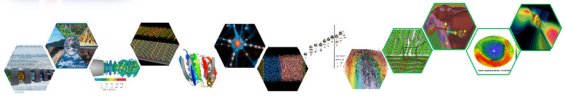
Executive Summary - HPC Activities in Iceland

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

21TH APRIL, KAISER GLOBAL MEETING, UNIVERSITY OF ICELAND, MAIN BUILDING

@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

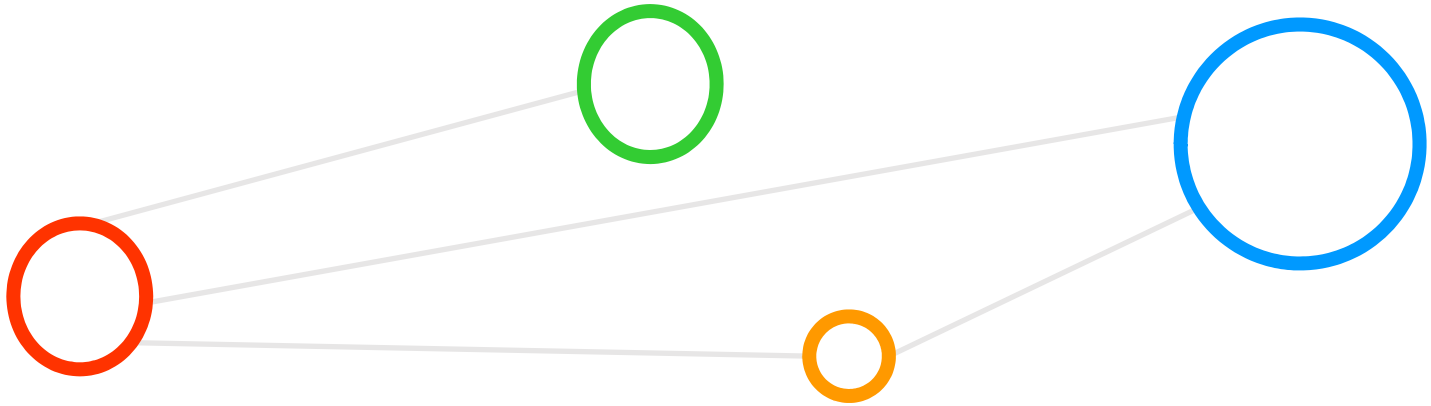
EURO

HELMHOLTZAI | ARTIFICIAL INTELLIGENCE COOPERATION UNIT

DEEP Projects

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

Executive Summary – Major Icelandic HPC Activities



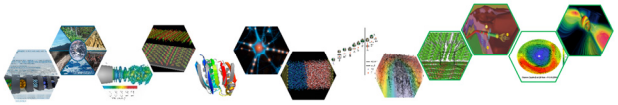
Executive Summary – Major Icelandic HPC Activities

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

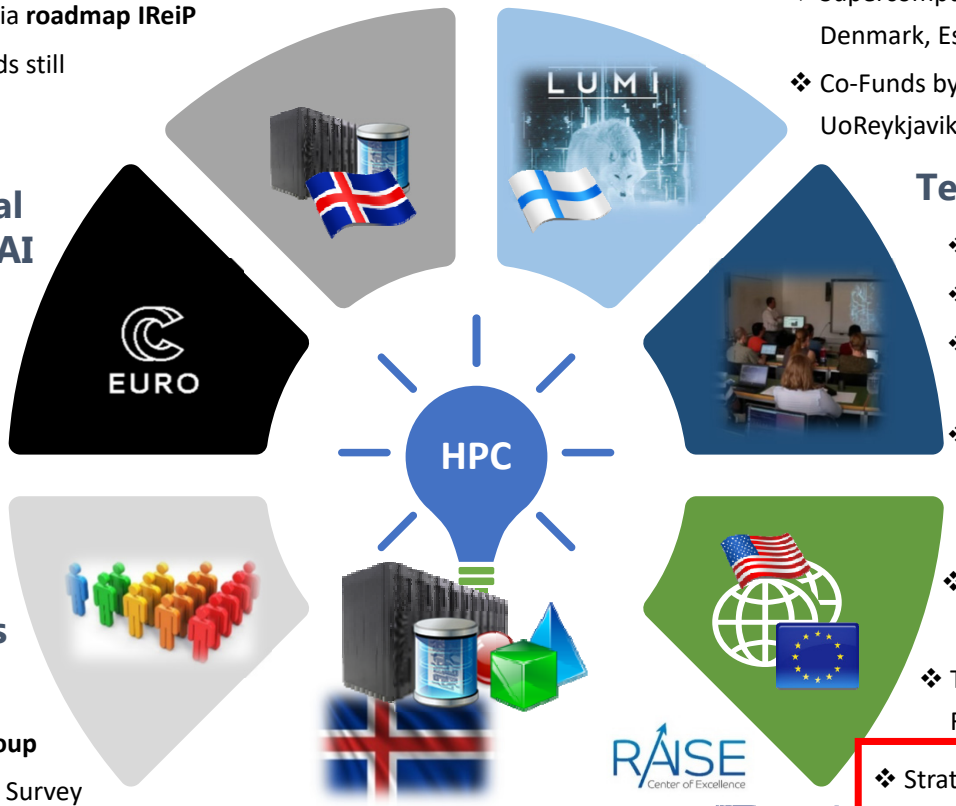
EuroHPC EuroCC National Competence Center for HPC & AI

- ❖ 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.



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

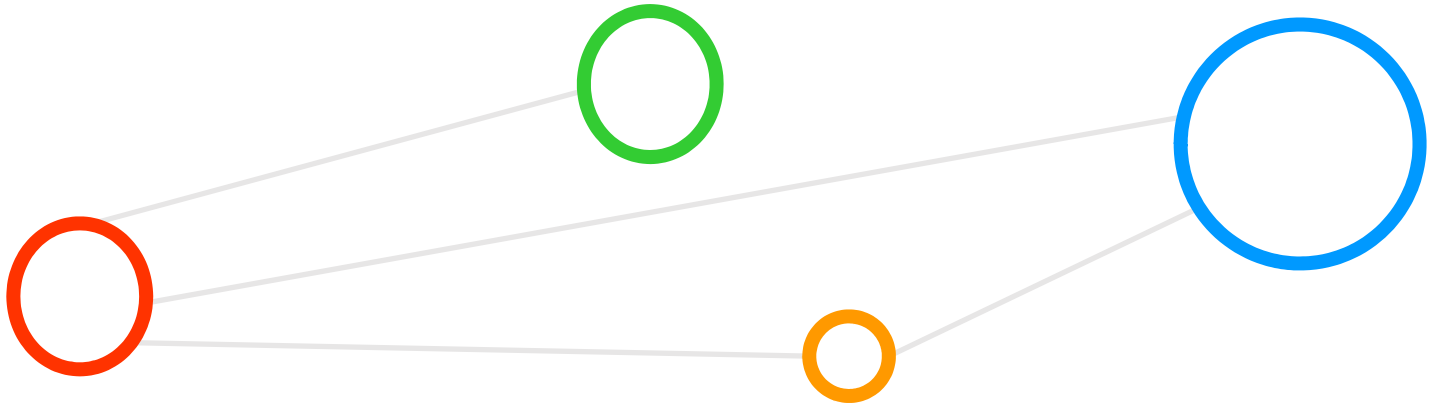
Teaching & Education in HPC & AI

- ❖ 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
Háskóli Íslands - VON	Ebba Þóra Hvannberg	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Ivan Shelykh	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Egill Skúlason	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Lotta María Ellingsen	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Haraldur Ólafsson	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Jesus Zavala Franco	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Jón Tómas Guðmundsson	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Pedro Simoes Costa	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Helmut Wolfram Neukirchen	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Morris Riedel	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Freysteinn Sigmundsson	Vikulega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - Heilbrigðisvísindasvið	Bryndís Eva Birgisdóttir	Vikulega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Tölvunarfræðideild	Eliahu August	Mánaðarlega	Doktorsgráða / eða sambærilegt

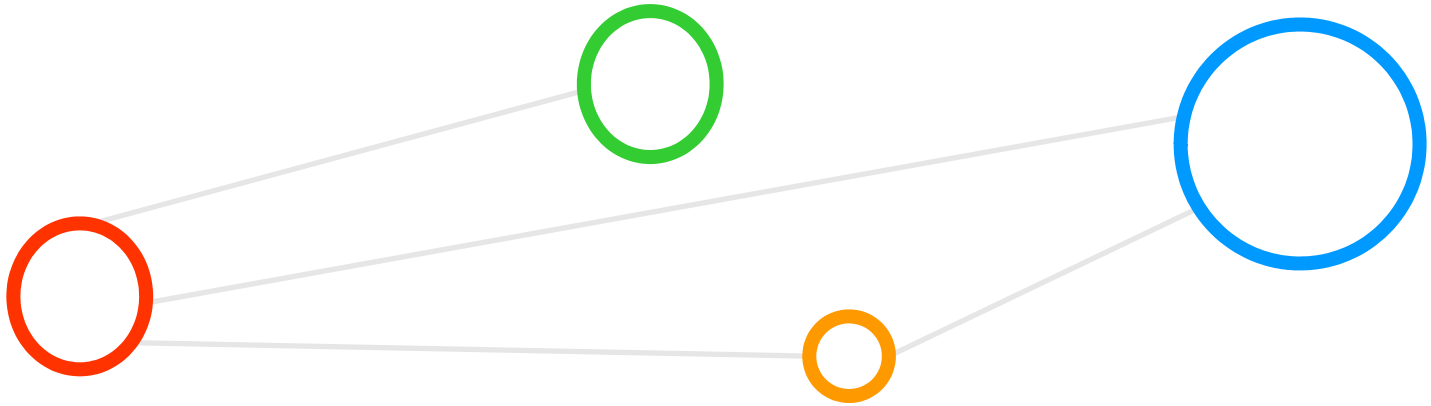
Háskólinn í Reykjavík - Verkfræðideild	Yonatan Afework Tesfahunegn	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Verkfræðideild	Erna Sif Arnardóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Verkfræðideild	Jón Guðnason	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Verkfræðideild	Kristinn Torfason	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Tölvunarfræðideild	María Óskarsdóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Verkfræðideild	Andrei Manolescu	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Tölvunarfræðideild	Henning Arnór Úlfarsson	Vikulega	Doktorsgráða / eða sambærilegt
Háskólinn í Reykjavík - Verkfræðideild	Anna Maria Sitek	Mánaðarlega	Doktorsgráða / eða sambærilegt
Veðurstofa Íslands	Angel Ruiz Angulo	Mánaðarlega	Doktorsgráða / eða sambærilegt
Veðurstofa Íslands	Jórunn Harðardóttir ktal 0512683509	Mánaðarlega	Doktorsgráða / eða sambærilegt
Veðurstofa Íslands	Matthew James Roberts	Mánaðarlega	Doktorsgráða / eða sambærilegt
Veðurstofa Íslands	Jón Elvar Wallevik ktal 1710684799	Mánaðarlega	Doktorsgráða / eða sambærilegt
Háskóli Íslands - VON	Sigurður M Garðarsson	Mánaðarlega	Doktorsgráða / eða sambærilegt
Matís	Viggó Þór Marteinsson	Mánaðarlega	Doktorsgráða / eða sambærilegt

IHPC Community of Users (2)

Matís	Sæmundur Sveinsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Matís	Guðmundur Óli Hreggviðsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Matís	Ólafur Héðinn Friðjónsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Thor Aspelund	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Jóhanna Jakobsdóttir	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Unnur Anna Valdimarsdóttir	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - VON	Viðar Guðmundsson	Daglega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Inga Þórsdóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Hugvísindasvið	Guðmundur Hálfdánarson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Elín Soffía Ólafsdóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Heiða María Sigurðardóttir	Vikulega	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 Árnason	Mánaðarlega	Doktorsgráða / eða sambærilegt	

Háskóli Íslands - Heilbrigðisvísindasvið	Arnar Pálsson	Daglega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Birkir Þór Bragason	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Guðmundur H Guðmundsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Kalina Hristova Kapralova	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Kristinn Pétur Magnússon	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Ólafur Eysteinn Sigurjónsson	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Oddur Þór Vilhelmsson	Vikulega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Snæbjörn Pálsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Vilmundur G Guðnason	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Þórarinn Guðjónsson	Mánaðarlega	Doktorsgráða / eða sambærilegt	
Háskóli Íslands - Heilbrigðisvísindasvið	Margrét Þorsteinsdóttir	Mánaðarlega	Doktorsgráða / eða sambærilegt	

IHPC Community – Simulation and Data Labs (SDLs)



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

[12] EuroCC Project

- 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

[5] EuroHPC Joint Undertaking

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)

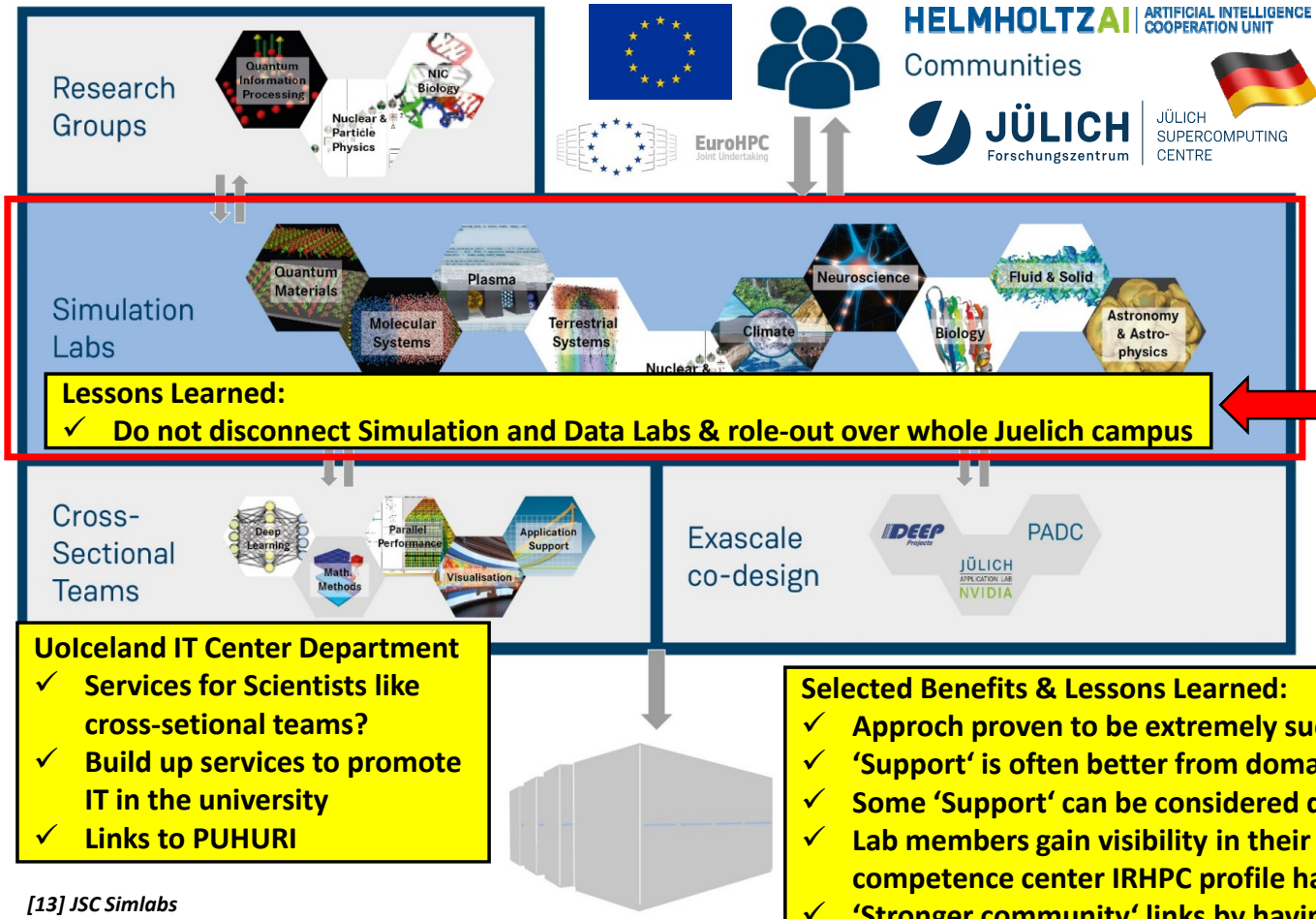
EuroCC funds two research activities for the University of Iceland in the area of neuroscience & computational fluid dynamics

setting up NCCs → roadmap definition → 1st phase of realisation & implementation → 2nd phase of realisation & implementation → continuation funding planed

timeline

- 1st NCC meetings arranged <M01>
- roadmap <M04>
- periodic report <M12>
- final report <M24>

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.'

Lessons Learned:
- ✓ **Do not disconnect Simulation and Data Labs & role-out over whole Juelich campus**

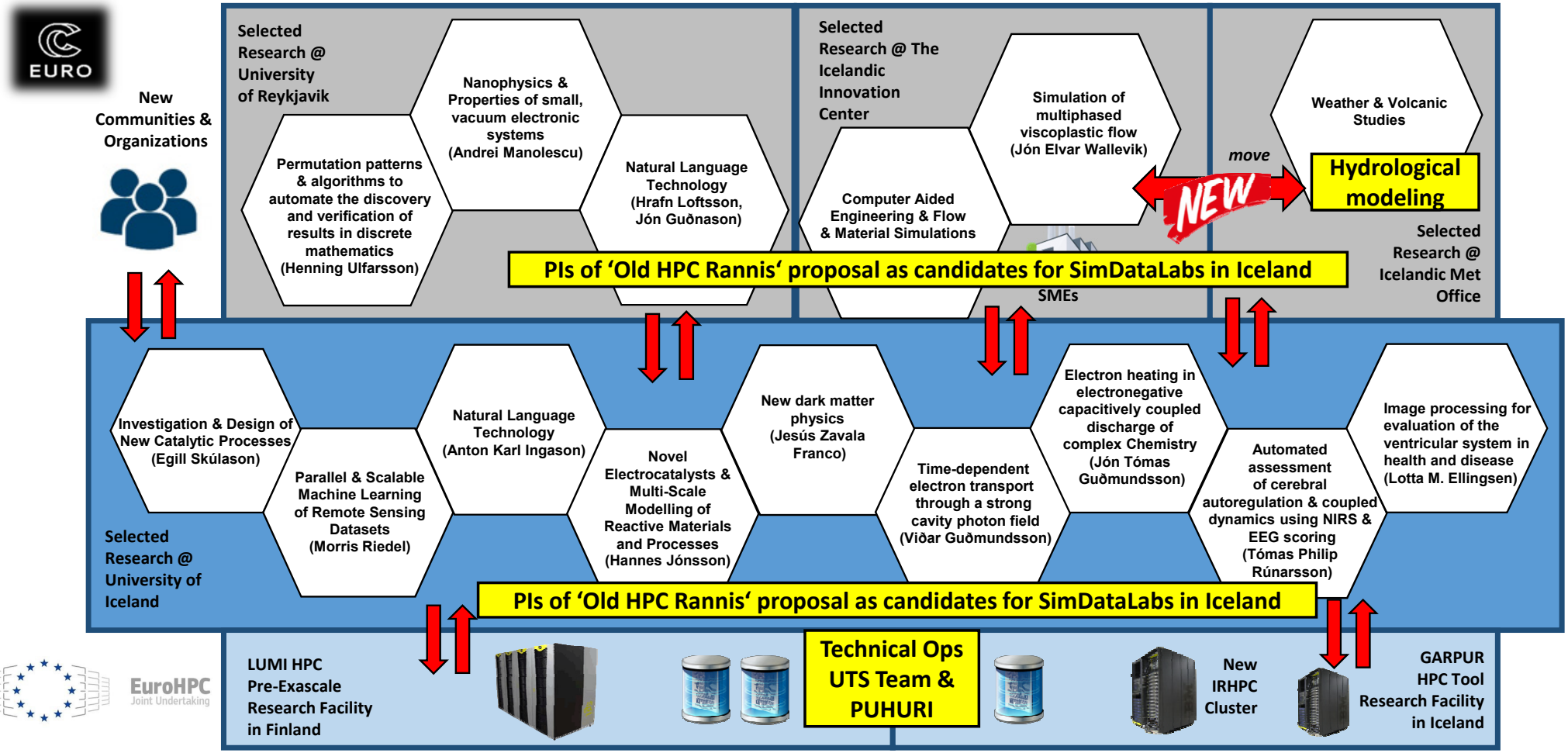
Lessons Learned:
- ✓ **The heart of an academic HPC Centre are the people doing the research that is a key differentiator to cloud computing companies (e.g., Amazon Web Services, MS Azure, or Google Platform/Colab) & ensure funding**

UoIceland IT Center Department
- ✓ **Services for Scientists like cross-setional teams?**
- ✓ **Build up services to promote IT in the university**
- ✓ **Links to PUHURI**

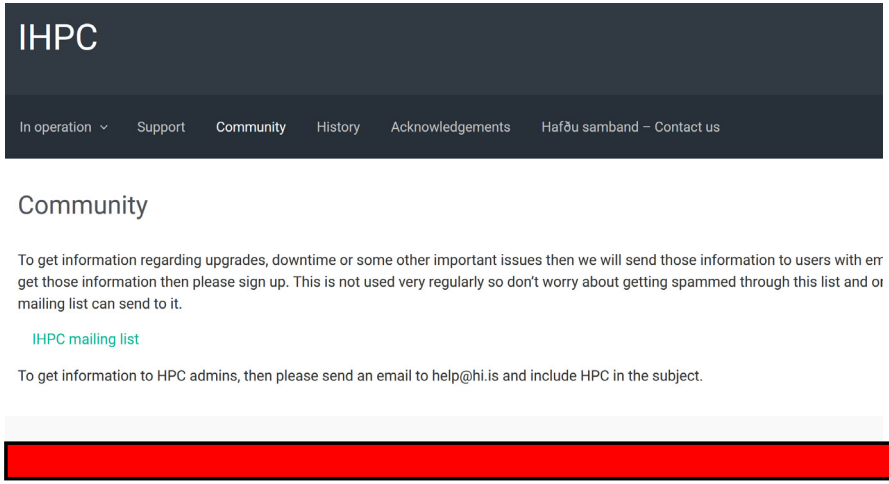
[13] JSC Simlabs

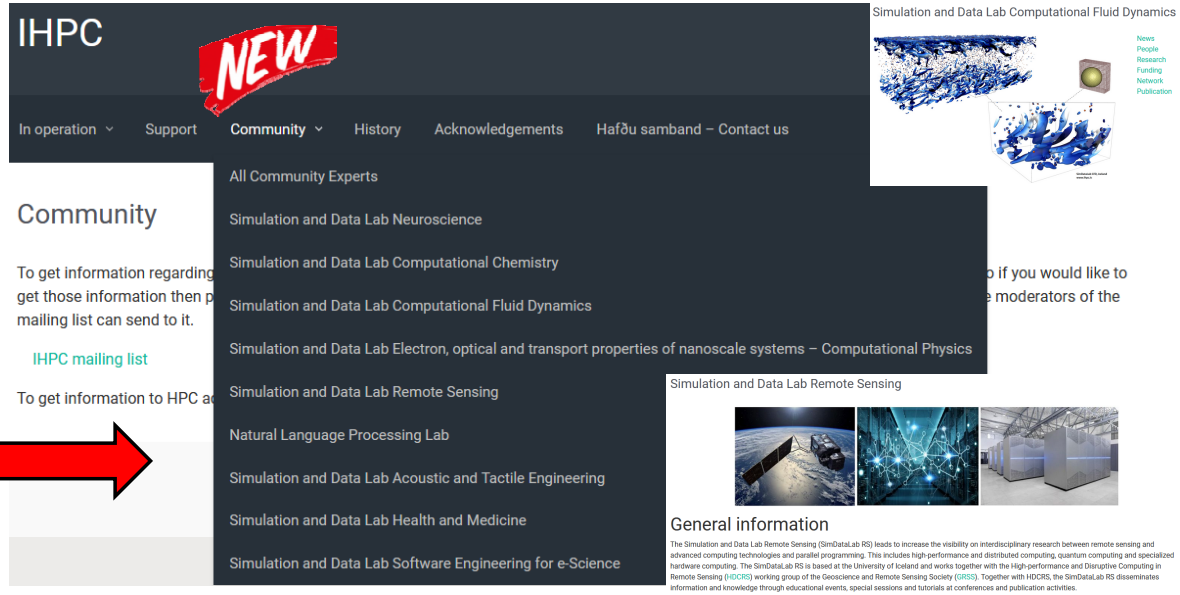
Selected Benefits & Lessons Learned:
- ✓ **Approch proven to be extremely succesful in HPC for over 15 years now (e.g., JSC)**
- ✓ **'Support' is often better from domain-scientists that knows domain substance**
- ✓ **Some 'Support' can be considered domain-specific research as part of codes/scaling**
- ✓ **Lab members gain visibility in their community & strengthening over time the competence center IRHPC profile having a clear long-term identity for each member**
- ✓ **'Stronger community' links by having domain-specific researchers in the labs**

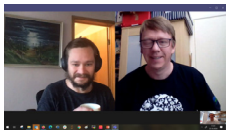
First Steps towards Potential Simulation and Data Labs in Iceland



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







[14] IHPC Community

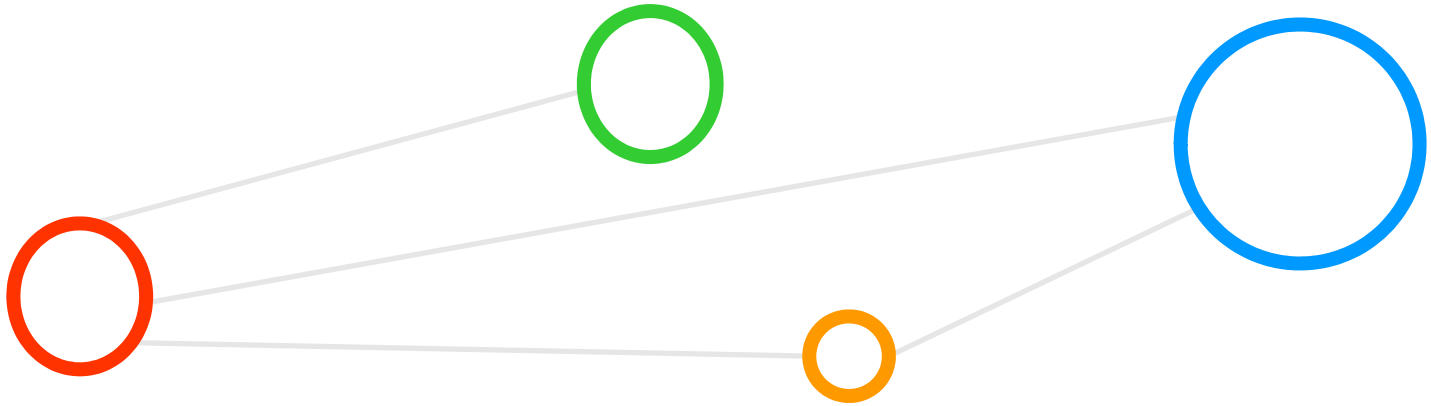
EuroHPC
Joint Undertaking

Jointly engage in future funding together, e.g. EuroHPC Master of Science in HPC program and many other activities planed 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 (Accoustic, 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 Infrastructure for HPC – Hardware Procurement

3.1 Innviðir

infrastructure

unit price

total cost

Raðnr.	Innviður	Fjöldi	Erl. einingaverð	Gjaldmiðill	Annar gjaldmiðill	Gengi	ISK einingaverð	ISK heildarkostnaður
1	CPU-nodes	1	0	ISK		1		
2	GPU notes	1	0	ISK		1		
3	CPU-GPU-nodes	1	0	ISK		1		
4	IO-heavy CPU-nodes	1	0	ISK		1		
5	Cloud-component	1	0	ISK		1		
6	E-infrastr. Provider / EuroHPC	1	0	ISK		1		
7	Renewal/Replacement	1	0	ISK		1		
8	New Storage System Core	1	0	ISK		1		
9	Additional storage solutions	1	0	ISK		1		
10	Datacenter network	1	0	ISK		1		
11	Software solutions	1	0	ISK		1		
12	Installation and implementation	1	0	ISK		1		
13	Additional servers	1	0	ISK		1		

no public information

3.2 Mótframlög

net contribution

X 1000 over 5 years

Stofnun/Fyrirtæki	Kt. stofnunar/fyrirtækis	Upphæð	Skýring	Yfirlýsing

no public information

rannís 200401-901 Innviðasjóður

75 % funding infrastructure fund

2.1 Innviðir

4. Skoða og skila inn

Heiti umsóknar*
Icelandic Research e-Infrastructure Project (IReIP)

Meginfagsvið*
Heilbrigðis- og lífvísindi

health & life sciences

Lykilorð 1
E-infrastructure

Lykilorð 2
Data processing, storage and sharing

Lykilorð 3
HPC

Heildarkostnaður

no public information

Hlutfall heildarkostnaðar sem sótt er um (án VSK)*
75

hardware & electronic equipments

Stutt lýsing til opinberrar birtingar*
Verkefnið snýst um uppbyggingu á öflugum innviðakjarna upplýsingatækni sem er sérsniðinn fyrir íslenskt vísindastarf. Þörf fyrir upplýsingatækni í flestum rannsóknaverkefnum hefur farið hratt vaxandi en verkefnin eru oft dreifð og megna ekki að höndla öfluga upplýsingatækni ein og sjálf. Það væri veruleg lyftistöng fyrir íslenskt vísindasamfélag ef það hefði aðgang að öflugum og jafnframt hagkvæmum innviðakjarna sem rekinn væri á faglegan hátt

Lýsing á innviðum*
Innvidalysing_vegvisir_vidarGHKfinal.pdf

2.2 Umsjónaraðilar

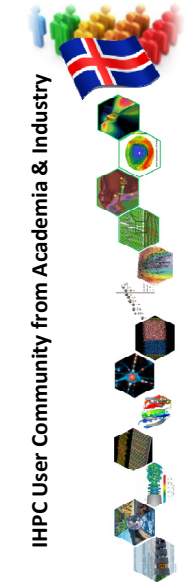
Hlutverk	Stofnun/Fyrirtæki
Bókhaldsumsjá innviðar:	Háskóli Íslands
Staðsetning innviðar:	Háskóli Íslands

no public information

Icelandic Research e-Infrastructure Project (IReIP) Pis of RANNIS proposal

rannís

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



HPC Users

IHPC Simulation & Data Labs

IHPC Infrastructure

LUMI Infrastructure

Start

Research Ideas & Proposal Document

Small runs with limited resource usage

Experience in using the IHPC Infrastructure

Need more ?

yes

HPC Resources via Collaborations (e.g., USA)

no

'Friendly' peer review approach & code scalable?

Use & 'Demonstrate' scalability on IHPC infrastructure

Need more ?

no

Use of national resources in agreement with labs & community

yes

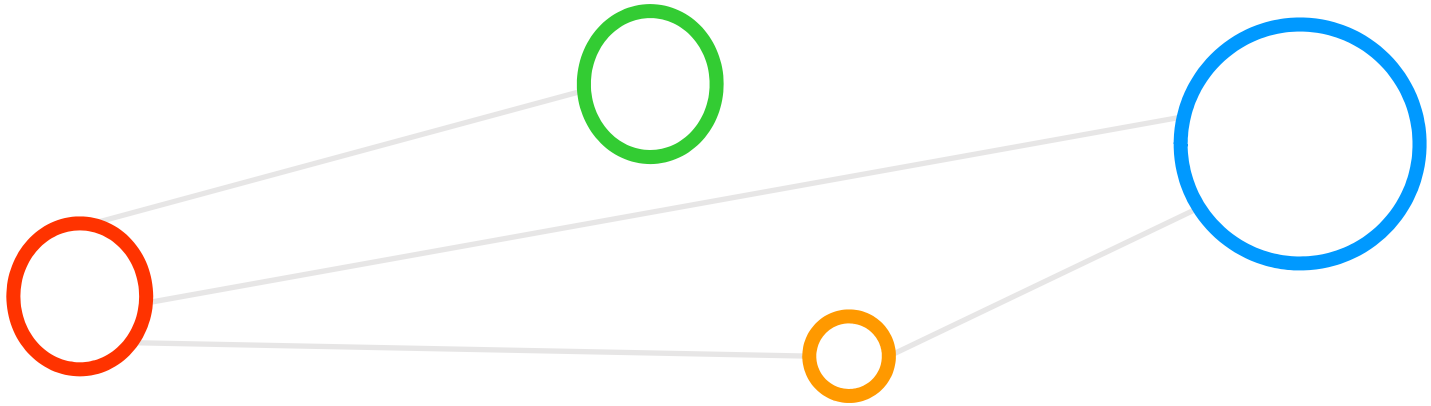
LUMI Icelandic Steering Committee

Use of LUMI resources according to share

SDL = Simulation & Data Labs

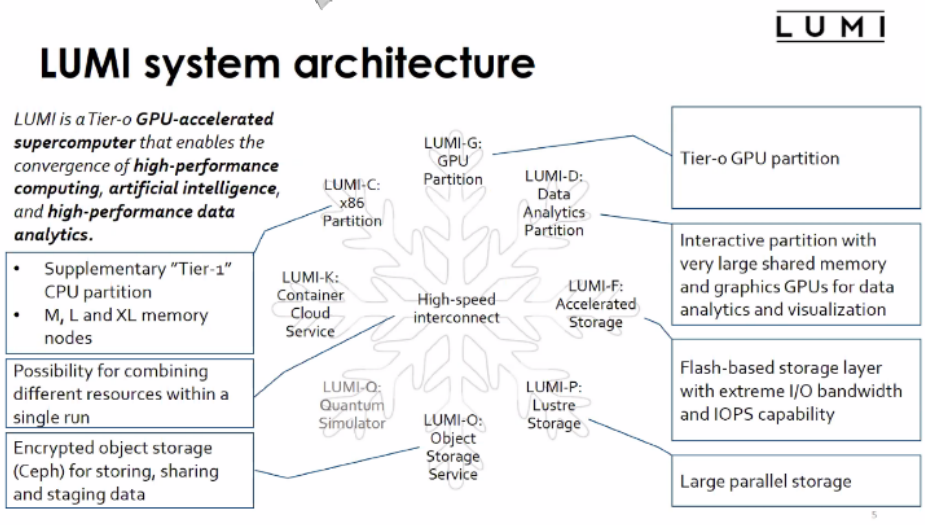
Monitoring of resource usage between SDLs

EuroHPC – LUMI Supercomputer in Finland



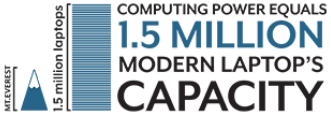
EuroHPC – LUMI Supercomputer in Finland

EuroHPC
Joint Undertaking



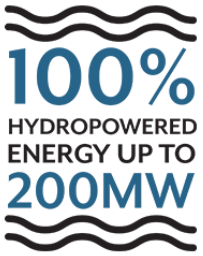
[6] LUMI Supercomputer

LUMI's computing power will be over 550 petaflops.



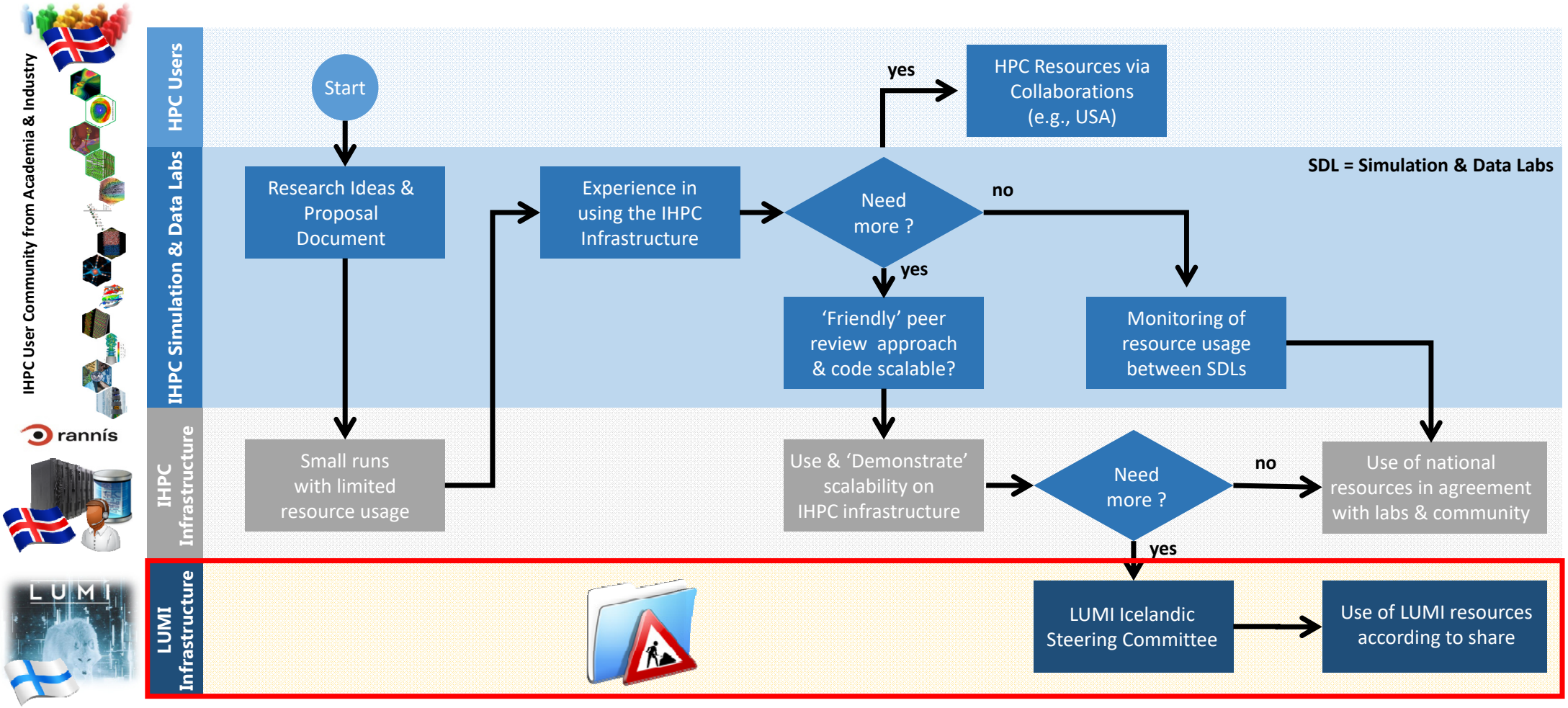
LUMI's computing power is equivalent to the combined performance of 1.5 million of the latest laptop computers. These would form over 23-kilometer high tower.

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

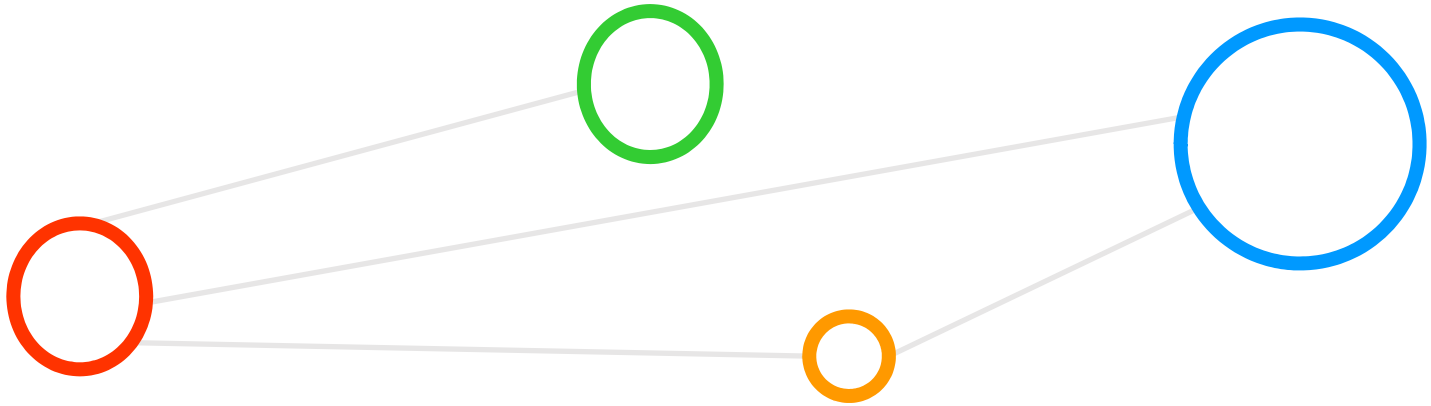


LUMI is using 100% hydropowered energy. Up to 200MWs are available. The waste heat of LUMI will produce 20 percent of the district heat of the area.

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/fog/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 Ulfarsson, Assistant Professor, Reykjavik University
- Steve Hammond, Senior Research Advisor, National Renewable Energy Laboratory

HÁSKÓLI ÍSLANDS

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

Teaching HPC & AI university courses at two universities

EuroHPC Joint Undertaking

emerging education activities

RAISE Center of Excellence

long-term center of excellent 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 | Topic description | Conditions and documents | Partner search | Submission service | Topic related FAQ | Get support | Call updates

General information

Programme
Horizon 2020 Framework Programme

Call
Training and Education on High Performance Computing (H2020-JTI-EuroHPC-2020-03)

Type of action
EuroHPC-CSA EuroHPC-CSA

Deadline model	Opening date	Deadline date
single-stage	17 March 2021	01 July 2021 17:00:00 Brussels time

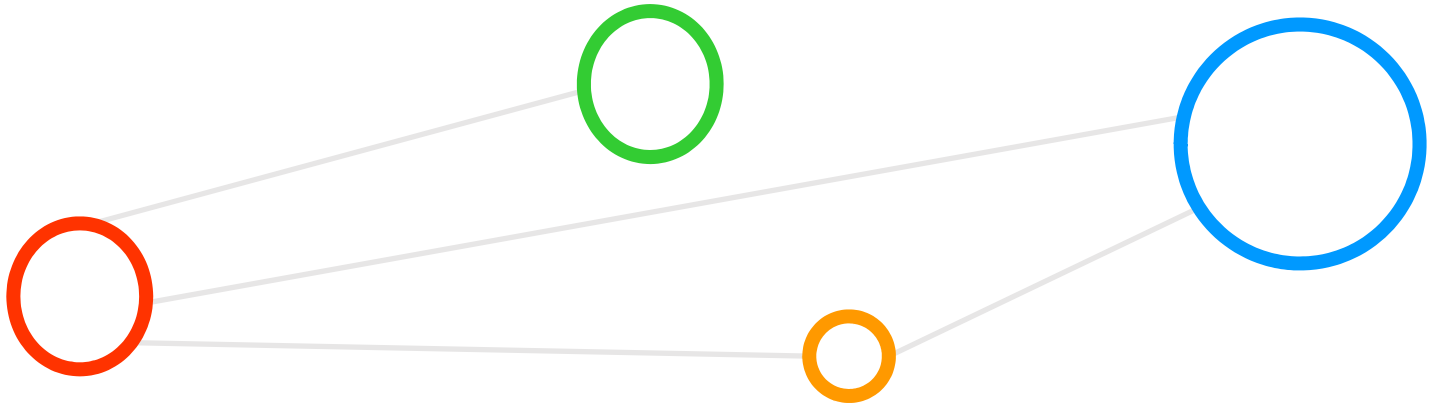
INDICATIVE

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

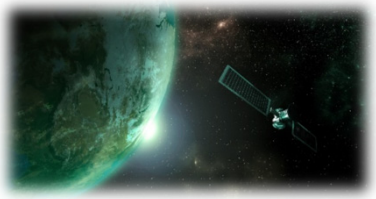
PILLAR	ACTION	Total EU (21 - 27)
Usage & Skills	Supporting Networking National Centres of Competence (CoC) on HPC (Actions to strengthen the wide application of HPC and increasing the innovation potential of SMEs using advanced HPC services)	€100M
Usage & Skills	Education (Curricula development) - Short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

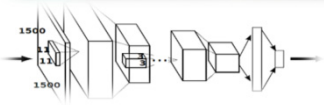
European Commission

International Cooperations – EU Projects in the HPC Field



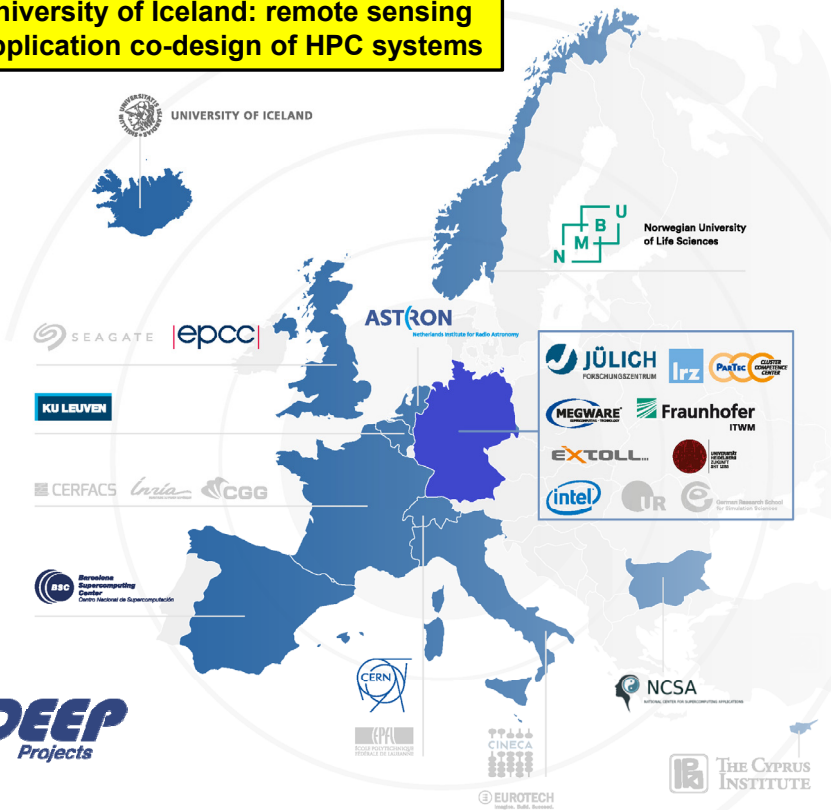
DEEP Series of HPC Projects – Modular Supercomputing Architecture Research





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

Strong collaboration with our industry partners Intel, Extoll & Megware



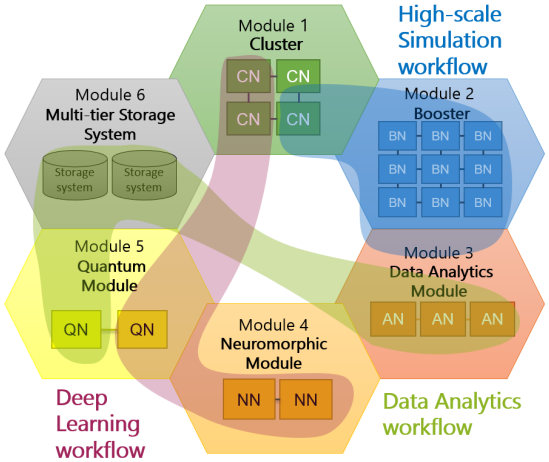
- 3 EU Exascale projects
  DEEP, DEEP-ER, DEEP-EST
- 27 partners
  Coordinated by JSC
- EU-funding: 30 M€
  JSC-part > 5,3 M€
- Nov 2011 – Mar 2021

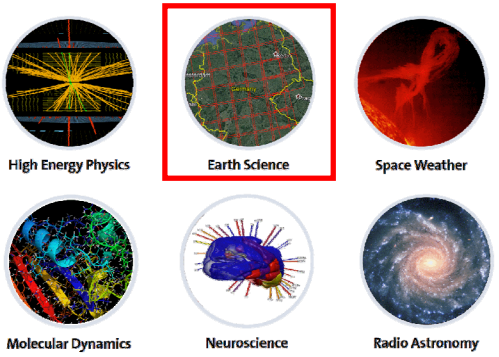
Strong collaboration with industry partners Intel, Extoll & Megware

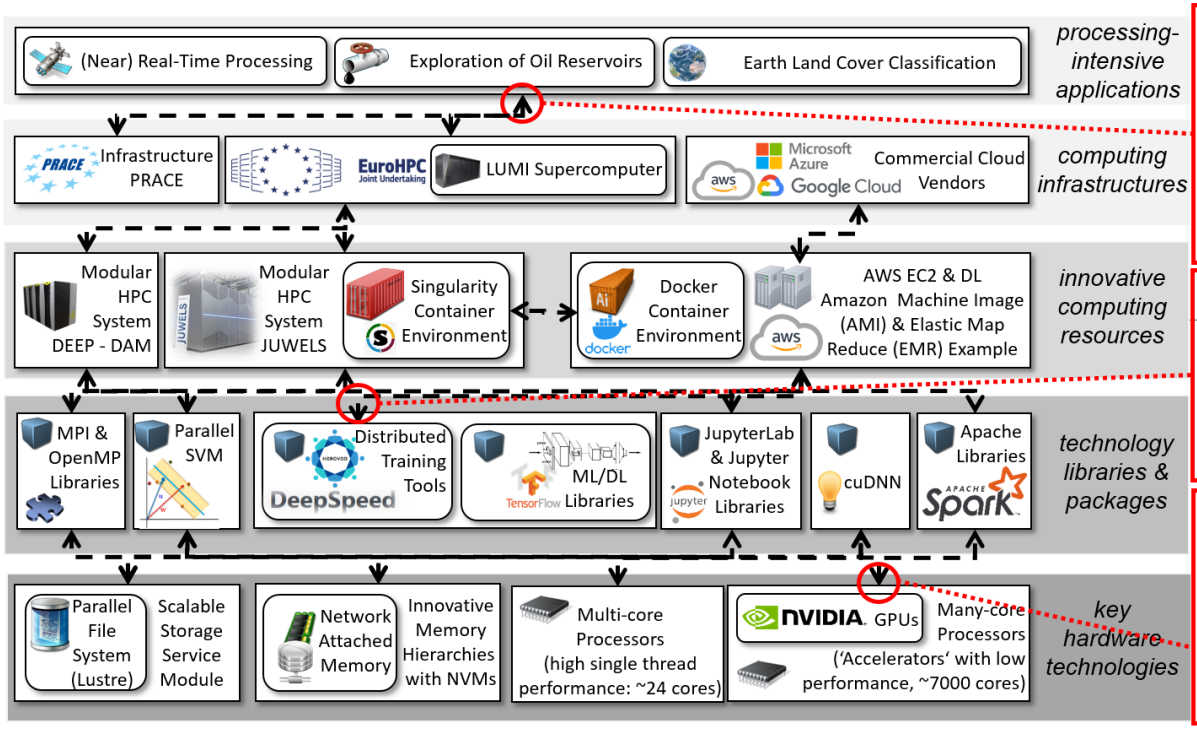
Juelich Supercomputing Centre implements the DEEP projects designs in its HPC infrastructure

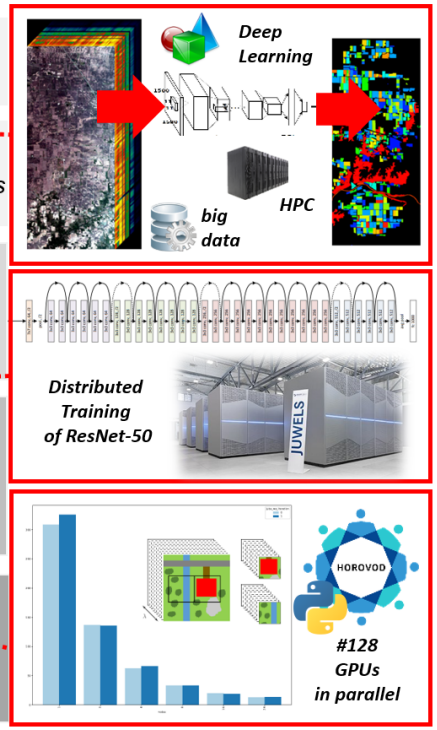
[1] DEEP Projects Web Page

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







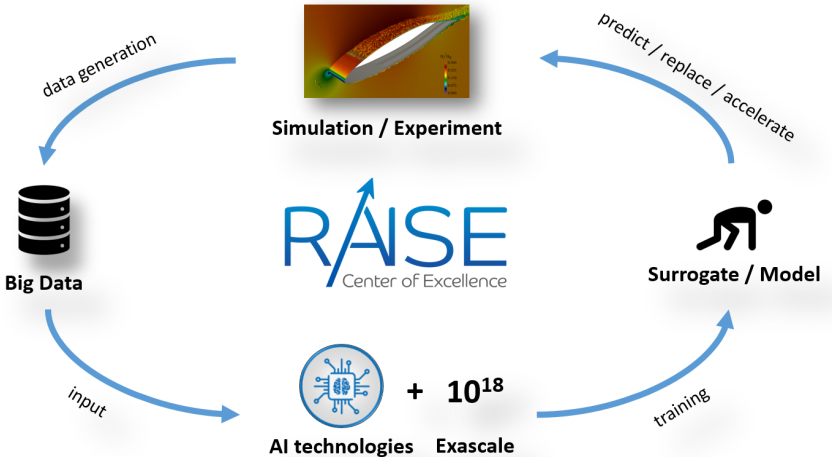


[11] R. Sedona & M. Riedel et al., MDPI, Journal of Remote Sensing

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

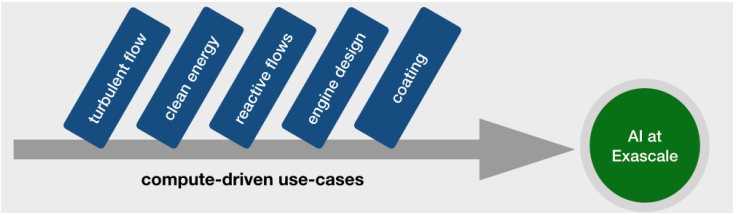
NEW RAISE Center of Excellence (CoE) EU Project – HPC Intertwined with AI

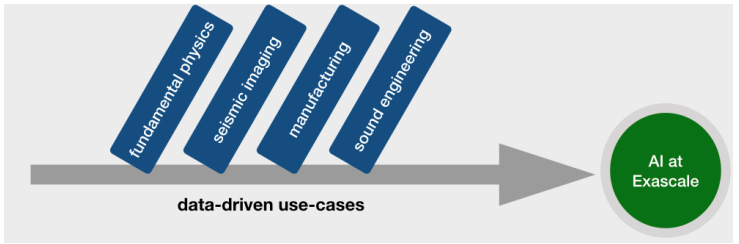


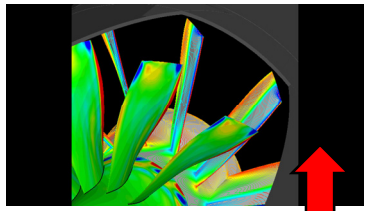
[4] CoE RAISE Web Page

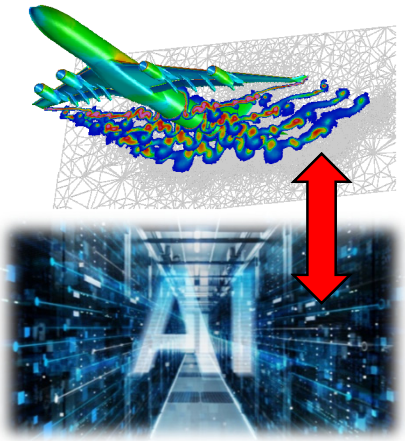
[3] Simulation Figure

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



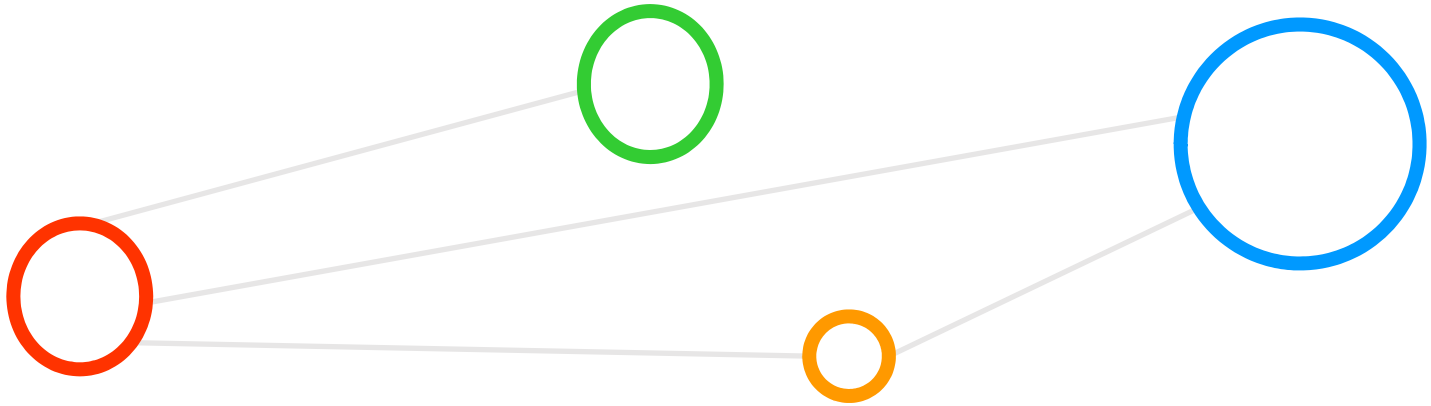




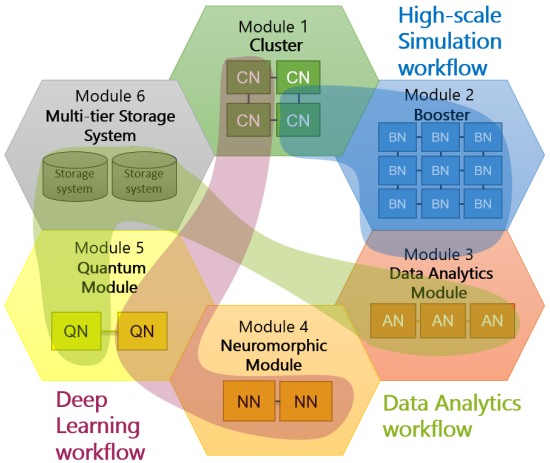


SAFRAN
JÜLICH Forschungszentrum
Atos
CERFACS
Delphi Consortium
1862 RĪGAS TEHNISKĀ UNIVERSITĀTE
CERN
UNIVERSITY OF ICELAND
FLANDERS MAKE
PARTEC CLUSTER COMPETENCE CENTER
The Modular Supercomputing Company
BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación
RWTH AACHEN UNIVERSITY
THE CYPRUS INSTITUTE RESEARCH·TECHNOLOGY·INNOVATION

International Cooperations – Juelich Supercomputing Centre – Germany



International Collaboration Partners: Juelich Supercomputing Centre



[1] DEEP Series of Projects Web Page

Simulation and Data Laboratories
SDL Biology
SDL Plasma Physics
SDL Molecular Systems
SDL Climate Science
SDL Fluid & Solid Engineering
SDL Quantum Materials
SDL Terrestrial Systems
SDL Numerical Quantum Field Theory
SL Neuroscience
SDL Astrophysics

[13] JSC Simlabs

Despite the strong collaborations, it is important to have local HPC resources in Iceland for education & research (!)

2018

12 PF

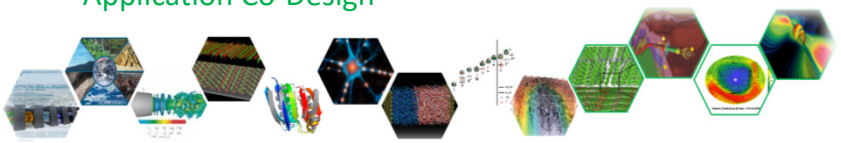
2020

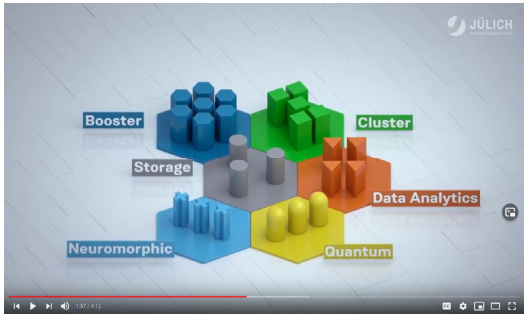
85 PF

2023

1 EF

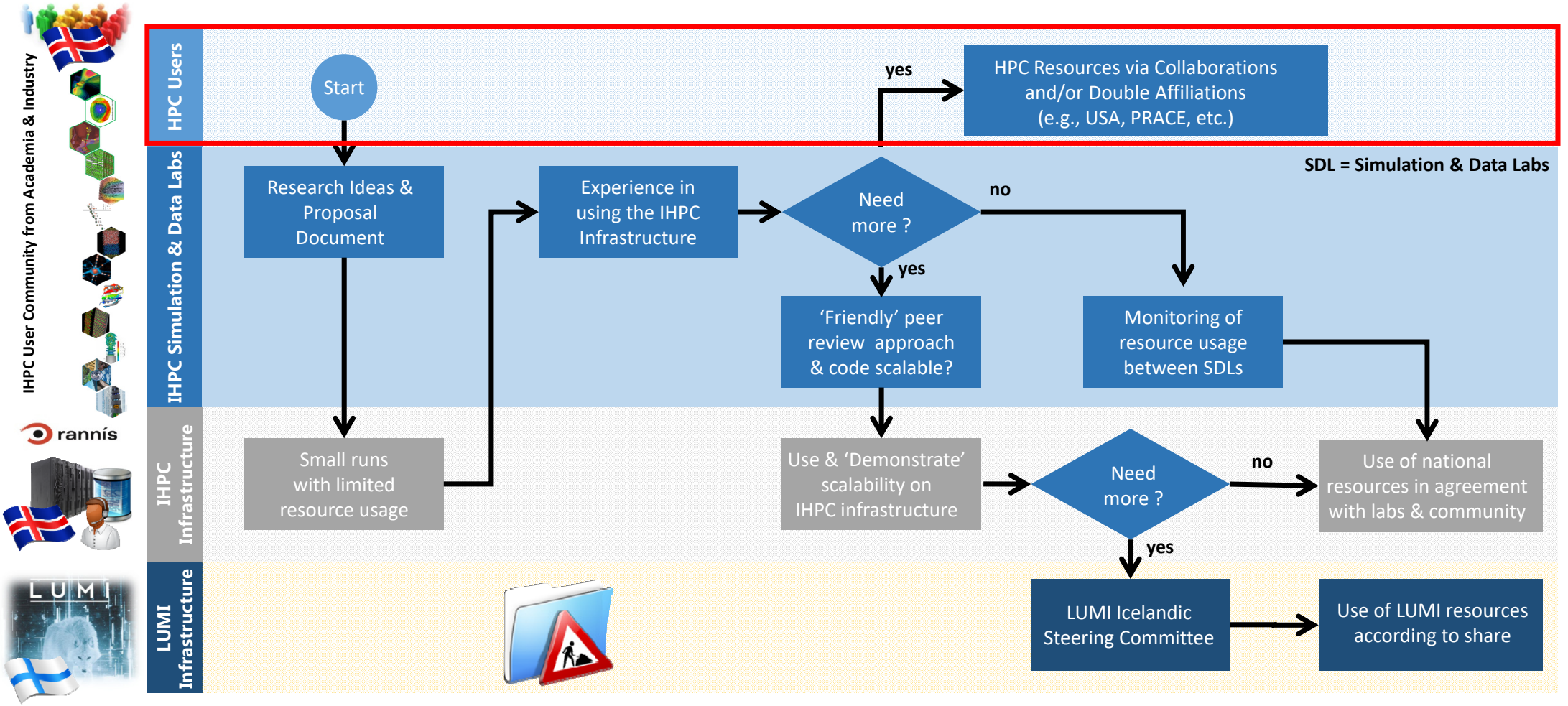
Application Co-Design



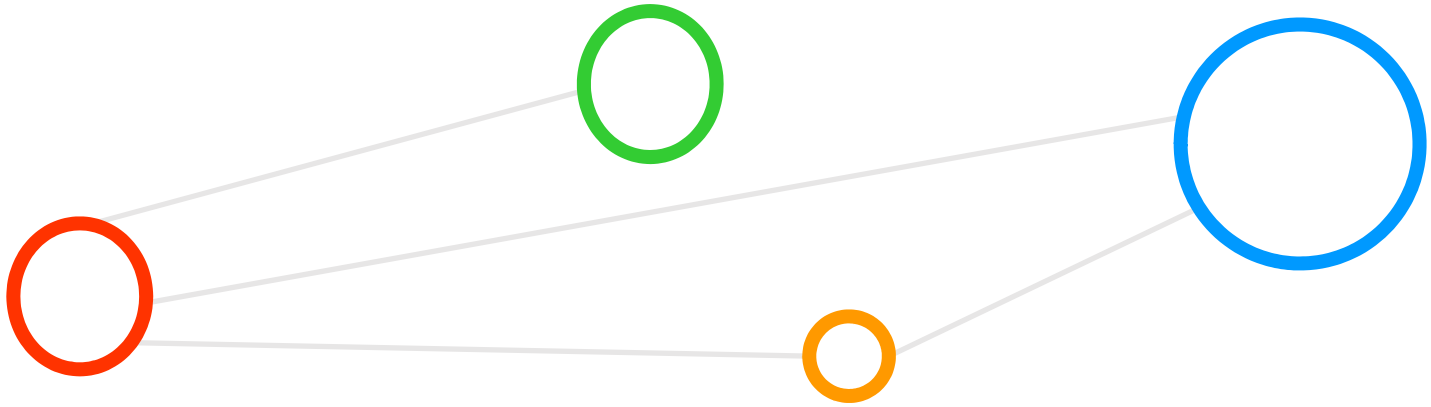


[2] YouTube, 'flexible and energy-efficient supercomputer: JUWELS is faster than 300 000 modern PCs

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



Lecture Bibliography



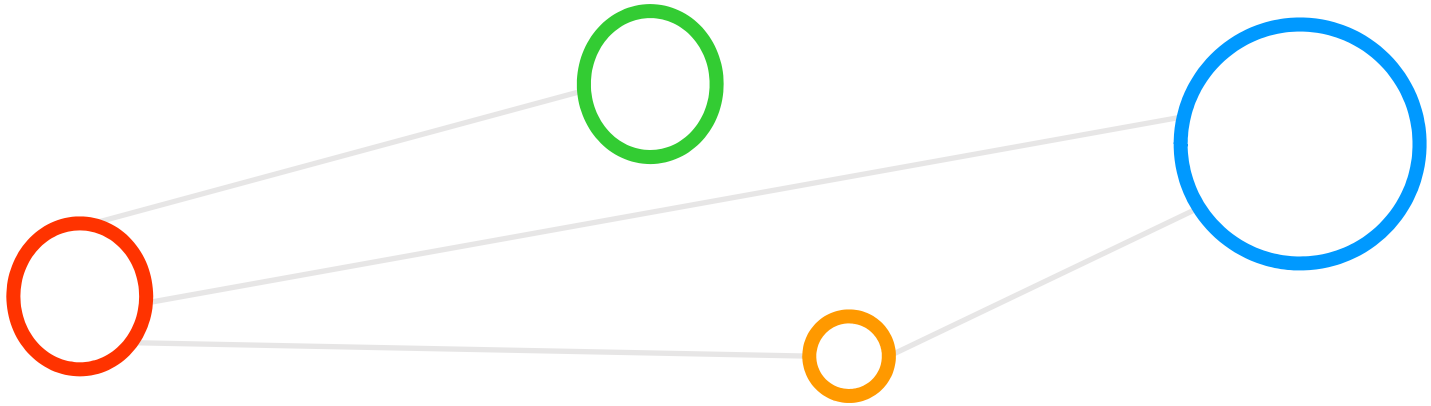
Selected References (1)

- [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-xIi6I
- [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, Hawai, 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/

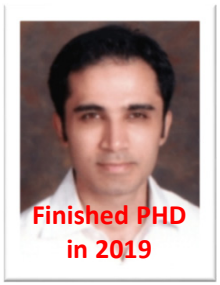
ACKNOWLEDGEMENTS



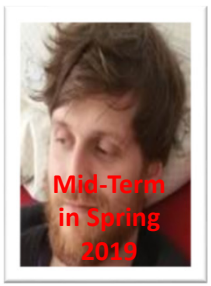
Acknowledgements – High Productivity Data Processing Research Group

PD Dr.
G. Cavallaro

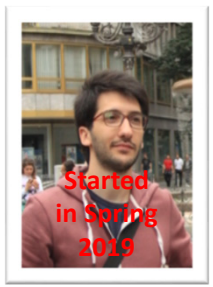
Senior PhD
Student
A.S. Memon



PD Dr.
M.S. Memon



PhD Student
E. Erlingsson

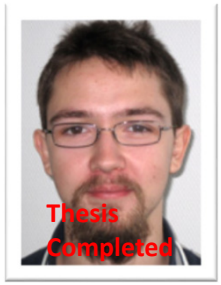


PhD Student
S. Bakarat

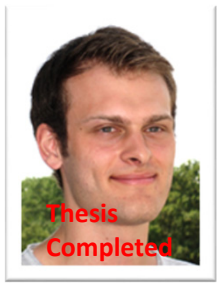
PhD Student
R. Sedona

PhD Student
P. H. Einarsson

Dr. M. Goetz
(now KIT)

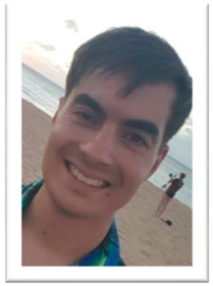


MSc M.
Richerzhagen
(now other division)

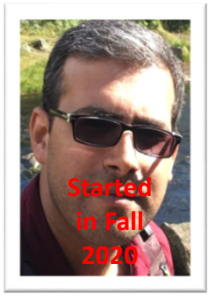


MSc
P. Glock
(now INM-1)

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)


services
measurement
within
fusion
new
funding
Policy-based
concepts
device
Analysis
forms
cross-disciplinary
resources
Centre
climate
Computer
expertise
Approaches
construction
Fusion
year
like
Computational
Test
E.g
Computing
disciplines
results
Enable
different
Cross-Disciplinary
methods
High
big
nodes
PB
community
Environment
Modelling
EU
Science
centers
Key
scientific
important
files
model
international
etc
DKRZ
Use
storage
basis
Infrastructure
SMAQ
engineering
References
formats
simulations
ENES
technologies
brain
increasing
via
EUDAT
physical
IPCC
Big
Project
Data
processing
Common
TB
MapReduce
create
Methods
computing
Using
European
databases
GB
Supercomputing
Work
images
codes
analysis
Large
Summary
data-intensive
Service
Scientific
levels
often
DLCL
stored
Resources
analyze
external
use
Level
Research
Matters
Concrete
performance
JSC
computational
research
e.g
science
HPC
Juelich
system
datasets
acquisition
compute
Landscape
management
System
Climate
modelling
AR5
Hardware
large-scale
cores
access
hundreds
Nutshell
Services
Understanding
Technologies
Earth
distributed
Structure
network
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project
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Simulation
Processing
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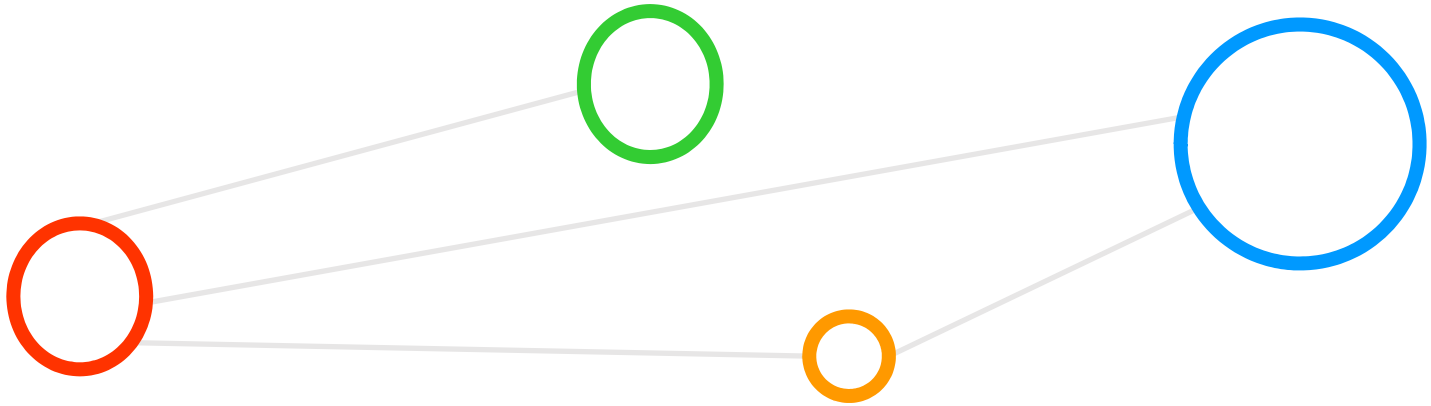
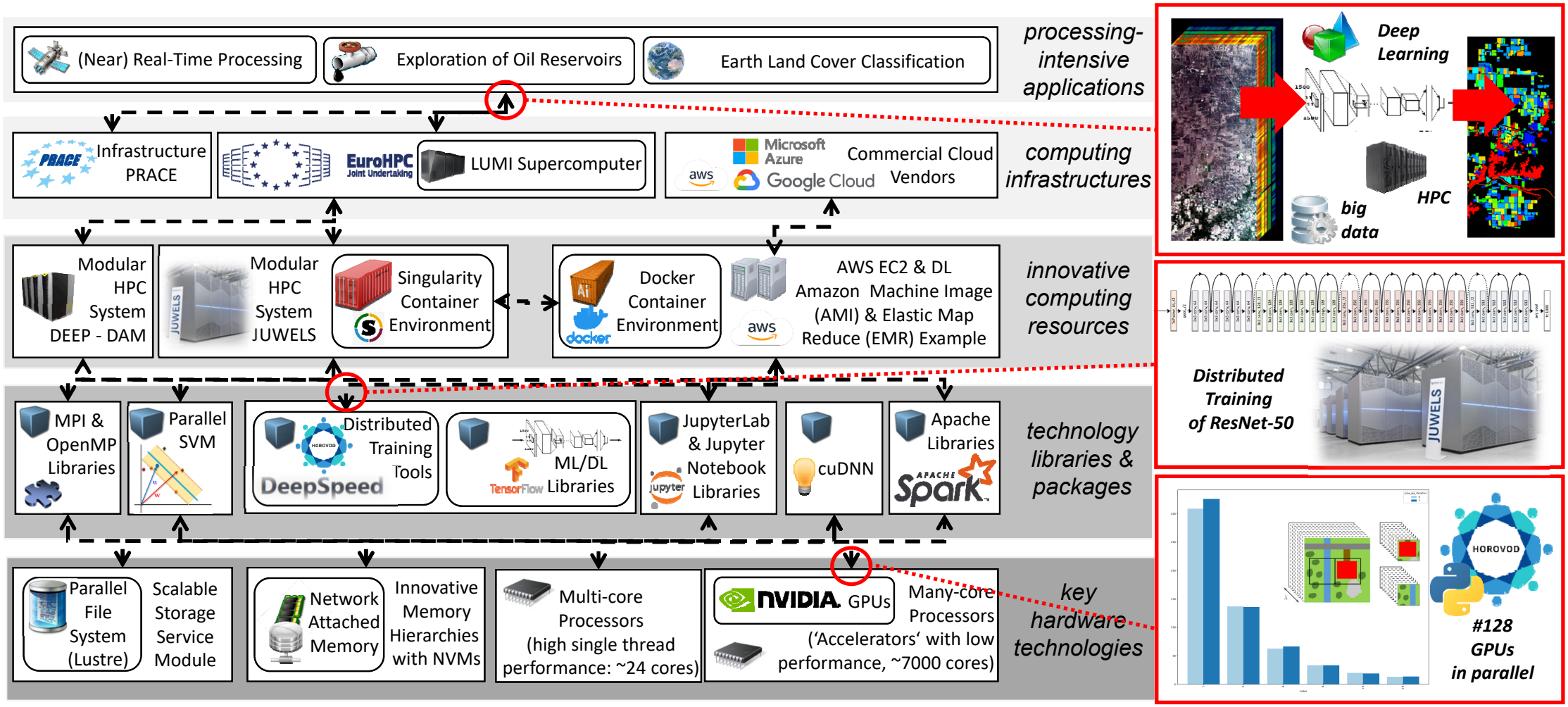
systems
day
Health

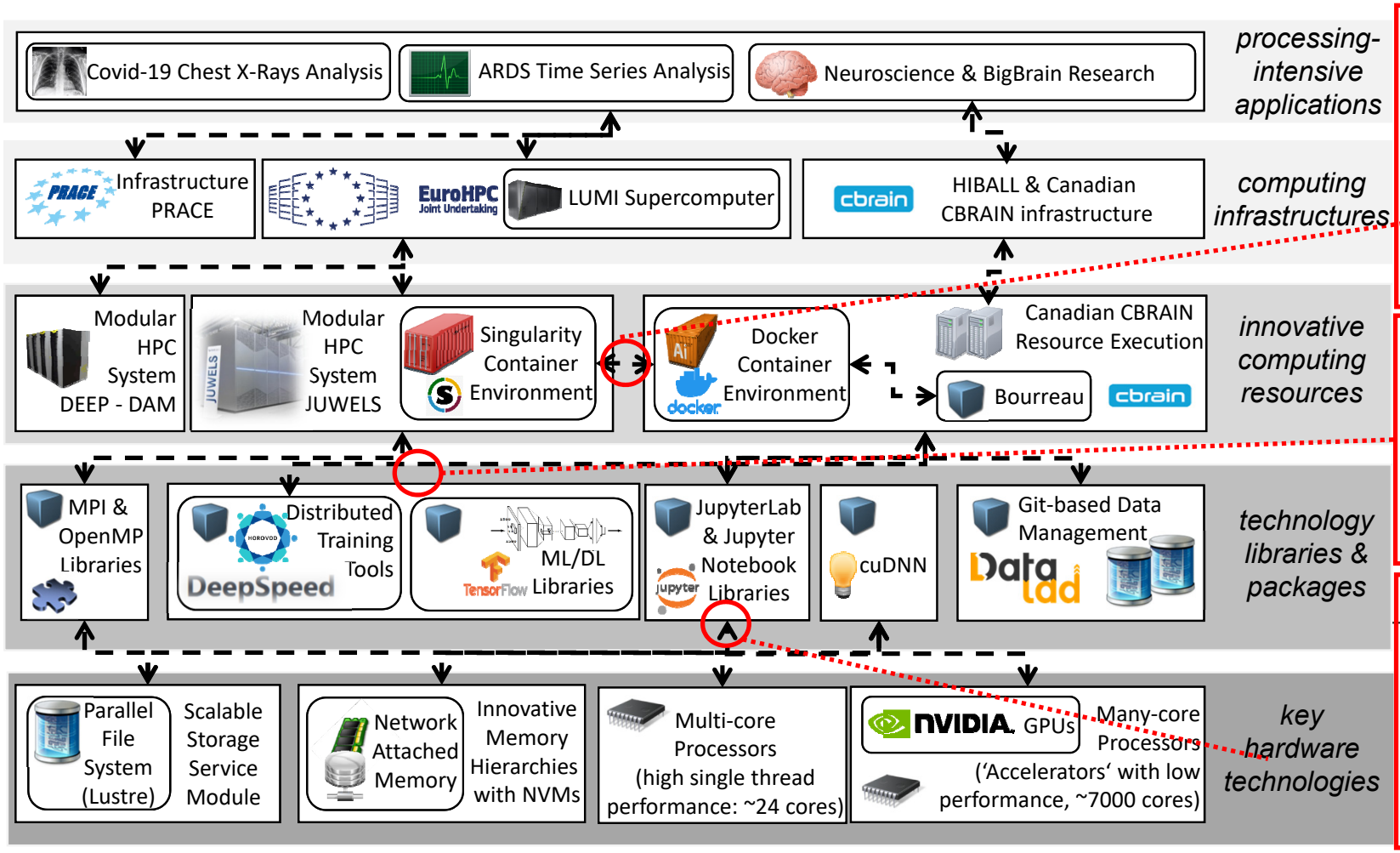
Appendix

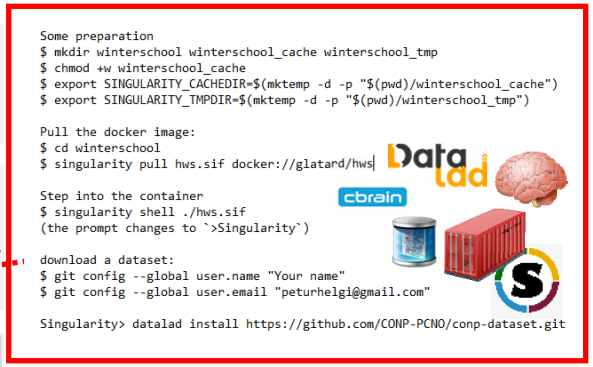


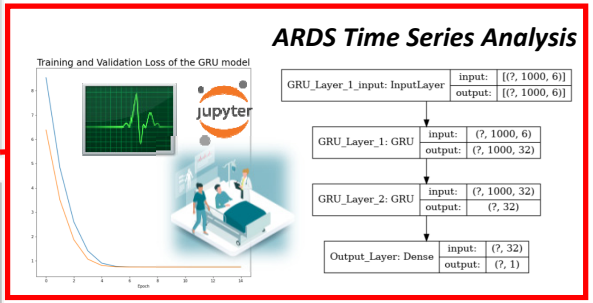
Research Examples – Remote Sensing AI & HPC Applications

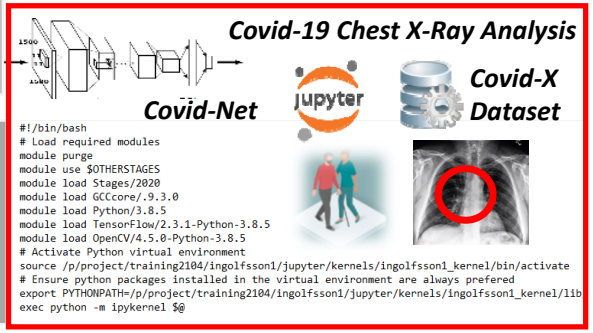


Research Examples – Health & Medical AI & HPC Applications

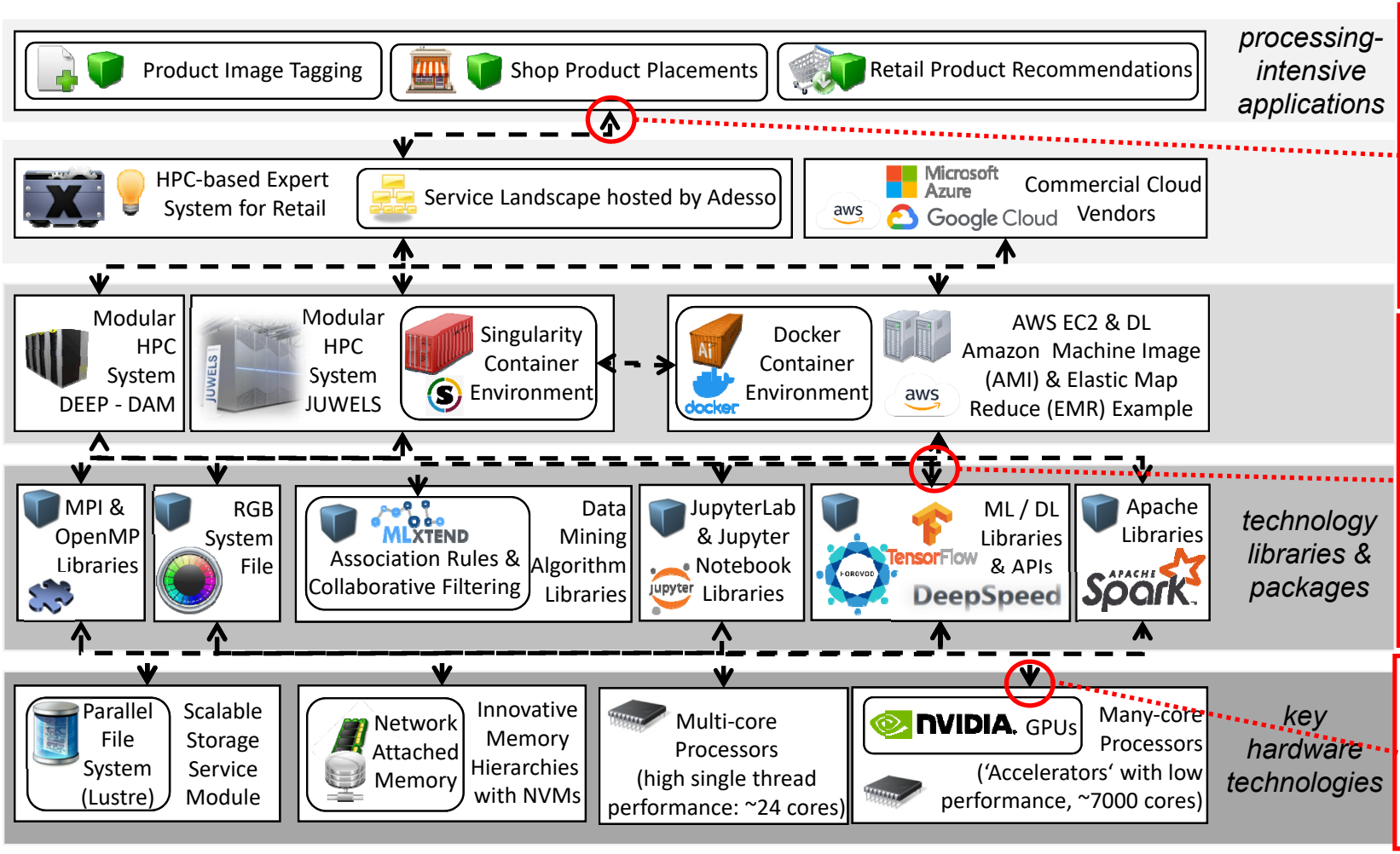


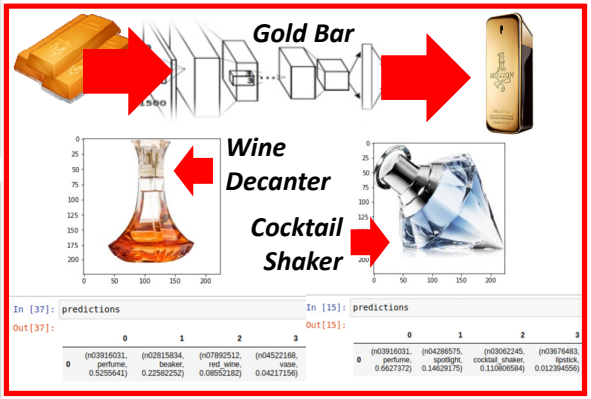






Research Examples – Retail AI & HPC Applications

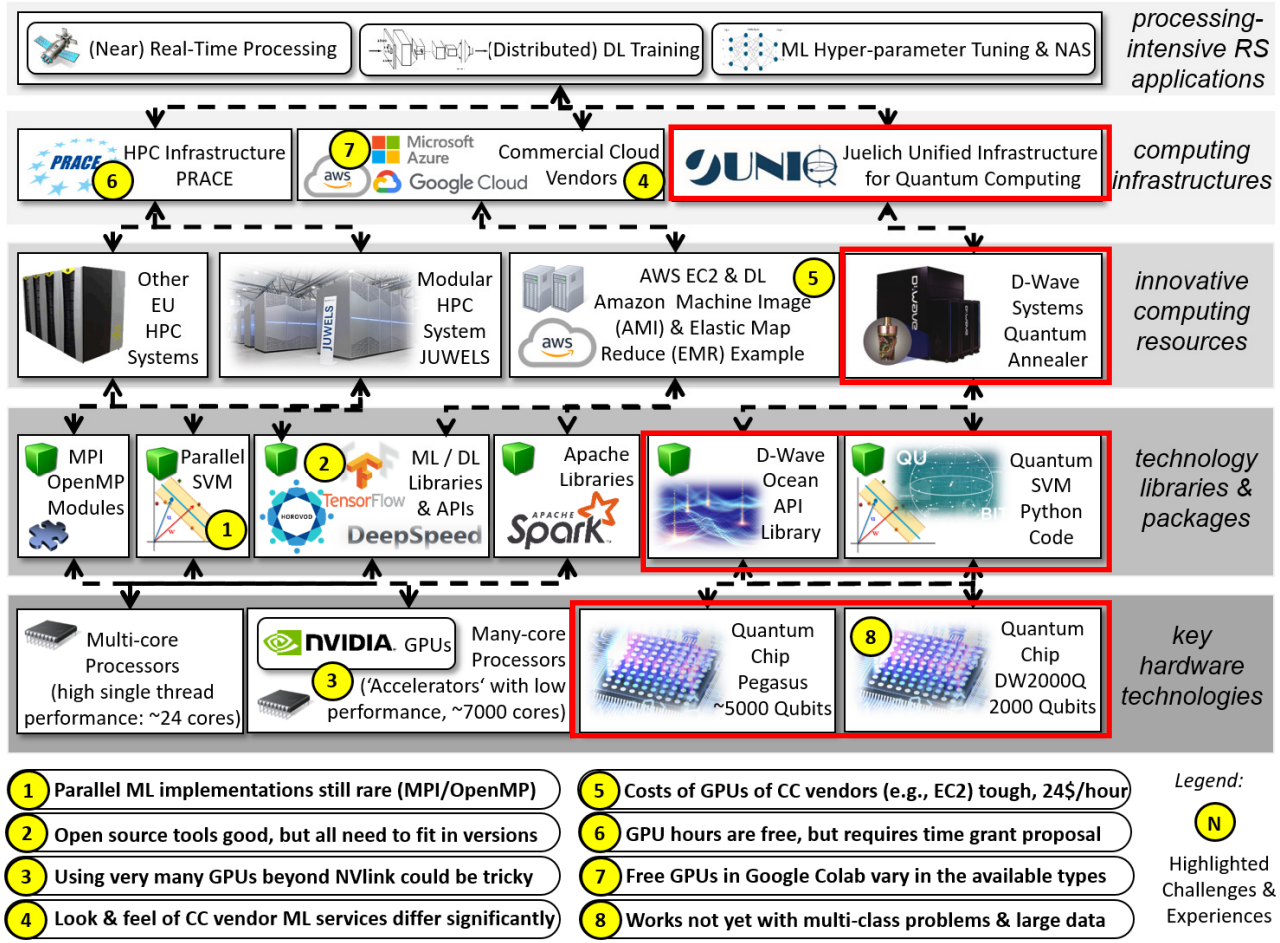




#GPUs	images/s	speedup	Performance per GPU [images/s]
1	55	1.0	55
4	178	3.2	44.5
8	357	6.5	44.63
16	689	12.5	43.06
32	1230	22.4	38.44
64	2276	41.4	35.56
128	5562	101.1	43.45

#128 GPUs in parallel

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



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

(ensembles due to small datasets compared to full datasets on CPUs/GPUs)

[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.

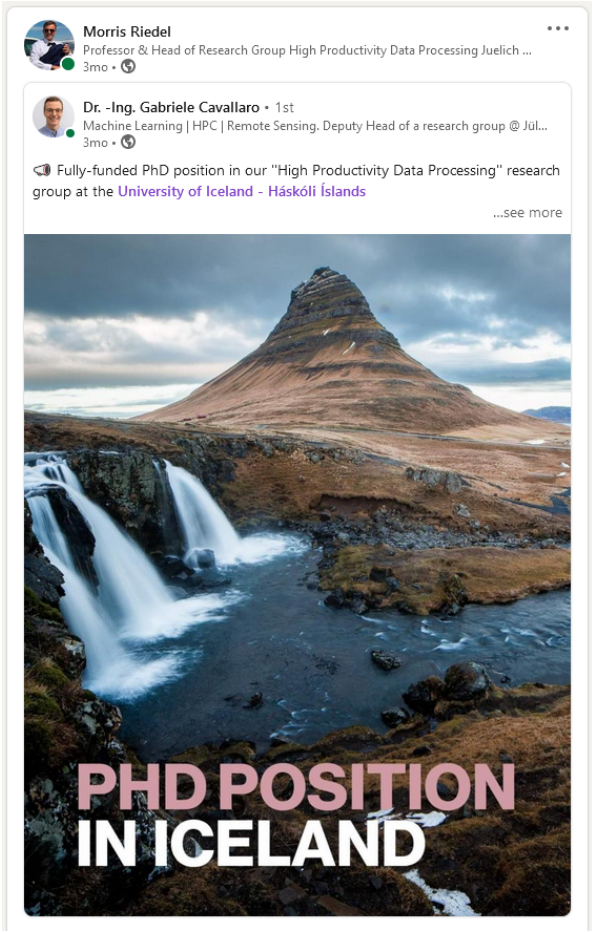
Other information: You will have the possibility to participate in international top conferences in the field of machine learning, HPC and remote sensing. You will be put in contact with several international partners for initiating research collaborations that match the topic of the PhD.

Background education: MSc degree in computer science or computer engineering. Level of English >= 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



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