Executive Summary – Major Icelandic HPC Activities

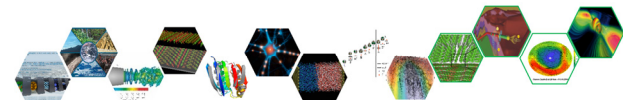


rannís Icelandic National Infrastructure for HPC

- ❖ HPC hardware funds by RANNIS; now via roadmap IReiP
- ❖ Proposals yearly required to obtain funds still
- ❖ Joint proposal from IHPC community

EuroHPC EuroCC National Competence Center for HPC & AI

- ❖ EU Project (09/2019-08/2021), 2 years
- ❖ Building **Simulation and Data Labs (SDLs)** of the IHPC Community of Users
- ❖ Supports industry engagement in HPC



IHPC Community of Users

- ❖ Organized around RANNIS proposals
- ❖ ~53 scientific experts & research group
- ❖ UoIceland/UoReykjavik, Iceland Geo Survey ÍSOR, Met Office & industry: Matis, etc.



IHPC Icelandic National Competence Center for High Performance Computing and Artificial Intelligence

EuroHPC LUMI Supercomputer in Finland

- ❖ Supercomputer funded by Finland, Belgium, Czech Republic, Denmark, Estonia, Iceland, Norway, Poland, Sweden, Switzerland
- ❖ Co-Funds by EC and Iceland participation funds from: UoIceland, UoReykjavik, and Hannes Jonsson & Egill Skulason

Teaching & Education in HPC & AI

- ❖ University of Reykjavik
- ❖ University of Iceland
- ❖ Arctic Webinar Series (with US partners)
- ❖ Digital/Horizon Europe MSc in HPC



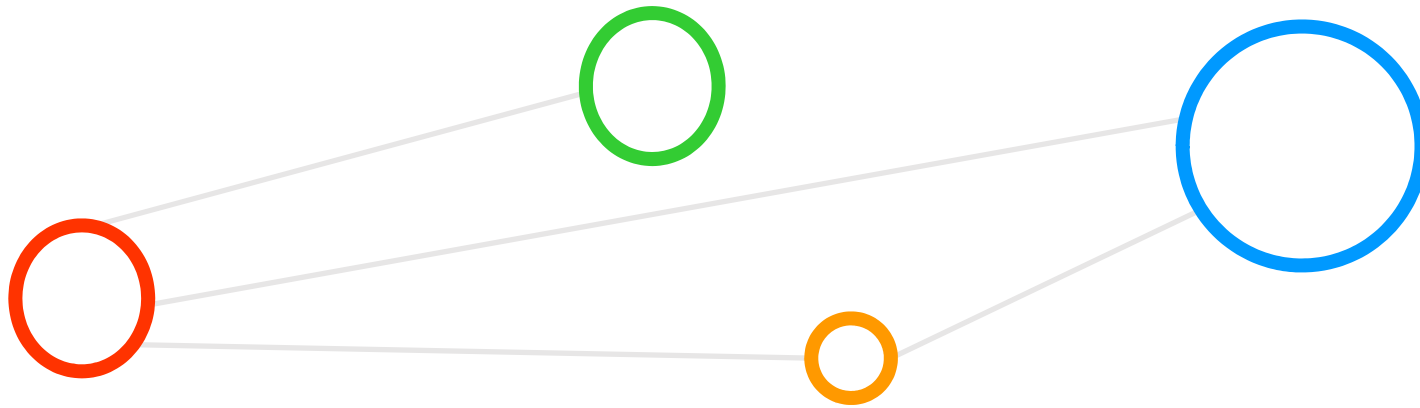
International Cooperations

- ❖ Tactical: ~4 Joint PhDs with Juelich Supercomputing Centre in Germany (#1 HPC System in Europe)
- ❖ Tactical: **EC Projects** like DEEP-EST, EOSC-Nordic, RAISE Center of Excellence (CoE)

- ❖ Strategic: Building an **Icelandic National Lab** with international cooperation together with Industry (e.g. Kaiser Global, other investors)



IHPC Community of Users



IHPC Community of Users (1)



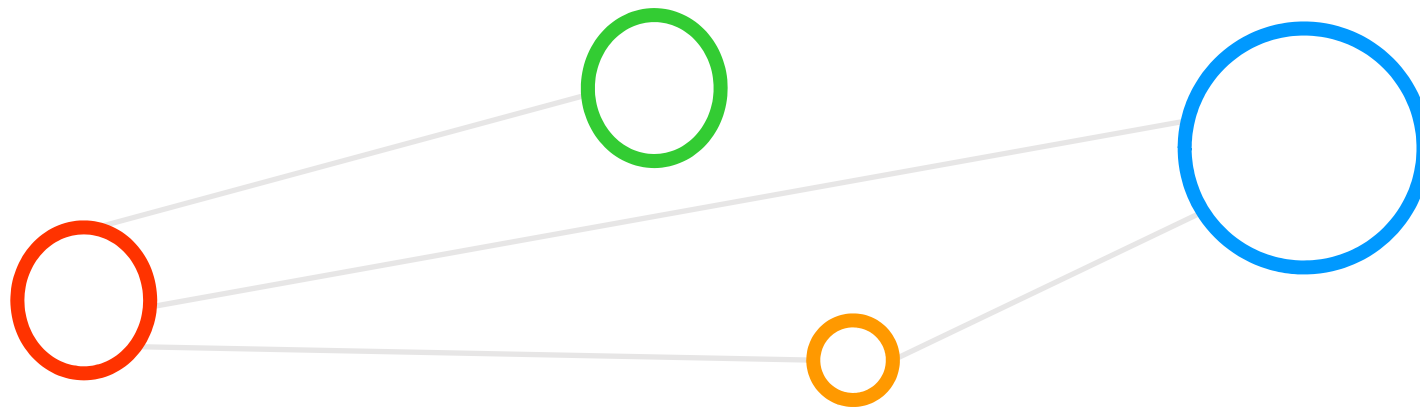
Háskóli Íslands - VON	Hafsteinn Einarsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Yonatan Afework Tesfahunegn	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Ebba Þóra Hvannberg	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Erna Sif Arnardóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Ivan Shelykh	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Jón Guðnason	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Egill Skúlason	Vikulega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Kristinn Torfason	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Lotta María Ellingsen	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Tölvunarfræðideild	María Óskarsdóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Haraldur Ólafsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Andrei Manolescu	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Jesus Zavala Franco	Vikulega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Tölvunarfræðideild	Henning Arnór Úlfarsson	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Jón Tómas Guðmundsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	Háskólinn í Reykjavík - Verkfræðideild	Anna Maria Sitek	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Pedro Simoes Costa	Mánaðarlega	Doktorsgráða / eða sambærilegt	Veðurstofa Íslands	Angel Ruiz Angulo	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Helmut Wolfram Neukirchen	Vikulega	Doktorsgráða / eða sambærilegt	Veðurstofa Íslands	Jórunn Harðardóttir ktal 0512683509	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Morris Riedel	Vikulega	Doktorsgráða / eða sambærilegt	Veðurstofa Íslands	Matthew James Roberts	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Freysteinn Sigmundsson	Vikulega	Doktorsgráða / eða sambærilegt	Veðurstofa Íslands	Jón Elvar Wallevik ktal 1710684799	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið	Bryndís Eva Birgisdóttir	Vikulega	Doktorsgráða / eða sambærilegt	Háskóli Íslands - VON	Sigurður M Garðarsson	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Tölvunarfræðideild	Elihu August	Mánaðarlega	Doktorsgráða / eða sambærilegt	Matis	Viggó Þór Marteinsson	Mánaðarlega	Doktorsgráða / eða sambærilegt

IHPC Community of Users (2)



Matis		Sæmundur Sveinsson		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Arnar Pálsson		Daglega Doktorsgráða / eða sambærilegt
Matis		Guðmundur Óli Hreggviðsson		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Birkir Þór Bragason		Vikulega Doktorsgráða / eða sambærilegt
Matis		Ólafur Héðinn Friðjónsson		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Guðmundur H Guðmundsson		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Thor Aspelund		Vikulega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Kalina Hristova Kapralova		Vikulega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Jóhanna Jakobsdóttir		Vikulega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Kristinn Pétur Magnússon		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Unnur Anna Valdimarsdóttir		Vikulega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Ólafur Eysteinn Sigurjónsson		Vikulega Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON		Viðar Guðmundsson		Daglega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Oddur Þór Vilhelmsson		Vikulega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Inga Þórsdóttir		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Snæbjörn Pálsson		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Hugvísindasvið		Guðmundur Hálfðánarson		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Vilmundur G Guðnason		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Elín Soffía Ólafsdóttir		Mánaðarlega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Þórarinn Guðjónsson		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Heiða María Sigurðardóttir		Vikulega Doktorsgráða / eða sambærilegt	Háskóli Íslands - Heilbrigðisvísindasvið	Margrét Þorsteinsdóttir		Mánaðarlega Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið		Þórhallur Ingi Halldórsson		Vikulega Doktorsgráða / eða sambærilegt				
Háskóli Íslands - Heilbrigðisvísindasvið		Sigríður Klara Böðvarsdóttir		Mánaðarlega Doktorsgráða / eða sambærilegt				
Háskóli Íslands - Heilbrigðisvísindasvið		Einar Arnason		Mánaðarlega Doktorsgráða / eða sambærilegt				

IHPC Community – Simulation and Data Labs (SDLs)



NEW EuroCC EU Project: Building National Competence Centers for HPC & AI



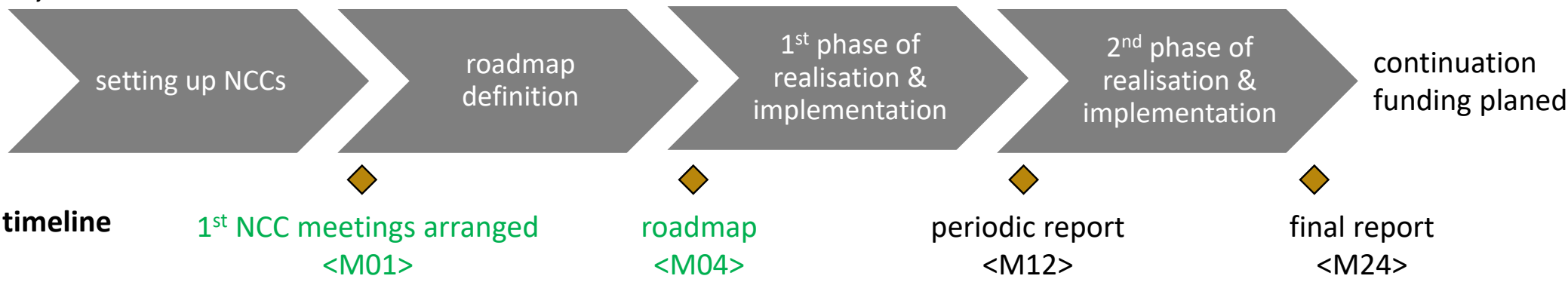
- EuroHPC Joint Undertaking Project
- 33 Countries as Partners
- 50% funding only for University of Iceland (in-kind funding by person Prof. Dr. – Ing. Morris Riedel & Prof. Dr. Ebba Hvanberg)
- Goal: Establish National Competence Centers (NCCs) in the area of HPC & AI to bring national activities together



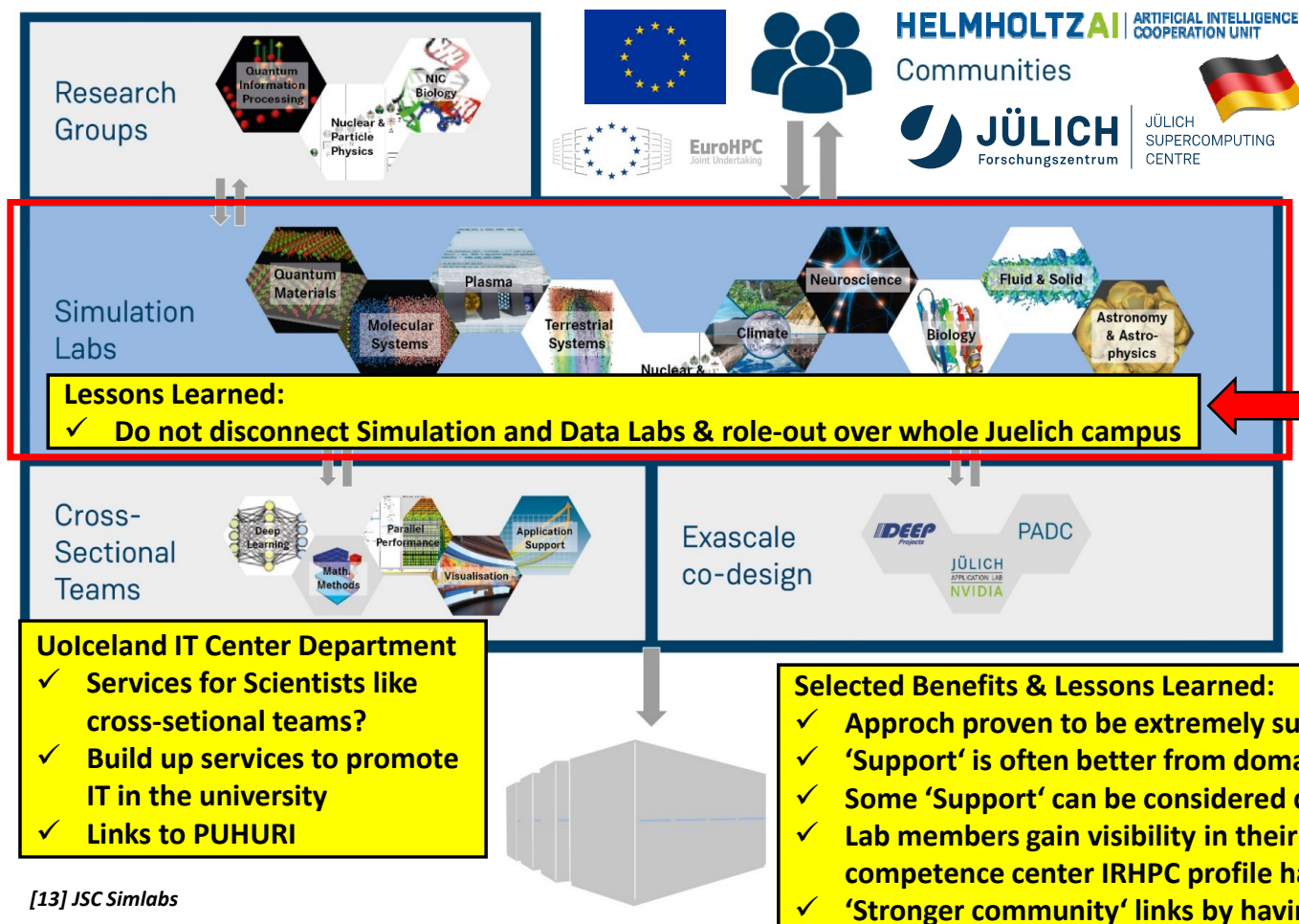
EuroCC funds two research activities for the University of Iceland in the area of neuroscience & computational fluid dynamics

The National Competence Center (NCC) for Iceland of the EuroCC project represents our already established IHPC & IRHPC activities is fully complementary to those activities

- Major activities: Community building (including industry)



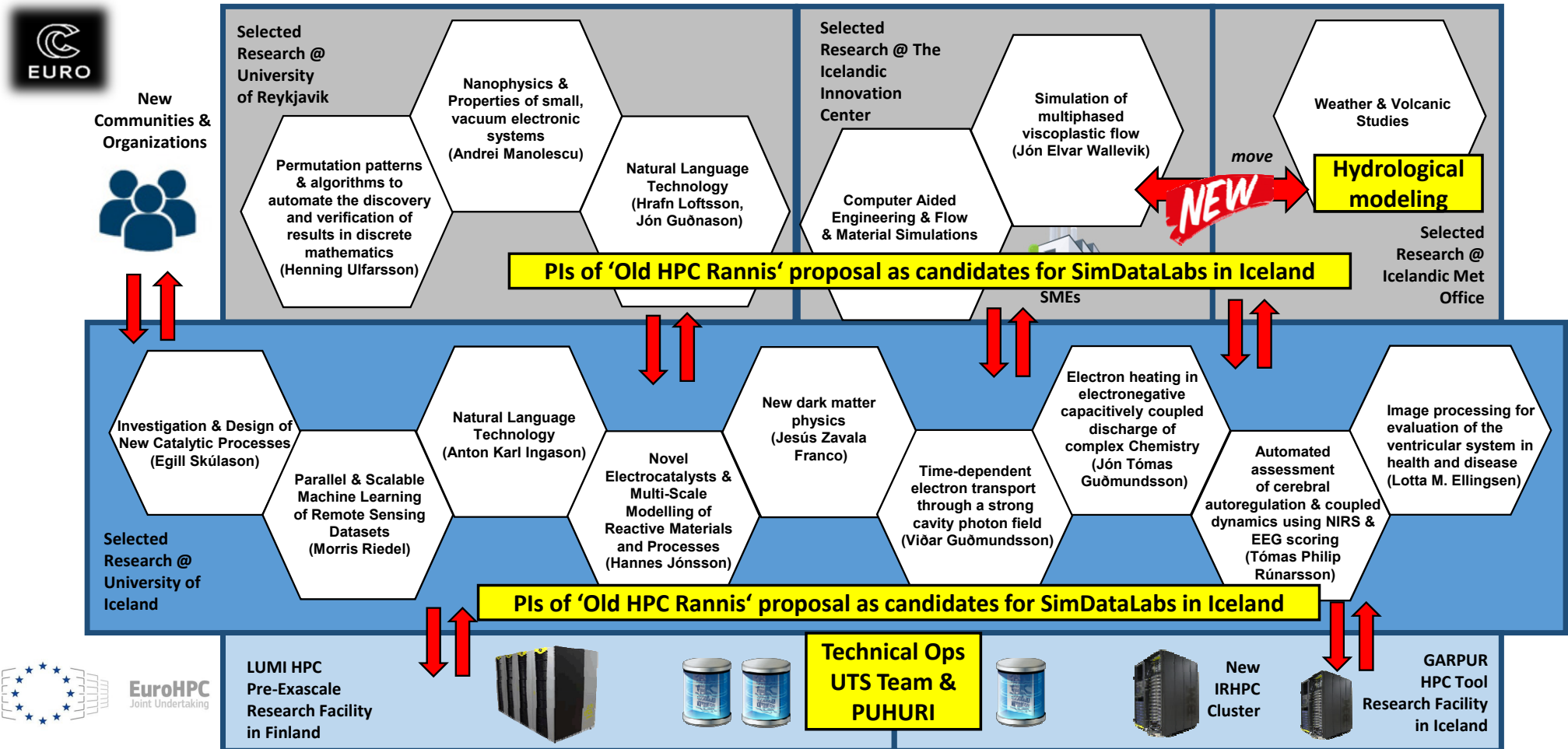
Community-building with Simulation & Data Labs (SDLs) – Lessons Learned



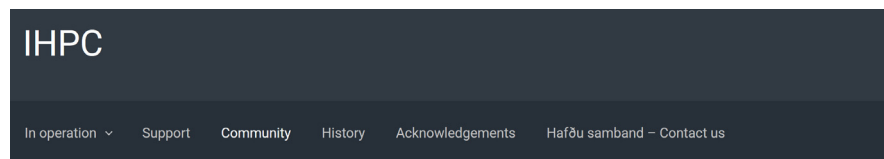
'For some years now there has been a growing realisation that application software is lagging behind HPC hardware developments. While several Petaflop-scale supercomputers are now available worldwide, it is becoming increasingly difficult to exploit these machines with single applications. Substantial efforts are needed in order to enable computational science communities to solve problems with high scientific impact through efficient use of high-end supercomputing resources. To help meet this challenge the Juelich Supercomputing Centre (JSC) has proposed a new type of domain-specific research and support structure: the Simulation Laboratory.'

[13] JSC Simlabs

First Steps towards Potential Simulation and Data Labs in Iceland



SimDataLabs in Iceland – Confirmed Participation (Work-in-Progress)

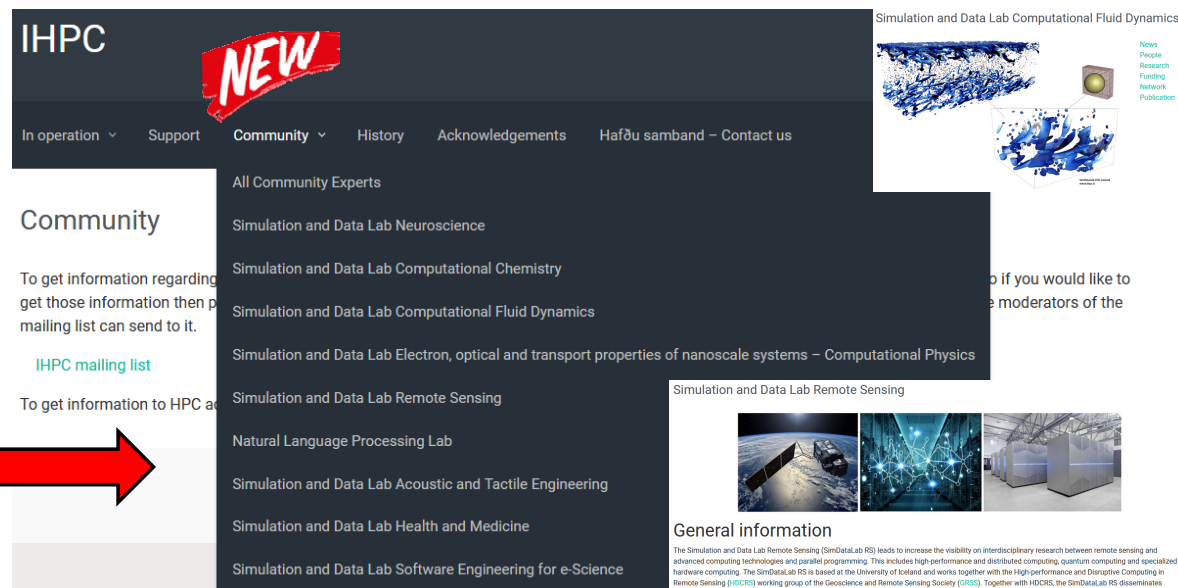


Community

To get information regarding upgrades, downtime or some other important issues then we will send those information to users with email. If you would like to get those information then please sign up. This is not used very regularly so don't worry about getting spammed through this list and our mailing list can send to it.

[IHPC mailing list](#)

To get information to HPC admins, then please send an email to help@hi.is and include HPC in the subject.



[14] IHPC Community

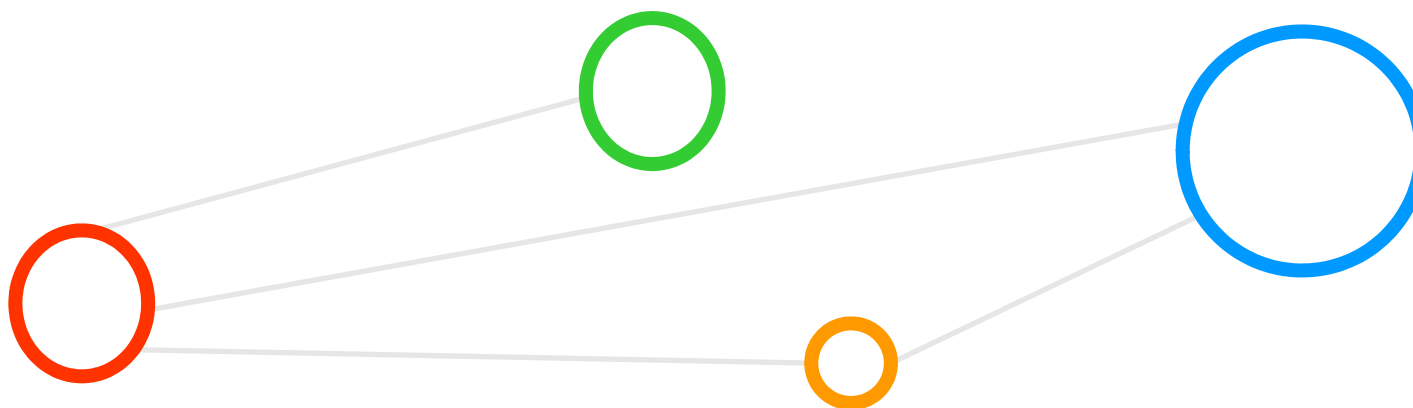


Jointly engage in future funding together, e.g. EuroHPC Master of Science in HPC program and many other activities planned in Horizon Europe

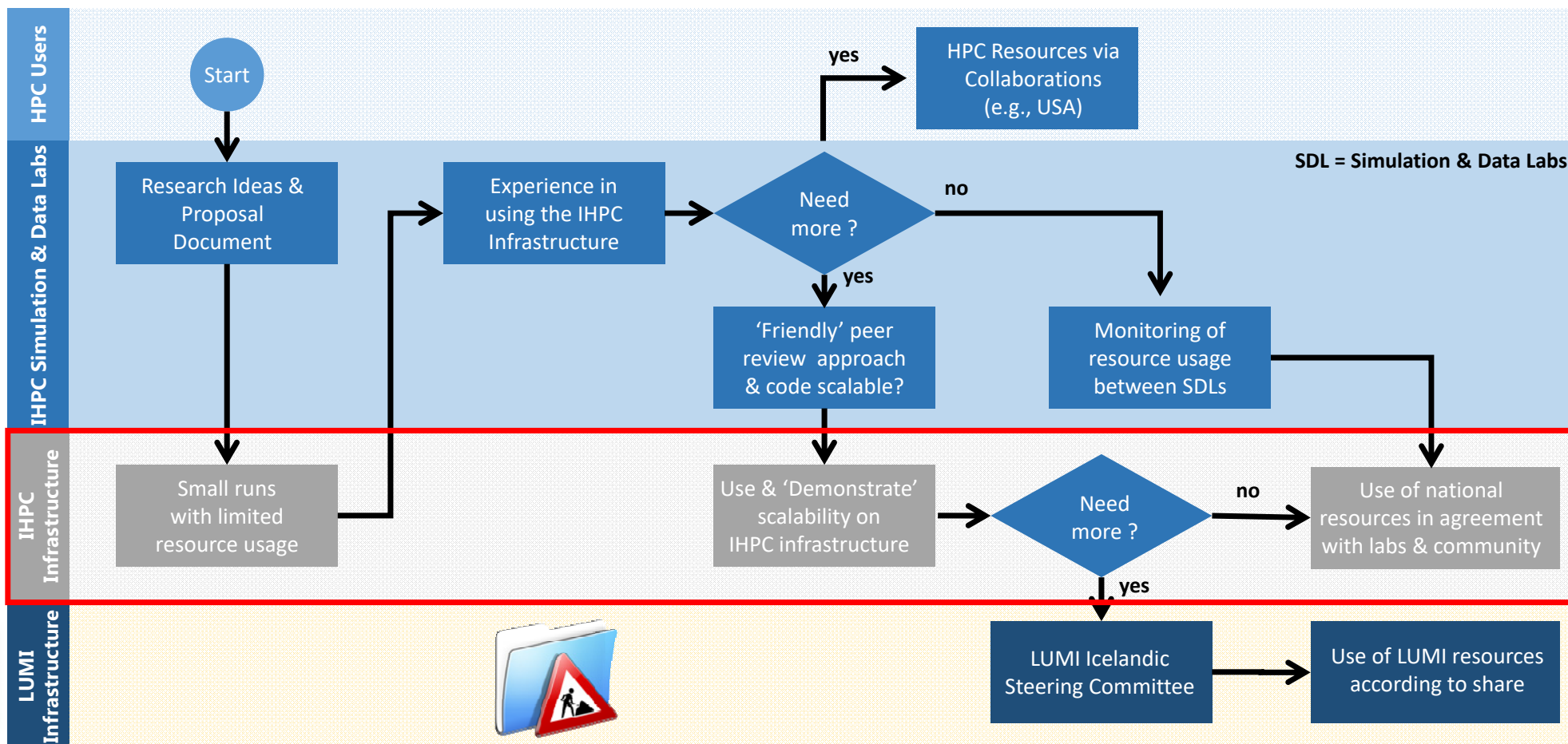
Selected Discussion Topics:

- ✓ Governance of Labs: Bottom-Up by PI, but optional Executive Advisory Board (EAB) members could be used to guide & 'review' labs on a yearly basis (could be useful): labs of Juelich are 'friendly' reviewed on a 1-2 years basis as part of funding program
- ✓ Engagement with Industry: ISOR, MATIS, MAREL, DECODE (work-in-progress), etc.
- ✓ Including Start-Ups: Nordverse (medical NLP, done), Treble (Acoustic, done), others?
- ✓ Relationship to our new IRHPC & steering board activities → Logo for IRHPC/NCC?!
- ✓ Teaching better topics of relevance in HPC Course for Iceland, other activities?

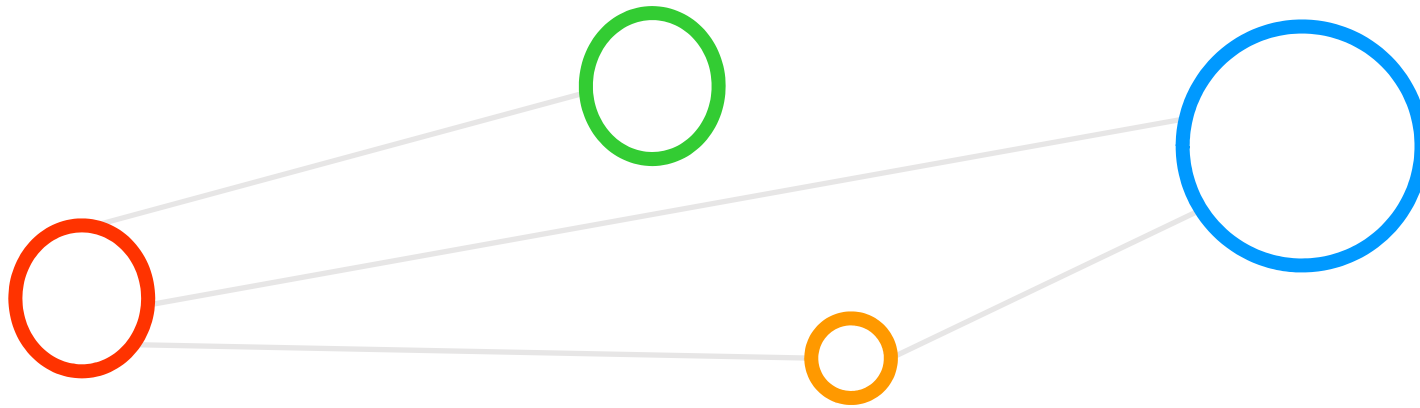
Icelandic National Infrastructure for HPC



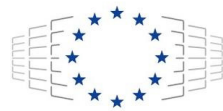
Icelandic National Resource Allocation Principle & LUMI – Work-in-Progress



EuroHPC – LUMI Supercomputer in Finland



EuroHPC – LUMI Supercomputer in Finland



EuroHPC
Joint Undertaking

LUMI

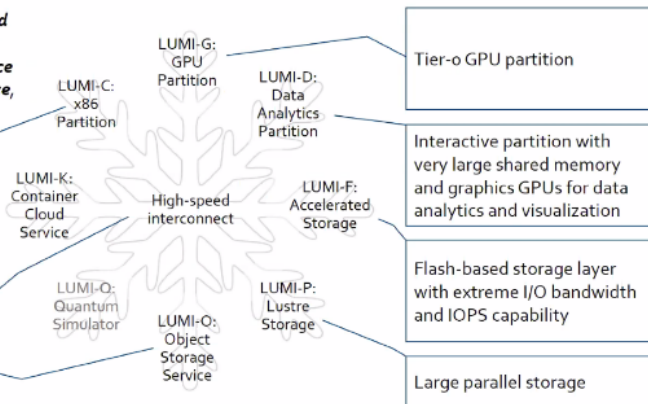
LUMI system architecture

LUMI is a Tier-0 GPU-accelerated supercomputer that enables the convergence of high-performance computing, artificial intelligence, and high-performance data analytics.

- Supplementary "Tier-1" CPU partition
- M, L and XL memory nodes

Possibility for combining different resources within a single run

Encrypted object storage (Ceph) for storing, sharing and staging data



1 SYSTEM
550+ Pflop/s
PEAK PERFORMANCE

LUMI's computing power will be over 550 petaflops.

COMPUTING POWER EQUALS
1.5 MILLION
MODERN LAPTOP'S
CAPACITY

LUMI's computing power is equivalent to the combined performance of 1.5 million of the latest laptop computers. These would form over 23-kilometer high tower.

117 PB
STORAGE

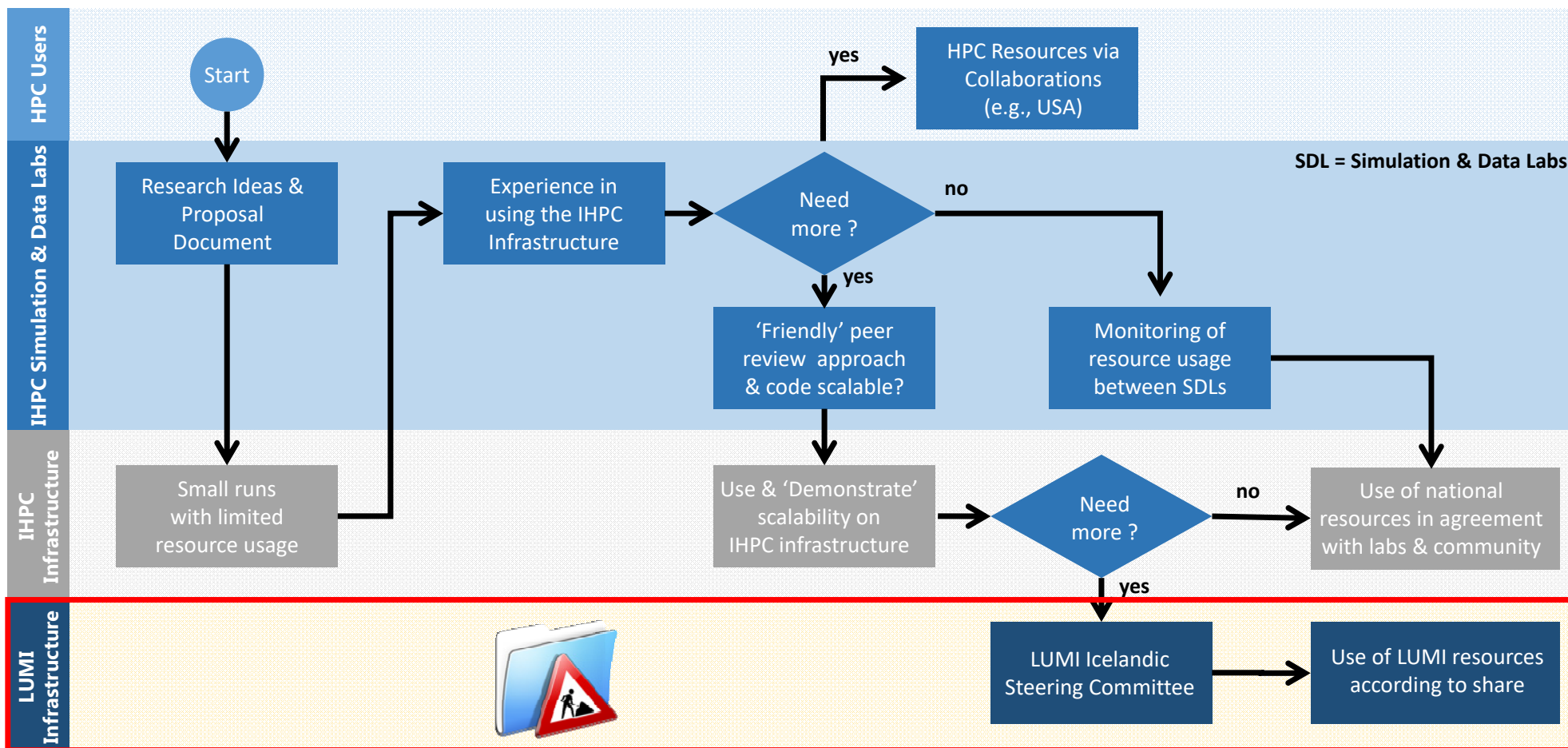
In total, LUMI will have astounding storage of 117 petabytes and an impressive aggregated I/O bandwidth of 2 terabytes per second.

100%
HYDROPOWERED
ENERGY UP TO
200MW

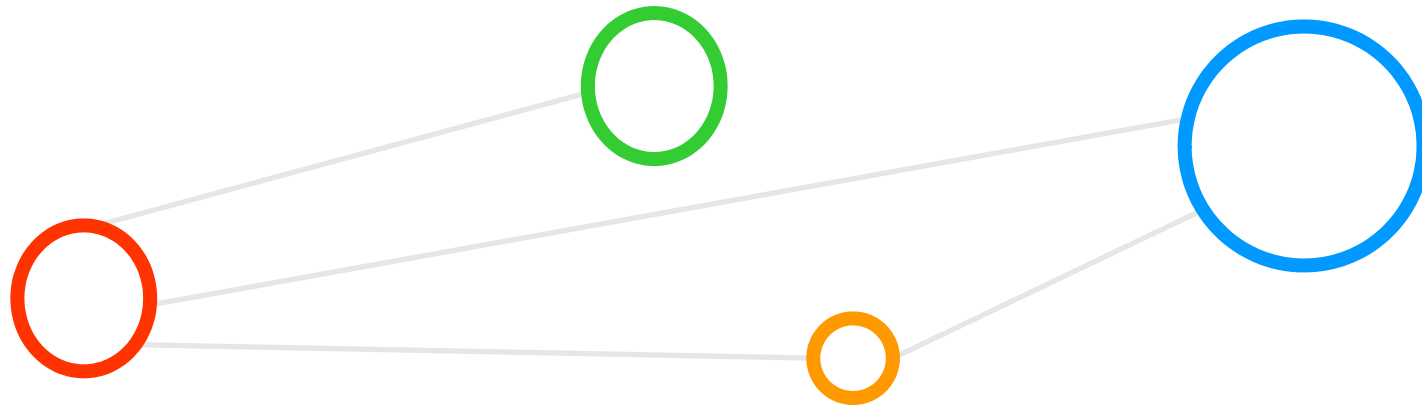
LUMI is using 100% hydropowered energy. Up to 200MWs are available. The waste heat of LUMI will produce 20 percent of the district heat of the area.

[6] LUMI Supercomputer

Icelandic National Resource Allocation Principle & LUMI – Work-in-Progress



Teaching & Education in HPC & AI



Teaching & Education in HPC & AI



Masterworks Webinar Series

Advanced Computing driven research in Health Sciences, Energy, and the Environment

Arctic Master Works Webinar and Panel Session 2 | Master Works Webinar and Panel Session 1

As part of an effort to promote and foster new scientific collaboration among Arctic nations, we are initiating a Master Works webinar series to highlight the impact of advanced computing in health sciences, energy, and environmental research. This webinar series brings together scientists from the U.S., Iceland and the Nordic countries to discuss compelling scientific challenges of common interest being addressed through advanced computing and to explore opportunities for collaboration. These Master Works events will feature two 30 minute presentations followed by a 30 minute panel session, total 90 min.

- Date: Wednesday December 9, 2020
- Time: 4pm GMT 10am CDT 9am MDT
- Zoom Link: [MasterWorks webinar link](#)

Presenter

Henrik Madsen - Professor, Head of Section, Dept. of Applied Mathematics and Computer Science (DTU COMPUTE), Technical University of Denmark.

Title: Digitalization for the future weather-driven low-carbon energy system

Abstract: Today energy systems are operated and planned such that the production follows the demand. However, a future low-carbon society calls for systems where demand follows the weather-driven energy production. This highlights a need for a disruption of the whole spectrum of methods ranging energy systems operation to planning. Most importantly we need methods for enabling energy flexibility at all levels of the society; examples being buildings, supermarkets, wastewater treatment plants, districts and cities. We describe a framework called the Smart-Energy Operating-System (SE-OS) for controlling the electricity load in integrated energy systems using big data analytics, AI, edge-to-cloud computing and IoT solutions. The framework can also provide ancillary services (like congestion management, voltage and frequency control) for systems with a large penetration of wind and solar power.

Ben Kroposki - Director of the Power Systems Engineering Center at the National Renewable Energy Laboratory and IEEE Fellow, where he leads strategic research in the design, planning and operations of electrical power systems.

Title: Understanding the Challenges with Integrating Very High Levels of Wind and Solar in Electric Power Systems

Webinar Series Organizing Committee

- Morris Riedel, Associate Professor, University of Iceland
- David Martin, Industry Partnerships and Outreach Manager, Argonne National Laboratory
- Henning Úlfarsson, Assistant Professor, Reykjavik University
- Steve Hammond, Senior Research Advisor, National Renewable Energy Laboratory



HÁSKÓLI ÍSLANDS



HÁSKÓLINN Í REYKJAVÍK
REYKJAVÍK UNIVERSITY

Teaching HPC & AI university courses at two universities



EuroHPC
Joint Undertaking

emerging education activities



long-term center of excellence in HPC, e.g. RAISE

European Commission | Funding & tender opportunities
Single Electronic Data Interchange Area (SEDIA)

SEARCH FUNDING & TENDERS | HOW TO PARTICIPATE | PROJECTS & RESULTS | WORK AS AN EXPERT | SUPPORT

Training and Education on High Performance Computing

TOPIC ID: EuroHPC-2020-03

[Grant](#)

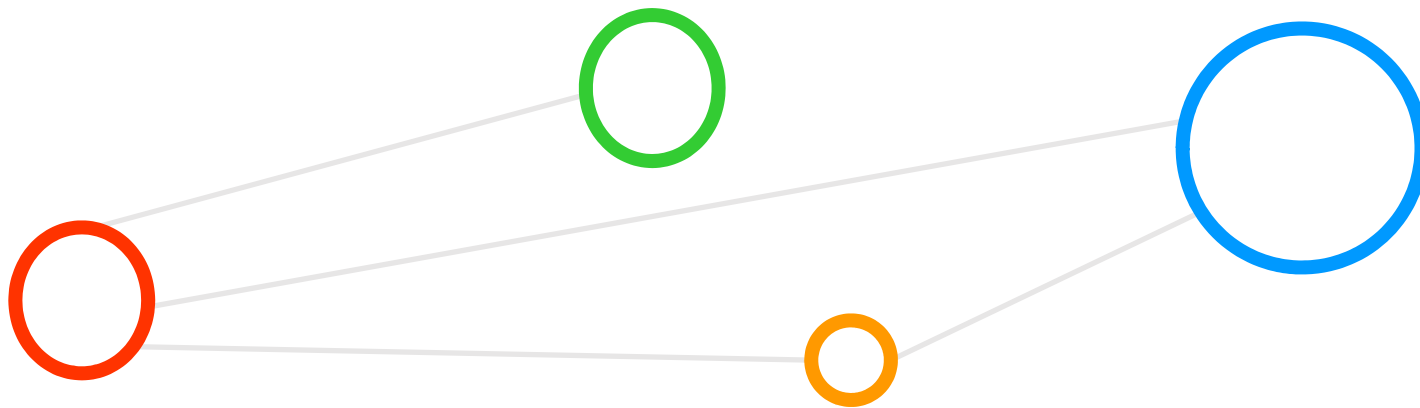
General information	General information	
Topic description	Programme	
Conditions and documents	Horizon 2020 Framework Programme	
Partner search	Call	
Submission service	Training and Education on High Performance Computing (H2020-JTI-EuroHPC-2020-03)	
Topic related FAQ	Type of action	
Get support	EuroHPC-CSA EuroHPC-CSA	
Call updates	Deadline model	Opening date
	single-stage	17 March 2021
		Deadline date
		01 July 2021 17:00:00 Brussels time

INDICATIVE Pillar 5: Investment Plan for 2021-27 Digital Europe Programme Funding

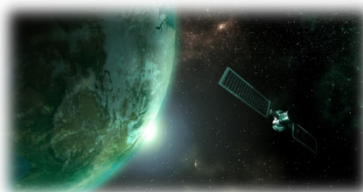
PILLAR	ACTION	Total EU (21 - 27)
Usage & Skills	Supporting Networking National Centres of Competence (CoC) on HPC (Actions to strengthen the wide application of HPC and increasing the innovation potential of SMEs using advanced HPC services)	€100M
Usage & Skills	Education (Curricula development) - Short Term trainings/Traineeships	€30M
Usage & Skills	M.Sc. HPC	€20M



International Cooperations – EU Projects in the HPC Field



DEEP Series of HPC Projects – Modular Supercomputing Architecture Research



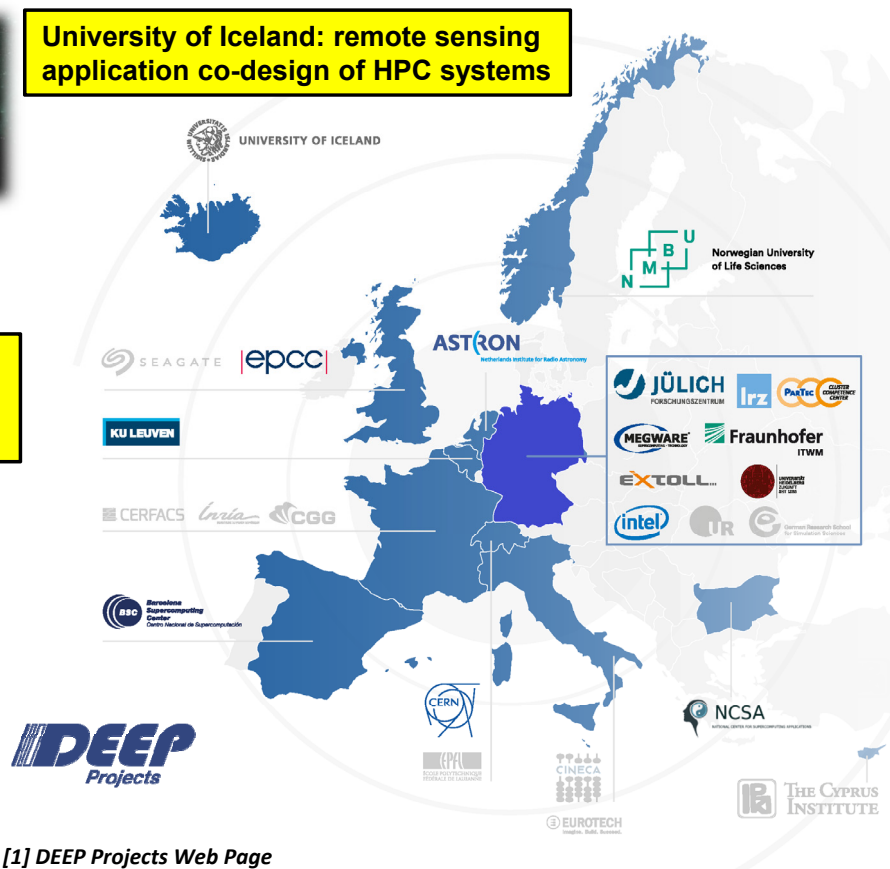
University of Iceland: remote sensing application co-design of HPC systems

Strong collaboration with our industry partners Intel, Extoll & Megware

Strong collaboration with industry partners Intel, Extoll & Megware

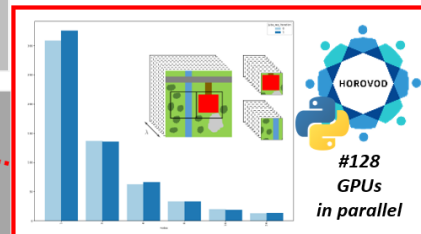
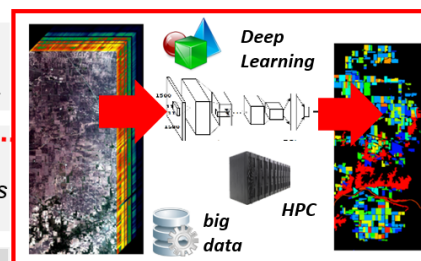
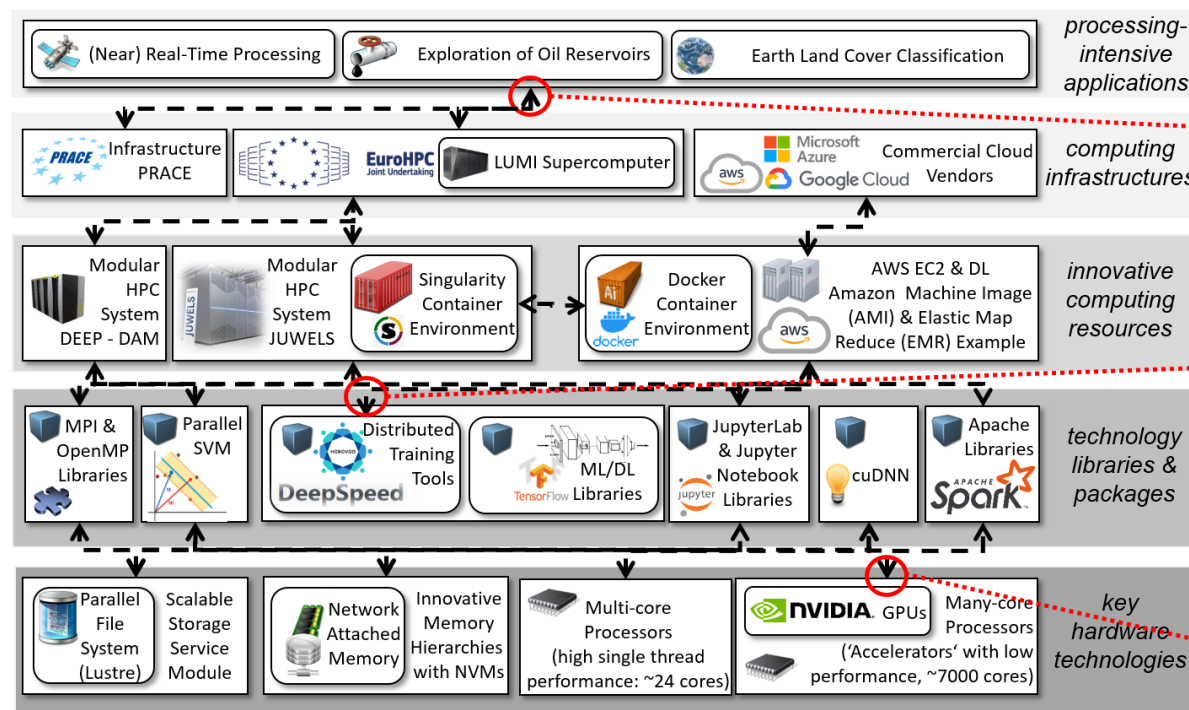
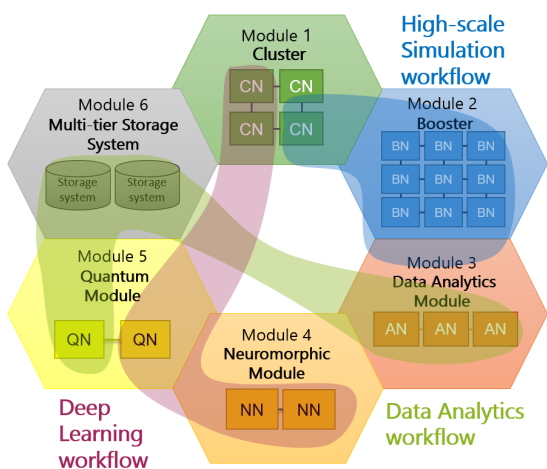
Juelich Supercomputing Centre implements the DEEP projects designs in its HPC infrastructure

- 3 EU Exascale projects
DEEP, DEEP-ER, DEEP-EST
- 27 partners
Coordinated by JSC
- EU-funding: 30 M€
JSC-part > 5,3 M€
- Nov 2011 – Mar 2021



[1] DEEP Projects Web Page

DEEP Series of Projects – Research Examples & Need for Academic HPC Centres

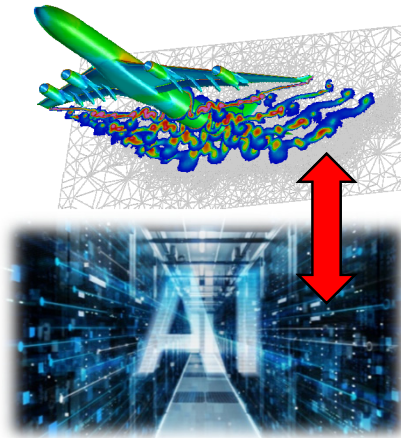
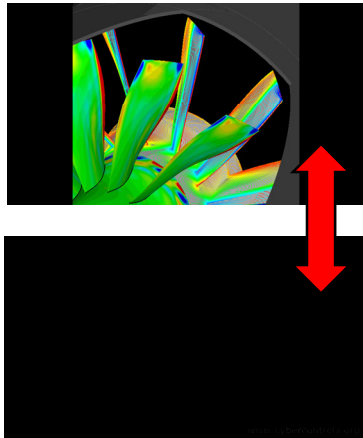
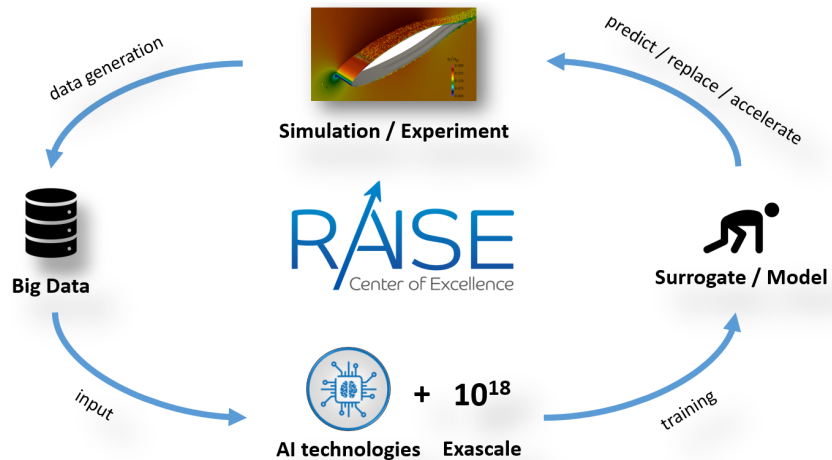


The modular supercomputing architecture (MSA) enables a flexible HPC system design co-designed by the need of diverse research application workloads

Commercial cloud computing is no option to be used here instead (e.g., Amazon Web Services charge 24\$/hour GPU)

[11] R. Sedona & M. Riedel et al., MDPI, Journal of Remote Sensing

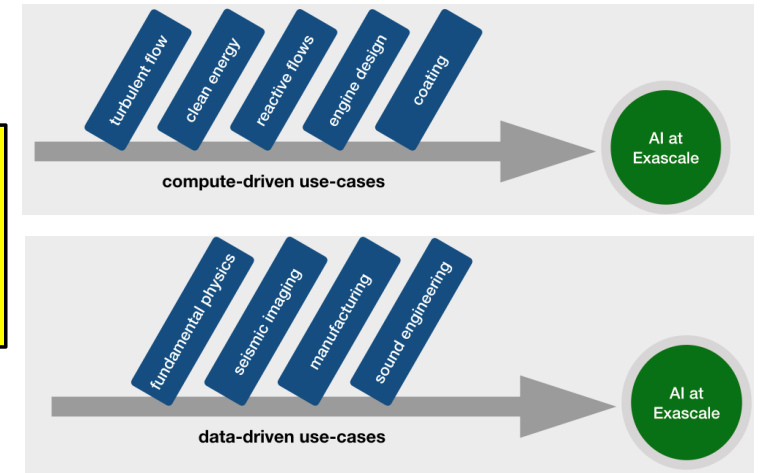
NEW RAISE Center of Excellence (CoE) EU Project – HPC Intertwined with AI



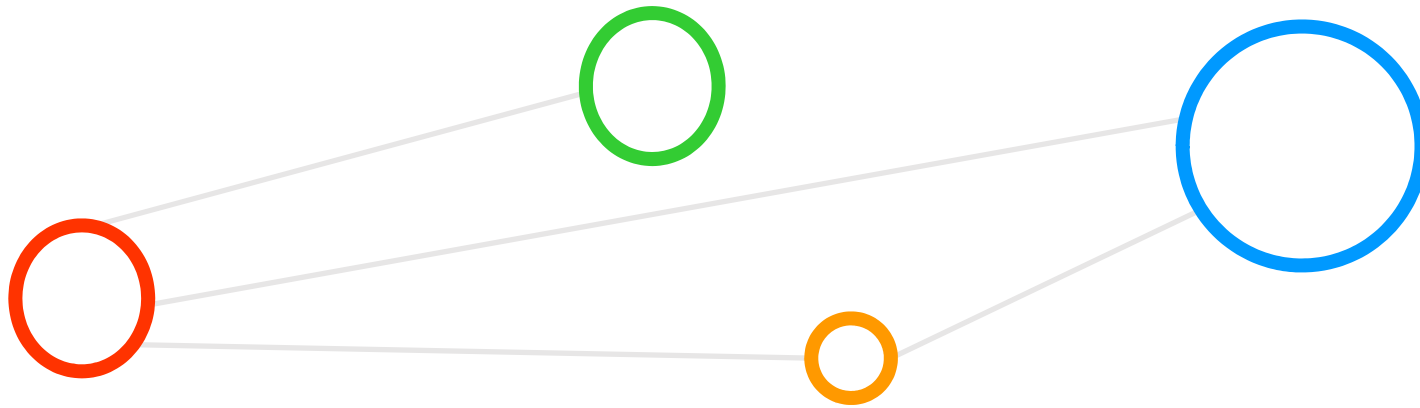
[4] CoE RAISE Web Page

[3] Simulation Figure

RAISE funds three use cases for the University of Iceland in the area of AI-enabled remote sensing, sound engineering, and links with our computational fluid dynamics activities



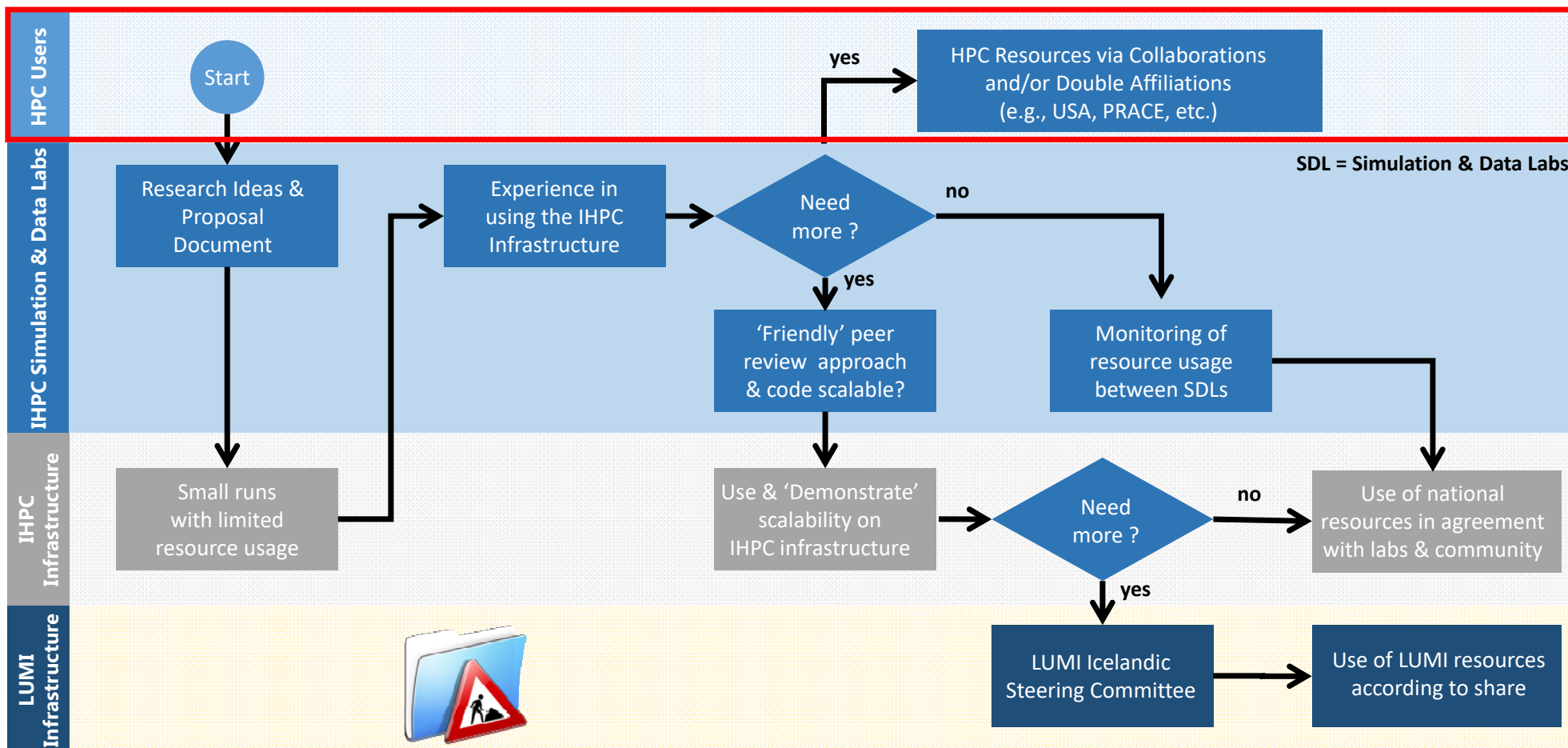
International Cooperations – Juelich Supercomputing Centre – Germany



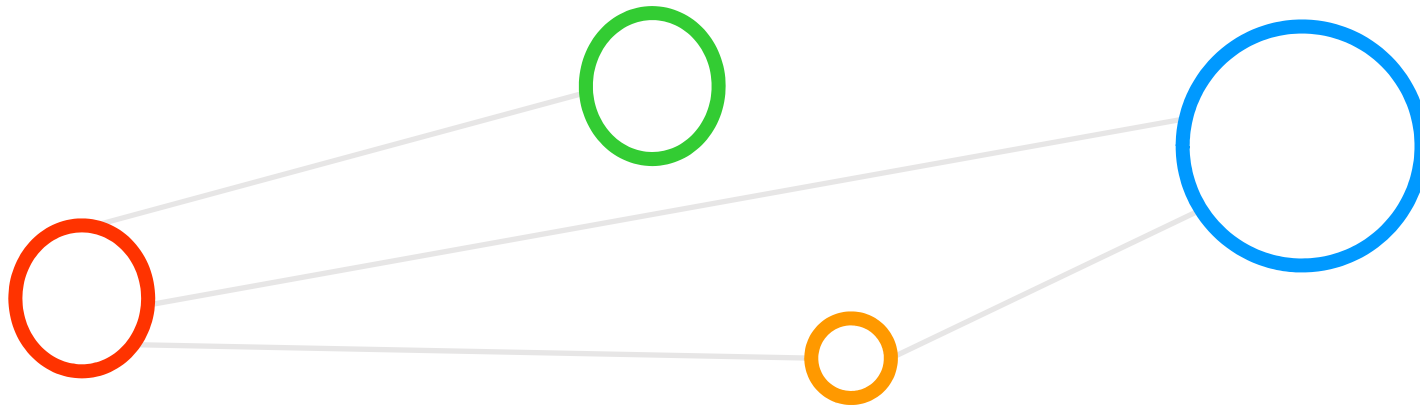
International Collaboration Partners: Juelich Supercomputing Centre



Icelandic National Resource Allocation Principle & LUMI – Work-in-Progress



Lecture Bibliography



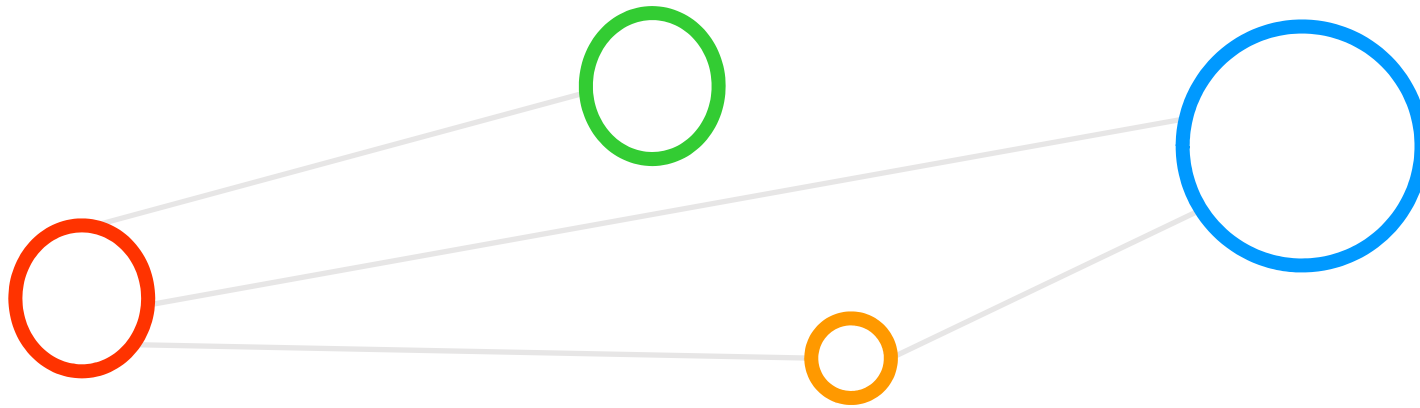
Selected References (1)

- [1] DEEP Series of Projects Web page, Online:
<http://www.deep-projects.eu/>
- [2] YouTube Video, 'flexible and energy-efficient supercomputer: JUWELS is faster than 300 000 modern PCs' Online:
<https://www.youtube.com/watch?v=t5kNxPT5rSY&list=PLCer2BlxxQ2zToC6SRVlfwj0MO1-xli6I>
- [3] Copyright Institute of Aerodynamics and Chair of Fluid Mechanics, RWTH Aachen University, Online:
<https://www.aia.rwth-aachen.de>
- [4] CoE RAISE Web page, Online:
<http://www.coe-raise.eu>
- [5] EuroHPC Joint Undertaking Web page, Online:
<https://eurohpc-ju.europa.eu/>
- [6] LUMI EuroHPC Supercomputer hosted at CSC Finland, Online:
<https://www.lumi-supercomputer.eu/>
- [7] YouTube, Morris Riedel, UTmessan 2020 - Demystifying Quantum Computing, Online:
<https://www.youtube.com/watch?v=EQGshhspn9A>
- [8] D. Willsch, M. Willsch, H. De Raedt, K. Michielsen, 'Support Vector Machines on the D-Wave Quantum Annealer', Online:
<https://www.sciencedirect.com/science/article/pii/S001046551930342X951733>
- [9] Cavallaro, G., Willsch, D., Willsch, M., Michielsen, K., Riedel, M.: APPROACHING REMOTE SENSING IMAGE CLASSIFICATION WITH ENSEMBLES OF SUPPORT VECTOR MACHINES ON THE D-WAVE QUANTUM ANNEALER, in conference proceedings of the IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2020), September 26 – October 2nd, 2020, Virtual Conference, Hawaii, USA, to appear, Online:
<https://igarss2020.org/Papers/ViewPapers.asp?PaperNum=1416>
- [10] Open PhD Position for the RAISE EU project @ Iceland, Online:
<https://www.gabriele-cavallaro.com/news/fully-funded-phd-position>

Selected References (2)

- [11] R. Sedona, G. Cavallaro, J. Jitsev, A. Strube, M. Riedel, J.A. Benediktsson, 'Remote Sensing Big Data Classification with High Performance Distributed Deep Learning', MDPI Journal of Remote Sensing, Online:
https://www.researchgate.net/publication/338077024_Remote_Sensing_Big_Data_Classification_with_High_Performance_Distributed_Deep_Learning
- [12] EuroCC Project, Online:
<http://www.eurocc-project.eu>
- [13] Juelich Supercomputing Centre – SimLabs Blueprint, Online:
https://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/simlab_node.html
- [14] Icelandic HPC Community Page, Online:
<https://ihpc.is/>

ACKNOWLEDGEMENTS



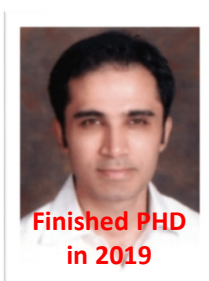
Acknowledgements – High Productivity Data Processing Research Group



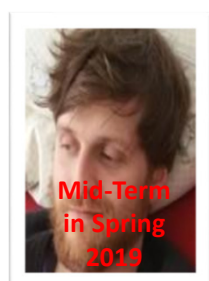
PD Dr.
G. Cavallaro



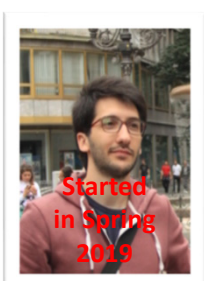
Senior PhD
Student
A.S. Memon



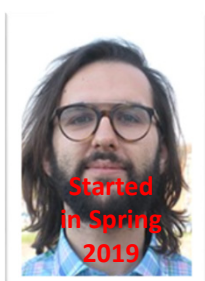
PD Dr.
M.S. Memon



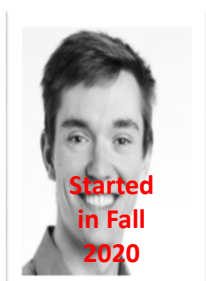
PhD Student
E. Erlingsson



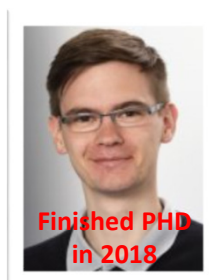
PhD Student
S. Bakarat



PhD Student
R. Sedona



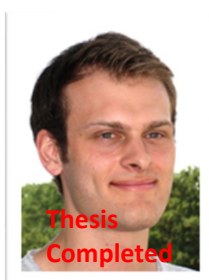
PhD Student
P. H. Einarsson



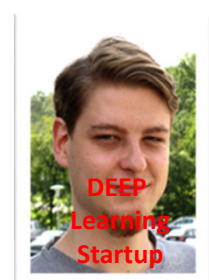
Dr. M. Goetz
(now KIT)



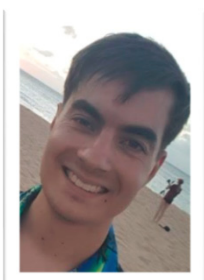
MSc M.
Richerzhagen
(now other division)



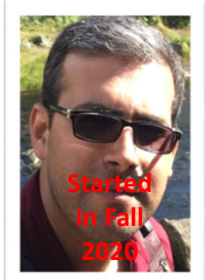
MSc
P. Glock
(now INM-1)



MSc
C. Bodenstein
(now
Soccerwatch.tv)



MSc G.S.
Guðmundsson
(Landsverkjun)



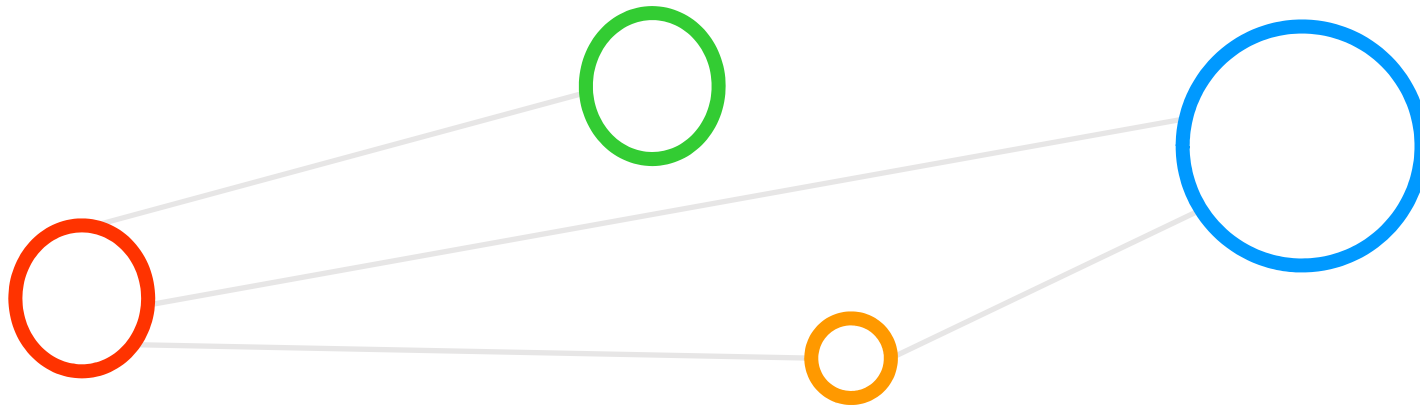
PhD Student
Reza



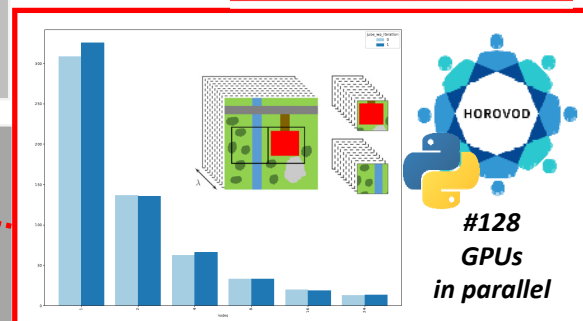
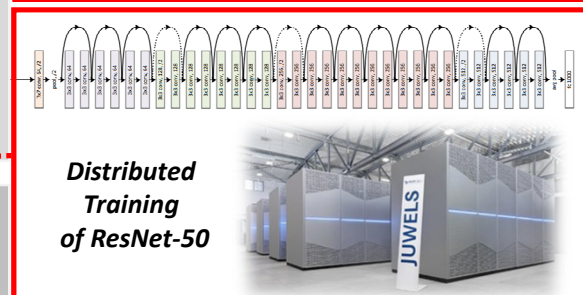
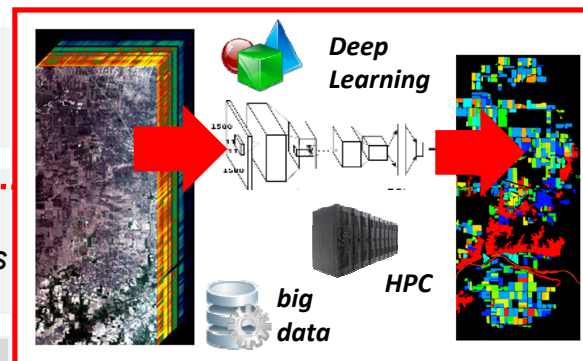
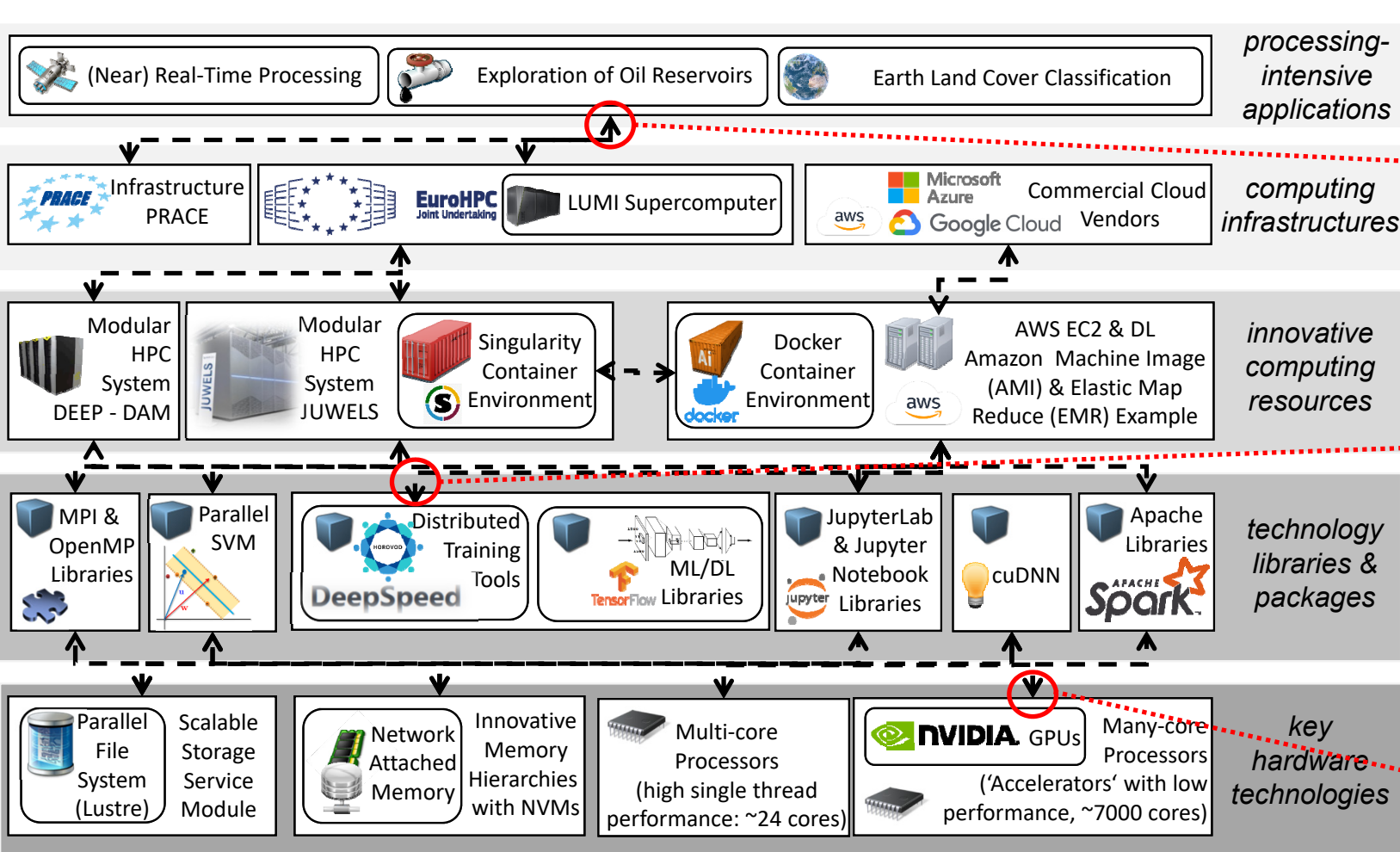
This research group has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 763558 (DEEP-EST EU Project) and grant agreement No 951740 (EuroCC EU Project) & 951733 (RAISE EU Project)



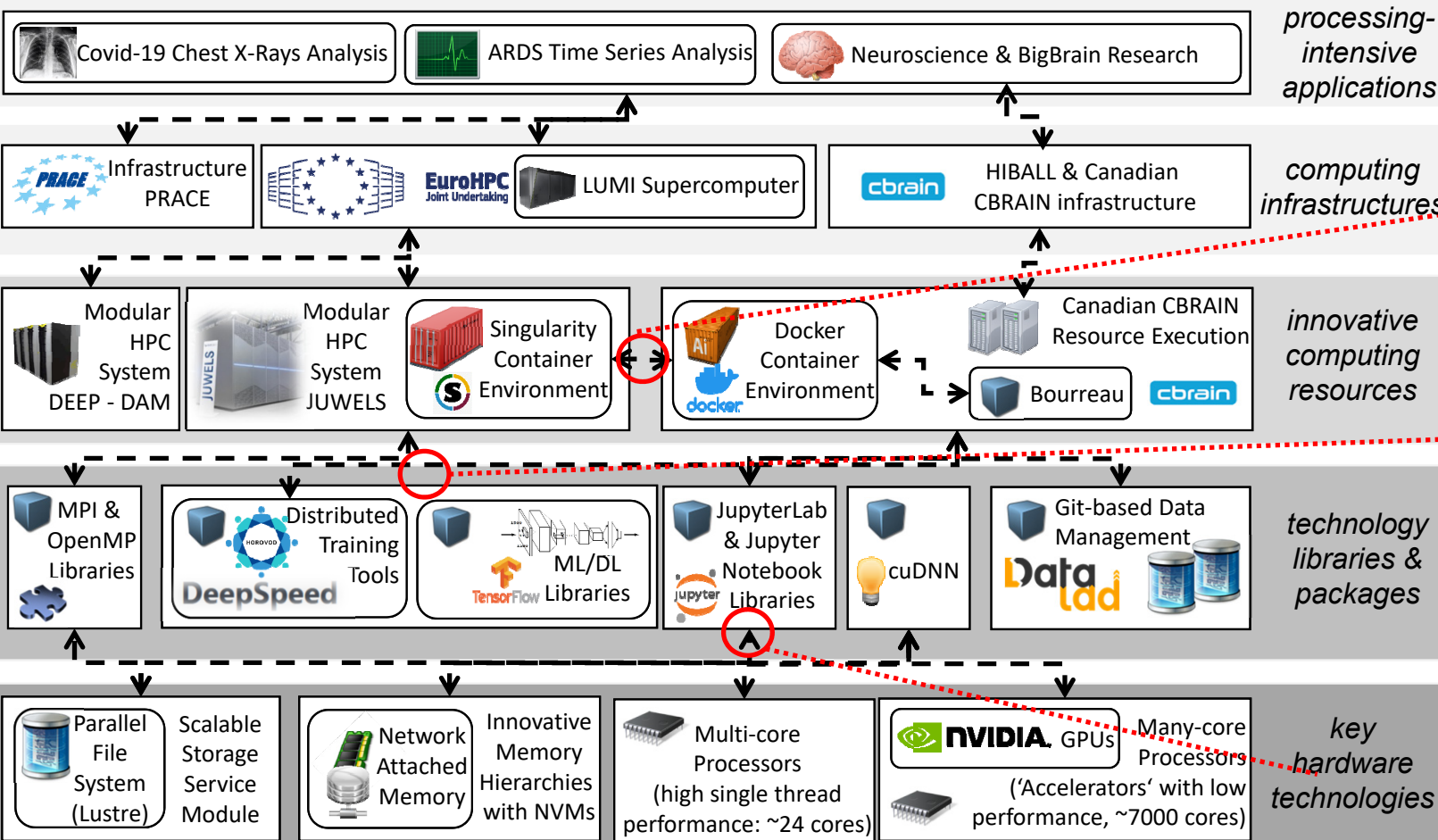
Appendix



Research Examples – Remote Sensing AI & HPC Applications



Research Examples – Health & Medical AI & HPC Applications



Some preparation

```
$ mkdir winterschool_winterschool_cache winterschool_tmp
$ chmod +w winterschool_cache
$ export SINGULARITY_CACHEDIR=$(mktemp -d -p "$(pwd)/winterschool_cache")
$ export SINGULARITY_TMPDIR=$(mktemp -d -p "$(pwd)/winterschool_tmp")
```

Pull the docker image:

```
$ cd winterschool
$ singularity pull hws.sif docker://glatard/hws
```

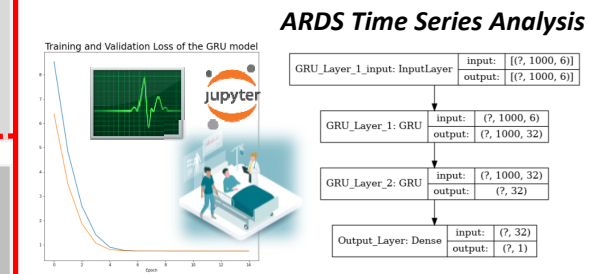
Step into the container

```
$ singularity shell ./hws.sif
(the prompt changes to `>Singularity`)
```

download a dataset:

```
$ git config --global user.name "Your name"
$ git config --global user.email "peturhelgi@gmail.com"
```

Singularity> datalad install https://github.com/CONP-PCNO/conp-dataset.git



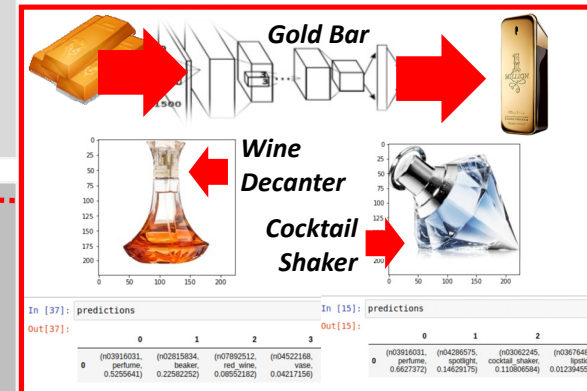
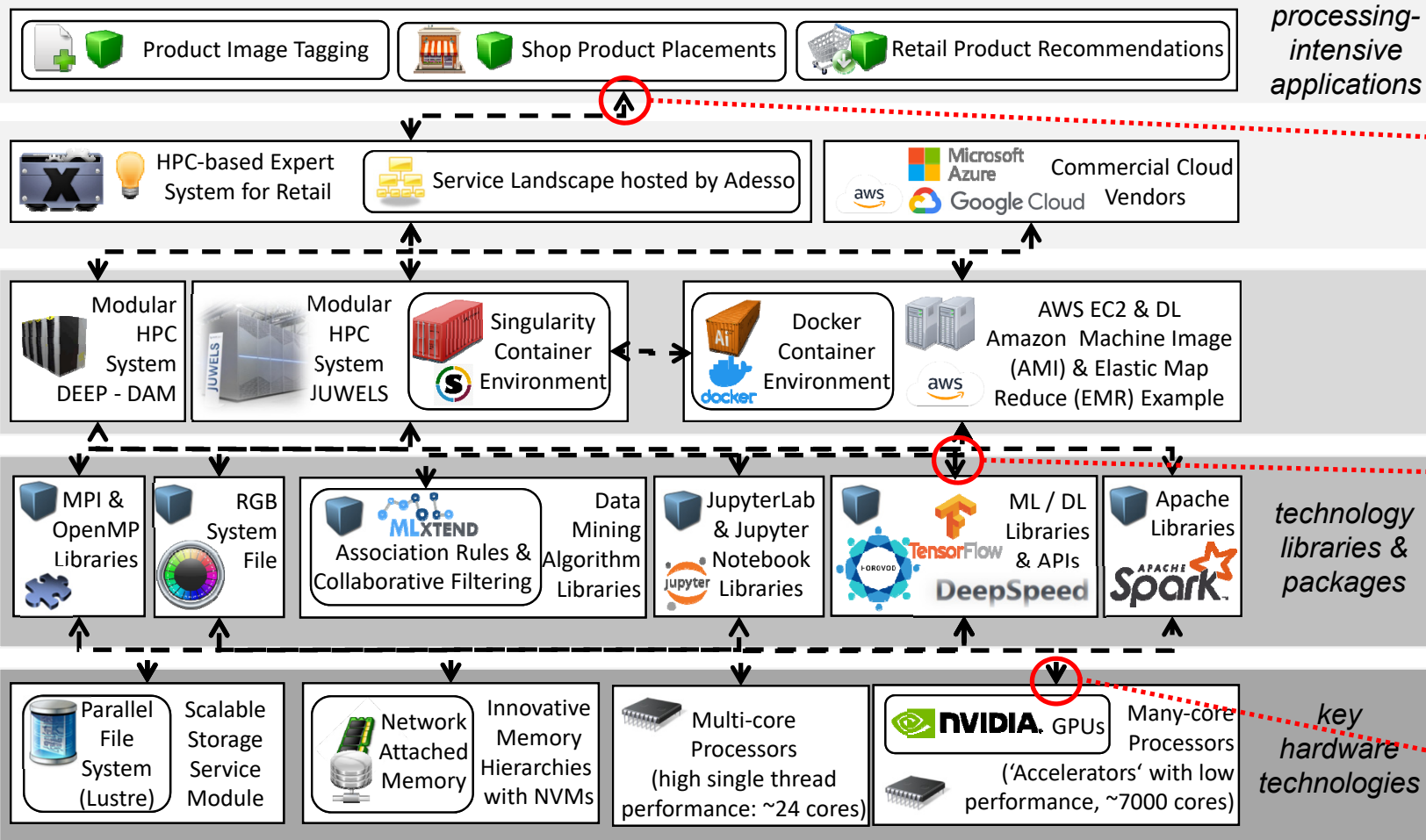
Covid-19 Chest X-Ray Analysis

Covid-Net

```
#!/bin/bash
# Load required modules
module purge
module use $OTHERSTAGES
module load Stages/2020
module load GCCcore/9.3.0
module load Python/3.8.5
module load TensorFlow/2.3.1-Python-3.8.5
module load OpenCV/4.5.0-Python-3.8.5
# Activate Python virtual environment
source /p/project/training2104/ingolfsson1/jupyter/kernels/ingolfsson1_kernel/bin/activate
# Ensure python packages installed in the virtual environment are always preferred
export PYTHONPATH=/p/project/training2104/ingolfsson1/jupyter/kernels/ingolfsson1_kernel/lib
exec python -m ipynbkernel $@
```

Covid-X Dataset

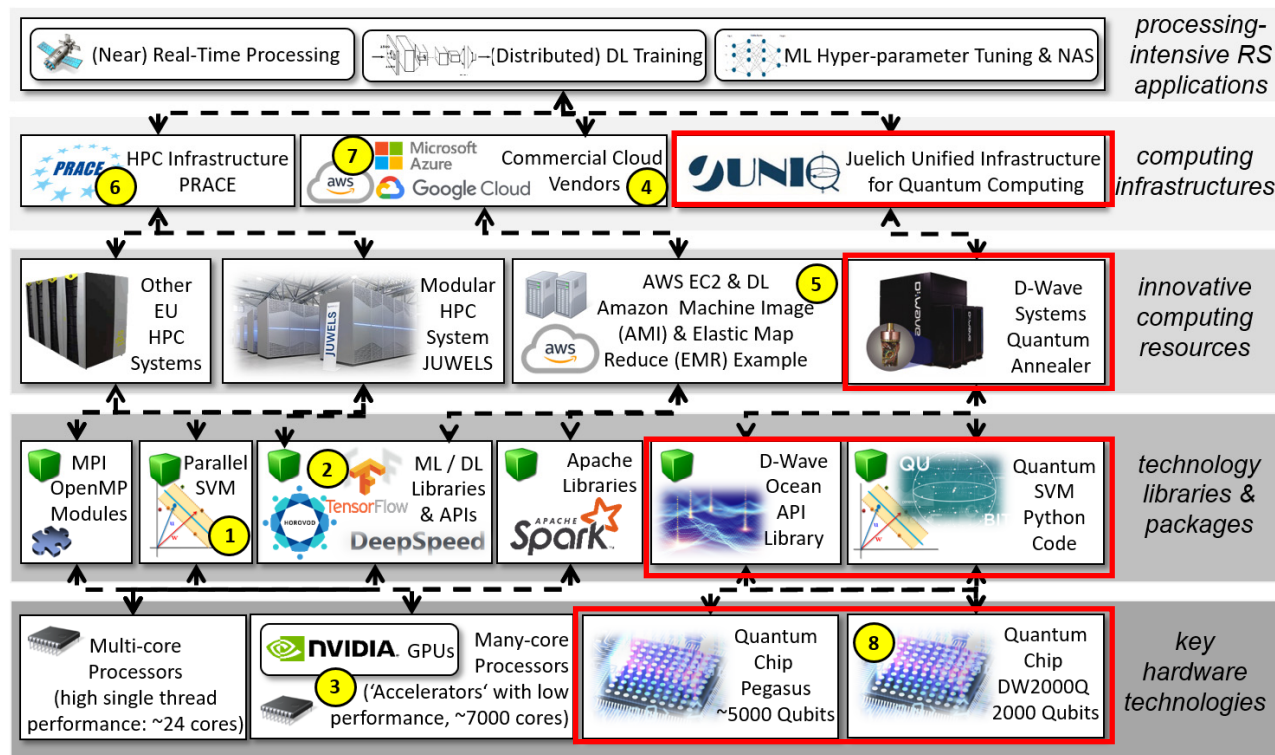
Research Examples – Retail AI & HPC Applications



#GPUs	images/s	speedup	Performance per GPU [images/s]
1	55	1.0	55
4	178	3.2	44.5
8	357	6.5	44.63
16	689	12.5	43.06
32	1230	22.4	38.44
64	2276	41.4	35.56
128	5562	101.1	43.45

#128 GPUs in parallel

Research Examples – Quantum Module with D-Wave Systems Quantum Annealer



- 1 Parallel ML implementations still rare (MPI/OpenMP)
- 2 Open source tools good, but all need to fit in versions
- 3 Using very many GPUs beyond NVlink could be tricky
- 4 Look & feel of CC vendor ML services differ significantly
- 5 Costs of GPUs of CC vendors (e.g., EC2) tough, 24\$/hour
- 6 GPU hours are free, but requires time grant proposal
- 7 Free GPUs in Google Colab vary in the available types
- 8 Works not yet with multi-class problems & large data

Legend:
N Highlighted Challenges & Experiences

```
In [ ]: from quantum_SVM import *
import numpy as np
from utils import *
from sklearn.model_selection import KFold
from sklearn import preprocessing

# Write the data
experiment=1
slices=0 # Number of samples to use for the training
fold=int(len(X_train)/40)

print(fold)

for i in range(0,experiment):
    cv = KFold(n_splits=fold, random_state=i, shuffle=True)
    count=0
    for test_index, train_index in cv.split(X_train):
        #print("Train index: ", len(train_index), "\n")
        X_train_slice = X_train[train_index], Y_train[train_index]
        X_train_slice = preprocessing.scale(X_train_slice)

        X_test_slice = X_train[test_index], Y_train[test_index]
        X_test_slice = preprocessing.scale(X_test_slice)
```

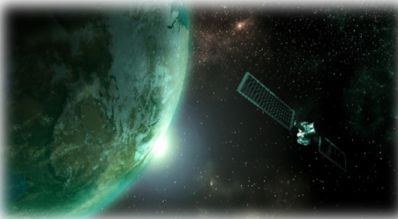
(a) cSVM (b) qSVM#1 (c) qSVM#6 (d) qSVM#16

[9] Approaching Remote Sensing Image Classification with Ensembles of SVMs on the D-Wave Quantum Annealer, G. Cavallaro & M. Riedel et al.

Morris Riedel
Juelich Super-computing Centre
Demystifying Quantum Computing

[8] Quantum SVM, D. Willsch et al. [7] M. Riedel, UTMessan 2020 YouTube Video

Open PhD Position Available in EU Project RAISE @ Iceland



Information

The PhD position is funded by the EU project Center of Excellence "Research on AI- and Simulation-Based Engineering at Exascale" (CoE RAISE). This project will be the excellent enabler for the advancement of European multi-physics and/or multi-scale applications on industrial and academic level and a driver for novel intertwined AI and HPC technologies.

👤 **Supervisor:** Prof. Morris Riedel (University of Iceland)

👥 **Co-Supervisors:** Dr. Gabriele Cavallaro (Jülich Supercomputing Centre) and Prof. Magnús Örn Úlfarsson (University of Iceland)

📅 **Starting date:** January 2021

⚠️ (Due to the current corona pandemic, the first work period can be conducted remotely)

📍 **Location:** Reykjavík (Iceland). You will be employed at the University of Iceland. A research stay at the Jülich Supercomputing Centre (Forschungszentrum Jülich, Germany) is envisaged for a minimum period of time of 6 months. To obtain your PhD degree at the University of Iceland you will have to acquire 30 ECTS from courses and seminars. Your working hours will be not monitored and working from home will be largely permitted.

🎯 **Goal:** pioneer the research of advanced deep transfer learning methods in the context of complex learning scenarios in applications from remote sensing. The priority will be put on the investigation of the transferability capacity of Deep Learning (DL) models with meta-learning and Neural Architecture Search methods.

🧑‍🔬 **Research Group:** be part of our joint research group "High Productivity Data Processing" at University of Iceland and Jülich Supercomputing Centre. The group is highly active in developing parallel and scalable machine (deep) learning algorithms for remote sensing data processing and many other types of applications (i.e., medical research and retail sectors).

⚙️ **Working Environment:** Direct access to high performance multi-GPU systems equipped with the state-of-the-art of DL frameworks (TensorFlow, pyTorch, Chainer, Horovod, DeepSpeed). There is also the possibility to access innovative quantum computing systems.

📖 **Other information:** You will have the possibility to participate in international top conferences in the field of machine learning, HPC and remote sensing. You will be put in contact with several international partners for initiating research collaborations that match the topic of the PhD.

🎓 **Background education:** MSc degree in computer science or computer engineering. Level of English \geq B2.

🧠 **Required knowledge and experience:** deep learning (Convolutional Neural Networks and/or Transformers) and Python programming (TensorFlow and/or pyTorch). Experience with parallel programming (OpenMP and MPI), High Performance Computing (HPC) and remote sensing data processing are a substantial plus.

✉️ **Apply:** Send your CV, a cover letter and the transcripts of records of your bachelor and master to Gabriele Cavallaro: g.cavallaro@fz-juelich.de.

[Apply now](#)

A screenshot of a Facebook post. At the top, it shows the profile of Morris Riedel, Professor & Head of Research Group High Productivity Data Processing Juelich. Below his name is a post by Dr. -Ing. Gabriele Cavallaro, 1st, Machine Learning | HPC | Remote Sensing, Deputy Head of a research group @ Jülich. The post text says: 'Fully-funded PhD position in our "High Productivity Data Processing" research group at the University of Iceland - Háskóli Íslands'. Below the text is a large, scenic photograph of a mountain peak with a waterfall in the foreground. At the bottom of the image, the text 'PHD POSITION IN ICELAND' is written in large, bold, white letters.

[10] Open PhD Position, RAISE EC Project @ Iceland