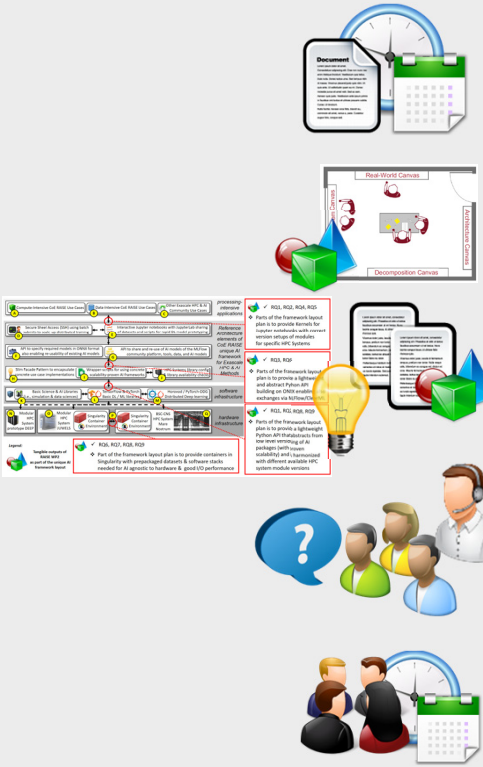
WP2 AI- & HPC-Cross Methods at Exascale – Monthly Meeting

Prof. Dr. – Ing. Morris Riedel et al.
School of Engineering & Natural Sciences, University of Iceland
2022-03-30, RAISE WP2 Monthly Meeting March 2022, Online

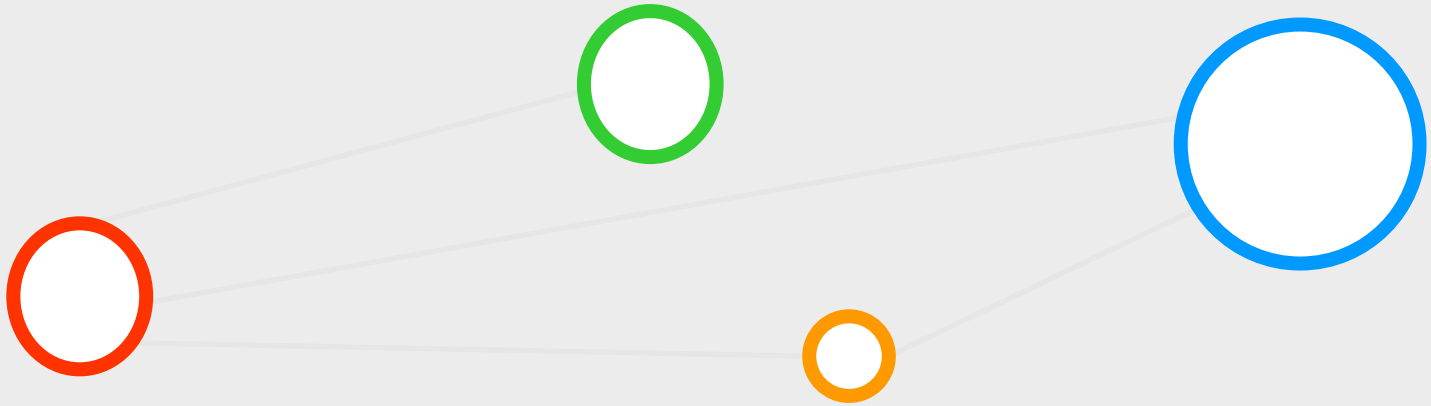
@ProfDrMorrisRiedel @Morris Riedel @MorrisRiedel @MorrisRiedel
https://www.youtube.com/channel/UCWC4VKHmL4NZgFfKoHtANKg morris@hi.is

WP2 February March – Welcome & Agenda

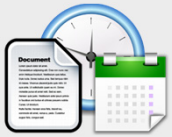
1. Approval of minutes from Monthly Meeting February 2022
   - (All), ~5 Min
2. Review WP2 Status on Interaction Rooms
   - (Morris Riedel, Matthias Book, Helmut Neukirchen), ~10 Min
3. Realization of the SW Framework
   - (Morris, Liang, Johannes et al.), ~20 Min
4. Status WP2 Seminar Plans
   - (Morris et al.), ~10 Min
5. Compelling Scoreboard Review & Next Steps
   - (All), ~15 Min



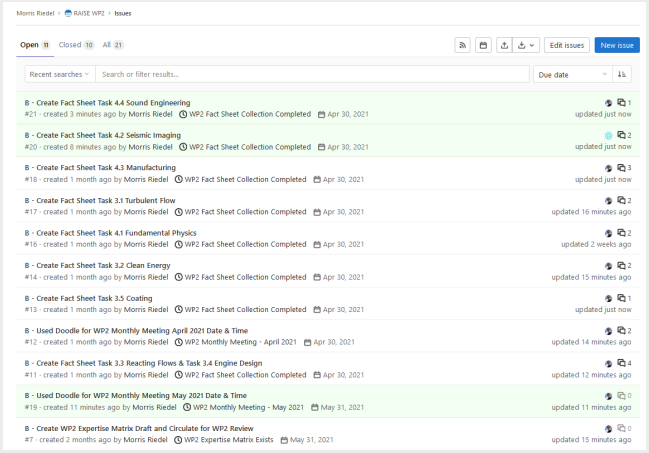
Agenda Item (1) – Minutes Approval – Meeting February 2022

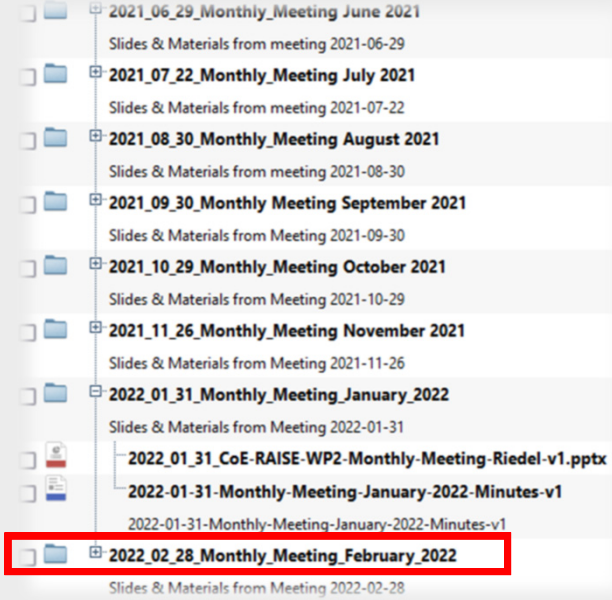


Minutes Approval – Monthly Meeting February 2022

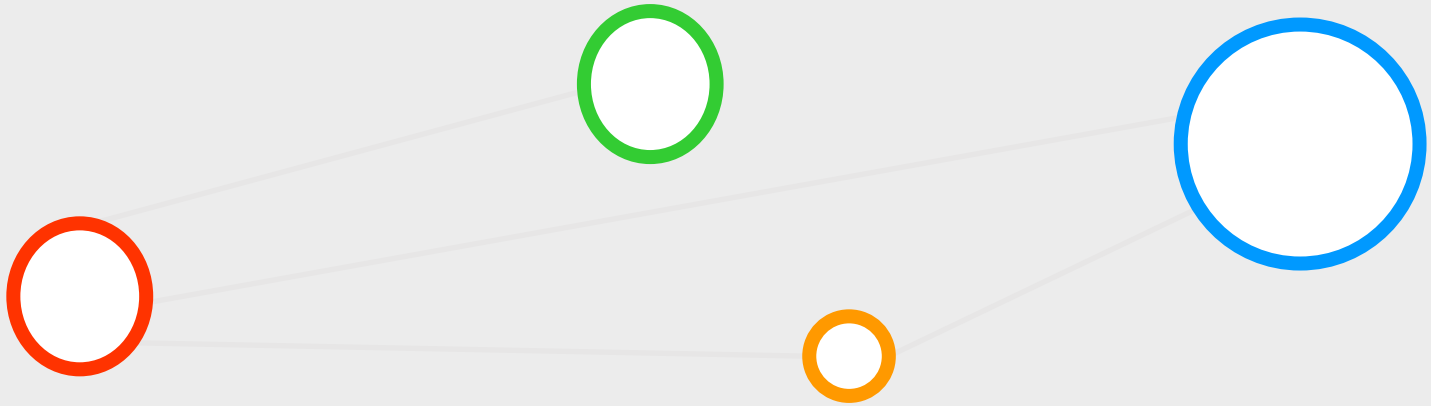


- Minutes available in BSCW
  - https://bscw.zam.kfa-juelich.de/bscw/bscw.cgi/3340884
  - TBD(all): Any objections or additions/changes?

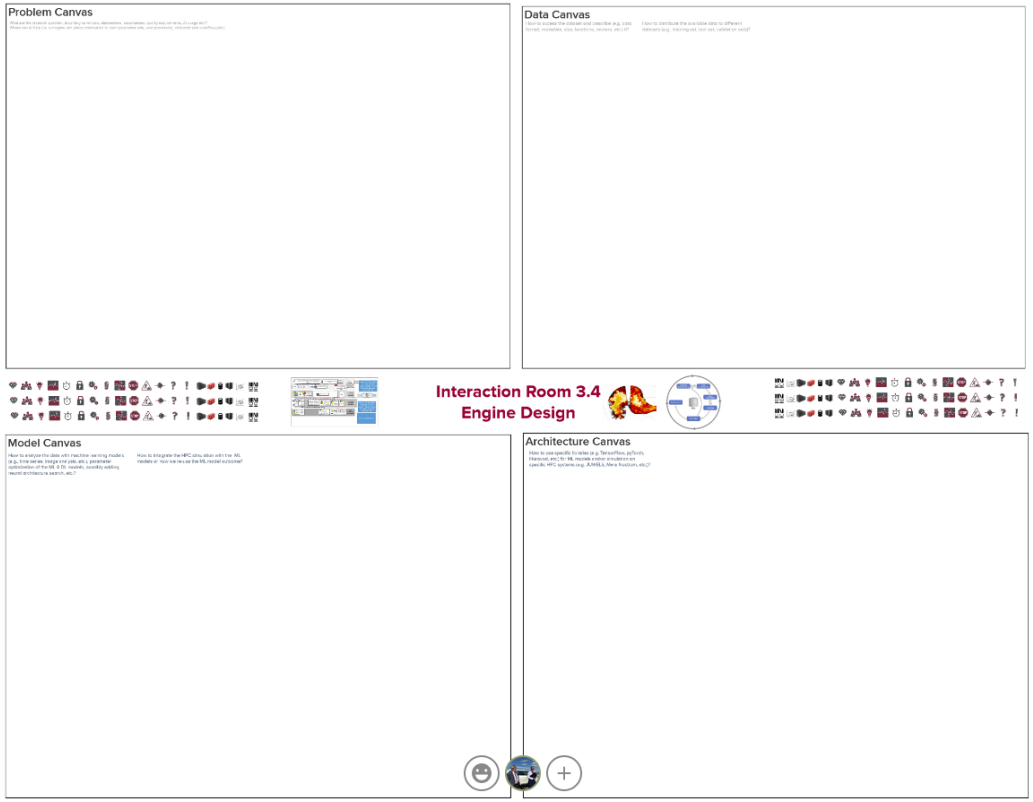


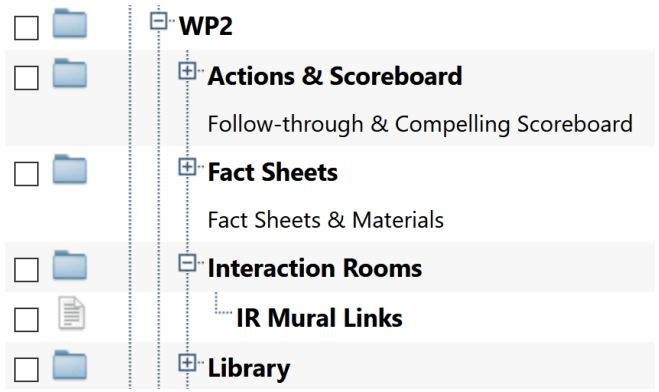


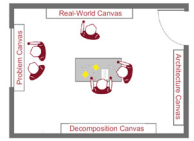
Agenda Item (2) – Review WP2 Status on Interaction Rooms



Interaction Rooms via MURAL Boards & Milestone Inputs







IR Mural Links

IR3.1 Turbulent Flow: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377866397/8613c384d54f66fb5e78599ff307a4ce8a9090c0?sender=u15e3008bb41d6628a5bb5701

IR3.2 Clean Energy: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377887905/cb44cca3eedd3bb9964fbfa36af16b1bfcce085f?sender=u15e3008bb41d6628a5bb5701

IR3.3 Reactive Flows: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377959022/0c363886f24833ecb19b025d87324b57fd50e2db?sender=u15e3008bb41d6628a5bb5701

IR3.4 Engine Design: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377976343/8d7aba6be09af3b2ffd305d2f709c53661ac889d?sender=u15e3008bb41d6628a5bb5701

IR3.5 Coating: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377991014/7a5d7e1eaf230178342d1e1d4a84d656d9055d52?sender=u15e3008bb41d6628a5bb5701

IR4.1 Fundamental Physics: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378007555/6f0d5285fcaec5eafa515bd6676c84d8b4879d39?sender=u15e3008bb41d6628a5bb5701

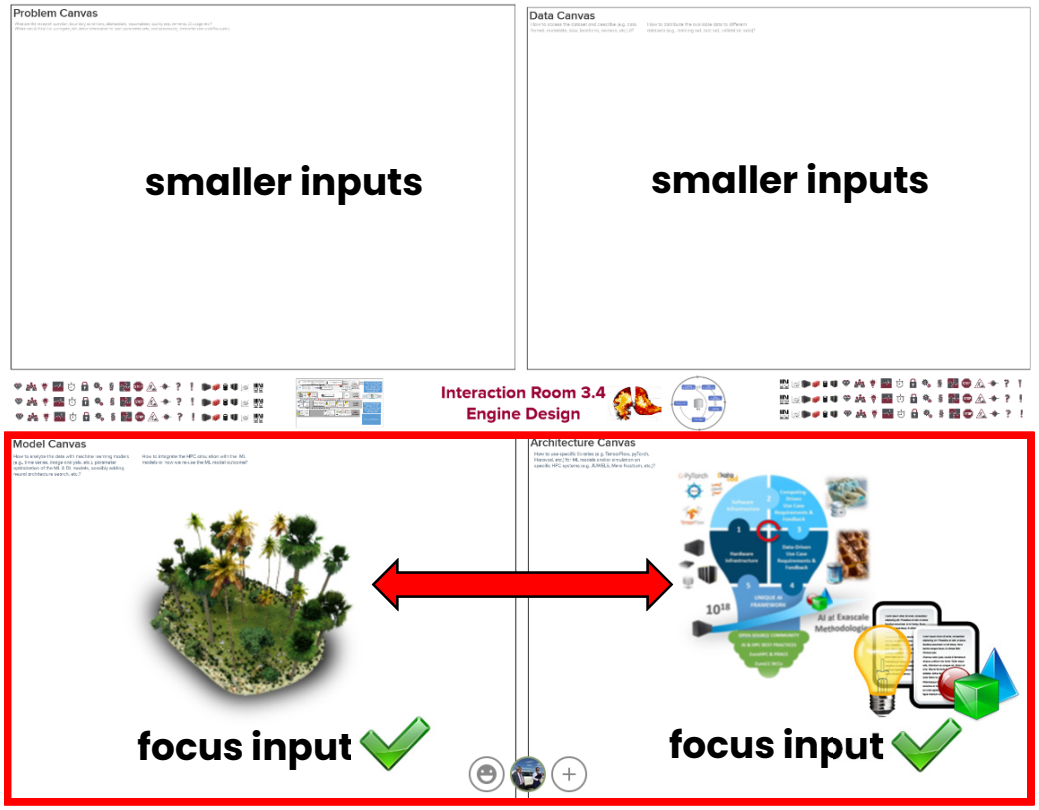
IR4.2 Seismic Imaging: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378023838/a0b9503abb837ae3e28af4bb8d9adbec33874998?sender=u15e3008bb41d6628a5bb5701

IR4.3 Manufacturing: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378038069/93df6fa7a41093f4eaae7be9d72979dc2ba42b9d?sender=u15e3008bb41d6628a5bb5701

IR4.4 Sound Engineering: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378050431/b5fa12219002404059f90a4bbb0101fa379a8503?sender=u15e3008bb41d6628a5bb5701

- TBD(all): Do people use the MURAL boards
- https://bscw.zam.kfa-juelich.de/bscw/bscw.cgi/3591551

MURAL Board contents for Deliverables & Milestones



- WP2
  - Actions & Scoreboard
    - Follow-through & Compelling Scoreboard
  - Fact Sheets
    - Fact Sheets & Materials
  - Interaction Rooms
    - IR Mural Links
  - Library

IR Mural Links

IR3.1 Turbulent Flow: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377866397/8613c384d54f66fb5e78599ff307a4ce8a9090c0?sender=u15e3008bb41d6628a5bb5701

IR3.2 Clean Energy: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377887905/cb44cca3eedd3bb9964fbfa36af16b1bfcce085f?sender=u15e3008bb41d6628a5bb5701

IR3.3 Reactive Flows: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377959022/0c363886f24833ecb19b025d87324b57fd50e2db?sender=u15e3008bb41d6628a5bb5701

IR3.4 Engine Design: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377976343/8d7aba6be09af3b2ffd305d2f709c53661ac889d?sender=u15e3008bb41d6628a5bb5701

IR3.5 Coating: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621377991014/7a5d7e1eaf230178342d1e1d4a84d656d9055d52?sender=u15e3008bb41d6628a5bb5701

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IR4.2 Seismic Imaging: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378023838/a0b9503abb837ae3e28af4bb8d9adbec33874998?sender=u15e3008bb41d6628a5bb5701

IR4.3 Manufacturing: https://app.mural.co/t/matthiasbook8855/m/matthiasbook8855/1621378038069/93df6fa7a41093f4eaae7be9d72979dc2ba42b9d?sender=u15e3008bb41d6628a5bb5701

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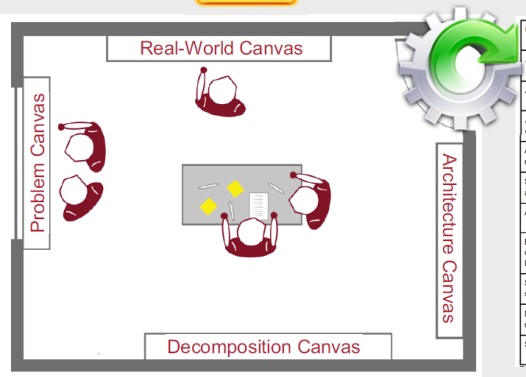
Interaction Room Status & Discussions – WP3/WP4 Overview

- WP3 (second round IRs)
  - T3.1: Turbulent Flow (asked) → later
  - T3.2: Clean Energy (not started)
  - T3.3: Reactive Flows (not started)
  - T3.4: Engine design (not started)
  - T3.5: Coating (not started)
- WP4 (second round IRs)
  - T4.1: Fundamental physics (asked) → later
  - T4.2: Seismic imaging (started) → next topic
  - T4.3: Manufacturing (not started)
  - T4.4: Sound engineering (not started)
- TBD(Katrín): Schedule further meetings with Interaction Room teams

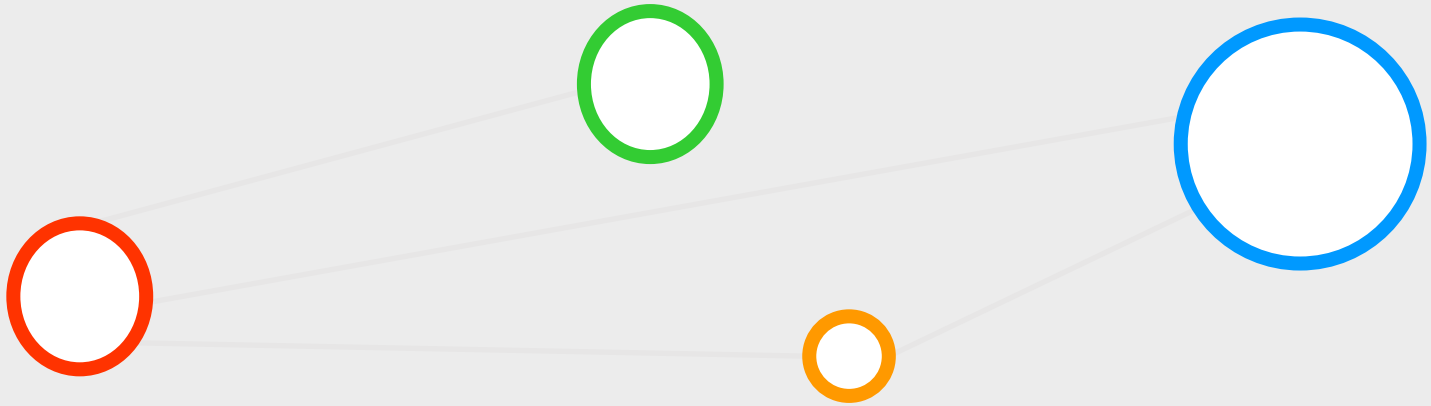
Continously Updating



Use Case	AE	PIML	ANNs	CNN		NO	SMs			GNN	IN	LSTM	GRU
Details	*CAE*		*RBF-ANN*	*U-Net*	*RESNET*	*FNO*	*AR*	*ARMA*	*ARIMA*		*JEDI-net*		
AI for turbulent boundary layers	X	X											
AI for wind farm layout optimization			X				X	X	X				
AI for data-driven models in reacting flows				X						X			
Smart models for next generation aircraft engine design				X						X			
AI for wetting hydrodynamics						X							
Event reconstruction and classification at the CERN HL-LHC use case										X	X		
Seismic imaging with remote sensing for energy applications	X				X								
Detect-free metal additive manufacturing	X				X								
Sound Engineering												X	X

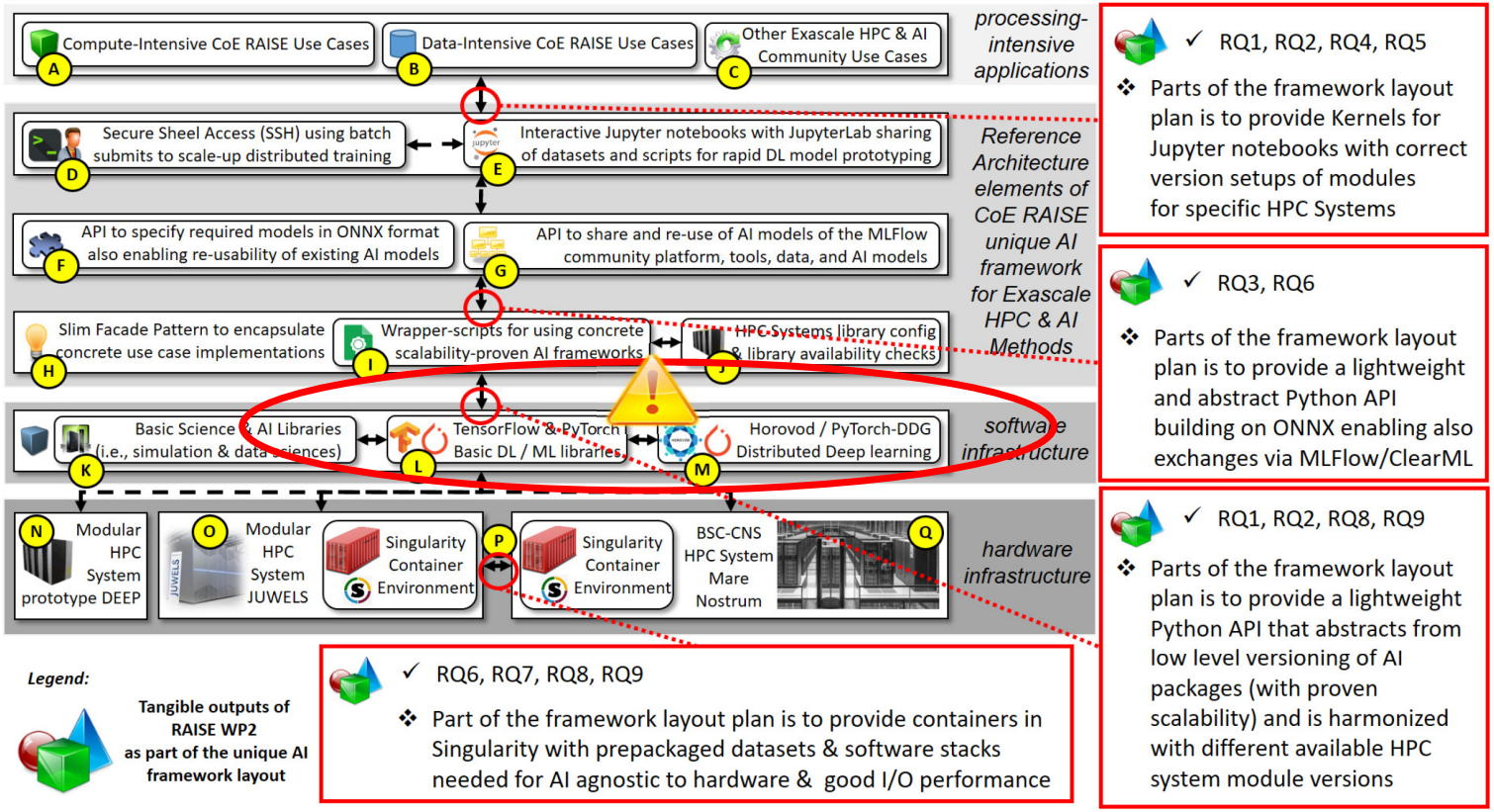
- Next round of Interaction Rooms with WP2
  - Carve out more details on AI/HPC methods
  - Contribute to the Unique AI Framework
  - Update our HPC/AI Methods Matrix

Agenda Item (3) – Realization of the SW Framework



Realization of SW Framework – Ideas of Web Page & Git Links

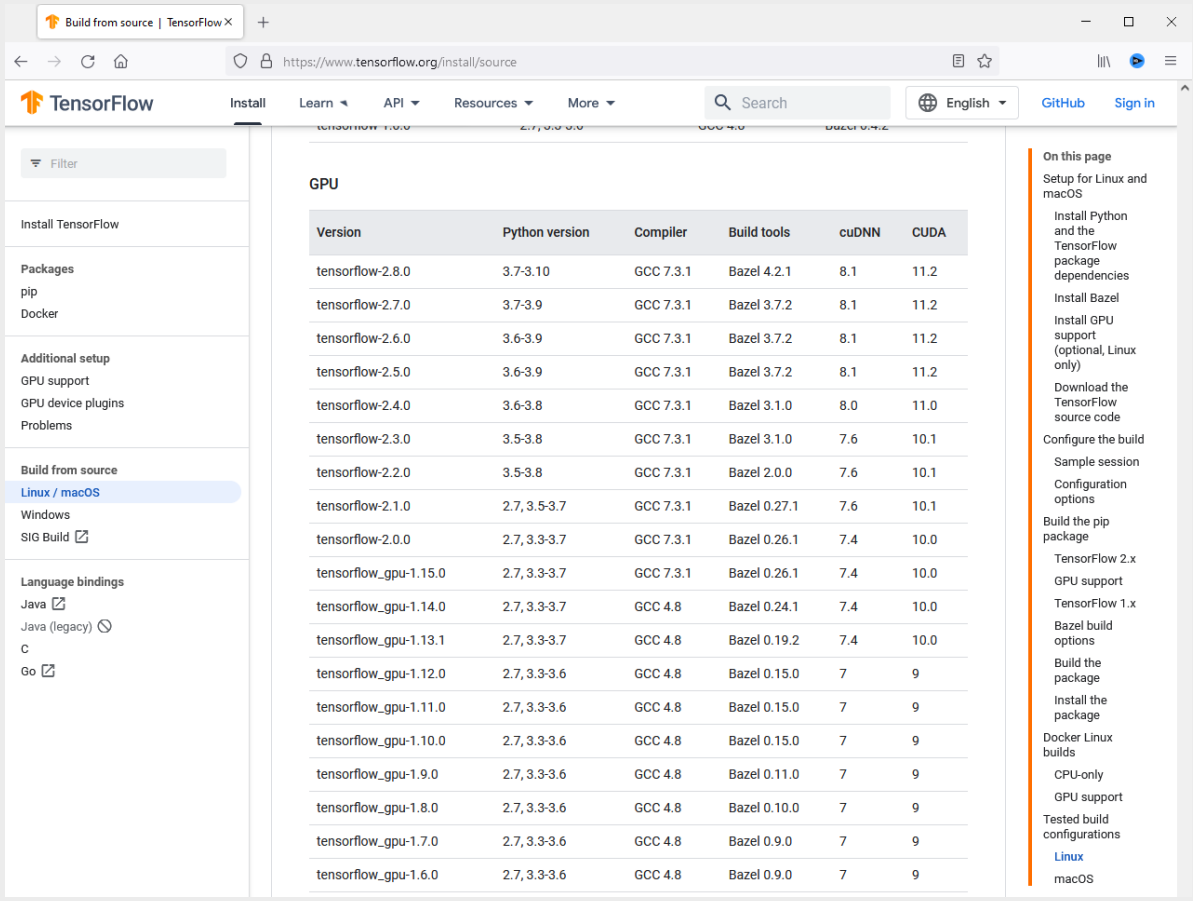
- Available in BSCW: https://bscw.zam.kfa-juelich.de/bscw/bscw.cgi/3694045



Continously Updating: e.g., add hyper-parameter optimization tools, pipelines?!

Realization of SW Framework – Assess Challenges for Solutions

- Example: TensorFlow
  - Can we create an automated module checker for the SW Framework RAISE?
  - Specific versions of TensorFlow require specific versions of underlying HPC modules
  - Python versions must be correct as well
  - E.g., differences in Python 3.8.x and 3.9.x
  - Support AI developers with tool?



Version	Python version	Compiler	Build tools	cuDNN	CUDA
tensorflow-2.8.0	3.7-3.10	GCC 7.3.1	Bazel 4.2.1	8.1	11.2
tensorflow-2.7.0	3.7-3.9	GCC 7.3.1	Bazel 3.7.2	8.1	11.2
tensorflow-2.6.0	3.6-3.9	GCC 7.3.1	Bazel 3.7.2	8.1	11.2
tensorflow-2.5.0	3.6-3.9	GCC 7.3.1	Bazel 3.7.2	8.1	11.2
tensorflow-2.4.0	3.6-3.8	GCC 7.3.1	Bazel 3.1.0	8.0	11.0
tensorflow-2.3.0	3.5-3.8	GCC 7.3.1	Bazel 3.1.0	7.6	10.1
tensorflow-2.2.0	3.5-3.8	GCC 7.3.1	Bazel 2.0.0	7.6	10.1
tensorflow-2.1.0	2.7, 3.5-3.7	GCC 7.3.1	Bazel 0.27.1	7.6	10.1
tensorflow-2.0.0	2.7, 3.3-3.7	GCC 7.3.1	Bazel 0.26.1	7.4	10.0
tensorflow_gpu-1.15.0	2.7, 3.3-3.7	GCC 7.3.1	Bazel 0.26.1	7.4	10.0
tensorflow_gpu-1.14.0	2.7, 3.3-3.7	GCC 4.8	Bazel 0.24.1	7.4	10.0
tensorflow_gpu-1.13.1	2.7, 3.3-3.7	GCC 4.8	Bazel 0.19.2	7.4	10.0
tensorflow_gpu-1.12.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.15.0	7	9
tensorflow_gpu-1.11.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.15.0	7	9
tensorflow_gpu-1.10.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.15.0	7	9
tensorflow_gpu-1.9.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.11.0	7	9
tensorflow_gpu-1.8.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.10.0	7	9
tensorflow_gpu-1.7.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.9.0	7	9
tensorflow_gpu-1.6.0	2.7, 3.3-3.6	GCC 4.8	Bazel 0.9.0	7	9

Realization of SW Framework – Understanding Challenges

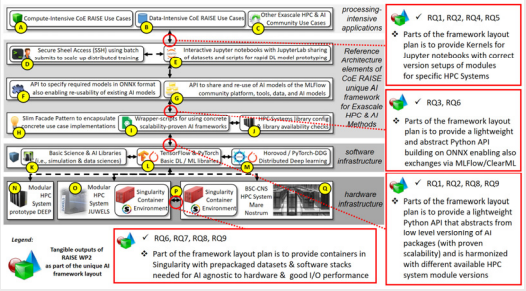
- Example of Setups
  - Many different versions / combinations
  - E.g. FZJ JSC DEEP-EST HPC System

```
[riedel1@dp-dam01 ~]$ module spider cudnn

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  cuDNN:
---------------------------------------------------------------------------------------------------------------------------------------------------------------
     Description:
       The NVIDIA CUDA Deep Neural Network library (cuDNN) is a GPU-accelerated library of primitives for deep neural networks.

     Versions:
        cuDNN/7.4.1.5-CUDA-9.2.88
        cuDNN/7.5.1.10-CUDA-10.1.105
        cuDNN/7.6.4.38-CUDA-10.1.105
        cuDNN/7.6.5.32-CUDA-10.2.89
        cuDNN/8.0.2.39-CUDA-11.0
        cuDNN/8.2.1.32-CUDA-11.3
        cuDNN/8.3.1.22-CUDA-11.5

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  For detailed information about a specific "cuDNN" module (including how to load the modules) use the module's full name.
  For example:

     $ module spider cuDNN/7.6.5.32-CUDA-10.2.89
---------------------------------------------------------------------------------------------------------------------------------------------------------------
```

```
[riedel1@dp-dam01 ~]$ module spider nccl

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  NCCL:
---------------------------------------------------------------------------------------------------------------------------------------------------------------
     Description:
       The NVIDIA Collective Communications Library (NCCL) implements multi-GPU and multi-node collective communication primitives that are performance optimized for NVIDIA GPUs.

     Versions:
        NCCL/2.4.2-1-CUDA-9.2.88
        NCCL/2.4.6-1-CUDA-10.1.105
        NCCL/2.4.8-CUDA-10.1.105
        NCCL/2.4.8
        NCCL/2.7.3-1-CUDA-10.2.89
        NCCL/2.8.3-1-CUDA-11.0
        NCCL/2.8.3-1-CUDA-11.3
        NCCL/2.10.3-1-CUDA-11.3
        NCCL/2.11.4-CUDA-11.5

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  For detailed information about a specific "NCCL" module (including how to load the modules) use the module's full name.
  For example:

     $ module spider NCCL/2.7.3-1-CUDA-10.2.89
---------------------------------------------------------------------------------------------------------------------------------------------------------------
```

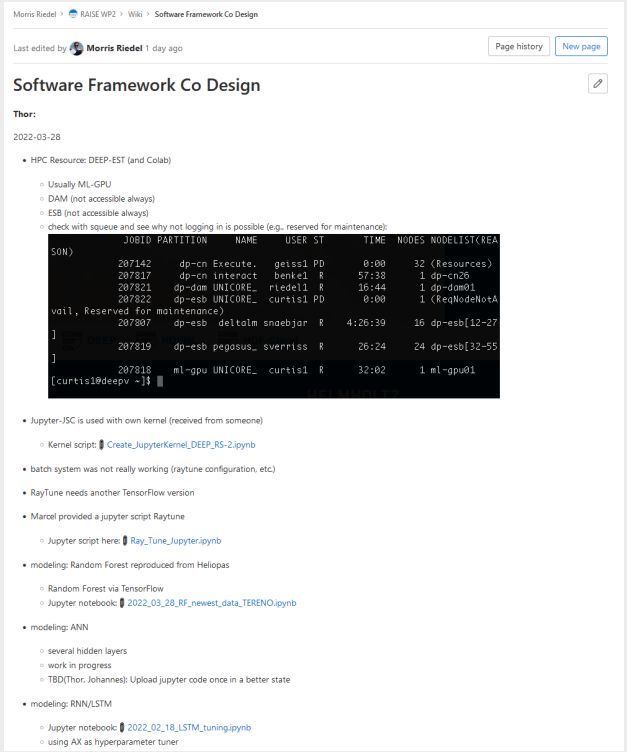
```
[riedel1@dp-dam01 ~]$ module spider tensorflow

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  TensorFlow:
---------------------------------------------------------------------------------------------------------------------------------------------------------------
     Description:
       An open-source software library for Machine Intelligence

     Versions:
        TensorFlow/1.12.0-GPU-Python-2.7.15
        TensorFlow/1.12.0-GPU-Python-3.6.6
        TensorFlow/1.13.1-GPU-Python-3.6.8
        TensorFlow/2.2.0-GPU-Python-3.6.8-1
        TensorFlow/2.3.1-Python-3.8.5
        TensorFlow/2.5.0-Python-3.8.5
        TensorFlow/2.6.0-CUDA-11.5

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  For detailed information about a specific "TensorFlow" module (including how to load the modules) use the module's full name.
  For example:

     $ module spider TensorFlow/2.2.0-GPU-Python-3.6.8-1
---------------------------------------------------------------------------------------------------------------------------------------------------------------
```


```
[riedel1@dp-dam01 ~]$ module spider cuda

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  CUDA:
---------------------------------------------------------------------------------------------------------------------------------------------------------------
     Description:
       CUDA (formerly Compute Unified Device Architecture) is a parallel computing platform and programming model created by NVIDIA and implemented by the graphics processing units (GPUs) that they produce. CUDA gives developers access
       to the virtual instruction set and memory of the parallel computational elements in CUDA GPUs.

     Versions:
        CUDA/9.2.88
        CUDA/10.1.105
        CUDA/10.2.89
        CUDA/11.0
        CUDA/11.0.207
        CUDA/11.3
        CUDA/11.5

---------------------------------------------------------------------------------------------------------------------------------------------------------------
  For detailed information about a specific "CUDA" module (including how to load the modules) use the module's full name.
  For example:

     $ module spider CUDA/11.0.207
---------------------------------------------------------------------------------------------------------------------------------------------------------------
```



Realization of SW Framework – Ideas of Web Page & Artefacts

- Initial ideas collected on WP2 RAISE
  - Should be transformed in a proper GIT structure (new WP2 RAISE programmer & RAISE folks → next slide)
  - Selected artefacts of different types: Jupyter notebooks of AI codes, Kernel for Jupyter notebooks, infos links to Nvidia drivers
  - Context: Concrete HPC machines (e.g., DEEP-EST DAM, ESB, ML-GPU)
  - Practice & experience: Shows highly unstable environments for AI configuration and setups (not deterministic behaviours) → room for framework idea
  - Lessons learned: Invested many hours to identify issues in kernel developments with new stages and new python versions → we need improvements!
  - Wiki page for now with attachment: https://gitlab.jsc.fz-juelich.de/riedel1/raise-wp2/-/wikis/Software-Framework-Co-Design



Morris Riedel › RAISE WP2 › Wiki › Software Framework Co Design

Last edited by **Morris Riedel** 1 day ago — Page history — New page

Software Framework Co Design

Thor:

2022-03-28

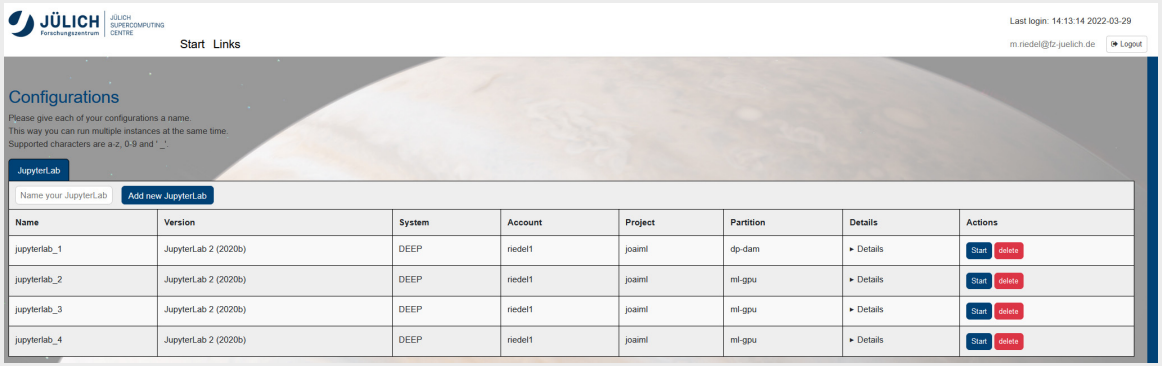
- HPC Resource: DEEP-EST (and Colab)
  - Usually ML-GPU
  - DAM (not accessible always)
  - ESB (not accessible always)
  - check with squeue and see why not logging in is possible (e.g., reserved for maintenance):

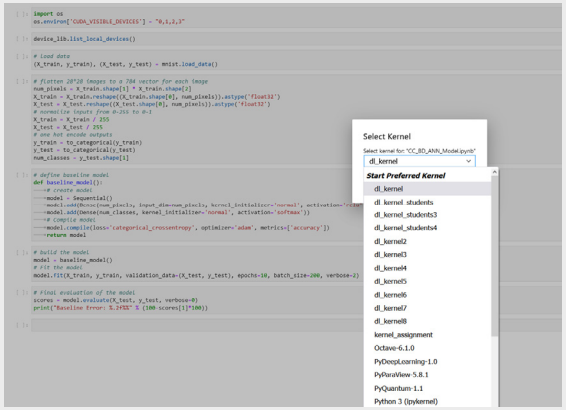
```
             JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
            207142     dp-cn Execute.    geiss1 PD       0:00     32 (Resources)
            207817     dp-cn interact   benke1  R      57:38      1 dp-cn26
            207821    dp-dam UNICORE_  riedel1  R      16:44      1 dp-dam01
            207822    dp-esb UNICORE_  curtis1 PD       0:00      1 (ReqNodeNotAvail, Reserved for maintenance)
            207807    dp-esb  deltalm snaebjar  R    4:26:39     16 dp-esb[12-27]
            207819    dp-esb pegasus_ sverriss  R      26:24     24 dp-esb[32-55]
            207818    ml-gpu UNICORE_  curtis1  R      32:02      1 ml-gpu01
[curtis10@deepv ~]$
```

- Jupyter-JSC is used with own kernel (received from someone)
  - Kernel script: Create_JupyterKernel_DEEP_RS-2.ipynb
- batch system was not really working (raytune configuration, etc.)
- RayTune needs another TensorFlow version
- Marcel provided a jupyter script Raytune
  - Jupyter script here: Ray_Tune_Jupyter.ipynb
- modeling: Random Forest reproduced from Heliopas
  - Random Forest via TensorFlow
  - Jupyter notebook: 2022_03_28_RF_newest_data_TERENO.ipynb
- modeling: ANN
  - several hidden layers
  - work in progress
  - TBD(Thor, Johannes): Upload jupyter code once in a better state
- modeling: RNN/LSTM
  - Jupyter notebook: 2022_02_18_LSTM_tuning.ipynb
  - using AX as hyperparameter tuner

Realization of SW Framework – Ideas of Web Page & Artefacts

- Example of Setups
  - Tried many varieties of kernels
  - Developers / PhD Students loose ~3-4 hours average by trying new HPC machine just to get new modules right and/or setup kernels that work with modules
  - Selected debug/solution tools not known always, e.g., nvidia-smi, etc.
  - Note: Jupyter-JSC itself seems not to be the problem, rather complex hardware/software configurations
  - E.g., DEEP-EST DAM different nodes: FPGAs and GPUs?! ML-GPU worked better

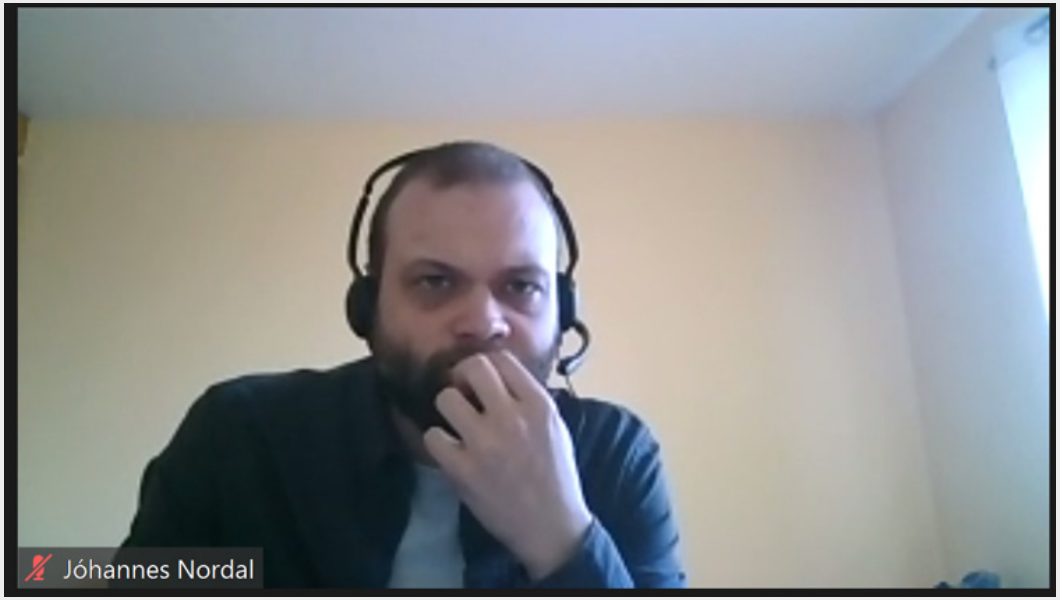




New WP2 Programmer - Jóhannes Nordal

- WP2 Programmer with experience in C/UNIX/HPC
  - University of Iceland
- Should be involved in all RAISE relevant programming aspects to collect and curate artefacts for the SW framework co-design efforts
- Email: jon8@hi.is

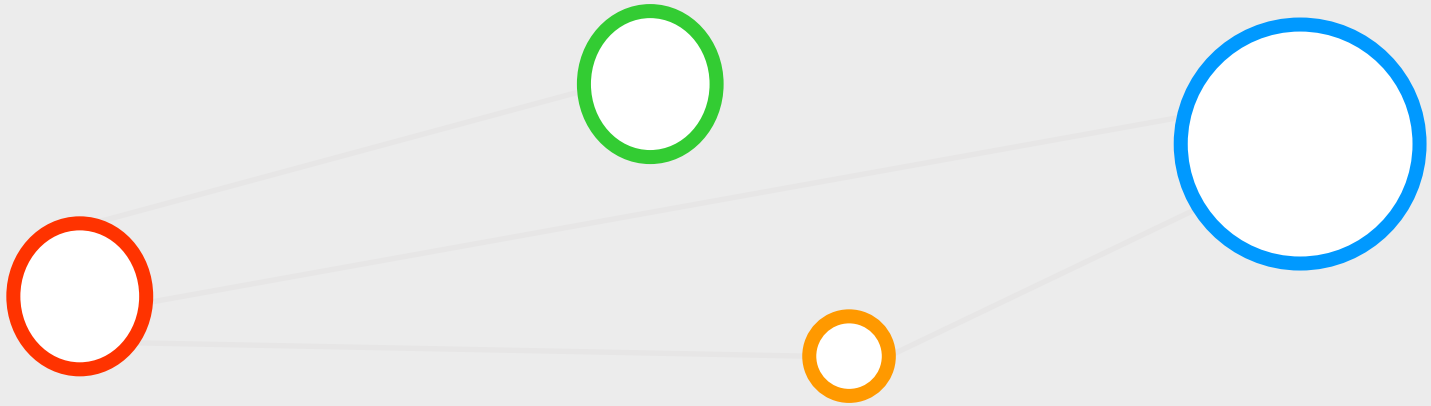
- WELCOME!



Realization of SW Framework – Interaction Room Seismic Imaging

- Pipeline activities relevant for the SW Framework Co-Design
  - Updates from Johannes (WP2) & Liang (WP3)
  - TBD: presentation by Johannes/Liang

Agenda Item (4) – Status WP2 Seminar Plans



WP2 Monthly Seminars – Review & Plan

WP2 Monthly Seminars – Review & Plan

December:
No Seminar

January:
RTU CUDA Seminar
(THANKS!)

February:
none

2022-03-31 14:00 GMT
Graph Neural Network
Morris: Intro GNNs (30 min)
Leo from Atos (45 min)
Eric from Cern (20 min)

TBD (all): Please suggest further training & teaching seminars for YouTube channel on our WP2 mailing list to plan better ahead

WP2 Monthly Seminars – Review & Plan

April:
Quantum Annealing
Maybe Gabriele Examles from SVMs, Amer SVR

May:
Request Project Partners?
ONNX / OpenML
Interoperable formats

June:
Morris: GPUs in general
Arnis & Cuda @ RTU

July:
Request Project Partners?
(Deliverables maybe in WP2)

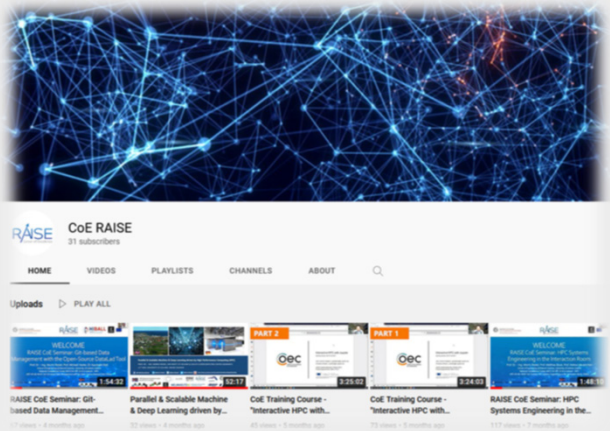
August:
Request Project Partners?
Gael (continous integration ATOS)???
Eray: Tooling with modules???

September:
Request Project Partners?

TBD (all): Please suggest further training & teaching seminars for YouTube channel on our WP2 mailing list to plan better ahead

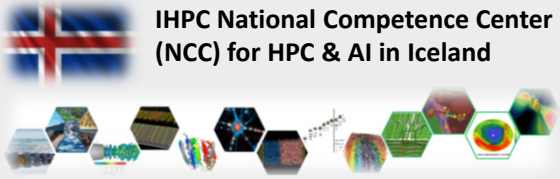
WP2 Monthly Seminars – Review & Plan

- Monthly WP2 Seminars
  - Co-organized with Icelandic National Competence Center (NCC) funded by the EuroCC project: http://ihpc.is
  - Performed since Quarter 2 of the project (April 2021)
  - Selected dates via agreement of availability of speakers
  - Used as major AI/HPC methods information/training for WP3/WP4
  - Contributed to outreach via YouTube Channel recordings: https://www.youtube.com/channel/UCAdIZ-v6cWwGdapwYxdN7dg
  - TBD(Katrín): Schedule the YouTube Seminar series with speakers



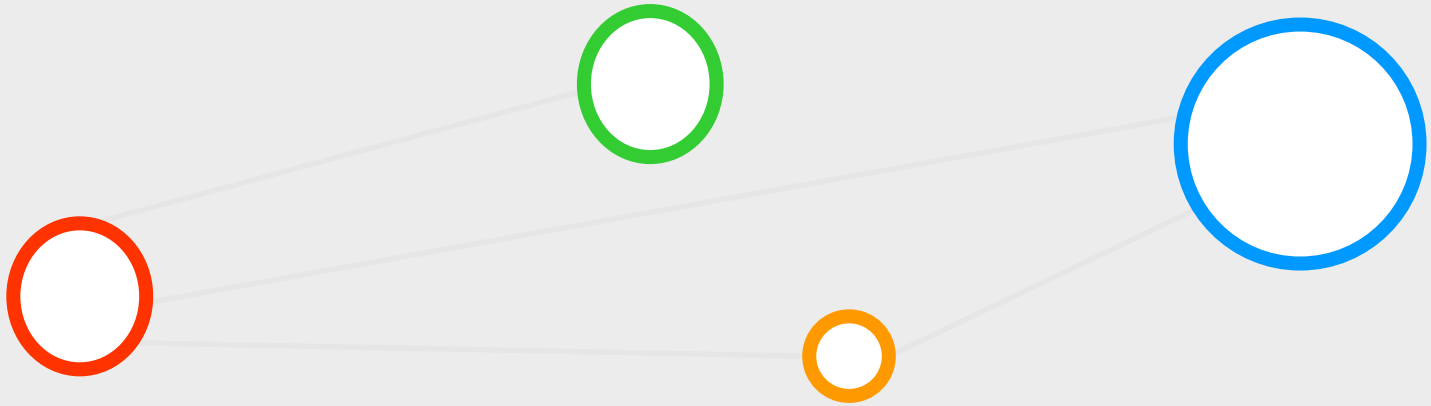
Plan for next 12 Month

- **Carry on with monthly WP2 seminars in the same style, but schedule on 3-4 month horizons**
- **Repeat certain seminars with advanced content and updates of activities (e.g., GraphCore & ATOS)**
- **Work better together with WP6 on releasing seminars on YouTube channel more regularly**
- **Collect slides of speakers and make them available on BSCW and/or on the RAISE Web Page**



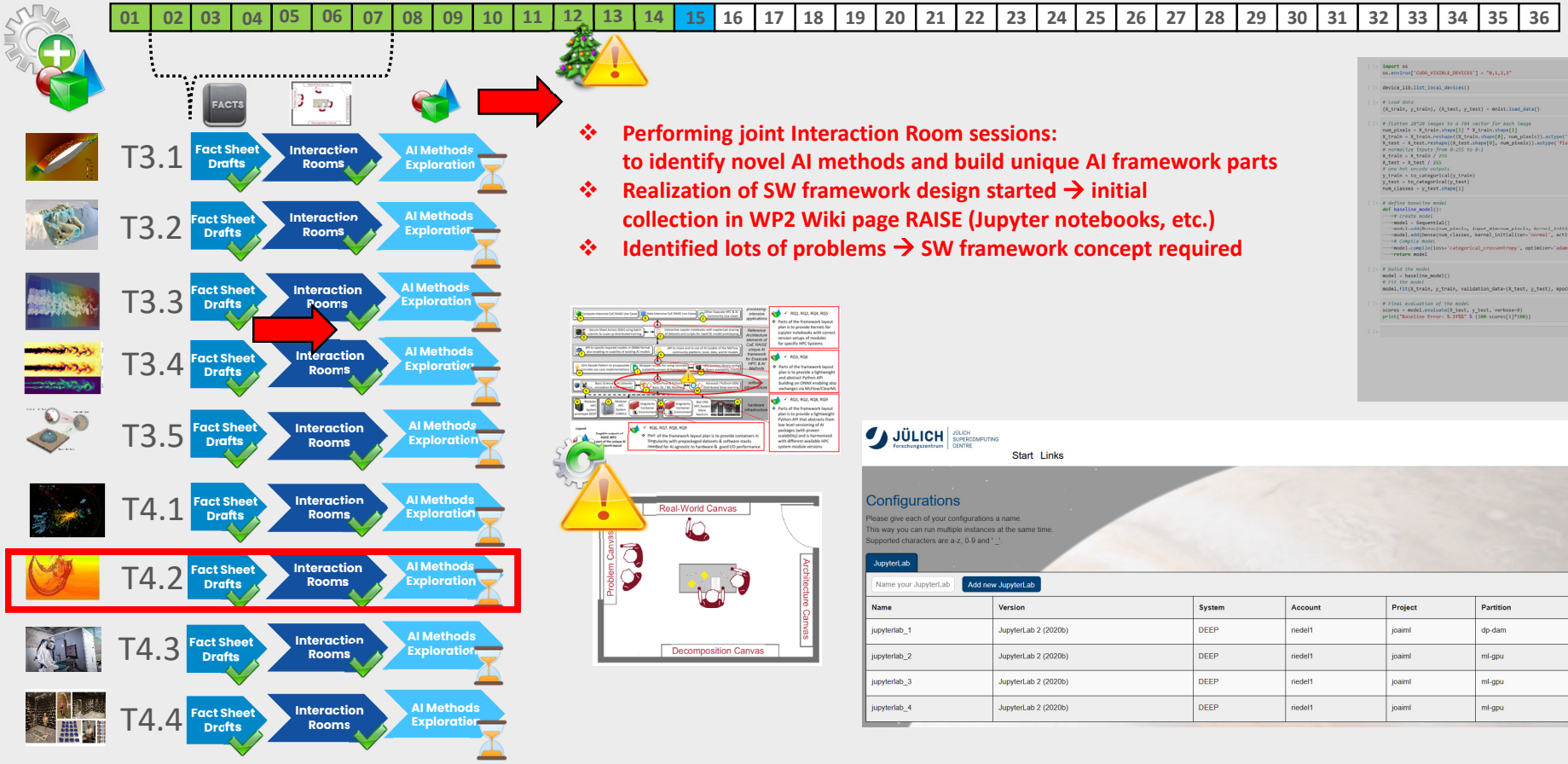
IHPC National Competence Center (NCC) for HPC & AI in Iceland

Agenda Item (5) – Compelling Scoreboard Review & Next Steps

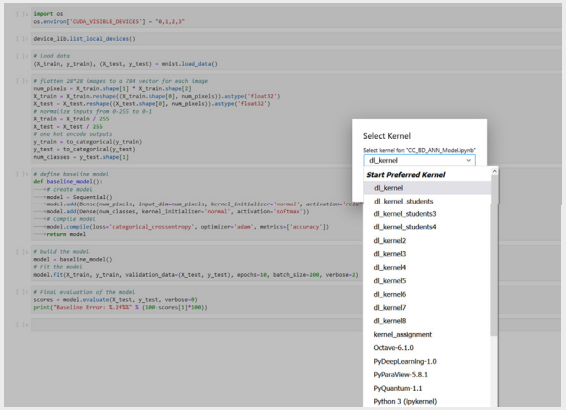


Compelling Scoreboard Review – Use Case Progress

RAISE Center of Excellence



- Performing joint Interaction Room sessions: to identify novel AI methods and build unique AI framework parts
- Realization of SW framework design started → initial collection in WP2 Wiki page RAISE (Jupyter notebooks, etc.)
- Identified lots of problems → SW framework concept required



Compelling Scoreboard Review & Next Steps

RAISE Center of Excellence

✓ Call for Monthly Meeting February & check missing people in WP2 (Kick-off)

✓ Monthly Meeting February

✓ Final D1.5 (M2) & D1.2 (M2)

✓ Monthly Meeting March

✓ IR Seminar 2021-04-08

✓ Monthly Meeting April

✓ Monthly Meeting May

✓ DataLad Seminar 2021-05-28

✓ HeAT Seminar 2021-06-28

✓ D2.6 Report on support activities (M6)

▪ Quaterly Report 2 (M6)

✓ Monthly Meeting June

✓ Distributed Training Seminar 2021-07-29

✓ AI/HPC Methods (M7)

✓ Monthly Meeting July

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

SC21


T3.1 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T3.2 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T3.3 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T3.4 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T3.5 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T4.1 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T4.2 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T4.3 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration


T4.4 Fact Sheet Drafts → Interaction Rooms → AI Methods Exploration

✓ AHM Meeting 2021-11-24/25

✓ GraphCore Seminar 2021-11-23

✓ Monthly Meeting November

✓ Hyperparameter Tuning with Ray Tune Seminar 2021-10-29

✓ Monthly Meeting October

✓ MLOps with ClearML Seminar ~end Sep

✓ Monthly Meeting September

✓ D2.12 Software layout plan for a unique AI framework (M9)

✓ Monthly Meeting August

✓ Autoencoder Seminar ~end August

❖ Graph Neural Networks Seminar 2022-03-31

❖ Monthly Meeting March

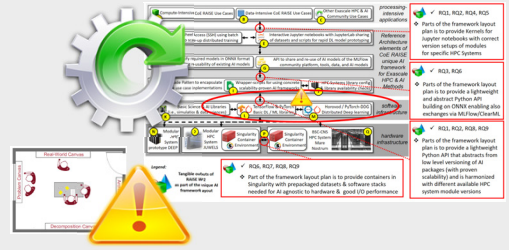
✓ Monthly Meeting February

✓ Monthly Meeting January

✓ CUDA Seminar January 2022-01-19/20

✓ D2.2 Report on porting & performance engineering (M12)

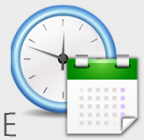
✓ D2.14 Report on novel AI technologies (M12)



➢ Next Steps

- Interaction Room 2nd Round → Discuss & Implement framework
- Collect materials from WP3/WP4 for Web/Git

Agenda Item (5) – Next Steps & Follow-Through



1. AOB (Andi): Review Dates & Agenda?
2. AOB: Plan a continous integration and toolset support for underlying module environment that works for specific HPC systems in RAISE (including MPI versions, for coupling, etc.)
    1. ATOS
3. AOB: Documentation of systems of FZJ, BSC: automation of modules that work
    1. Still challenges with on top libraries, horovod, pip install tensorflow
    - WP2 Eray → more automated over time (e.g., what happens with LUMI AMD roc toolkits)

drive. enable. innovate.

RAISE Center of Excellence

The CoE RAISE project have received funding from
the European Union's Horizon 2020 –
Research and Innovation Framework Programme
H2020-INFRAEDI-2019-1 under grant agreement no. 951733

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