JURECA

First Modular Supercomputer Worldwide

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- Overview
- 2 Architecture
- Classifications
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Research centre

- 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;

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JURECA

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

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JURECA Cluster



JURECA Cluster

- 1872 compute nodes²;
 - 2 Intel Xeon E5-2680 v3 Haswell CPUs per node;
 - 2 x 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;

JURECA Cluster

- 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.

Cluster + Buster

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

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Flynn

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

Memory sharing

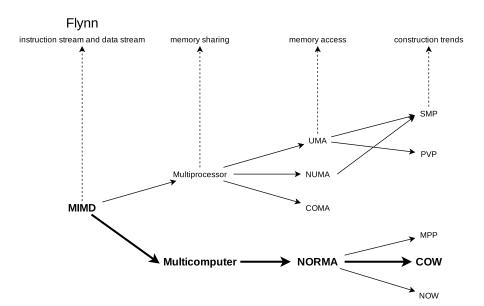
- Multiprocessor;
- Multicomputer;

Type of memory access

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

Construction trends

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



Dongarra et al. (2003)

- 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.

Eric E. Johnson (1988)

- 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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References and resources

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