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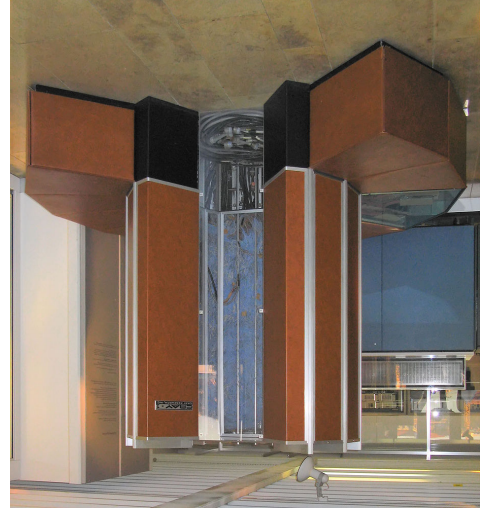
Christian Küller

# Supercomputer - A simple introduction

# What is a Supercomputer?

- A Supercomputer a big computer
- «Super» stands for something extraordinary in terms of performance
- A unambiguous definition do not exist, because the method of measuring the performance (speed of calculation) is not possible on all high performance computers in the same manner
- A popular definition is, at least all computers out of the Top500 and GreenTop500 list are Supercomputers.

## How does a Supercomputer look like - previously



- previously: single computer, single case
- Example CRAY 1<sup>1</sup>

<sup>1</sup> Photo from Clemens PEIFFER, shows CRAY 1 at deutsche Museum München.  
URL: <http://en.wikipedia.org/wiki/File:Cray-1-deutsches-museum.jpg>  
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- Simulation
- Theory building and model review
- Data mining
- Mass calculations
- Movies
- Pharmacy

## What is a Supercomputer used for?

<sup>2</sup>Photo by Argonne National Laboratory,  
URL: [http://en.wikipedia.org/wiki/File:IBM\\_Blue\\_Gene\\_P\\_supercomputer.jpg](http://en.wikipedia.org/wiki/File:IBM_Blue_Gene_P_supercomputer.jpg)  
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- today at most: a bunch of cabinets
- Example IBM Blue Gene P<sup>2</sup>



## How does a Supercomputer look like - today

## Who buys a Supercomputer?

- Rich countries
- Universities
- Research institutes
- Military
- Big companies

## How is a Supercomputer used?

- A Supercomputer normally has not screen or keyboard
- a Supercomputer can not speak or hear (not jet)
- But a Supercomputer has a high speed network
- One uses a different computer (e.g. a laptop)
- On this a small file "job" is created
- The job contains a link to program
- The job requests resources: time, performance (CPU)
- The job will be send to the Supercomputer waiting queue
- A so called "scheduler" (a program) decides when the job turn comes
- When the jobs turn comes, the job starts the actually program in parallel
- When the job is finished, one receives an e-mail
- One has just to collect the data

## How to measure performance? Example Top500

- Program: HPL 2.0 - High Performance Linpack
- Task: Performance number, measured in FLOPS
- FLOPS: Floating point operations per second
- Operation: Operation (multiplication) with numbers
- Floating point number: z.B.  $1.528535047 \times 10^5$ , or 152853.5047
- 1 PFLOPS = 1 PETA FLOPS = 1 000 000 000 000 000 FLOPS

## Top 10 (of Top500.org) from November 2012 SLC

Name	Computer	Site	OEM	Country	PFLOPS	OS
1 Titan	Cray XK7	DOE/SC/Oak Ridge National Laboratory	Cray Inc.	United States	17,590000	Linux
2 Sequoia	BlueGene/Q	DOE/NNSA/LLNL	IBM	United States	16,324751	Linux
3 <b>K computer</b>	<b>RIKEN (AICS)</b>	<b>Fujitsu</b>	<b>Japan</b>	<b>10,510000</b>	<b>Linux</b>	
4 Mira	BlueGene/Q	DOE/SC/Argonne National Lab	IBM	United States	8,162376	Linux
5 JUQUEEN	BlueGene/Q	Forschungszentrum Juelich (FZJ)	IBM	Germany	4,141180	Linux
6 SuperMUC	DataPlex DX360M4	Leibniz RZ	IBM	Germany	2897000	Linux
7 Stampede	PowerEdge C8220	Texas Adv. Comp. Center/Univ. of Texas	Dell	United States	2,660290	Linux
8 Tianhe-1A	NUDT YH MPP	National Supercomp. Center in Tianjin	NUDT	China	2,566000	Linux
9 Fermi	BlueGene/Q	CINECA	IBM	Italy	1,725492	Linux
10 DARPA Trial Sub-set	Power 775	IBM Development Engineering	IBM	United States	1,515000	Linux

# Example

## The K Supercomputer from Kobe

- K as in 京(kei), represents  $10^{16}$
- RIKEN Advanced Institute for Computational Science (AICS)
- Kobe Port Island in Kobe, Hyogo Prefecture.
- 3rd level, 50m x 50m
- 864 racks
- Performance: 10.51 PFLOPS
- Consumption: 12659.89 KW

### Applications

Earth Science	physics
nano science	nano science
plane wave expansion	engineering
flow analysis based on simulations	nano science
Atmospheric models, Sismic waves	molecular dynamics calculation
	Lattice QCD simulation

## Example: Deep Blue Supercomputer



### Deep Thought 1989

- Predecessor of Deep Blue
- Carnegie Mellon University later IBM
- Kasparov wins easily

### Deep Blue 1997

- IBM RS/6000 SP Thin P2SC
- 30 node with 120 MHz P2SC CPU
- 480 special VLSI chess IC
- OS: AIX, program in C
- evaluates 200 million positionen per second
- number 259 of Supercomputer Top500, June 1997
- 11.38 GFLOPS
- Kasparov loses 3-2

### Deep Blue 1996

- evaluate 100 million positions per second
- Kasparov wins 4-2

# Christian Küller

## Open Source Projects:

- Skolelinux.de/ Debian Edu
- CIPUX

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## Occupation:

- HPC Project Manager
- Partnership Program Coordinator
- Eurotech - ETH Lab - Business Unit HPC

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## Vocabulary - 単語

- キュー Queue
- ジョブ Job
- スケジューラ Scheduler
- フロップス FLOPS: Floating point operations per second
- 浮動小数点数演算 Floating point operations per second
- 演算 Operation
- 分子動力学計算 Molecular dynamics calculation
- 平面波展開 Simple wave expansion
- 格子量子色力学 Quantum chromo dynamics