

JURECA

First Modular Supercomputer Worldwide

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Parallel Architectures, June 2020

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1 Overview

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- Forschungszentrum Jülich is a interdisciplinary research centre in Germany;
- Institute for Advanced Simulation (IAS);
- Jülich Supercomputing Centre (JSC);
 - Supercomputing centre since 1987;

Managed supercomputers

- JUSUF;
- JUWELS (position 31¹);
 - Helped Google demonstrate the quantum supremacy (source);
 - Quantum computer: 200 seconds;
 - Fastest supercomputer: 10.000 years;
- JURECA (position 56¹);
 - The name is short for Jülich Research on Exascale Cluster Architectures;

¹November 2019 ranking.

- 2015-04: begins to operate the cluster;
- 2017-11: included a buster module;
- First modular supercomputer worldwide (source);

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JURECA Cluster



- 1872 compute nodes²;
 - 2 Intel Xeon E5-2680 v3 Haswell CPUs per node;
 - 2 × 12 cores, 2.5 GHz;
 - 75 compute nodes with 2 NVIDIA K80 GPUs;
 - 4992 CUDA cores;
 - 24 GiB GDDR5 memory;
 - DDR4 memory (2133 MHz);
 - 1605 compute nodes with 128 GiB memory;
 - 128 compute nodes with 256 GiB memory;
 - 64 compute nodes with 512 GiB memory;

²You can see the details here.

- 12 visualization nodes;
 - 2 Intel Xeon E5-2680 v3 Haswell CPUs per node;
 - 2 NVIDIA K40 GPUs per node;
 - 12 GiB GDDR5 memory;
 - 10 nodes with 512 GiB memory;
 - 2 nodes with 1024 GiB memory;

Summary - JURECA Cluster

- 1872 compute nodes;
- 12 visualization nodes;
- 45.216 CPU cores;
- 1.8 (CPU) + 0.44 (GPU) Petaflop per second;
- 100 GiB per second storage connection;

JURECA Buster



Summary - JURECA Buster

- 1640 compute nodes³;
 - 1 Intel Xeon Phi 7250-F Knights Landing CPUs per node;
 - 68 cores, 1.4 GHz;
 - 96 GiB memory plus 16 GiB MCDRAM high-bandwidth memory;
- 111.520 CPU cores;
- 5 Petaflop per second;
- 100+ GiB per second storage connection;

³You can see the details here.

- CentOS 7;
- Intel MPI and ParTec MPI;
- InfiniBand EDR;
- 1,345.28 kW;

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- SISD - Single Instruction, Single Data;
- SIMD - Single Instruction, Multiple Data;
- MISD - Multiple Instruction, Single Data;
- **MIMD - Multiple Instruction, Multiple Data;**

Memory sharing

- Multiprocessor;
- **Multicomputer;**

Type of memory access

- UMA - Uniform Memory Access;
- NUMA - Non-Uniform Memory Access;
- COMA - Cache-Only Memory Architecture;
- **NORMA - Non-Remote Memory Access;**

- PVP - Parallel Vector Processors;
- SMP - Symmetric Multiprocessors;
- MPP - Massively Parallel Processors;
- NOW - Network Of Workstations;
- **COW - Clusters Of Workstations;**

Flynn

instruction stream and data stream

memory sharing

memory access

construction trends

MIMD

Multiprocessor

UMA

NUMA

COMA

SMP

PVP

Multicomputer

NORMA

MPP

COW

NOW

- Clustering;
 - **c - commodity cluster**;
 - m - monolithic system;
- Parallelism;
 - t - multithreading;
 - v - vector;
 - **c - communicating sequential processes or message passing**;
 - s - systolic;
 - w - VLIW;
 - h - producer/consumer;
 - p - parallel processes;
- Naming;
 - **d - distributed**;
 - s - shared;
 - c - cache coherent;
- Latency;
 - c - caches;
 - v - vectors;
 - t - multithreaded;
 - m - processor in memory;
 - **p - parcel or message driven split-transaction**;
 - f - prefetching;
 - a - explicit allocation;

Final classification: c/d/c/p.

- GMSV - Global Memory-Shared Variables;
 - Shared memory;
- **DMMP - Distributed Memory-Message Passing;**
 - Message passing;
- DMSV - Distributed Memory-Shared Variables;
 - Hybrid;
- GMMP - Global Memory-Message Passing;

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- Jülich Supercomputing Centre;
- Time lapse video of cluster installation;
- Time lapse video of booster installation;