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

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Science and Technology

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

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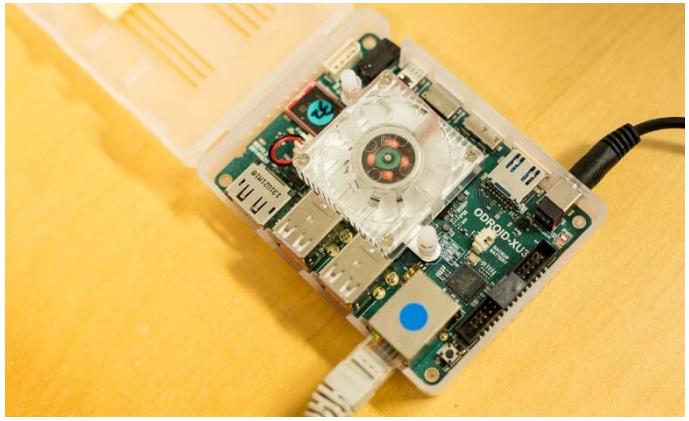

Outline

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

The inspiration

MONT-BLANC
http://www.montblanc-project.eu

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

SEVENTH FRAMEWORK PROGRAMME

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

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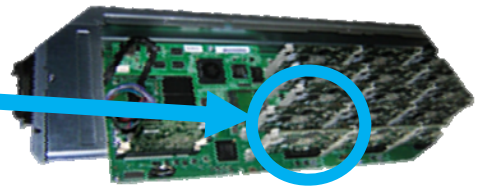
MONT-BLANC

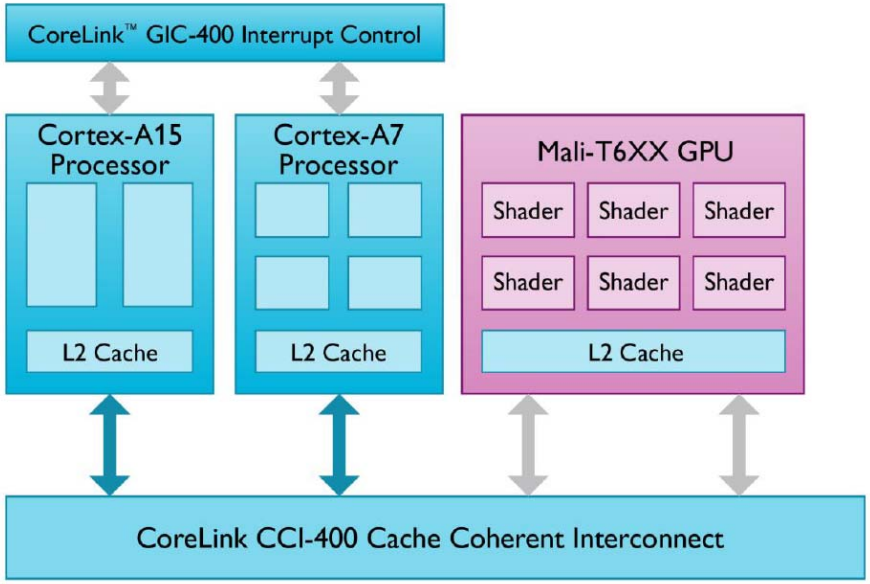
26 TFLOPS – 18KW

- 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					C++	0.000	2015-09-13 20:51:56
16096058					C++	1.000	2015-09-13 20:51:54
16096057					C++	0.000	2015-09-13 20:51:52
16096056					C++11	3.000	2015-09-13 20:51:49
16096055							09-13 20:51:29
16096054							09-13 20:51:23
16096053	11631	Dark roa					09-13 20:51:09
16096052	12940	Next Pal					09-13 20:51:05
16096051	11321	Sort! Sor					09-13 20:51:05
16096050	12075	Counting					09-13 20:50:56
16096049	100	The 3n +					09-13 20:50:24
16096048	12940	Next Pal					09-13 20:49:38
16096047	1188	Enigmat					09-13 20:49:33
16096046							09-13 20:49:15
16096045							09-13 20:49:15
16096044							09-13 20:49:07
16096043	543	Goldbac					09-13 20:49:04
16096042	455	Periodic					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
		4 hours	4164
		days	32567
		0.44 days	162868
		65.24 days	1875532
		ll	16316519

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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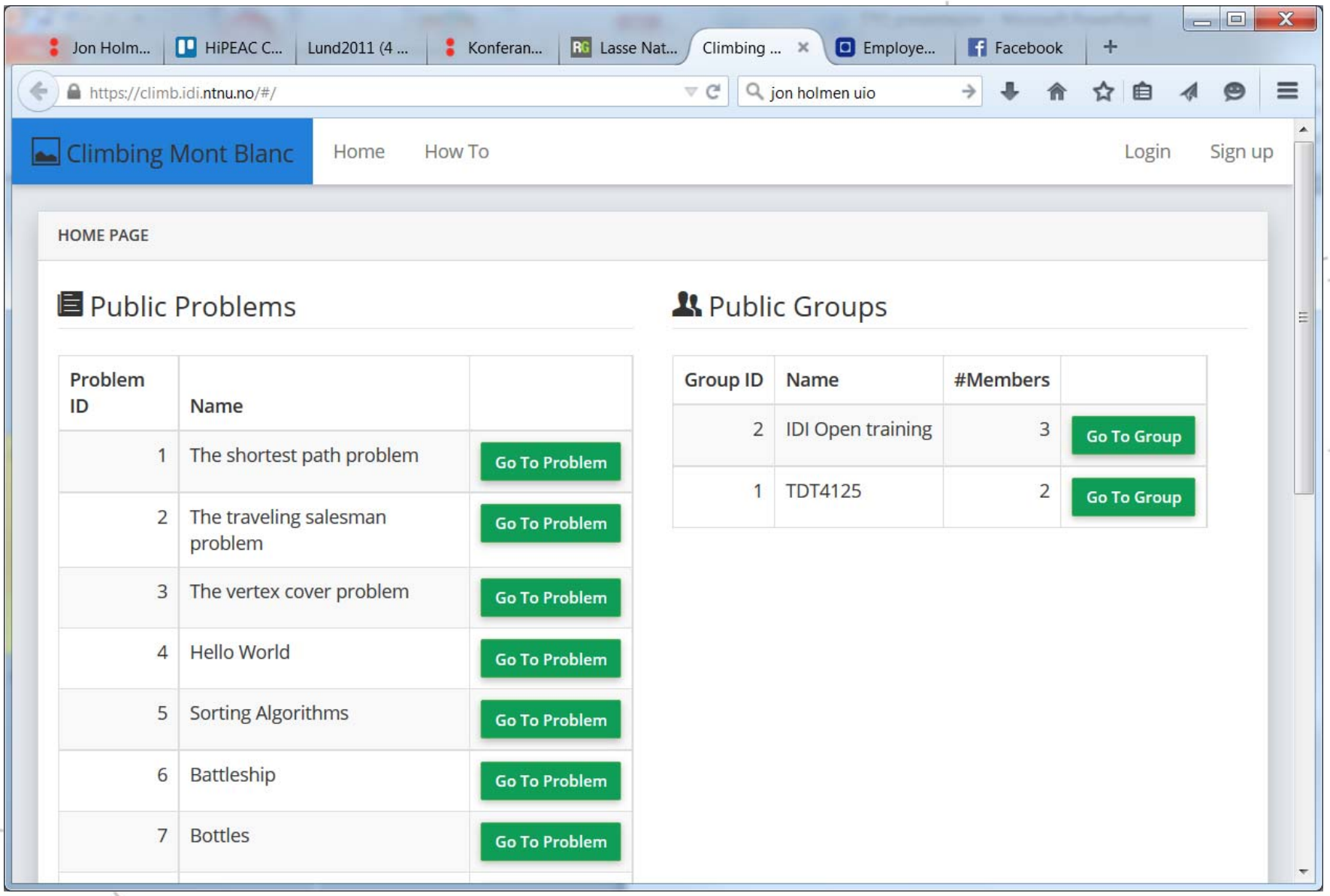
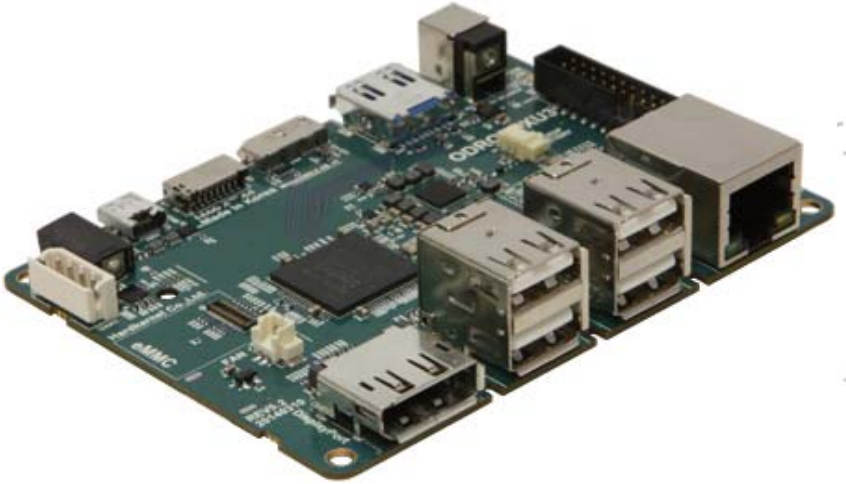
CMB SHORT INTRO

CMB select group or problem

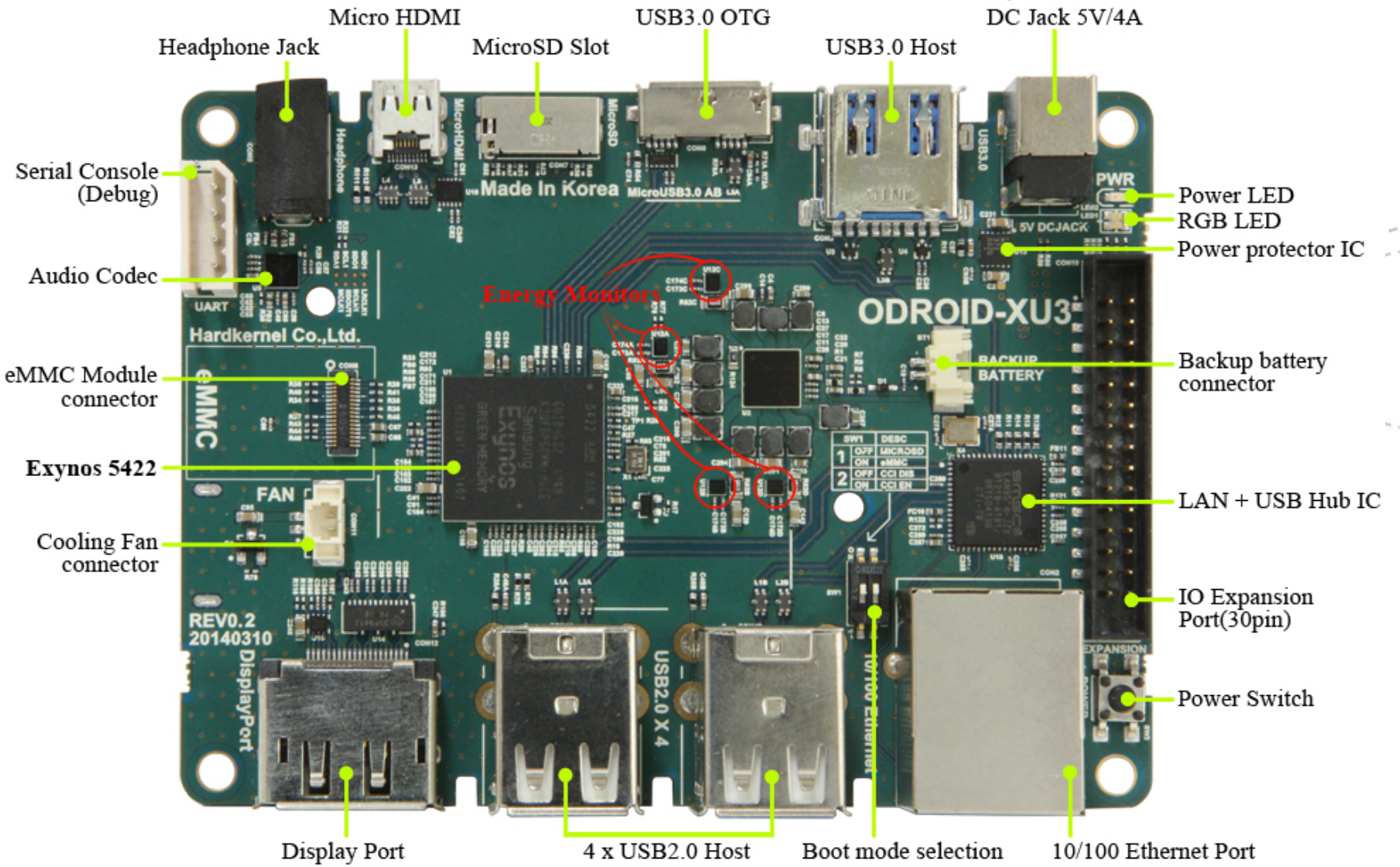


Odroid XU-3

- Odroid board from hardkernel.com
  - Full details at http://www.hardkernel.com/main/products/prdt_info.php?g_code=G140448267127
- Samsung Exynos 5422
  - Cortex™- A15 2.0Ghz quad core & Cortex™-A7 quad core CPUs
  - Mali-T628 MP6 533 MHz
  - ubuntu or android

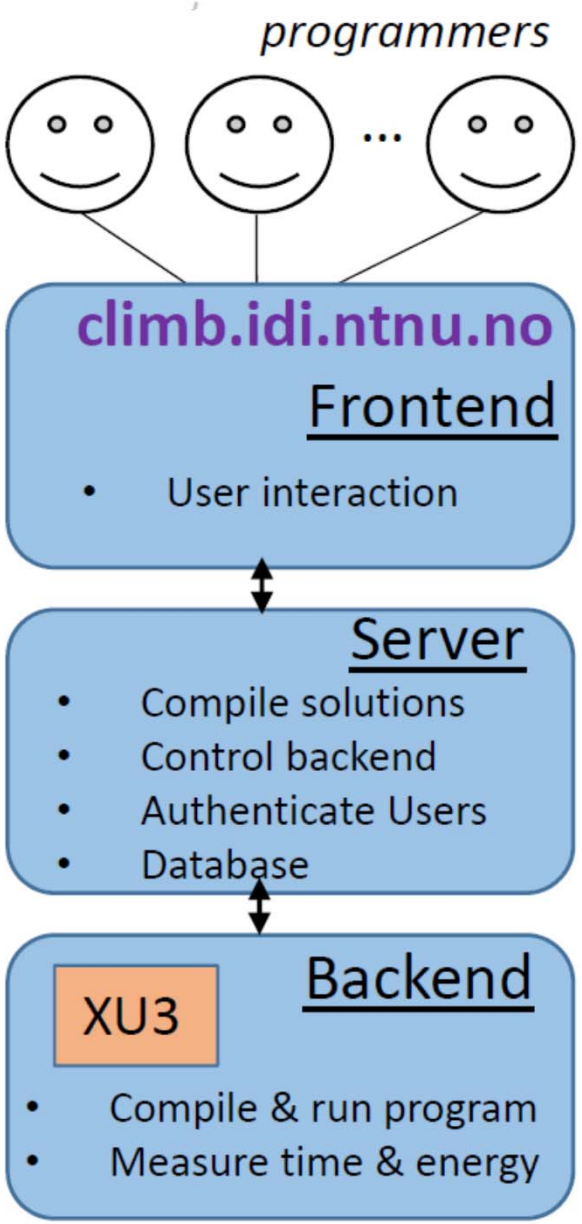


Odroid XU-3

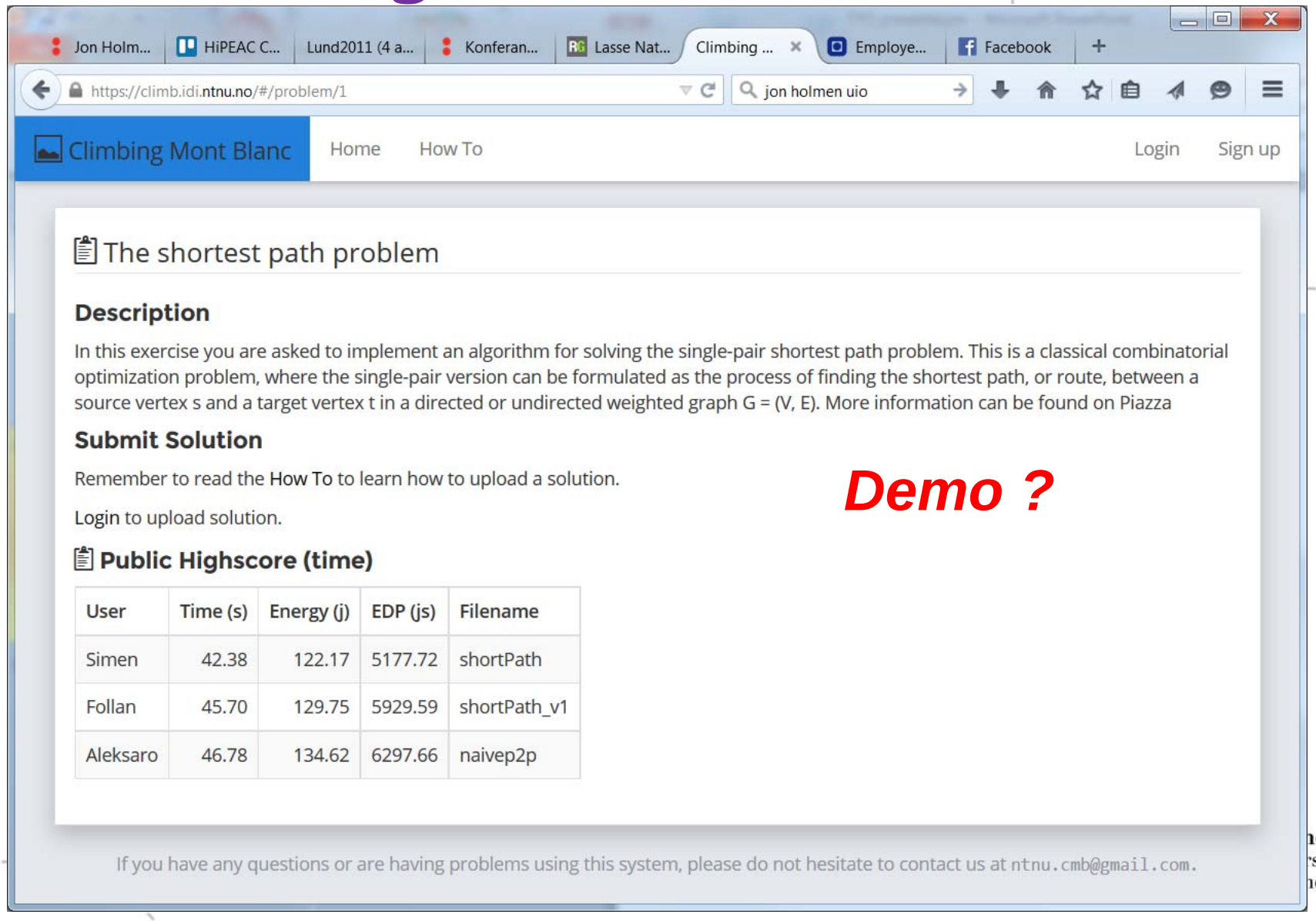

Micro HDMI
USB3.0 OTG
DC Jack 5V/4A
Headphone Jack
MicroSD Slot
USB3.0 Host
Serial Console (Debug)
Power LED
RGB LED
Power protector IC
Audio Codec
Energy Monitors
ODROID-XU3
Hardkernel Co.,Ltd.
eMMC Module connector
Backup battery connector
Exynos 5422
LAN + USB Hub IC
Cooling Fan connector
IO Expansion Port(30pin)
Power Switch
Display Port
4 x USB2.0 Host
Boot mode selection
10/100 Ethernet Port

CMB technnical overview

- Currently
  - C, C++, OpenCL
  - Pthreads, OpenMP 4.0
- Coming (?)
  - Java, python, Haskell?
  - MPI
- More info
  - Workshop paper at arXiv:1511.02240



CMB – high score

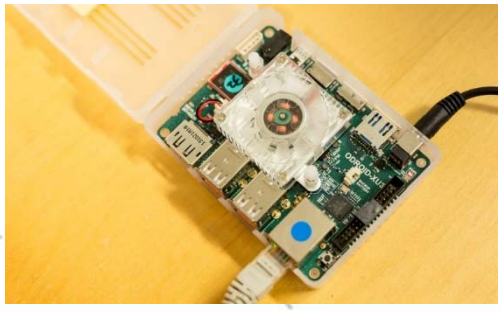


Demo ?

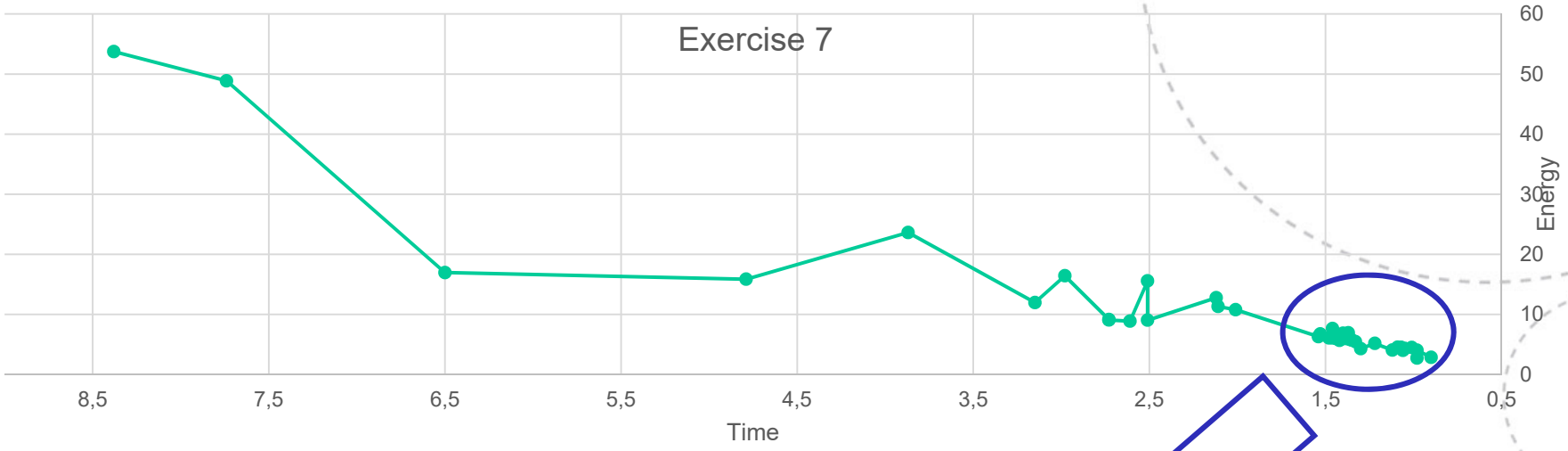
EARLY EXPERIENCE

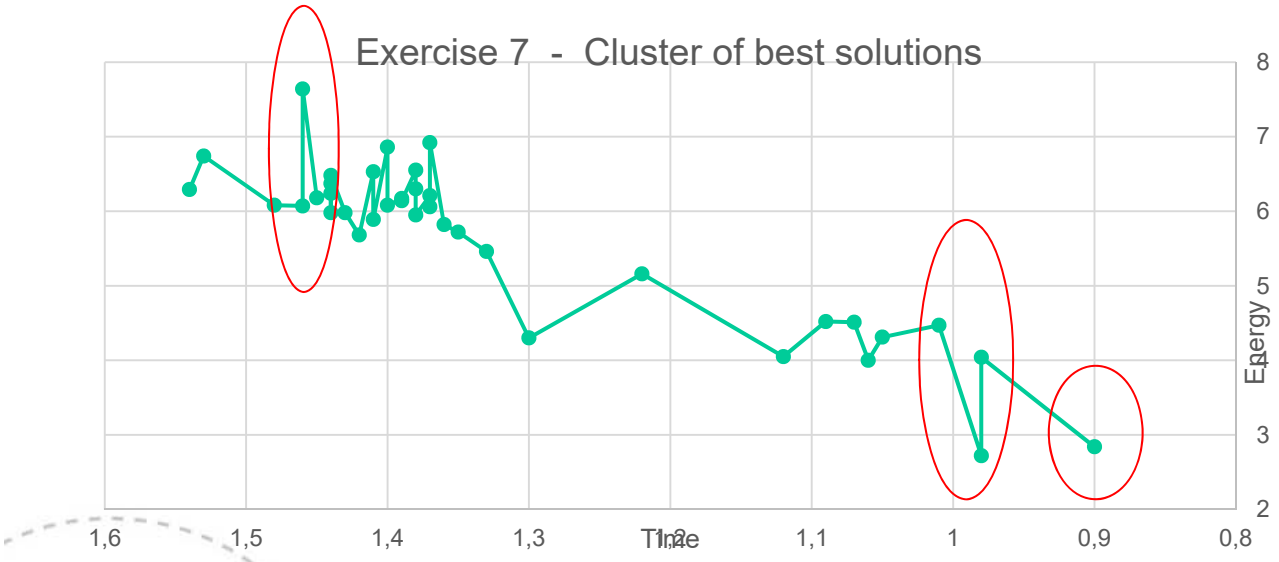
CMB – VERY early experience

- 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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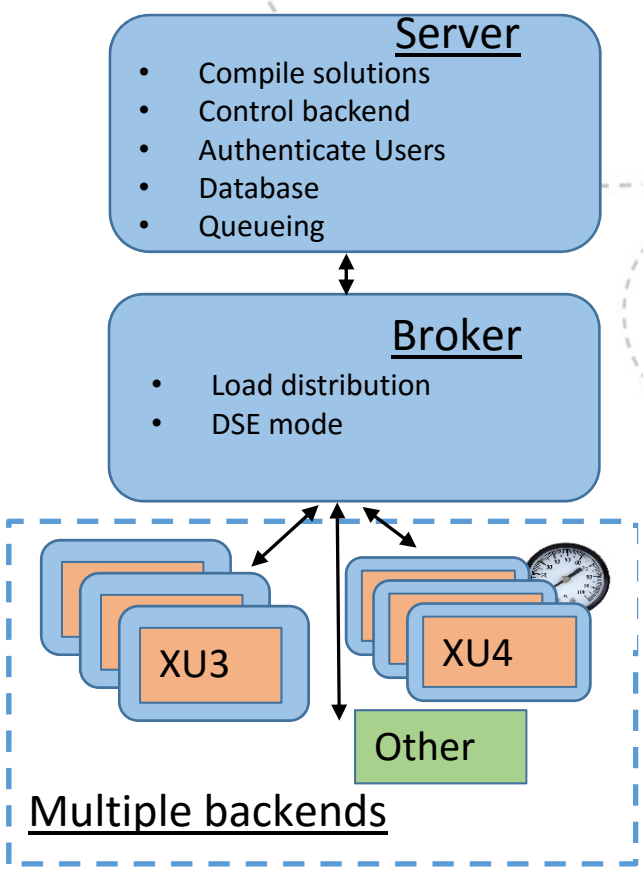
Future work

- 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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