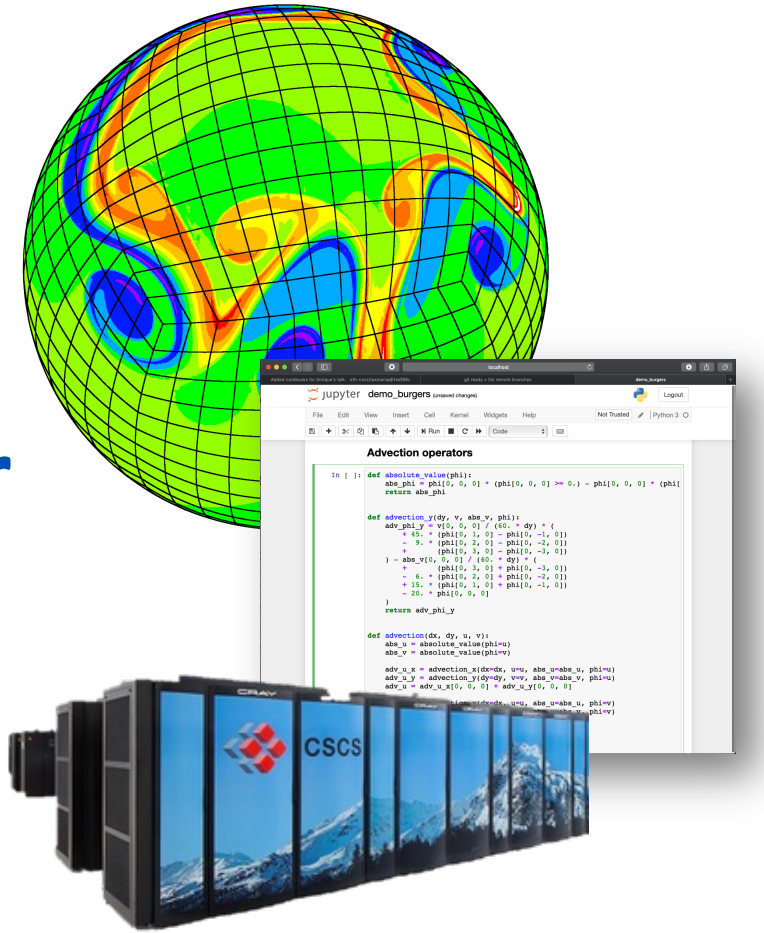
High Performance Computing for Weather and Climate (HPC4WC)

Content: Intro
Lecturers: Oliver Fuhrer
Block course 701-1270-00L
Summer 2021

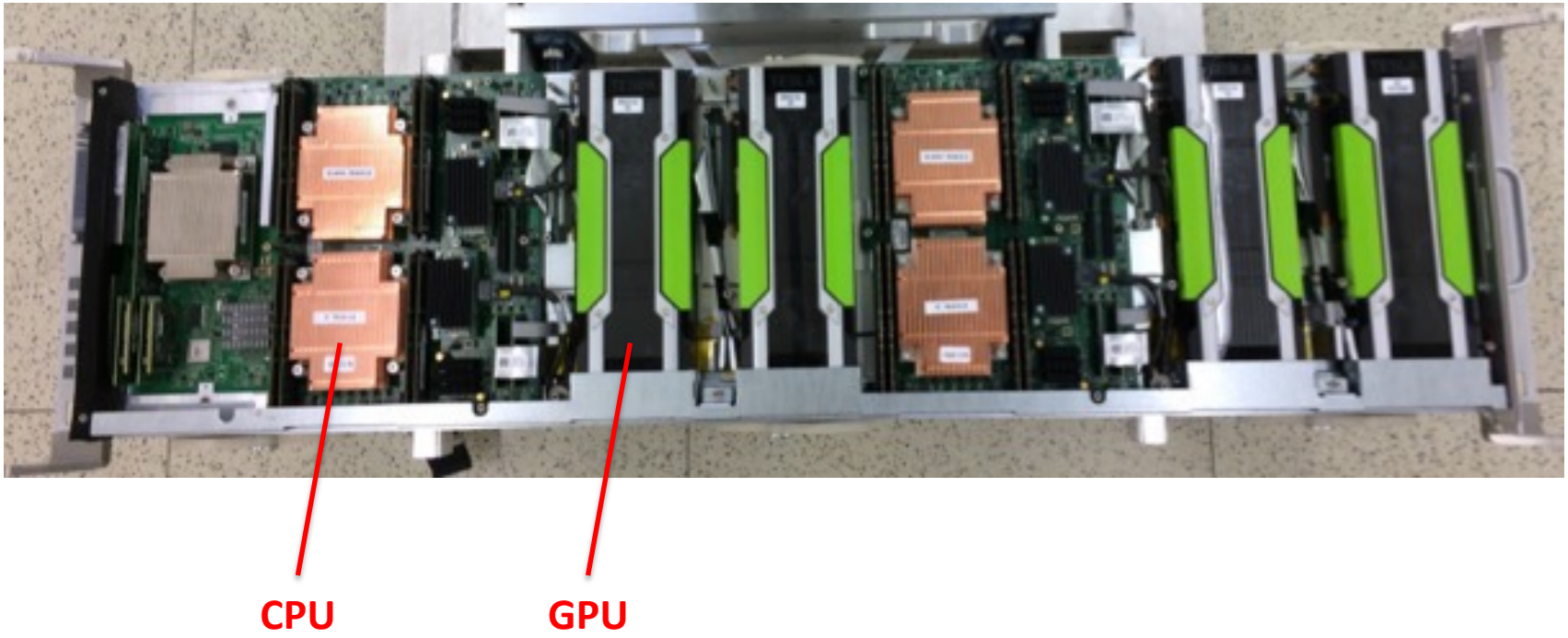


Work projects

- **Effort is approximately 60h per person**
  - Pick a topic that is challenging, but realistic
- **Decide by end of next week (Deadline 1.7.2022)**
  - Enter group and topic in google docs sheet
- **Work with your assistant!**
  - Each project will be assigned an advisor (in google docs)
  - Meet with your advisor before starting and disucuss the plan
  - Create a public #projectXX channel on Slack to stay in touch
- **Hand-in source code and report (Deadline 31.8.2022)**
  - Source code and report as pull request to https://github.com/ofuhrer/HP4WC/projects/2022/groupXX

Hybrid Supercomputer

Piz Daint blade (4 nodes)

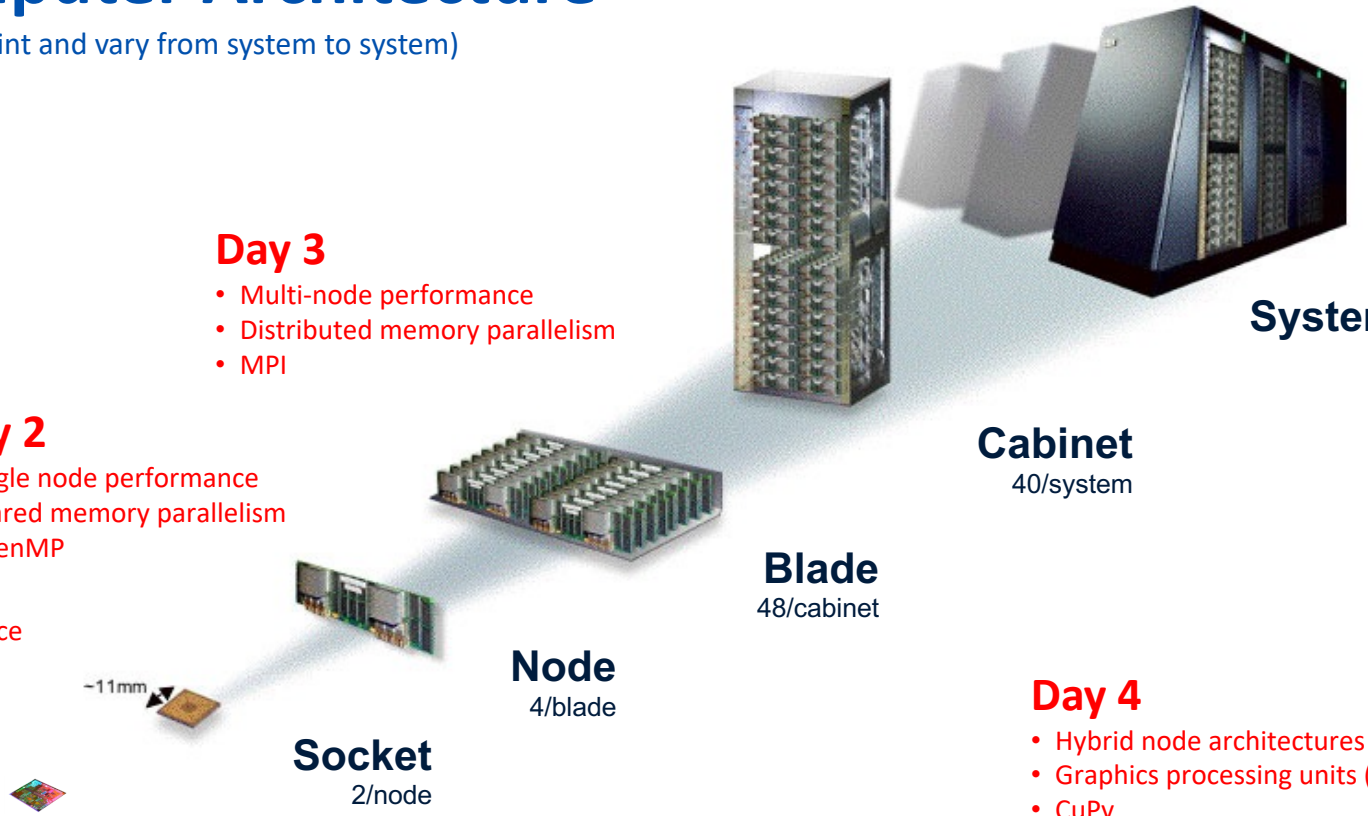


Top500.org

Rank	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	**Supercomputer Fugaku** - Supercomputer Fugaku A64FX 48C 2.2GHz, Tofu interconnect D, **Fujitsu** RIKEN Center for Computational Science Japan	7,630,848	442,010.0	537,212.0	29,899
2	**Summit** - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, **IBM** DOE/SC/Oak Ridge National Laboratory United States	2,414,592	148,600.0	200,794.9	10,096
3	**Sierra** - IBM Power System AC922, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, **IBM / NVIDIA / Mellanox** DOE/NNSA/LLNL United States	1,572,480	94,640.0	125,712.0	7,438
4	**Sunway TaihuLight** - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway, **NRCPC** National Supercomputing Center in Wuxi China	10,649,600	93,014.6	125,435.9	15,371
5	**Perlmutter** - HPE Cray EX235n, AMD EPYC 7763 64C 2.45GHz, NVIDIA A100 SXM4 40 GB, Slingshot-10, **HPE** DOE/SC/LBNL/NERSC United States	706,304	64,590.0	89,794.5	2,528
6	**Selene** - NVIDIA DGX A100, AMD EPYC 7742 64C 2.25GHz, NVIDIA A100, Mellanox HDR Infiniband, **Nvidia** NVIDIA Corporation United States	555,520	63,460.0	79,215.0	2,646
7	**Tianhe-2A** - TH-IVB-FEP Cluster, Intel Xeon E5-2692v2 12C 2.2GHz, TH Express-2, Matrix-2000, **NUDT** National Super Computer Center in Guangzhou China	4,981,760	61,444.5	100,678.7	18,482
8	**JUWELS Booster Module** - Bull Sequana XH2000 , AMD EPYC 7402 24C 2.8GHz, NVIDIA A100, Mellanox HDR InfiniBand/ParTec ParaStation ClusterSuite, **Atos** Forschungszentrum Juelich (FZJ) Germany	449,280	44,120.0	70,980.0	1,764
9	**HPC5** - PowerEdge C4140, Xeon Gold 6252 24C 2.1GHz, NVIDIA Tesla V100, Mellanox HDR Infiniband, **Dell EMC** Eni S.p.A. Italy	669,760	35,450.0	51,720.8	2,252
10	**Frontera** - Dell C6420, Xeon Platinum 8280 28C 2.7GHz, Mellanox InfiniBand HDR, **Dell EMC** Texas Advanced Computing Center/Univ. of Texas United States	448,448	23,516.4	38,745.9	

Supercomputer Architecture

(Numbers are for Piz Daint and vary from system to system)



Day 1
- Single core performance
- Caches

Day 2
- Single node performance
- Shared memory parallelism
- OpenMP

Day 3
- Multi-node performance
- Distributed memory parallelism
- MPI

Day 4
- Hybrid node architectures
- Graphics processing units (GPUs)
- CuPy

Future of HPC in Weather and Climate?