

MCC 2015: Eighth Swedish Workshop on Multi-Core Computing, Copenhagen, November 25-26, 2015



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Climbing Mont Blanc – A Training Site for Energy Efficient Programming on Heterogeneous Multicore Processors

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Outline

- The inspiration
- What is CMB?
- Early experience
- Future work



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The inspiration



European scalable and power
efficient HPC platform based on
low-power embedded technology

Alex Ramirez
Barcelona Supercomputing Center
Technical Coordinator

- Using Exynos SoC from Samsung
 - ARM big.LITTLE + Mali GPU
 - Sold in large numbers
 - Samsung Galaxy mobile phones ++
 - Energy efficiency
 - Very challenging programming



GPU family started
by NTNU-students
→ Falanx → ARM
Media Processing
Division

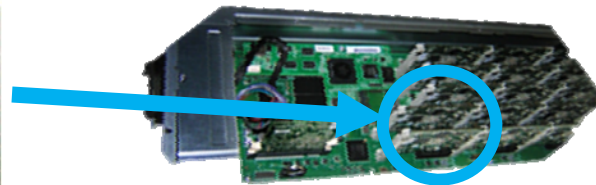
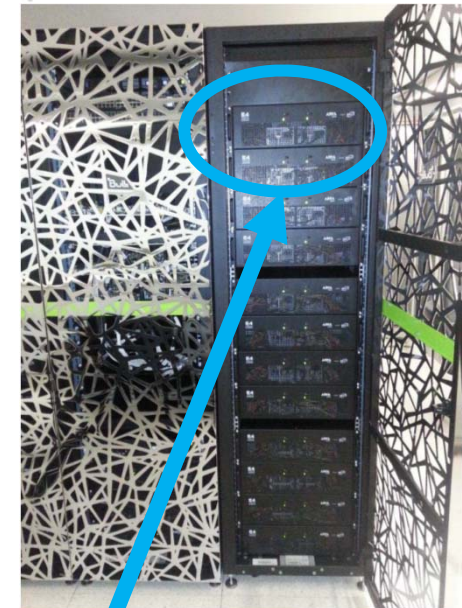


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MONT-BLANC

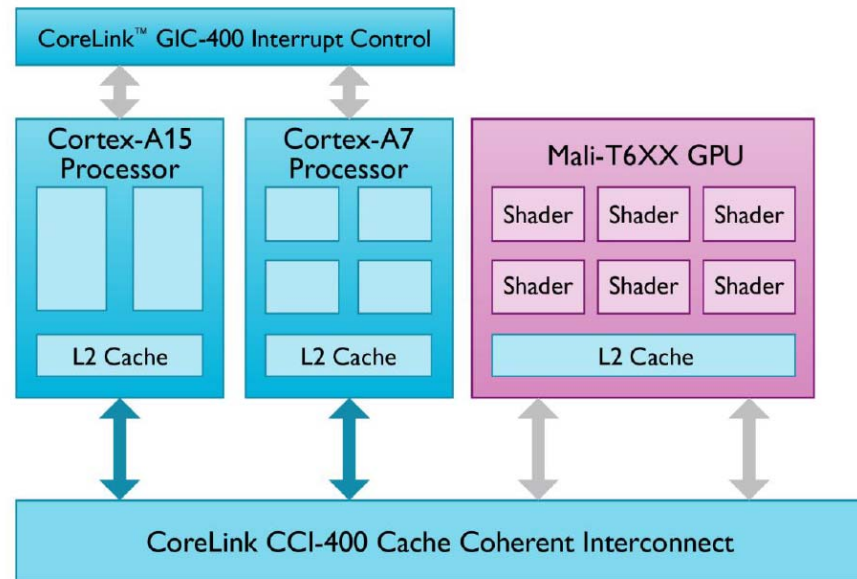
26 TFLOPS – 18KW

- Prototype
 - Exynos 5 based (32.3GFLOPS – CPU+GPU)
 - One blade: 15 compute cards (30 Cortex A15 + 15 Mali-T604)
 - One chassis: 9 blades (270 Cortex A15 + 135 Mali-T604)
 - Prototype: 6 chassis (1620 CPUs + 810 GPUs)



The idea

1. The need for energy-efficiency (Mont Blanc project)
2. Difficult programming
 - Exynos 5422 is **“3-way heterogeneous” with 14 cores**
 - → need for training
3. How to get programmers? ...



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#	Problem	User	Verdict	Language	Run Time	Submission Date
16096060	763 Fibinary Number...	Ahmad Elsa...	Accepted	JAVA	0.312	2015-09-13 20:52:03
16096059		Adria Gar...	Wrong answer	C++	0.000	2015-09-13 20:51:56
16096058		Duban Cara...	Time limit exceeded	C++	1.000	2015-09-13 20:51:54
16096057		Wei Chen	Wrong answer	C++	0.000	2015-09-13 20:51:52
16096056	10839 Trouble of 13-0...	Mostafa Ga...	Time limit exceeded	C++11	3.000	2015-09-13 20:51:49
16096055	10008 What's C...					2015-09-13 20:51:29
16096054	763 Fibinary					2015-09-13 20:51:23
16096053	11631 Dark roa					2015-09-13 20:51:09
16096052	12940 Next Pal					2015-09-13 20:51:05
16096051	11321 Sort! Sor					2015-09-13 20:51:05
16096050	12075 Counting					2015-09-13 20:50:56
16096049	100 The 3n + 1					2015-09-13 20:50:24
16096048	12940 Next Pal					2015-09-13 20:49:38
16096047	1188 Enigmat					2015-09-13 20:49:33
16096046	1296 The 3n + 1					2015-09-13 20:49:15
16096045	1296 The 3n + 1					2015-09-13 20:49:15
16096044	79892 Present Month					2015-09-13 20:49:07
16096043	543 Goldbac					2015-09-13 20:49:04
16096042	455 Periodic					2015-09-13 20:48:40
16096041	12959 Strategy Game	Carlos Men...	Accepted	C++	0.019	2015-09-13 20:48:09

UVA Online:

(Universidad de Valladolid, Spain)

* 16 million submissions so far

* 9 submi

Current UTC (or GMT)-time: 2015-11-16 09:31:56

Live rankings at UVa Online Judge

Only new AC or cpu time improved

RANKING (UTC)	SUBMISSIONS	RANKING	SUBMISSIONS
Actual hour	144	Last 60 minutes	233
		Last 4 hours	4164
		Last 24 hours	32567
		Last 7 days	162868
		Last 30.44 days	1875532
		Last 65.24 days	16316519
		Overall	

Peking University Online Judge:

* Close to 15 million submissions so far

* ≈ 3000 per day

The force (Background)

- UVA Online (Spain) (16 million submissions)
- PKU (Peking University) (14 million)
- **KATTIS (KTH, Sweden)**
- Jutge.org
- TopCoder
- Sphere Online Judge
- HackerRank
- CodeChef
- LeetCode
- Timus Online Judge
- A2 Online Judge
- URI Online Judge



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CMB SHORT INTRO



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CMB select group or problem

The screenshot shows a web browser window with the URL <https://climb.idi.ntnu.no/#/>. The page has a blue header with the logo "Climbing Mont Blanc" and navigation links "Home" and "How To". There are also "Login" and "Sign up" links in the top right.

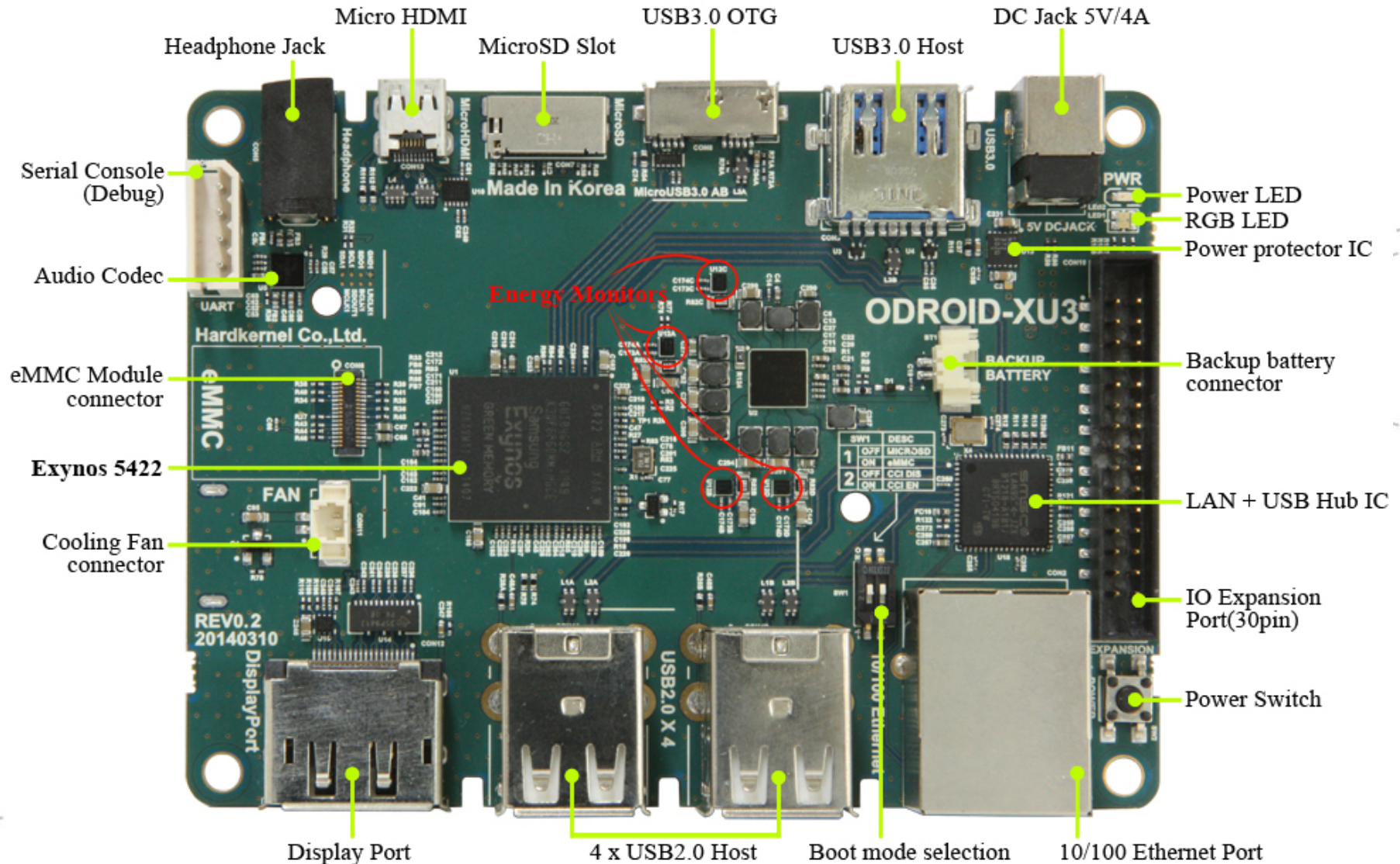
The main content area is titled "HOME PAGE" and contains two sections:

- Public Problems:** A table listing seven problems with their IDs and names. Each row has a green "Go To Problem" button.
- Public Groups:** A table listing two groups with their IDs, names, and member counts. Each row has a green "Go To Group" button.

Problem ID	Name	Go To Problem
1	The shortest path problem	Go To Problem
2	The traveling salesman problem	Go To Problem
3	The vertex cover problem	Go To Problem
4	Hello World	Go To Problem
5	Sorting Algorithms	Go To Problem
6	Battleship	Go To Problem
7	Bottles	Go To Problem

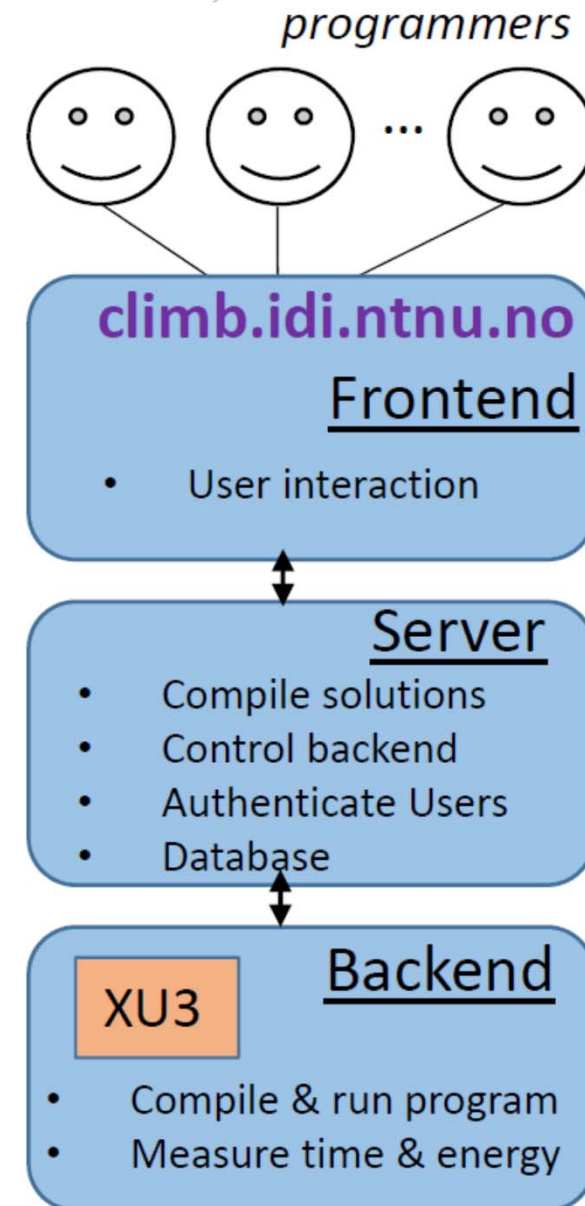
Group ID	Name	#Members	Go To Group
2	IDI Open training	3	Go To Group
1	TDT4125	2	Go To Group

Odroid XU-3



CMB technical overview

- Currently
 - C, C++, OpenCL
 - Pthreads, OpenMP 4.0
- Coming (?)
 - Java, python, Haskell?
 - MPI
- More info
 - Workshop paper at [arXiv:1511.02240](https://arxiv.org/abs/1511.02240)



CMB - high score

The screenshot shows a web browser window with the URL <https://climb.idi.ntnu.no/#/problem/1>. The page title is "Climbing Mont Blanc". The navigation bar includes "Home" and "How To" links, and "Login" and "Sign up" buttons. The main content area is titled "The shortest path problem" and contains the following sections:

Description

In this exercise you are asked to implement an algorithm for solving the single-pair shortest path problem. This is a classical combinatorial optimization problem, where the single-pair version can be formulated as the process of finding the shortest path, or route, between a source vertex s and a target vertex t in a directed or undirected weighted graph $G = (V, E)$. More information can be found on Piazza

Submit Solution

Remember to read the How To to learn how to upload a solution.
Login to upload solution.

Public Highscore (time)

User	Time (s)	Energy (j)	EDP (js)	Filename
Simen	42.38	122.17	5177.72	shortPath
Follan	45.70	129.75	5929.59	shortPath_v1
Aleksaro	46.78	134.62	6297.66	naive2p

If you have any questions or are having problems using this system, please do not hesitate to contact us at ntnu.cmb@gmail.com.

Demo ?

EARLY EXPERIENCE



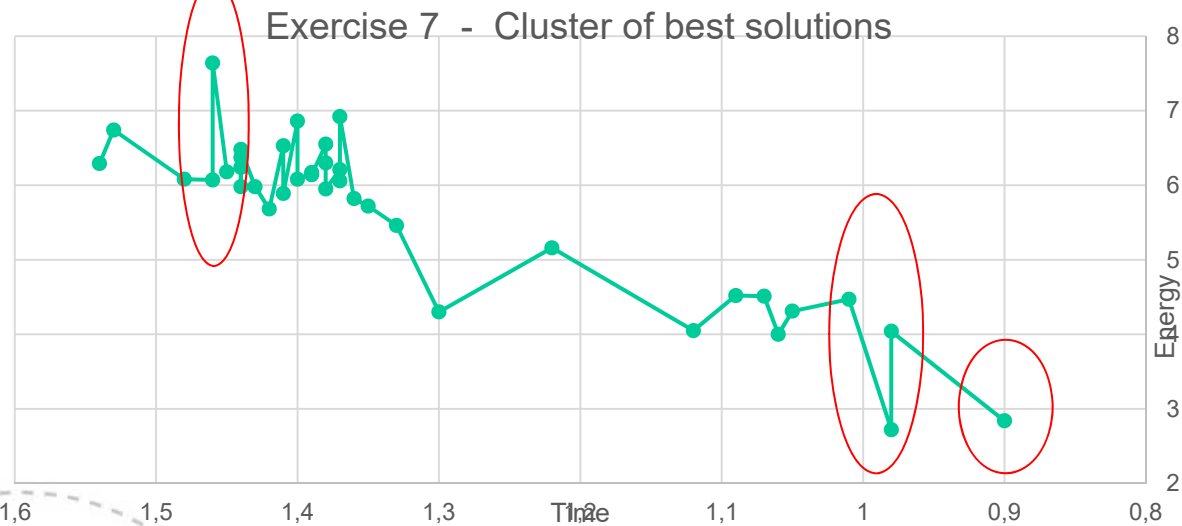
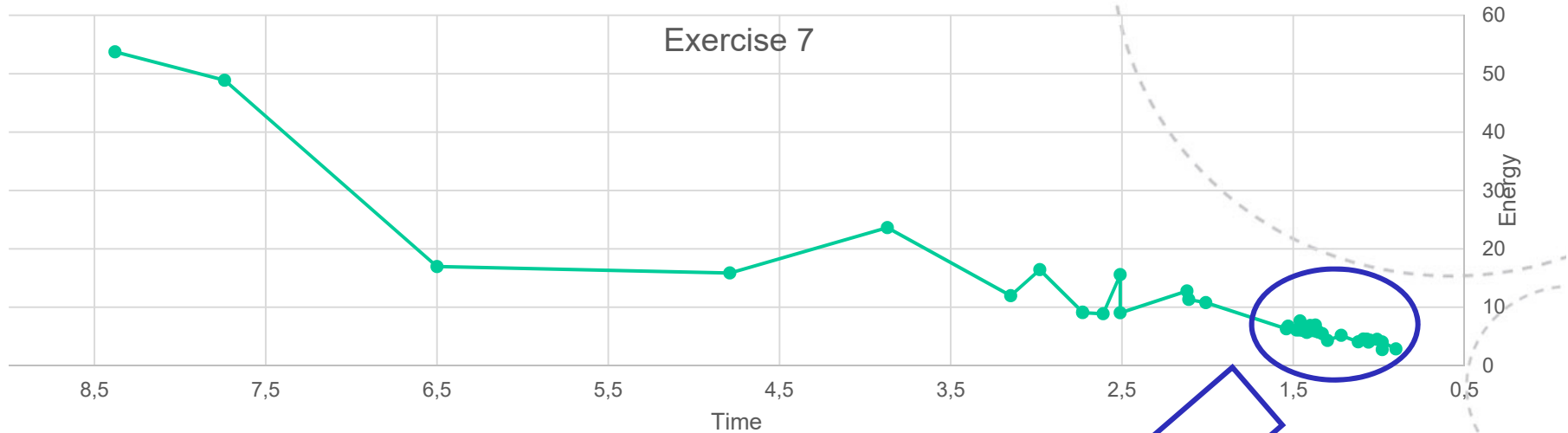
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CMB - VERY early experience

- 5 programming exercises in a course on parallel computing
 - Autumn 2015, approx. 65 students
 - 7 exercises in total
 - CMB as one of three experimental platforms
 - Students also used
 - desktops w/NVIDIA-GPU
 - Supercomputer Vilje, 22000+ cores



Submitted solutions to Exercise 7



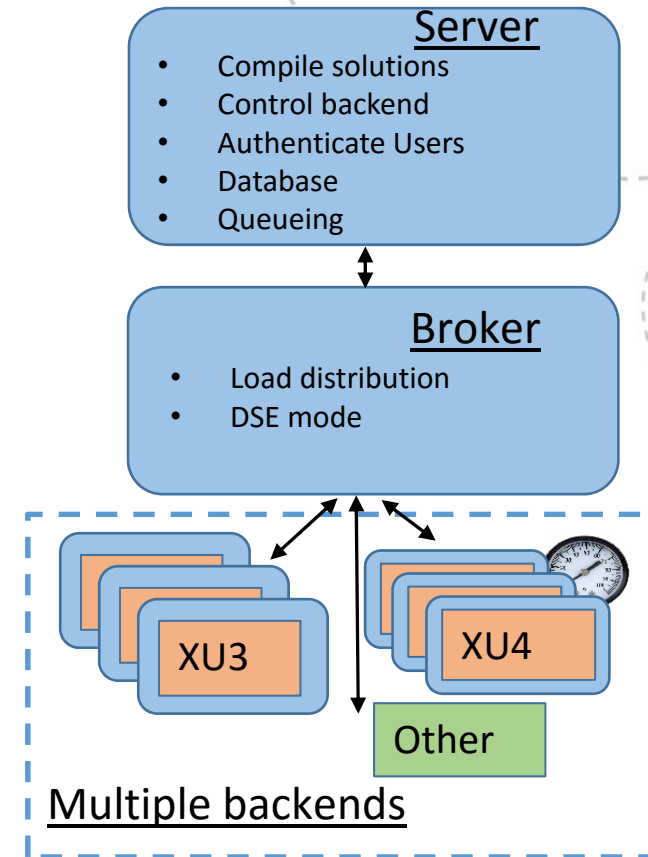
Energy used
vs. shorter
execution time



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Future work

- Spring 2016
 - Optional use by students in a big C++ course spring 2016
 - Improved functionality & capacity
 - Broker
 - DSE mode
 - More languages
- Sabbatical autumn 2016
 - Developing more problems
 - Parallel programming
- More tests in C++-course spring 2017
- More platforms
 - (Parallella?)
 - Intel Skylake
 - Kirin from Hi-Silicon (Huawei)



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Potential models for collaboration

- Application cases/kernels → define problem (now, easy)
 - Precise problem specification
 - Small data set (input, correct output)
 - “Big” data set (Correct output not visible, to avoid cheating)
 - Checker.cpp
 - Checking byte by byte is often not what you want
 - Floating-point operations, approximation problems
 - Optional user-defined “goodness”-parameter
- System development (from spring 2016, medium)
 - GUI?, statistics?, ...
- Best practice, build experience, textbook? (long term)
- <https://www.ntnu.edu/idi/card/cmb>



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QUESTIONS?

Send me an e-mail if you want to be kept updated by our short newsletter (No. 1 in Q1-2016)

arXiv:1511.02240

Contact: Lasse.Natvig@idi.ntnu.no



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